# NSW strategic water information and monitoring plan

## Final report

NSW GOVERNMENT

Water Information
DATA · INFORMATION · INSIGHT

IMPORTANT NOTE

During the preparation of this report, the following administrative changes occurred in the New South Wales Government: the Department of Water and Energy (DWE) was abolished and the functions relating to the administration of water legislation transferred to the Office of Water within the Department of Environment, Climate Change and Water (DECCW), previously the Department of Environment and Climate Change (DECC). The energy functions of DWE were transferred to the newly created Industry and Investment NSW, previously the Department of Primary Industries (DPI). References throughout this report are to the former agencies.

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# Abbreviations

| | |
|---|---|
| AWRIS | Australian Water Resources Information Service |
| AWRC | Australian Water Resources Council |
| BI | Business Intelligence |
| BoM | Bureau of Meteorology |
| CMA | Catchment Management Authority |
| COAG | Council of Australian Governments |
| EDW | Enterprise Data Warehouse |
| FTP | File Transfer Protocol |
| GAB | Great Artesian Basin |
| GWCWA | Gosford-Wyong Councils Water Authority |
| GW | Groundwater |
| HWC | Hunter Water Corporation |
| IPART | Independent Pricing and Regulatory Tribunal |
| IP | Internet Protocol |
| MDB | Murray-Darling Basin |
| MDBA | Murray-Darling Basin Authority |
| M&E program | Monitoring and Evaluation Funding Program 2009/2010 |
| MER Strategy | NSW Natural Resources Monitoring, Evaluation and Reporting Strategy. |
| MHL | Manly Hydraulics Laboratory (part of NSW DECC) |
| MI | Murrumbidgee Irrigation |
| MIA | Murrumbidgee Irrigation Area |
| MPMS | Sydney Water's Monitoring Process Management System |
| NAP / NHT2 | National Action Plan for Salinity and Water Quality (NAP) and Natural Heritage Trust, program 2 |
| NSW DECC | NSW Department of Environment and Climate Change |
| NSW DPI | NSW Department of Primary Industries (includes Forestry NSW) |
| NSW DWE | NSW Department of Water and Energy |
| NWI | National Water Initiative |
| RTA | Roads and Traffic Authority |
| SCA | Sydney Catchment Authority |
| SCADA | Supervisory control and data acquisition |
| SCC | Shoalhaven City Council |
| SES | State Emergency Service |
| SQID | Stormwater Quality Improvement Devices |
| SQL | Structured query language |
| SW | Sydney Water |
| SW | Surface water |
| SWC | State Water Corporation |

| | |
|---|---|
| SWIC | Strategic Water Information Coordinator |
| SWIMP | Strategic Water Information Monitoring Plan |
| SWMA | Surface Water Management Area |
| The Bureau | Bureau of Meteorology |
| WDTF | Water Data Transfer Format |
| WQ | Water quality |
| WSP | Water Sharing Plans |

# Executive summary

## Preamble

Under the *Commonwealth Water Act 2007,* the Bureau of Meteorology ('the Bureau') has the responsibility of developing and managing the Australian Water Resources Information System (AWRIS). The system is being built with data provided by organisations within the States and Northern Territory. To assist the States and Territory with their participation in building the database, $80m has been provided to the Bureau, which through a competitive funding program, allocates the money towards supporting the data transfer from the jurisdictions to the Bureau.

The Strategic Water Information and Monitoring Plan (SWIMP) is a requirement under the AWRIS project to assist New South Wales and the Commonwealth by:

- outlining current data inventory
- specifying any strategic gaps in data and information systems
- prioritising data gaps relative to data delivery requirements of the Bureau.

The SWIMP will be used by the Bureau to review and prioritise investment under the $80m funding program.

To achieve these outcomes, the Bureau has funded a Strategic Water Information Coordinator (SWIC) in each State and Territory. The SWIC has three primary roles: to facilitate data delivery from the jurisdiction to the Bureau, to produce the SWIMP, and to assist with the prioritisation of funding applications under the $80m funding program.

## Report structure

This report is based on the Bureau's *Framework Guidance* document, and is a key deliverable for the Bureau's $80m *Modernisation and Extension of Hydrologic Monitoring Program*. It consists of four sections.

***Section A*** identifies the important water information drivers for NSW. These underpin the strategic and operational issues and challenges facing water managers in this State.

***Section B*** provides significant detail on the NSW data collection networks and management systems. Descriptions are included of the monitoring network policies that ensure the networks are cost efficient, effective and appropriate for the State's needs.

Section B also includes an *Inventory*, a collation of monitoring network *metadata* provided by key water monitoring agencies. It describes 97 per cent of the surface water and groundwater data being collected in NSW.

***Section C*** describes a *data gaps analysis* of strategically important water monitoring activities. It links the data gaps with the State's *information drivers*.

***Section D*** is a strategic overview of the key areas for investment in water monitoring. This section of the report brings together the outcomes of Sections A, B and C, and leads to a list of prioritised actions for which Bureau backing is sought. These actions have been developed into projects by the various water agencies and organisations in NSW, and submitted as Funding Applications under the M&E Program 2009.

## SWIMP process

The preparation of a *Strategic Water Information and Monitoring Plan* (SWIMP) for NSW has two clear objectives:

1. Provide a state-wide view of water monitoring systems and priorities within NSW leading to enhanced water data capture and delivery processes to the Bureau
2. Support an ongoing SWIMP program in NSW between key water data collectors and data managers.

To meet this first objective, this report links the State's **'strategic drivers for water monitoring'** with the **'data gaps review'** leading to '**strategies and actions'** for addressing the data gaps. The report presents the most current information on which to assess the funding applications under the M&E Program. It also contains the *Data Gaps Analysis Report* in Section C.

To ensure the report is representative of organisations in NSW, the key water monitoring agencies have been asked to prepare an *Agency SWIMP.* These are also based on the Bureau's 'Framework Guidance' document. This approach has been taken for two purposes:

- To provide the Bureau with each agency's water monitoring priorities that support their individual strategic water management objectives
- To involve key organisations in the detail of developing the SWIMP for the current and future rounds of the M&E Program.

The *Agency SWIMPS* are included in Appendix 1 of this final report. Important detail has been extracted and included in Section B of this report. It is expected that this approach will be extended to all organisations submitting funding applications in future revisions of the NSW SWIMP.

## Contributing organisations

Within NSW, it has been estimated that over 97 per cent of the water monitoring and data management activities are undertaken by seven key State agencies plus the Bureau of Meteorology NSW (Flood Forecasting Division). The focus for developing the SWIMP throughout 2008/09 has been to concentrate on this 97 per cent of data and to link to other water data collectors where possible. The seven NSW agencies are:

- NSW Department of Water and Energy
- Sydney Water Corporation
- Sydney Catchment Authority
- Manly Hydraulics Laboratory
- Department of Environment and Climate Change
- Department of Primary Industries
- Hunter Water Corporation

This year we have included the flood monitoring activities of local government organisations through the Bureau's NSW flood forecasting activities. In a similar way, the NSW Department of Environment and Climate Change (DECC) has provided advice on monitoring activities undertaken by Catchment Management Authorities (CMAs) through the State's Monitoring, Evaluation and Reporting Program. This approach means we have detail on around 80 per cent of the named organisations in the *Water Regulations 2008*. Work is progressing to include the other 20 per cent. If the SWIMP process is extended into further rounds, this process will be further extended.

## Exclusions

Although the Bureau has excluded the categories of water licensing, usage and trading information from SWIMP 2009, it is expected that bids under the M&E Program will be submitted to the Bureau for work in this area. Bids will likely focus on enhancements to existing data systems to facilitate meeting data delivery targets for Category 5, 6 and 7. This issue has already been highlighted in the Deferred Data Delivery Plan submitted by the lead NSW agency, the Department of Water and Energy (DWE). More recently, discussions have been initiated by the Bureau to ensure annual performance reporting from local government will be included in data delivered to the Bureau.

## Strategic water management issues in NSW

NSW is faced with major water management issues arising from the following challenges:

- Environmental sustainability
- Extreme drought and extreme events
- Intense competition for water
- Productive use of water
- Finite water resources

The State's various water monitoring programs are being designed and adapted to provide the necessary information to describe the quantity, quality, distribution and variability of the State's water resources to meet these management challenges. The following six water information drivers have been developed to guide the current and ongoing management of our water monitoring networks, namely:

- planning for future sharing of the resource
- operational management
- compliance
- public interest
- water accounting and assessment
- special purpose water monitoring.

Section A addresses these in terms of issues and questions. All the key water monitoring agencies were asked to link their bids for M&E Program funds to the State's strategic drivers. Some of this detail is presented in the Appendix 1 as Agency SWIMPS. The detail of these documents has been integrated into the body of this report.

## Summary

This final report was prepared to meet the Bureau's 'Framework Guidance' requirements. The approach adopted has been to link the strategic drivers for water monitoring to the data gaps review leading to identified strategies and actions to improve water information availability and data delivery to the Bureau.

In Section D the project actions are collated in activity areas and ranked in terms of each organisation's strategic planning priorities (Table D3) namely:

- The Murray-Darling Basin
- Water Sharing Plans — regulated, unregulated (including estuaries) and groundwater
- major urban metro water supply monitoring systems
- medium urban metro water supply systems
- flood and extreme event warning
- environmental water quality data
- research — surface water, groundwater and water quality
- small non-metro urban monitoring.

These 'project actions' will form the basis for funding applications in this and future rounds of the M&E Program for NSW.

# Section A – Water management issues and drivers

## Introduction

The *Commonwealth Water Act 2007* was launched with $450m funding over 10 years. Under this Act, the Bureau has a new role and $80m to transform Australia's water resources information and water monitoring infrastructure (www.bom.gov.au/water). This includes updating data management and data transfer systems in the states and territories to enable efficient water information transfer to the Bureau.

The Bureau will build, own and manage the Australian Water Resources Information System (AWRIS). The Bureau is building this system with data from the states, and has specified to the states when water data must be transferred, and in what format. To assist the organisations, departments and agencies within each State that are required to transfer data, the Bureau has established a competitive funding program that aims to fill data gaps and assist with data delivery.

This Strategic Water Information and Monitoring Plan (SWIMP) is a requirement of the Bureau to assist NSW and the Commonwealth by:

- outlining current data inventory
- specifying any data gaps
- prioritising data gaps relative to data delivery requirements of the Bureau.

The SWIMP will be used by the Bureau to review and prioritise investment under the $80m Monitoring and Evaluation Program (M&E). To achieve these outcomes, the Bureau has funded a Strategic Water Information Coordinator (SWIC) in each jurisdiction. The SWIC has three primary roles, namely to facilitate delivery of data from the jurisdiction to the Bureau, to produce the SWIMP, and to assist the prioritisation of funding applications under the M&E Program.

## Background

Reliable water information is a basic tool for effective water management and better use of our water resources. In many river basins the hydrological cycle is being modified both quantitatively and qualitatively. Human activities such as land use change, urbanisation, population growth and movement, water storage, inter-basin transfer, irrigation and drainage have major impacts on both the quantity and quality of the resource. It is probable that global climate change is also having an impact on water resources throughout the world. It may no longer be assumed that information collected in the past is a sufficient or reliable indicator of recent or future conditions.

NSW, being such a large state, covers a range of geographical and climatic conditions. As a result, the hydrological conditions vary significantly across the state and from north to south. Water and environmental issues are directly related to the hydrologic and socioeconomic conditions of each region. The impacts of flood, drought, competition for water and impact on ecological features, combined with regionally-based finite water resources, means that the management of those issues requires an understanding of the regional hydrology. Measurements are the only reliable indicator of the status and trends in the available surface and groundwater resources.

# The need for data

The rational development and management of water resources depends to a considerable degree on the ready availability of hydro-meteorological data. If management practices are to have a scientific base and optimal engineering designs are to be developed, a large volume of data needs to be collated, organised and analysed.

Sound management decisions depend not just on the amount of water resources data available, but also on the information that the data can yield. Therefore, the data needs to be organised, accessible and comparable.

In 1991, the NSW Water Resources Council approved the *NSW Cooperating Agency Policy on Water Data Management* (Wright & Malone 1991). This policy stresses the need and opportunity to introduce cooperative arrangements between agencies for the sharing of water resources data and provide adequate access to data by the public. The policies adopted considered data management practices in the United States (USGS) and New Zealand (NIWA).

Within NSW, water data is collected and archived by many government agencies to meet various statutory obligations. Their objectives include:

- providing data and statistics for water resource assessments
- enabling sophisticated water planning models to be developed and applied to answer very specific questions around water management planning and operations
- detecting and monitoring environmental changes and trends
- enabling publication of data and summary statistics
- promoting and stimulating hydrological research
- promoting good practice in data management and dissemination.

It is intended that during further rounds of the SWIMP in 2009–10, the *NSW Cooperating Agency Policy on Water Data Management* will be reviewed to take into account the *Water Regulations 2007*.

# Data collectors

There are many groups and individuals that require data from water monitoring activities. Some of the main users and uses for these services are listed below.

## Government

Many state and federal government responsibilities depend on accurate surface water and groundwater data for proper execution. For example, activities associated with fisheries, forestry, navigation, interstate agreements, irrigated and dryland agriculture, crown lands, water rights and allocation all rely on water data and information. State governments, as the owners and stewards of the resource, licence activities such as irrigation, pollution control and other consumptive and non-consumptive water uses that are even more dependent on surface water and groundwater data.

## Water management

Federal and state government agencies and water supply authorities as well as industry and hydropower companies all use water data to operate discharge structures, control reservoir levels, divert water into irrigation canals, and control town water supply withdrawals, sewage and other discharge. These activities have serious and far-reaching financial and social implications. They should be based on the best possible data and information. Flow forecasting is a major use of water level and streamflow data, particularly for flood warning and protection.

## Planning

Scientific, engineering, and planning professionals use streamflow and groundwater data to analyse issues, project future conditions, determine impacts, assess alternatives, and set policy for planning of a variety of large-scale water and other resource projects.

## Environmental assessment

Government agencies, environmental consultants and interest groups often need surface water and sediment data and information as well as precise records to assess critical concentrations of pollutants and toxic chemicals in some situations. Managing environmental flows depends on accessing accurate surface water data including flow volumes and flow variability at specific locations.

## Research

Professionals and scientists engaged in water-related research use water data as the basis of understanding fundamental hydrologic relationships and to define and assess catchment water balance. This research is vital to NSW long-term interests and cannot be carried out using approximations. High quality, accurate information is essential. Research into evaporation processes, for example, is important in water-short western regions of the State, and research into the effects of bushfires and other land-use changes and interception activities on catchment runoff is necessary for water management planning and other programs. Further, the potential impacts of climate variability and possible climate change on water supplies need to be understood so that appropriate changes in water management can be implemented.

## Interstate water sharing

Water-sharing agreements exist in legislation, where water systems are shared or where upstream systems have obligations to supply water to downstream jurisdictions. Many of our systems are large and span regions of significant climatic variability as well as having long travel times. This also applies to large regional groundwater systems, where impacts of water extraction and changing recharge can take many years to appear. Accurate, relevant and consistent water data and technologies improve the quality of water planning negotiations and outcomes at this scale.

## Public uses

Many private citizens and interest groups want access to water-related data and information for a wide range of situations, from planning recreational activities to preventing property damage caused by erosion or flooding, to public confidence in governments and industries for water planning and real time management.

## Design and construction

Professional engineers must have accurate water data for a variety of hydraulic design projects such as dams, reservoirs, pipelines and canals. Safety during project construction and sound economic and environmental performance during their lifespan are important criteria for clients who depend on site-specific data, supplemented by regional information, to meet their needs.

## Drivers for water information in NSW

Water management in NSW is becoming more sophisticated as greater demands are being placed on the finite resource. Water distribution and supply now adhere to rules established in water sharing plans. In addition to specific rules to control access to river flows, environmental water is purchased and managed for specific ecological purposes. Water savings hold real value for users and the environment, and water trading is now a reality. To support these management initiatives and gain and maintain community trust in their implementation demands that the water data provided to support the processes is of appropriate and defensible quality. The data must also be available in a reasonable timeframe to support the decision making process.

NSW is faced with major water management issues arising from these challenges:

- Environmental sustainability
- Extreme drought and extreme events
- Intense competition for water
- Productive use of water
- Finite water resources

The State's various water monitoring programs are being designed and adapted to provide the necessary information to describe the quantity, quality, distribution and variability of the State's water resources to meet these management challenges. The following six water information drivers have been developed to guide the current and ongoing management of our water monitoring networks, namely:

- planning for future sharing of the resource
- operational management
- compliance
- public interest
- water accounting and assessment
- special purpose water monitoring.

*Section A* describes these water information drivers in terms of the water management issues they address, and the questions they help answer. All the key water monitoring agencies were asked to link their bids for M&E Program funds to these strategic drivers. Some of this detail is presented in the Appendix 1 as *Agency SWIMPS*. The detail of these documents has been integrated into the body of this report.

The following is the list of the information drivers for NSW. They have been interpreted in terms of water management challenges, issues and questions facing the State. The drivers rely on water data to make and support planning, policy level and operational decisions about management. Data to support these responsibilities is not always available and, in some cases, not available in a timely matter. Gaps in data are discussed in Section C and D.

## Information drivers and management issues

### 1. Planning for future sharing of the resource

a) Sustainability – for water users and the environment

b) Drought management

c) Competition for water

d) Climate variability and climate change

e) Medium and long-term forecasting

### 2. Operational management

a) River operations — delivery, short-term forecast, plan operation, including wetland watering, environmental contingencies, algae impacts, and access to river flows for industry.

b) Flood operations — flood forecasting, emergency planning.

c) Environmental monitoring — flow variability, flow targeting, water quality, estuary health.

### 3. Compliance

a) Auditing of compliance (MDB Cap and water sharing plans)

b) Access rules (cease to pump, etc.) particularly for unregulated systems

c) Groundwater use — pumping drawdown, interference, trading

d) Drought sharing

### 4. Public information

a) Reporting/internet — key stakeholders, e.g. river heights and flows, water quality, current storage levels, reliable and near real time.

b) Recreation — e.g. water levels, predicted conditions.

### 5. Water accounting and water resource assessment (reporting)

a) Institutional Government requirements. NSW is a signatory to:
   - National Water Initiative (including recent COAG updates)
   - interstate agreements (Murray-Darling Basin Agreement, NSW QLD Border Rivers Agreement).

b) Legislation (Water Sharing Plans, Federal Water Act).

c) Public disclosure of water management information.

### 6. Special purpose monitoring

DWE is funded for water monitoring across NSW to support particular water management activities of other agencies, organisations and industry.

## Information drivers and strategic questions

The six water management information drivers listed above address current water management issues across NSW. Addressing these management needs will contribute to answering the following questions about water use and supply, and environmental water management.

1. Planning for future sharing of the resource
   - How do we develop water policy to provide security for rural use and long-term sustainability for ecological assets such as river channels, wetlands, floodplains and estuaries?
   - Will the policy accommodate climatic variation and increasing demands on water as a finite resource?
   - How have water resources changed over time or over the period for which we have water level and other data?
2. Operational management
   - How do we supply water to support productive use and environmental needs? How do we measure success?
   - What can we do to make the community more flood resilient and emergency ready?
   - Does the water quality meet community standards and expectations?
   - Do the water sharing arrangements support the ecology of the rivers, estuaries floodplains?

3. Compliance
    - Are we meeting our objectives under current rules, policies and agreements for water sharing in NSW?
    - How do we demonstrate this to our local and regional communities?
4. Public interest
    - Where are the floodwaters now, and are regular updates available?
    - Will the quantity of water in the system affect my recreational pursuit?
    - How dry is it, locally or in other regions?
5. Water accounting and assessment
    - How much water was supplied to the river system?
    - How much water was extracted from the river system?
    - How did water extraction compare with recent years?
    - How did water availability compare with long-term predictions?
6. Special Purpose water monitoring
    - Meeting client and industry demands for information driven by business or special interest needs.

The questions lead to the identification of gaps in data and systems which are described in detail in Section C. In Section D the strategies and actions to address the Gaps are presented, and then collated in ***Project Activity Areas*** where they are ranked in terms of the jurisdiction's strategic planning priorities (Table D3).

# Section B – Inventory and observation networks summary

## Introduction

***Section B*** of the SWIMP provides significant detail on the State's data collection networks and data management systems. Descriptions are included of the monitoring network policies that ensure the networks are cost efficient, effective and appropriate for the State's needs.

Section B also includes an Inventory of monitoring network metadata provided by key water monitoring agencies. It describes 97 per cent of the surface water and groundwater data being collected in NSW.

Being comprehensive, Section B, has been prepared and presented as a separate report *Water inventory and observation networks in New South Wales*. A summary of some key points is included for quick reference.

## Inventory and observation networks

The Bureau specified that each jurisdiction outline existing water information-related monitoring systems, database infrastructure and water information transfer processes including:

- sites where data is collected
- type of telemetry equipment (if any) at each site
- frequency of measurement/downloading at each site (time series, daily, etc.)
- parameters collected at each site
- length of data record at each site
- indicative data quality standards
- other non-site-specific monitoring activities (e.g. remote sensing etc.)
- how storage of the information occurs within the jurisdiction
- the data transfer processes in place between agencies.

The named agencies in NSW (those identified by the Bureau as organisations holding water data) were contacted by DWE and asked to fill in their monitoring site details on a supplied Excel spreadsheet. The responses were collated in two Excel spreadsheets (one for major government agencies and another for the smaller agencies). This Inventory was forwarded to the Bureau as requested. The following agencies responded to the request for Inventory information:

**Table 1: Monitoring inventory response summary**

| | Monitoring sites | | | | |
|---|---|---|---|---|---|
| | **SW** | **GW** | **WQ** | **Met** | **Total** |
| **Major agencies** | | | | | |
| DWE | 990 | 9,043 | 1,887 | 161 | 12,081 |
| SWC* | 350* | 0 | 0 | 25 | 25 |
| SCA | 134 | 0 | 115 | 167 | 416 |
| MHL | 259* | 0 | 6* | 0 | 0 |
| DECC** | 269 | 12 | 0 | 73 | 0 |

| | Monitoring sites | | | | |
|---|---|---|---|---|---|
| DPI | 48 | 5 | 41 | 31 | 125 |
| Bureau of Meteorology NSW | 218 | 0 | 0 | 450 | 668 |
| Sydney Water | 5 | 0 | 179 | 179 | 363 |
| Total | 1,664 | 9,060 | 2222 | 1086 | |
| **Other Agencies** | | | | | |
| Armidale-Dumaresq Council | 10** | 0 | 17 | 7 | 34 |
| Ballina Shire Council | 0 | 0 | 15 | 0 | 15 |
| Bathurst Regional Council | 7 | 0 | 0 | 0 | 7 |
| Country Energy | 3 | 0 | 3 | 0 | 6 |
| Eurobodalla Council | 6 | 0 | 0 | 0 | 6 |
| Gosford Wyong Council | 10 | 20 | 0 | 0 | 30 |
| Kempsey Shire Council | 2 | 86 | 51 | 9 | 148 |
| Lismore Council | 12 | 0 | 0 | 15 | 27 |
| Murrumbidgee Irrigation# | 16 | 900 | 27 | 7 | 950 |
| Murray Irrigation# | 6 | 1,449 | 0 | 0 | 1,455 |
| Coleambally Irrigation# | 6 | 809 | 56 | 0 | 871 |
| **Total** | **58** | **3,264** | **169** | **38** | |

Notes:

* SWC requires a number of river sites for their river operations (these sites are funded by irrigators and SWC collects these monies). DWE operates these sites and these numbers are included in the DWE totals.

* SWC operates 20 major storages where a range of manual data is collected and some 280 weirs, many of which supply data via SCADA. At some storages, water quality is monitored, but not on a regular basis at this stage.

* All SWC data is stored on the DWE Hydstra system and DWE sends this data to the Bureau on SWC's behalf.

** DECC – all sites are operated by MHL and/or DWE. Their numbers are included in the MHL and DWE totals and are not double-counted in the totals

*** Armidale-Dumaresq Council has 10 surface water sites, of which nine are operated by DWE. DWE sends the data from these sites to the Bureau.# The Irrigation Corporations monitor a large number of shallow bores on an irregular basis. This information has been included for completeness

The NSW SWIMP Report Section B has summarised the information collected as part of this process and addressed a number of other areas related to water monitoring in NSW. The information presented in Section B includes:

- a more detailed examination of the named agencies in NSW
- an examination of NSW water monitoring issues and objectives
- an examination of network design in NSW
- a summary of the results of NSW inventory including:
    - number of monitoring sites
    - details of information systems used
    - data currency.

In addition, the following sections on water availability are an extract from *Water inventory and observation networks in New South Wales* and are reproduced as an overview of the water resources and water monitoring activities in NSW.

## How much surface water does NSW have?

New South Wales is located between the summer monsoon rainfall system of northern Australia and the winter cold front rainfall system of southern Australia. River flows in NSW show distinct variations in time, with streamflow showing both a seasonal pattern and substantial year to year variability in discharge.

The inland Murray and Murrumbidgee Rivers in southern NSW experience most of their runoff in the late winter/spring period, with about 58 per cent of the average annual natural flow in the Murrumbidgee River occurring in the four month period from July to October. The seasonal pattern in the northern inland rivers is less obvious, with 36 per cent of the average annual natural flow in the Gwydir River occurring in the four month period from July to October, and 31 per cent in the three month period from January to March. The annual flow in the southern inland rivers is less variable than in the northern rivers, with the minimum and maximum annual natural flows for the Murrumbidgee being 12 and 392 per cent of the average annual natural flow, while for the Gwydir River the range is five to 480 per cent. The Macquarie River, located in the central inland part of NSW, demonstrates the most variability of the western flowing rivers with minimum and maximum annual natural flow ratios of three and 780 per cent.

The inland rivers with the lowest average annual flows are those flowing from Queensland and crossing the border west of Mungindi. Therefore, it is not unexpected that the Darling River is subject to extreme variability with minimum and maximum annual natural flow ratios of seven and 300 per cent.

For coastal streams, the catchment size and distance from the coast are the main factors influencing the flows. The large coastal catchments of the Clarence, Hunter and Hawkesbury-Nepean Rivers have proportionally low rates of flow. The exception is the Snowy River, which benefits from snow melt, although a large part of its flow is now diverted inland.

## Available resource

The total average annual surface water resource for NSW is 42,000 GL. This information has been determined from a combination of water resource system models and historical flow analysis.

The total annual divertible surface water resource for NSW is based largely on the volumetric water entitlements issued for the large regulated river systems, combined with the rules that have been developed as part of the NSW Water Sharing Plans (WSPs). The combination of observed streamflows and WSP rules create a Plan limit, which is a long term average diversion limit. Where close connectivity between surface and groundwater exists, part of the groundwater recharge that replenishes these aquifers comes from surface water as well. The major groundwater systems are also covered by Water Sharing Plans, which also have long term average diversion limits. These limits are essentially a portion of the average recharge, thus providing a buffer to protect environmental assets as well as aquifer integrity.

Priority for Water Planning in NSW was originally placed on water sources where the major diversions were occurring and where significant environmental assets required protection. However, there is also a considerable level of activity developing water sharing arrangements for a large number of minor unregulated surface water and aquifer systems. Consequently, NSW has placed a high priority on the management of the unregulated rivers. Management plans for the most highly stressed unregulated rivers have been prepared. Plans for other stressed and high conservation unregulated rivers are being covered by macro water sharing plans which are nearing completion.

With respect to the regulated streams, most of these occur inland and are part of the Murray-Darling basin. As this basin is subject to a cap on diversions, NSW has assumed that there will be no further infrastructure development in the basin that would increase diversions. In the valleys, where NSW has implemented environmental flow rules, average annual diversions have been designed to be lower than the long term Murray-Darling Basin Cap values. Hence, the specific river health rules that have been developed in the WSPs have been used by NSW to maintain compliance with the MDB Cap.

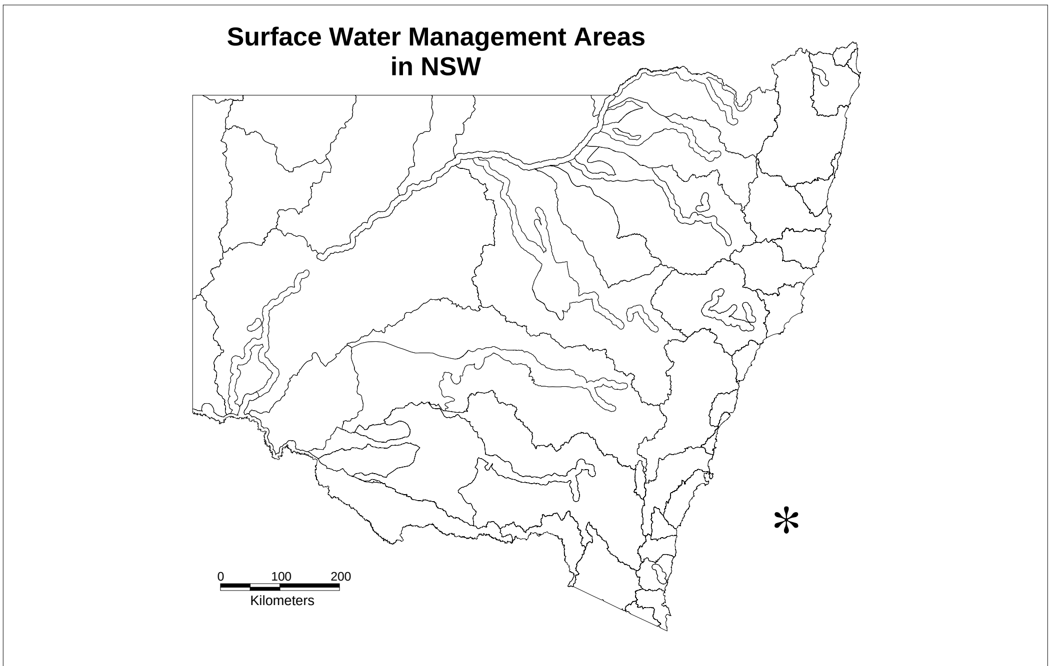
For a range of federal reporting purposes, 55 Surface Water Management Areas (SWMAs) as designated by the NSW DWE have been adopted as the reporting units for NSW. These SWMAs largely coincide with the old Australian Water Resources Council (AWRC) basins. The only exceptions are the basins in which major storages are operated by the State Water and the Barwon Darling management area. The SWMA boundaries are shown in Figure 4 below.

In those basins with major storages, the AWRC basin has been subdivided to distinguish between those parts of the basins in which State Water storages control part of the river system to assure supply (regulated SWMAs) and those parts where it does not (unregulated SWMAs). In a number of the other basins such as the Hawkesbury-Nepean, the Shoalhaven and the Snowy, significant regulation is carried out by other agencies, but these basins have not been included in the regulated category. All other catchments where no major storages exist are also regarded as unregulated SWMAs.

The boundary of the regulated SWMAs has generally been obtained by buffering the main stream downstream of the storages and including major irrigation areas and districts and areas of major groundwater usage. It has been assumed that there is little or no contribution to resources from these regulated areas.

The regulated SWMAs include the Murray-Riverina, Lower Darling, Murrumbidgee, Lachlan, Macquarie, Namoi, Gwydir and Border Rivers within the Murray-Darling Basin, and the Bega, Hunter and Richmond Rivers in coastal NSW. DWE has also defined the Barwon-Darling River between Wilcannia and Mungindi as a separate SWMA to distinguish between the specific management of the water resources in this area and other unregulated flow areas.

**Figure 1: Surface water management areas in NSW**



## How much groundwater does NSW have?

NSW has enough groundwater to cover the whole of the state to a depth of 11.5 m. Its availablity is unevenly spread across the state with some rocks being impermeable so any bores sunk are 'dry' while other units yield over 30 ML/day to suitably constructed bores. The quality of the groundwater varies greatly ranging from rainfall quality in some coastal areas to over 200,000 mg/L TDS (seven times saltier than sea water).

The dominating influences on the location and magnitude of groundwater resources in NSW are geology, geomorphology and climate. The runoff divide formed by the Great Dividing Range separates the short, steep, eastwards flowing rivers that flow directly into the Pacific Ocean from the western flowing rivers that have a much longer and more circuitous course to the Southern Ocean as tributaries of the Murray River.

The eastern flowing rivers have had a relatively short period, since the last major sea level changes, in which to develop, with only limited development of alluvial deposits. Where such deposits occur, they commonly grade laterally into unconsolidated estuarine and marine deposits. Consequently, the highly productive aquifer systems often associated with alluvial deposits are generally not available in association with these eastern flowing rivers. Extensive, but shallow, alluvial deposits are associated with the Hunter and Richmond Rivers. The other coastal river systems have only limited groundwater resources associated with their alluvial deposits, but are used extensively as a stock and domestic source of water, especially during droughts.

The most productive aquifer systems in the eastern coastal region are the coastal dune deposits, which have been extensively developed along some parts of the coast during a succession of sea level changes. They provide a water supply source for most urban settlements north from the Shoalhaven River at Nowra. Of particular importance are the Tomago Sand Beds and associated Tomaree and Stockton deposits, which provide an important part of the water supply for Newcastle and surrounding areas.

The western flowing rivers have a much longer route to the sea, with lower gradients across the western slopes and plains. Alluvial deposits have formed extensively along their valley systems and, in the case of the southern rivers, in delta areas where in past times they debouched into the eastern marginal areas of the lakes and swamps of the Murray Basin. A large proportion of these deposits formed during periods when the climate was very humid, resulting in chemical deposition of the products of erosion from the highlands. Under these conditions, quartz grains remain as an inert residual product, while all other products of decomposition are soluble and removed as part of the salt load of the rivers. The outcome of this process is the accumulation of thick and extensive deposits of clean quartz gravel and sand, and it is these deposits that form the main aquifers in the westerly flowing river systems in NSW.

Highly permeable sediments associated with the western flowing rivers have developed extensive aquifers containing significant volumes of lower salinity (less than 800 mg/L TDS) which yield in excess of 1,100 GL in the last water year. These aquifer include the Gwydir Valley (downstream of Moree), Murrumbidgee Valley (upstream of Narrandera downstream from Wagga Wagga), Namoi Valley (generally downstream from east of Gunnedah) and Lachlan Valley (downstream from Hillston and between Cowra and Condobolin), Murray Valley (downstream of Howlong), Macquarie Valley (downstream from Wellington). In all these areas, it is possible to construct bores with very large supplies. Pumping rates of 20 ML/day are not uncommon and water salinity is as low as 300 mg/L. Less substantial resources are available in all the other westward flowing rivers, to a varying degree.

The alluvial deposits described above are, in terms of their geological character, superficial, i.e. they form a thin veneer on some parts of the landscape, obscuring the underlying basement rocks. These are of varying character and have a very wide range of water storage and transmitting capacity. Sandstone, with residual intergranular porosity, is generally the most highly productive, occurring in a number of large sedimentary basins. From a groundwater sense, the Great Artesian Basin (GAB) is by far the most important. It occupies an area covering 20 per cent of the Australian landmass, extending over four states/territories. Its water resources are discussed elsewhere.

The Oxley Basin contains a sandstone and volcanic rock that locally can generate large supplies of water from bores. The aquifers are extensively covered and obscured by the basalt of the Liverpool Range. Sandstone and coal seams in the Clarence-Morton, Gunnedah and Sydney Basins is generally less productive than in the GAB but locally yield in excess of 5 ML/day where fracturing has enhanced the normal porosity. Stock and domestic supplies are commonly available.

Older, fractured crystalline rocks of igneous or metamorphic origin form the landscape in large areas of the State and have been grouped here into the New England, Lachlan Fold Belt and Olary Provinces. These rocks are intrinsically impermeable and only attain a degree of porosity and permeability, which enables them to store and transmit water by secondary processes. Such processes may be tectonism (earth movements), which causes fracturing and jointing and consequently open spaces within the rock mass, or chemical erosion, which may differentially remove some of the rock mass leaving a matrix of residual material with some porosity and permeability. In the more humid areas along the Great Dividing Range, salinity is generally less than 1500-2000 mg/L, with small pumping rates sufficient for stock and domestic use. Towards the west, as the rainfall decreases and the land slopes and elevation that control the hydraulic gradients decrease, the salinity increases gradually. Due to this salinity, the water can only be used for stock watering and limited domestic purposes.

Groundwater monitoring tends to be related to the high use aquifer outlined above both along the coast and inland. In these areas water level information is required to manage aquifer storage and the associated impacts on stream flow and other users as well as aquifer compaction and water quality change.

In most of the other areas it has been found that due to the large volume of groundwater in storage pumping has little impact on the natural system.

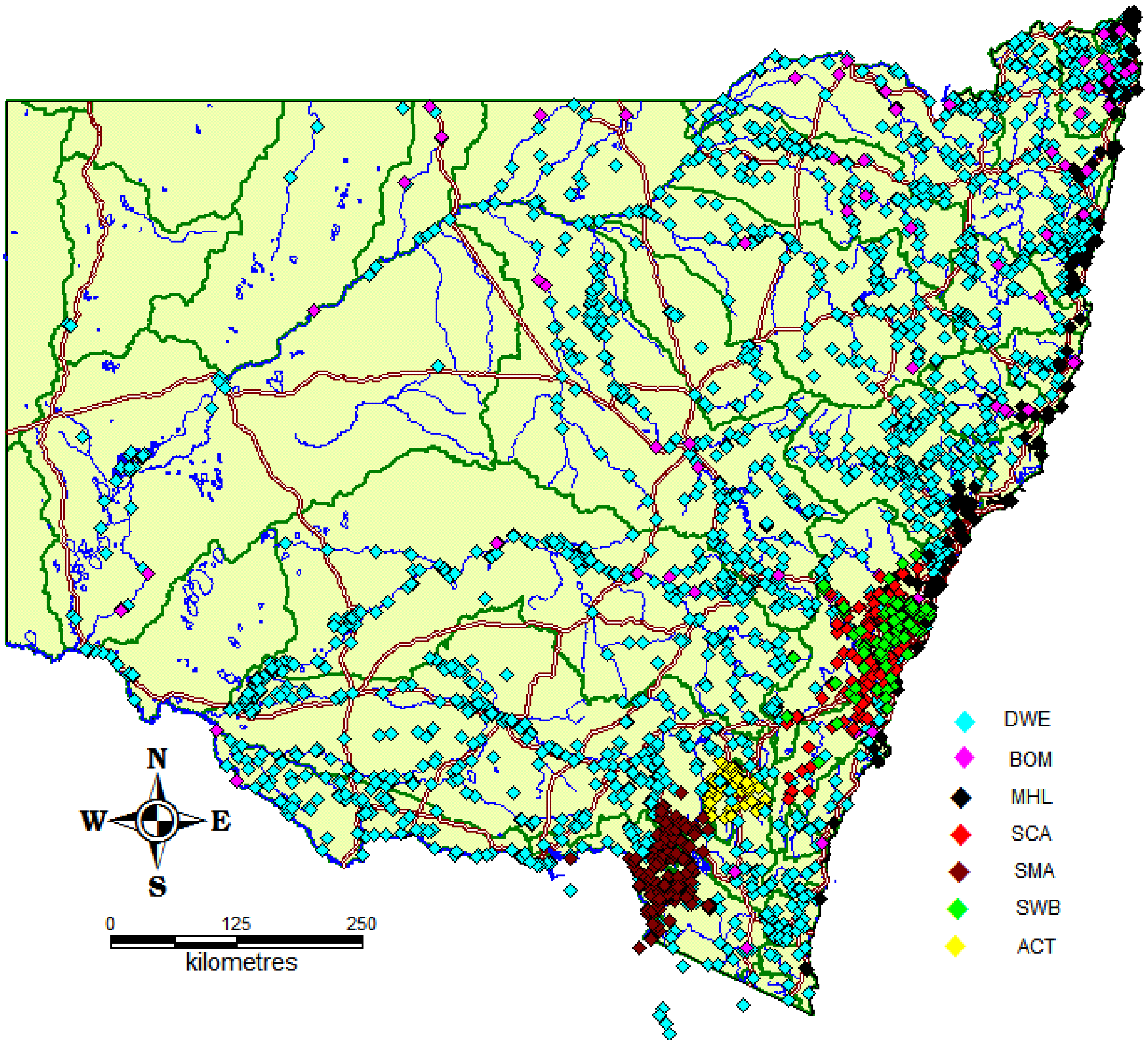
## Water monitoring sites in NSW

As required by the Bureau's brief, this section of the report concentrates on the more physical side of water monitoring, i.e. Surface Water Quantity, Groundwater Level, Surface and Groundwater Quality, and Meteorological monitoring.

## Surface water

The Surface Water network is the oldest data collection system in NSW and is the basis of modern water monitoring activity. The oldest gauging station was established at Windsor NSW in 1,799, with some 1,841 river gauging stations in NSW having been operated by the current NSW DWE or one of its predecessors. Of this total, 230 of these stations are or were run by other authorities. Of the remainder run by the Department, over 1,000 remain operational and data is archived from over 750 of these stations (see Table 9).

**Figure 2: Surface water monitoring sites in NSW**




The total State surface water network recorded so far in the Inventory totals over 1,700 current sites. There are also over 1,000 discontinued sites that are not included in the Inventory.

These gauging stations have been operated on behalf of the state as a whole, for various branches within DWE, a variety of state and interstate authorities and a range of other clients including private firms and councils. However, the bulk of the non-directly client-funded stations have been operated under the State's capital budget.

DWE networks currently consist of some 900 active surface installations where comprehensive water quantity data is captured and another 150 installations where other surface water data is collected. Some 650 of these active installations provide real-time data via a range of telecommunications networks. The surface water archive holds data from 1,800 sites, 45 of which date pre-1,900. At 200 of these surface water installations, water quality data is/has also been collected for various clients.

The DWE network is currently expanding as various state legislative requirements (Water Sharing Plans) and National Water Commission funding drive this expansion. Anecdotal evidence suggests that most other networks appear to be relatively stable. Figure 5 displays the location of the monitoring sites operated by the major agencies.

**Table 2: Age of surface water network on the DWE archive**

| Stations | Opened | Closed | Sites still open |
|---|---|---|---|
| Opened before 1900 | 45 | 0 | 45 |
| Between 1900-1920 | 86 | 8 | 123 |
| Between 1920-1940 | 192 | 55 | 260 |
| Between 1940-1960 | 305 | 74 | 491 |
| Between 1960-1970 | 292 | 74 | 709 |
| Between 1970-1980 | 231 | 107 | 833 |
| Between 1980-1990 | 170 | 192 | 811 |
| Between 1990-2000 | 231 | 138 | 904 |
| After 2000 | 289 | 120 | 1,073 |
| **Total** | **1,841** | **768** | |

*Source: DWE Site Database Queries April 2009.*

# Groundwater in NSW

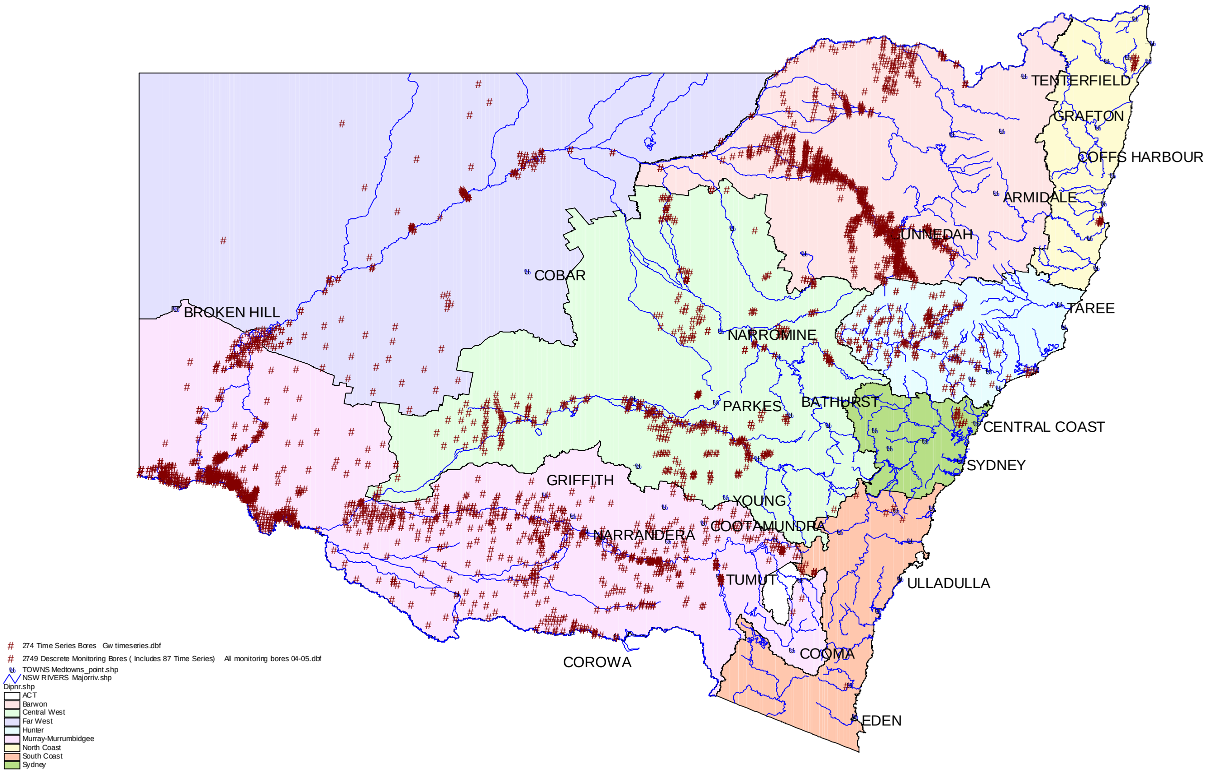
Groundwater is an important and vital natural resource in NSW. It makes a substantial contribution as a source of water for the maintenance of aquatic environments and is an integral component in the long-term management of water resources at both State and regional levels. It is coming under increasing pressure to meet human uses for agriculture and industry as well as drinking water for many country towns. It also sustains a variety of ecosystems.

In NSW, groundwater plays an important role in town water supply. The city of Newcastle relies on the Tomago Sandbeds Aquifer for up to one-third of its town water, especially when drought or water quality problems affect its surface water supplies. Outside the metropolitan centres, over 130 towns and 220,000 people rely at least in part on groundwater for domestic supplies. However, one-quarter of these supplies is drawn from bores in alluvial aquifers alongside rivers and is likely to also contain surface water.

Many thousands of private properties in rural NSW also rely on groundwater, especially in arid and semi-arid areas such as the GAB, where surface water supply can be scarce and infrequent.

Now that most of NSW river systems are stressed, there is increasing demand for groundwater to meet human needs. As groundwater demand and use increase, so too does the need for groundwater management. Groundwater extraction by humans disrupts the natural water cycle. It lowers and alters the natural variability of groundwater levels, which in turn alters the timing of availability and volume of groundwater to its dependent ecosystems. Groundwater use must be made to be sustainable, for the long-term benefit of all the people, plants and animals that depend on it.

**Figure 3: DWE GW monitoring sites**




Groundwater monitoring is expanding at a rapid pace, especially continuous monitoring of bores. Some 5,000 manual-read groundwater installations are currently active. Of these, 250 are operated by DWE's hydrographic staff. The water archive holds data for almost 900 installations, where groundwater level data has been measured continuously by logging devices. Of these, over 320 are still operating.

## Water quality

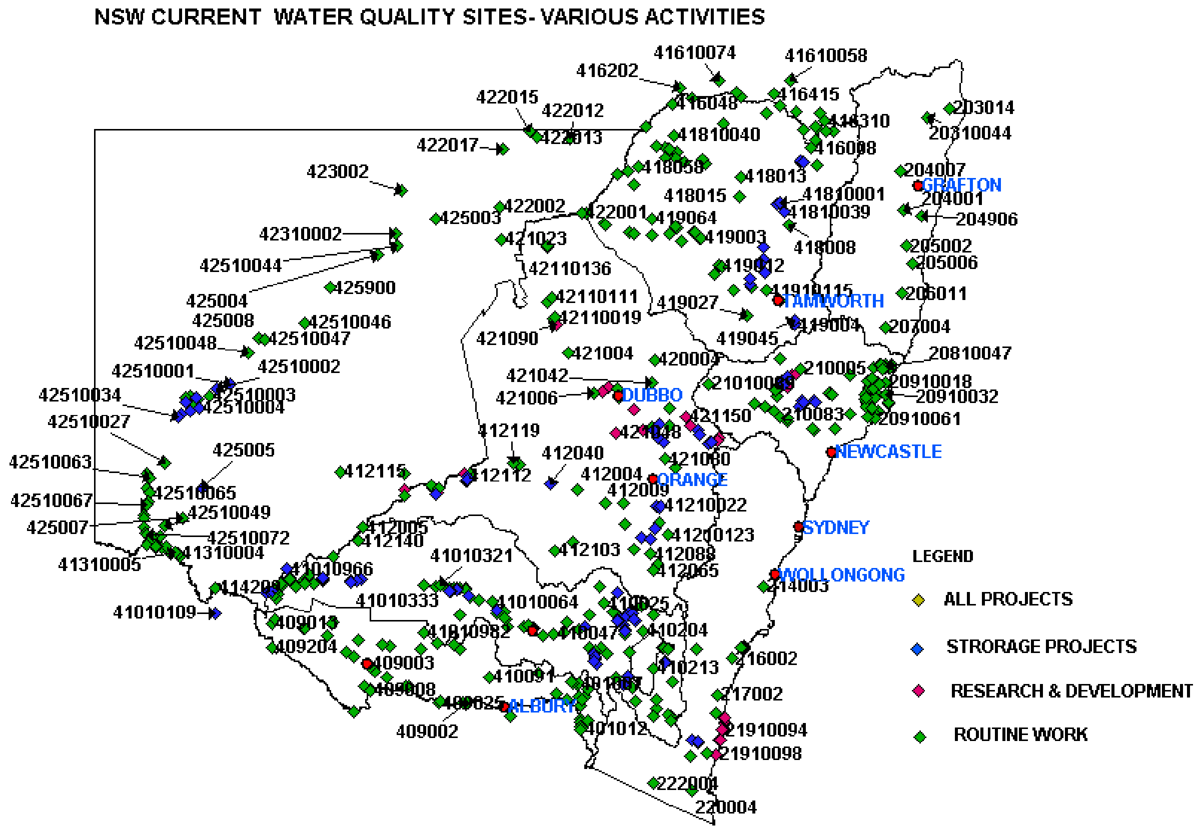
We can use water without depleting its supply. However, water is a fundamental component of a complex ecosystem. Its maximum sustainable yield depends on how we exploit it within the system. Evidence of over-exploitation and environmental stress is abundant. Pollution from human activities destroys aquatic life and threatens human health. Misuse of the water resource causes widespread degradation of soils, disrupts the supply of potable water and generates massive economic losses. To be aware of the extent of these problems and to manage them, baseline data is needed.

The business of water quality monitoring is divided into two separate areas:

1. Continuous monitoring
2. Discrete sampling.

The Continuous Monitoring business processes have been externally quality certified to ISO 9001. Investigations are continuing regarding the practicality of seeking quality accreditation for manual/discrete sampling.

**Figure 4: DWE Water Quality Monitoring Sites**



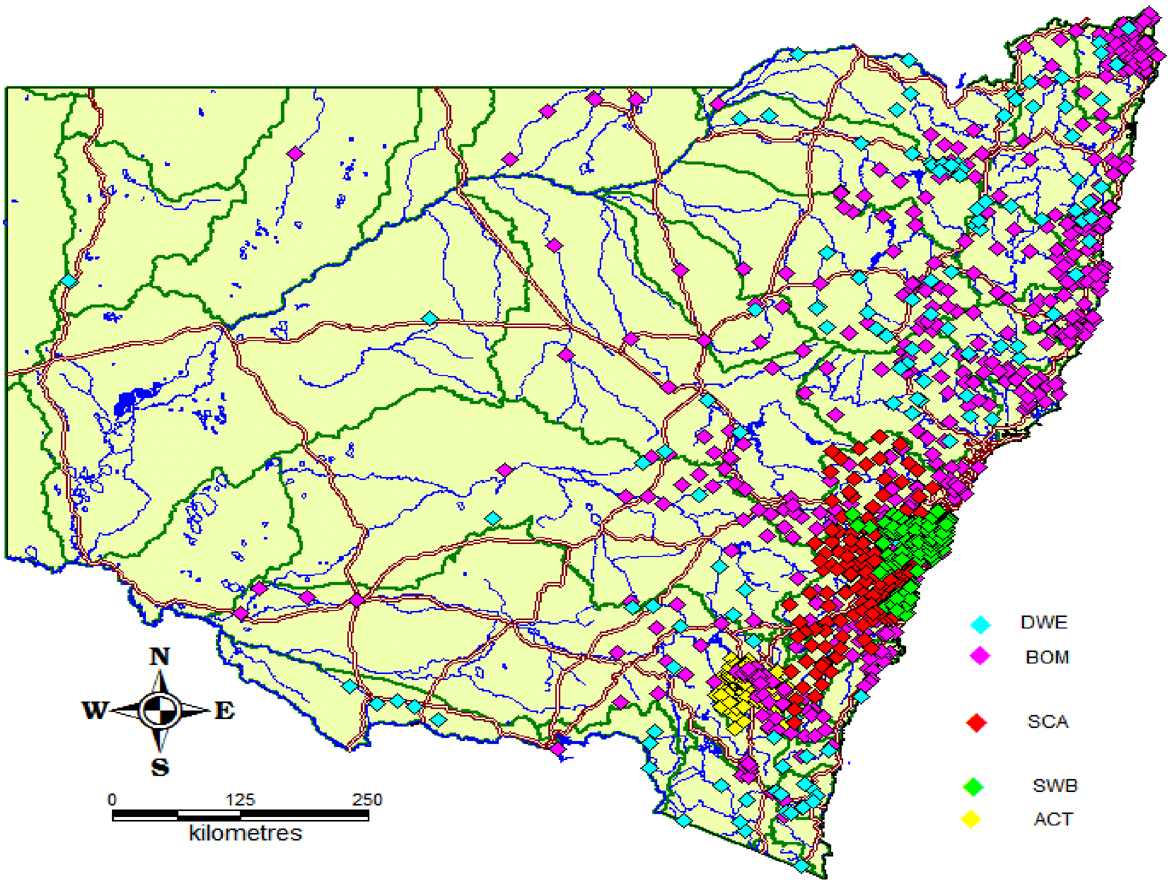

## Meteorological

While the Bureau is the primary meteorological data collector in Australia, various state agencies also have meteorological networks.

The state agencies networks were primarily for river and storage operations especially during flood times, so these agencies were earlier adopters of automated technology for rainfall measurement. Many of the sites are in non-standard installations and as such are not used as long-term rainfall data stations by the Bureau, but the information is supplied to the Bureau's flood forecasting sections.

Recently, there has been increased installation of weather stations for research purposes measuring a range of meteorological data, but the number is still low compared to rainfall sites. Figure 5 identifies where meteorological data is collected in NSW.

**Figure 5: Meteorological monitoring NSW**



# Section C – Analysis of gaps in data and systems

***Section C*** is a critical assessment of the water monitoring networks and water information systems outlined in Section B. It identifies whether they provide the required water information to address the six key water information drivers that focus on water planning, management and operations. The monitoring networks and data management systems have also been examined in terms of data delivery to the Bureau of Meteorology's *Improved Water Information Program.*

The assessment has been undertaken as a **data gap review** by comparing what is available to what is needed. The context for this comparison is *Section A: Water Information Drivers*. These drivers characterise the challenges and issues facing water managers and planners in NSW. Iterative communication with agency practitioners in the areas of surface water, groundwater, water quality, modelling, water accounting and water operations was used to determine what data was available relative to the key information drivers, and where there were notable gaps.

The format for Section C has been to:

- derive the data gaps through interview and a targeted workshop
- provide ***descriptions*** of each of the ***36 data gaps*** – Table C1
- link the ***gaps*** to the ***information drivers*** described in section A – Table C2.

In Section D the strategies and actions to address the Gaps are presented, and then collated in ***Project Activity Areas*** where they are ranked in terms of the jurisdiction's strategic planning priorities (Table D3) namely:

- The Murray-Darling Basin.
- Water sharing plans – regulated, unregulated (including estuaries) and groundwater.
- Major urban metro water supply monitoring systems.
- Medium urban metro water supply systems.
- Flood and extreme event warning.
- Environmental water quality data.
- Research – surface water, groundwater and water quality.
- Small non-metro urban monitoring.

DWE, as the lead agency in NSW, in consultation with other key organisations, will seek Bureau support for the *prioritised actions* to be funded under the M&E Program in this and subsequent years. (Section D).

There are a total of 36 gaps in data and systems that have been identified by DWE. These were developed in consultation with other organisations and government departments that either collect, manage or use water data in NSW. The gaps relate to water management information requirements across NSW. In this report these gaps have been described in Table C1 and linked to Water Information Drivers in Table C2. The gaps are listed relative to the Bureau's Themes in Tables D1.

**Table 3: Gaps in data and systems**

**GAP 1: In some catchments the surface water network coverage is not fully meeting water information requirements (see information drivers, section A)**

**Description**
Strategic network coverage of NSW streams will support adequate detail in development of water planning models and contribute to river operations, flood operations and environmental monitoring. Currently rainfall runoff modelling is used to provide indicative coverage for some unregulated streams. This is not adequate for catchments where water extraction competition is significant or important environmental assets exist.

A regular network review in NSW helps determine the distribution of the gauges. Results from a consultants report that outlines coverage gaps for the operational management of regulated rivers and streams is also currently available for review, and results will be integrated into this report at a later date.

Other data gap processes have been undertaken in NSW including the ongoing internal network reviews, national projects including some comments in the CSIRO Sustainable Yields Report, and the National Land and Water Audit. All of these reports are outlined in the Appendix and will be integrated into later versions of the SWIMP.

**GAP 2: Streamflow data not meeting all accuracy requirements**

**Description**
The accuracy of flow information particularly in low flows is critical. For example, pumping restrictions are now in place in Water Sharing Plan areas. These plans rely on robust flow data

**GAP 3: Lack of adequate asset management and replacement for surface water**

**Description**
There is no funded long-term asset management system being implemented. Planned asset management is more efficient in terms of cost and time saving than ongoing response to individual issues.

**GAP 4: Data capture and transfer not meeting time requirements**

**Description**
The currency of the data from the surface water network is not meeting management needs to an adequate standard including floods, river operations, drought management, and compliance.

**GAP 5: Inadequate water mass balance information**

**Description**
Data gaps for the adequate representation of water balance in planning and operational models include:

- ‘Total Valley Outflow’ measurement is limited due to a lack of measurement of tributary inflows or streamflow rating accuracy (particularly floodplain flows) (this information can also be important for environmental management)
- effluent creek data is often not available due to a lack of gauging on these small systems. Due to water savings initiatives (e.g. proposed piping of the stock and domestic flows of these creeks), this lack of data is becoming more significant
- we have inaccurate data for area cropped and type of crop. This limits representation of on-farm interception, irrigation water requirements and vertical fluxes for groundwater system model inputs. There are also limits to modelling irrigator behaviour based on economic and water drivers
- rainfall/evaporation data is not accurate enough – currently using SILO to get estimated values
- the quantification of the amount of water being exchanged and losses incurred (e.g. groundwater/surface water interaction is only in early days of measurement)
- this gap is described in multiple dimensions to obtain a holistic view of modelling gaps. Addressing all aspects of this gap is beyond the scope for the SWIMP, but some issues, including total valley outflow, effluent creeks, and surface water/groundwater interaction, are within the scope of this Plan.

**GAP 6: Inadequate spatial location of surface water monitoring sites**

**Description**

Many sites have poor or missing details about location and elevation. With recent developments in surveying equipment, the accurate location of sites is now possible.

**GAP 7: Surface water sites no longer meet OHS and accuracy requirements**

**Description**

Much of the surface water monitoring network was established in the 1960s–1970s. A significant number of these sites are nearing the end of their life and need to be replaced. Some of these sites have confined spaces and elevated structures making them more costly to maintain and are also at heightened OH&S risk.

**GAP 8: Height/flow calibrations not meeting accuracy requirements**

**Description**

Traditionally, flow data has been derived from height/flow calibrations (rating tables). For some sites, this is not the ideal method to derive flow. New technologies (Doppler) are now available to increase the accuracy of flow information. Flows in the lower range are becoming more important. Improving the low flow control at sites will redress low flow inaccuracies.

**GAP 9: Water storage and surface water data not in electronic format**

**Description**

The spatial and temporal detail of data is available for assessment, but not in electronic format. For some agencies, as little as 3% of new information (electronic) is added to the water database annually, while significantly more old information (from paper records) is not added. Many of the datasets used for water management and planning are still held in paper format. This is the prime record (heights and flows) at sites used for long-term modelling and many other uses. Perhaps more importantly, the metadata associated with this data is located in many places (including the personal knowledge of key individuals) and is increasingly at risk of being permanently lost.

**GAP 10: Insufficient quality attributes for data stored in Groundwater Database (GDS)**

*Note: See gap six and18 for similar gaps in other water disciplines.*

**Description**

There are data quality issues with the information stored in the GDS for water levels and bore construction. The issues include:

- water level data incorrectly recorded against a bore at a nested site
- anonymous water level reads where the reading is below the screen interval, the bore was dry, or it was free-flowing
- ensuring that the appropriate strata graphic unit is assigned to drillers logs
- the improvement of data quality, which will improve numeric models, assessment of trades, and analysis of the relationship between aquifer systems and surface water sources.

**GAP 11: Insufficient groundwater data in electronic format (data at risk)**

**Description**

The spatial and temporal detail of data is available for assessment, but not in electronic format. For some agencies, as little as three per cent of new information (electronic) is added to the groundwater database annually, while significantly, older information (from paper records) is not added. Many of the datasets used for groundwater management and planning are still held in paper format. This is the prime record at sites used for long-term modelling and many other uses. Perhaps more importantly, the metadata associated with this data is located in many places (including the personal knowledge of key individuals) and is increasingly at risk of being permanently lost.

**GAP 12: Lack of adequate asset management and replacement for groundwater bores**

**Description**

In some cases, data from the groundwater network does not meet needs. There are a range of site-related physical factors that impact on data accuracy. They include:

- silting of the bores, which blocks the screened interval and prevents the bores reflecting the groundwater level in the aquifer
- general deterioration and corrosion of steel casings in older bores
- age of loggers and sensors used in the groundwater level, pressure and electrical conductivity monitoring.

**GAP 13: In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A)**

**Description**

The expansion of the network would enable appropriate level of data for numerical model development of the interaction between surface water and groundwater systems and whole of groundwater unit management to better meet the information drivers.

Examples are: for assessment of the water sharing plan, long-term average extraction limits and monitoring of MDB groundwater and surface water CAPs. The assessment of permanent and temporary trades in areas where there is insufficient network coverage to be able to make a confident assessment of the impact on water markets.

**GAP 14: In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see information drivers, section A)**

**Description**

Groundwater use has the potential to induce leakage from adjacent saline aquifers causing a decline in higher quality groundwater aquifers. In coastal areas, groundwater use has the potential to impact on the groundwater/sea water interface. Over extraction has the potential to increase groundwater salinity through increasing sea water intrusion.

In coastal areas, the influence of climate change will result in sea level rise, causing inundation of coastal estuaries and lakes and changes in the groundwater/sea water interface. This has the potential to impact on GDEs and the availability of water for users.

**GAP 15: Lack of information about GDEs for their sustainable management**

**Description**

There is a growing understanding of the need to have monitoring around GDEs for the protection of environmental assets; and monitoring of groundwater levels and quality in the area of GDEs to assess the influence of climate change, climate variability and competition for water between users and the environment. Knowledge of these impacts are required to ensure that the appropriate risks assessments are undertaken to protect GDEs and for water sharing plan development and monitoring.

**GAP 16: Inadequate spatial mapping of groundwater network**

**Description**

The spatial component of the data is not up-to-date. The surveying of the x, y and z coordinates of the State monitoring network require verification when:

- the coordinates have not been checked since the work was installed. In some circumstances, this is 40 to 50 years
- the coordinates have been identified as being suspect
- the monitoring site is missing an elevation measurement in AHD
- monitoring sites that have not been surveyed since installation.

**GAP 17a: Inadequate water quality monitoring network for flow/water quality associations**

**Description**

Flow and water quality relationships are poorly understood. Information on these relationships is required to inform future water sharing planning and to better share the resource between extractive industries and environmental needs.

Low flow pool water quality monitoring is necessary for ecological flow response, which is significant for pools following cease to flow events or during very low flows. This can impact on stream biota as micro-habitats are lost, water quality deteriorates and competition for resources between biota increases. Cease to pump (CtP) or pool protection provisions can be used to protect environmental water in unregulated water sources.

Ecological Response Monitoring is necessary for the review and assessment of the success or impact of water sharing plans and other water management activities. Some monitoring is being undertaken in NSW, but temporal and spatial coverage is not adequate. Major data gaps include:

- gaps in the number of permanent vegetation transects to assess response to flow
- detailed survey sites at key flow points such as riffles and benches, and the development of hydraulic models
- long-term macroinvertebrate monitoring sites across priority water sharing plans to assess taxa sensitive to change in flow and allow evaluation of plans
- flow and water quality response of key fish taxa in priority water sharing plans.

In order to understand water quality and flow relationships, a better understanding of the factors contributing to changes in water quality is required. Such factors can include sediment and nutrient run-off from the catchment as well as changes to river stability as a result of fluvial processes. Without an understanding of the causal factors leading to water quality change, it is difficult to attribute cause and effect, or tease out the influence of externalities when evaluating water sharing plans. Additionally, major changes to stream geomorphology (such as streambed lowering) can significantly alter stream character and hence flow behaviour (e.g. stream incision can influence the frequency of recurrence of overbank flows). Major data gaps include:

- up-to-date land use mapping and, in some cases, development of nutrient export models
- development of permanent monitoring cross-sections within stream channels to assess stream stability and its long-term trajectory, channel flow relationships, and instream sediment and nutrient sources
- state coverage of fluvial geomorphic type, condition and recovery potential, including reference reaches
- extent and condition of riparian vegetation (influences water quality via filter role and bank stability).

**GAP 17b: Inadequate water quality monitoring network for surface water physical/chemical parameters**

**Description**

There are several water quality gaps related to operational water management:

**Salinity** – Inadequate coverage and quality of stream salinity data to enable flow surrogates for generation of salt loads in salt transport modelling.

**Salinity** – EC probes and salinity models required in estuary areas so that flow/water extraction/EC relationships can be developed for the development and evaluation of water sharing plans.

There is limited information on streams to determine salt loads (see Gap 20). Currently, broad estimates are used. Longitudinal profile measurements and data to determine if there are groundwater/surface water interactions affecting the loads are also lacking.

**Temperature** – There is limited information around storages in relation to cold water pollution impacts and evaluation of the performance of dam management change (including structural works and operating protocols).

**GAP 17c: Inadequate water quality monitoring network for groundwater/surface water interaction**

**Description**
Stream temperature can provide an excellent dataset for the study of surface groundwater interactions. When water levels in piezometers and the stream stage are measured concurrently, the combined data will enable assessment of water fluxes between the stream and the subsurface and quantification of streambed hydraulic properties. In conjunction with water level elevation measurements, temperature data collected in shallow piezometers and deep bores can be used to estimate the rate of streambed seepage, hydraulic conductivity and conductance of the geologic materials that surround them.

There is also little understanding of the relationships between water quality/chemistry and stygofauna/general GDE health and requirements.

**GAP 18: Inadequate spatial mapping of water quality network**

**Description**
There are other water quality gaps related to the spatial information on the stream network:

- Stream order mapping for NSW is incomplete. Spatial information is lacking particularly for stream orders 1 and 2.
- Spatial information on weirs is lacking.
- Accurate (1:25,000 or better) information is required for the State's regulated rivers.
- Many sites are poorly located in location and elevation. With recent developments in mapping tools, relocation and referencing of sites is now possible. There is equipment to accurately connect sites to a reorganised level datum.

**GAP 19: Insufficient water quality data in electronic format (data at risk)**

**Description**
Water quality data is available for assessment, but not in electronic format. Many of the datasets used for water quality and planning are still held in paper format. Perhaps more importantly, the metadata associated with this data is located in many places (including the personal knowledge of key individuals) and is increasingly at risk of being permanently lost.

**GAP 20: Inadequate number of water quality sensors in the surface water network**

**Description**
There is a need to benchmark models to approximate quality and quantity levels to model associations between flows and EC values. However, there is currently limited information on streams to determine salt loads, and broad estimates are used with little understanding of whether groundwater/surface water interactions are affecting the loads.

**GAP 21: Insufficient coordination for SWIMP activities at jurisdictional/lead agency level**

**Description**
Water data is collected, stored and used by a range of government agencies across NSW. It is efficient to have coordinated data access to support informed water management decisions. The Bureau currently supports a data coordinator in each state or territory in Australia. This role will be left vacant upon completion of the Commonwealth funding program that supports this position.

**Gap 22: Inadequate blue-green algae monitoring**

**Description**
Major blooms of blue-green algae occur from time to time in the MDB. The NSW Blue Green Algae Program is not using up-to-date methods and processes. It responds to ad hoc field sampling. New technologies (e.g. Flouroprobes) need to be tested, with monitoring established in priority locations.

Some modelling has been undertaken in NSW to assess the relationship between flow and algal blooms. The information collected through these programs can be used to assess the types of flows required to prevent blooms from forming, or to dissipate existing blooms. Such a model has been developed for some sections of the Darling River and its capabilities should be extended throughout the Basin.

**GAP 23: Insufficient monitoring for a range of water quality programs**

**Description**
Water quality programs running in NSW do not cover all water management issues and in addition to extending the current programs, there is a need to collect more water quality information to meet management needs. There is currently no State-wide coordinated monitoring of pesticides or other environmental contaminants. There is also a need for more monitoring of sulphuric conditions as they can impact on wetland management.

**GAP 24: Lack of access to integrated datasets on the web**

**Description**
The data is not consistent with reporting expectations with regard to temporal and spatial, accuracy and reliability, including systems backup.

**GAP 25: Licensing database system unable to export data in WDTF format**

**Description**
The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**GAP 26: Surface water database system unable to export data in WDTF format**

**Description**
The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required, particularly from large agencies that transfer data between local systems and from clients.

**GAP 27: Inability to collate and delivery water accounting data efficiently**

**Description**
Current systems do not have the capacity for the extraction and provision of data to meet the reporting needs of the National Water Account or the delivery of Bureau data as specified under the regulations in the format detailed in WDTF specifications.

**GAP 28: Groundwater database unable to export data in WDTF format**

**Description**
The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**GAP 29: Groundwater Water Licensing and Usage Database system unable to export data in WDTF**

**Description**
The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**GAP 30: Water quality database unable to export data in WDTF format**

**Description**
The preferred method of data ingestion at the Bureau is the Water Data Transfer Format (WDTF). It is highly likely that over time this format will become the data transfer standard for water data in Australia. To increase the utility of this format, both data export and import routines will be required.

**Gap 31: Insufficient redundancy in telemetry systems**

**Description**
A significant proportion of water data is now collected and published in near real time to meet operational needs (such as flood warning). The dependence on having reliable data is such that redundancy of some or all components of water information systems is being considered. Most agencies do not have fully integrated redundancy of systems and infrastructure. The major components include power, communication, logger and computer hardware, telemetry software, FTP and web publishing.

**GAP 32: Inadequate water data QA system**

**Description**

There is no common data quality attributes system within the jurisdiction to send data to the Bureau.

**GAP 33: Insufficient collection of meteorological data in electronic format**

**Description**

The analogue system needs to be upgraded to digital to enable data to be collected in a more timely manner, and in electronic format.

**GAP 34: Insufficient number of hydro-meteorological stations at critical sites, e.g. storages**

**Description**

The ability to manage storages is limited by the insufficient number of meteorological stations.

**GAP 35: Insufficient knowledge of capacity of river storages**

**Description**

Bathymetric survey information for storages is essential for managing storage capacity, water accounting, routing water events downstream, and modelling.

**GAP 36: Core database unable to meet current and future data management and delivery needs**

**Description**

Access to data is needed in the correct format for WDTF, modelling, reporting and compliance.

These 36 Gaps in Data and Systems will influence the ability of NSW to respond in a timely, efficient and accurate manner to some of the challenges in managing the water resources of NSW. The challenges were outlined in Section A and include:

- environmental sustainability
- extreme drought and extreme events
- intense competition for water
- productive use of water
- finite water resources.

Section A also outlined the key information drivers that developed from these challenges. The information drivers establish a management context to which all the data can be applied. The data that is collected, stored and analysed, and the equipment and systems set up around this data collection therefore work towards supporting the following information needs:

- Planning for future sharing of the resource.
- Operational management.
- Compliance.
- Public interest.
- Water accounting and assessment.
- Special purpose water monitoring.

Identifying how the 36 Gaps in Data and Systems fit with the information drivers can assist with not only prioritising the resolution of the gaps, but also determine which of the information drivers may not have enough data to support the development of solutions for key water management questions and issues. The table C2 below links the 36 data gaps to the six information drivers.

**Table 4: Water information – Driver one**

| | |
|---|---|
| **1. Planning for future sharing of the resource** | |
| • Sustainability for water users and the environment.<br>• Drought management.<br>• Competition for water.<br>• Climate variability and climate change.<br>• Medium and long-term forecasting. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |
| Gap 3 | Lack of adequate asset management and replacement for surface water. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 5 | Inadequate water mass balance information. |
| Gap 6 | Inadequate spatial location of surface water monitoring sites. |
| Gap 7 | Surface water sites no longer meet OHS and accuracy requirements. |
| Gap 8 | Height/flow calibrations not meeting accuracy requirements. |
| Gap 9 | Water storage and surface water data not in electronic format. |
| Gap 21 | Insufficient coordination for SWIMP activities at jurisdictional/lead agency level. |
| Gap 33 | Insufficient collection of meteorological data in electronic format. |
| Gap 35 | Insufficient knowledge of capacity of river storages. |
| **Ground water – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 12 | Lack of adequate asset management and replacement for groundwater bores. |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 14 | In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 15 | Lack of information about Groundwater Dependent Ecosystems (GDE's) for their sustainable management. |
| Gap 16 | Inadequate spatial mapping of groundwater network |
| **Water quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations |
| Gap 18 | Inadequate spatial mapping of water quality network |
| Gap 19 | Insufficient water quality data in electronic format (data at risk) |

**Table 5: Water information – Driver two**

| 2. Operational management | |
|---|---|
| • River operations. | |
| • Delivery, short-term forecast, plan operation, including wetland watering, environmental contingencies, algae impacts, and access to river flows for industry. | |
| • Flood operations. | |
| • Flood forecasting, emergency planning. | |
| • Environmental monitoring. | |
| • Flow variability, flow targeting, water quality. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 20 | Inadequate number of water quality sensors in the surface water network. |
| Gap 34 | Insufficient number of hydro-meteorological stations at critical sites, e.g. storages. |
| **Ground water – Gaps in data and systems** | |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 12 | Lack of adequate asset management and replacement for groundwater bores. |
| **Water quality – Gaps in data and systems** | |
| Gap 17b | Inadequate water quality monitoring network for surface water physical/chemical parameters. |
| Gap 17c | Inadequate water quality monitoring network for groundwater/surface water interaction. |
| Gap 19 | Insufficient water quality data in electronic format (data at risk). |
| Gap 22 | Inadequate blue-green algae monitoring. |
| Gap 23 | Insufficient monitoring for a range of water quality programs. |

**Table 6: Water information – Driver three**

| 3. Compliance | |
|---|---|
| • Auditing of compliance (MDB Cap and water sharing plans). | |
| • Access rules (cease to pump, etc.) particularly for unregulated systems. | |
| • Groundwater use – pumping drawdown, interference, trading. | |
| • Drought sharing. | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |

| | |
|---|---|
| Gap 3 | Lack of adequate asset management and replacement for surface water. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| **Ground water – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 12 | Lack of adequate asset management and replacement for groundwater bores. |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A). |
| GAP 14 | In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 15 | Lack of information about Groundwater Dependent Ecosystems (GDE's) for their sustainable management. |
| Gap 16 | Inadequate spatial mapping of groundwater network. |
| **Water quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations |

**Table 7: Water information – Driver four**

**4. Public information**

- **Reporting/internet – Key stakeholders**
  e.g. river heights and flows, water quality, current storage levels, reliable and near real time.
- **Recreation**
  e.g. water levels, predicted conditions.

| | |
|---|---|
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A) |
| Gap 4 | Data capture and transfer not meeting time requirements |
| Gap 6 | Inadequate spatial location of surface water monitoring sites |
| Gap 9 | Water storage and surface water data not in electronic format |
| Gap 24 | Lack of access to integrated datasets on the web |
| **Ground water – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk) |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A |
| **Water quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations |
| Gap 18 | Inadequate spatial mapping of water quality network |
| Gap 19 | Insufficient water quality data in electronic format (data at risk) |

**Table 8: Water information – Driver five**

| 5. Water accounting and water resource assessment (reporting) | |
|---|---|
| • Institutional Government requirements<br>• NSW is a signatory to National Water Initiative (including recent COAG updates), inter-state agreements (Murray-Darling Basin Agreement, NSW QLD Border Rivers Agreement)<br>• Legislation (water sharing plans, Commonwealth Water Act)<br>• Public disclosure of water management information | |
| **Surface water – Gaps in data and systems** | |
| Gap 1 | In some catchments, the surface water network coverage is not fully meeting water information requirements (see information drivers, section A). |
| Gap 2 | Streamflow data not meeting all accuracy requirements. |
| Gap 3 | Lack of adequate asset management and replacement for surface water. |
| Gap 4 | Data capture and transfer not meeting time requirements. |
| Gap 5 | Inadequate water mass balance information. |
| Gap 25 | Licensing database system unable to export data in WDTF format. |
| Gap 26 | Surface water database system unable to export data in WDTF format. |
| Gap 27 | Inability to collate and delivery water accounting data efficiently. |
| Gap 30 | Water quality database unable to export data in WDTF format. |
| Gap 32 | Inadequate water data QA system. |
| Gap 36 | Core database unable to meet current and future data management and delivery needs. |
| **Ground water – Gaps in data and systems** | |
| Gap 10 | Insufficient quality attributes for data stored in the Groundwater Database System (GDS). |
| Gap 11 | Insufficient groundwater data in electronic format (data at risk). |
| Gap 13 | In some catchments, the groundwater network coverage is not fully meeting water information requirements (see information drivers, section A). |
| GAP 25 | Export licensing database system unable to export data in WDTF format. |
| Gap 28 | Groundwater database unable to export data in WDTF format. |
| Gap 29 | Groundwater Water Licensing and Usage Database system unable to export data in WDTF. |
| **Water Quality – Gaps in data and systems** | |
| Gap 17a | Inadequate water quality monitoring network for flow/water quality associations |

**Table 9: Water information – Driver six**

| 6. Special purpose monitoring | |
|---|---|
| • DWE is funded for water monitoring across NSW to support particular water management activities of other agencies, organisations and industry. | |
| **Surface water – Gaps in data and systems** | |
| Gap 26 | Surface water database system unable to export data in WDTF format. |
| Gap 31 | Lack of telemetry system full redundancy. |

# Section D – Priorities

NSW has undertaken a detailed review of its water information and monitoring needs from the perspective of current water management priorities and issues. As part of this SWIMP, these outcomes have been aligned with the requirement of the Bureau's Improved Water Information Program. The outcomes are described in this section (Section D) of the report, which brings together the work of the previous three Sections and leads to a list of prioritised actions for which Bureau backing is sought.

## Summary of sections A, B and C

### Section A

Identifies the important water information *drivers* for NSW. These underpin the strategic and operational issues and challenges facing water managers in this State.

### Section B

Provides significant detail on the State's data collection networks and data management systems. Descriptions are included of the monitoring network policies that ensure the networks are cost efficient, effective and appropriate for NSW needs.

Section B also includes the Inventory. This is a collation of monitoring network metadata provided by key water monitoring agencies. It describes 97 per cent of the surface water and groundwater data being collected in NSW.

### Section C

***I***ncludes a data gaps analysis of strategically important water monitoring activities. It links the data gaps with the State's information drivers and proposed actions to address the gaps.

## Section D approach

The data gaps developed in Section C were assessed, and strategies and actions developed that could contribute to resolving the gaps. This information is presented in Table D1 and was provided to representatives of the seven key agencies for detailed review and consideration at a workshop.

Representatives of these agencies brought to the workshop draft funding applications with indicative costs for their projects. This information was merged with the detail developed in Table D1 and:

- projects were collated into activity groups that reflected the action being undertaken
- the projects were then aligned with appropriate data gaps and the Bureau's eight themes
- the results were placed into a table – see Attachment 1, Table D4
- additional fields were added for project name, indicative cost and comments.

The outcome of this provided a clear indication of the project activities and indicative costs for the five key agencies and nine organisations lodging funding applications for 2009–10. In summary this amounted to 53 projects at a cost of around $10.69 m from 14 organisations.

## Key strategies and actions for each gap, associated with the Bureau themes

The Bureau has identified eight themes for improving data collection, storage and delivery across Australia. These themes and associated actions are outlined below.

**Theme 1:** Improving accuracy of measurement

**Theme 2:** Improving data currency

**Theme 3:** Improving data coverage

**Theme 4:** Data management and transfer

**Theme 5:** Improving the Australian Hydrologic Geospatial Fabric

**Theme 6:** The National Water Account

**Theme 7:** Strategic Water Information Coordinators

**Theme 8:** Rescue of strategic data.

Table D1 outlines the priority ***strategies and actions*** for NSW to address the data gaps within each of the eight eligibility themes of the Bureau, they are listed below.

**Table 10: Improving accuracy of measurement networks – Theme 1**

| Data gap | Strategies and actions |
|---|---|
| **Gap 2 – Streamflow data not meeting all accuracy requirements** | **Strategy:** Address data accuracy in priority locations.<br>**Action:** Develop prioritisation process to identify and target locations of greatest need for increased gauging frequency or other methods.<br>**Action:** Lobby clients to obtain resources to meet standards. |
| | **Strategy:** Acoustic Doppler installations. Continuous measurement of velocity in streams adds another dimension to the measurement of streamflow in increasing the accuracy of flow distribution in streams.<br>**Action:** Install ADCP at priority assessed end-of-system backwater-affected sites. After initial calibration, these devices will free up resources to undertaken more height/flow calibrations. |
| | **Strategy:** Improve stability of low flow controls. Invest in the stabilization of low flow section of critical sites in support of more accurate low flow assessment, reducing the need for height flow calibrations when the weir controls the total flow (needs to be aligned with NSW Fisheries weirs policy).<br>**Action:** Undertake priority assessment and execute site upgrades for priority stations as part of an overall asset upgrade process. |
| | **Strategy:** Update processes to reflect changed accuracy requirements.<br>**Action:** Implement (guided by the Bureau) national standards for data collection.<br>**Action:** Improve and standardise QA and QC processes, practices and systems within and across agencies to drive consistency of data provision. |
| | **Strategy:** Evaluate appropriate streamflow calibration frequency that is based on network prioritisation analysis to determine the stage discharge relationship.<br>Need to work with the Bureau to develop a national targeted approach that allows for some variability based upon location.<br>**Action:** Strategic increase in human resources. |

| Data gap | Strategies and actions |
|---|---|
| **Gap 3 – Lack of adequate asset management and replacement for surface water** | **Strategy:** Improve financial and asset management models and systems as the long-term asset depreciation management is currently reliant on capital enhancement bids. Develop and implement plans to manage the replacement of assets at the end of their life, acquire and carry finances over the life of assets.<br><br>**Action:** Develop an asset upgrade and replacement plan, obtain client support and implement. |
| **Gap 7 – Surface water sites no longer meet OHS and accuracy requirements** | **Strategy:** Prioritise upgrade of key site infrastructure and accuracy objectives.<br><br>**Action:** DWE upgrades in 2009/10 include shelter refurbishment, removal of elevated structures on a priority basis and strategic installation of EC probes. |
| **Gap 8 – Height and flow Calibrations not meeting accuracy requirements** | **Strategy:** Institute alternate/new technology solutions to resolve site-specific limitations in measurement – including low flow criteria.<br><br>**Action:** Install and calibrate in-situ Dopplers in priority locations.<br><br>**Action:** Undertake site works in priority locations to assess/improve low flow accuracy. |

**Table 11: Improving the currency of measurement networks – Theme 2**

| Data Gap | Strategies and actions |
|---|---|
| **Gap 4 – Data capture and transfer not meeting time requirements** | **Strategy:** Improve capture and reliability of real time data for transfer to the Bureau and other reporting obligations.<br><br>**Action:** Progressively upgrade logger and modems to new generation technology.<br><br>**Action:** Upgrade software systems to manage real time data transfers.<br><br>Note: Gap 31 Redundancy. |
| **Gap 12 – Lack of adequate asset management and replacement for groundwater bores** | **Strategy:** Improve utility of GDS for planning the maintenance and upgrade of monitoring bores, evaluate requirements for bore maintenance.<br><br>**Action:** Implement a State-wide bore maintenance program and data logger upgrade schedule.<br><br>**Action:** Undertake site maintenance of the casing head protector, review of casing head survey data, site surrounds from influence of adjacent land use and flood events for priority bore locations as identified in groundwater network review.<br><br>**Action:** Progressively upgrade logger and modems to provide real time data transfer capability. |
| **Gap 33 – Insufficient collection of meteorological data in electronic format** | **Strategy:** Improve capture and reliability of real time data for transfer to the Bureau and other reporting obligations.<br><br>**Action:** Progressively upgrade logger and modems to new generation technology. |

**Table 12: Improving the coverage of monitoring networks — Theme 3**

| Data gap | Strategies and action |
|---|---|
| **Gap 1: In some catchments, the surface water network coverage is not fully meeting water information requirements (see Information drivers – Section A)** | **Strategy:** Continued implementation of projects to address emerging monitoring priority areas and regular reassessment of the surface water network. The priority focus of the DWE Hydrometric Network Expansion Project is on unregulated rivers covered by water sharing plans.<br>**Action:** Completion of hydrometric network expansion. |
| **Gap 5: Inadequate water mass balance information** | **Strategy:** Identify key information elements to improve system water balances for planning models and water accounting/assessment reporting through implementation of water accounting standards and pilot projects supporting development of NWAC. Match information needs with priority questions to be addressed for contemporary water management issues.<br>**Action:** Refer to Theme 1 and 2. These actions support an improvement to assessment of system water balances.<br>**Action:** Increase network coverage of ungauged tributaries into gauged rivers.<br>**Action**: Increase, e.g. 'paired sites' monitoring of groundwater/surface water interactions for HNE project. This has commenced within DWE (HNE, and Gaining/Losing Streams Project). |
| **Gap 20: Inadequate number of water quality sensors in the surface water network** | **Strategy:** Install new salinity probes to improve coverage and quality of stream salinity measurement.<br>**Action:** Probes installed to meet specific needs of salt transport models and salinity target monitoring as per Murray-Darling Basin Plan, water quality and salinity plans. |
| | **Strategy:** Develop specific run of river salinity surveys to improve knowledge of point source and diffuse salt load distributions.<br>**Action:** Develop recommendations for refinement of salinity probe network. |
| **Gap 13: In some catchments, the groundwater network coverage is not fully meeting water information requirements (see Information drivers – Section A)** | **Strategy:** Maximise capture, coverage and utility of groundwater network information by prioritised expansion of the current monitoring network.<br>**Action:** Review groundwater bore coverage and prioritise locations that contribute to the assessment of sustainability of groundwater management units in water sharing plan areas and groundwater management units where plans are being developed.<br>**Action:** In the review of the network, prioritise coverage in areas monitoring the impact of climate variability in high connected systems, and also areas where water table aquifers are influenced by seasonal variations.<br>**Action:** Rollout of additional monitoring through programs such as DWE's WMMIS and GIMP programs. |
| **Gap 14: In some catchments, the groundwater water quality network coverage is not fully meeting water information requirements (see Information drivers – Section A)** | **Strategy:** Priority expansion of the current monitoring network to meet monitoring needs.<br>**Action:** Seek and obtain funding for, and install a network of bores to provide the information required. |

| Data gap | Strategies and action |
|---|---|
| **Gap 15: Lack of information about GDEs for their sustainable management** | **Strategy:** Targeted monitoring of groundwater quality and levels in the area of GDEs to identify the influence of groundwater use, the influence of duration, magnitude and frequency of surface water flows events on groundwater quality and groundwater levels in the area of GDEs.<br><br>**Action:** Bore location paired with surface water gauges at priority GDEs. |
| **Gap 17 A, B:**<br><br>**Inadequate water quality monitoring network for:**<br>• **Gap 17a: flow/water quality associations**<br>• **Gap 17b: surface water physical/chemical parameters**<br>• **Gap 17c: groundwater/ surface water interaction** | **Strategy:** Assess the adequacy of commence to pump levels through assessment of water quality.<br><br>**Action:** Changes to water quality at no or very low flows and the influence of climate change on the frequency and duration of these events.<br><br>**Action:** Changes to wetted perimeter and loss of riffle micro-habitat under various low flow, cease to pump (CtP) scenarios, including the need for riffles surveys to develop low flow response models.<br><br>**Action:** Development of low flow response models.<br><br>**Action:** Information on micro-habitat preferences of aquatic biota and the sensitivity of these to increased frequency and duration of no, or very low flow events.<br><br>**Action:** Develop methods and locations for a water quality program focused on adequacy of commence to pump levels. |
| | **Strategy:** Prioritise locations and assets for ecological response monitoring of water sharing plans and other water management activities.<br><br>**Action:** Implement ecological response monitoring at specific sites across NSW. |
| | **Strategy:** Ongoing data collection on physical characteristics of rivers to contribute to improved understanding of the relationship between geomorphologic features and fluvial processes, and their possible contribution to river stability and water quality.<br><br>**Action:** Research to develop key relationships that could assist with improved water quality management. |
| | **Strategy:** Extend water quality programs, and align results to regional guidelines.<br><br>**Action:** Increase coverage of water quality monitoring across NSW.<br><br>**Action:** Assess and calibrate results to regional condition. |
| | **Strategy:** Expand spatial extent of the water quality monitoring network to meet prioritised river operational needs.<br><br>**Action:** Integrate water quality data needs into network review process to allow for prioritised growth and spatial expansion of the network.<br><br>**Strategy:** To assess surface water and groundwater connectivity, in-stream and off-channel piezometers should be established or expanded in strategic locations. Off-channel piezometers can be located at strategic locations and should be equipped with electrical conductivity (EC) loggers. EC variations in groundwater together with stream EC can be used as a natural tracer.<br><br>**Action:** Prioritise locations and then install paired piezometers to gain a better understanding of surface water/groundwater interactions. |

| Data gap | Strategies and action |
|---|---|
| **Gap 22: Inadequate blue-green algae monitoring** | **Strategy:** Use a combined approach of improved monitoring and modelling to improve blue-green algae monitoring in NSW.<br>**Action:** Test new sampling technologies in priority locations across NSW.<br>**Action:** Extend the capacity of the current blue-green algae model. |
| **Gap 23: Insufficient monitoring for a range of water quality programs** | **Strategy:** Strategic coordination and expansion of water quality programs coordinated with water management needs. All data to be incorporated into one database.<br>**Action:** Implement priority programs, matched with management needs.<br>See database gap (Gap 19). |
| **Gap 34: Insufficient number of hydro-meteorological stations at critical sites, e.g. storages** | **Strategy:** Improved meteorological data to support modelling and water accounting.<br>**Action:** Prioritise locations at key storages and install meteorological stations. |

**Table 13: Improving data management and transfer – Theme 4**

| Data gap | Strategies and actions |
|---|---|
| **Gap 25: Surface Water Licensing and Usage Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to water licensing database to improve WDTF export functionality. |
| **Gap 26: Surface Water Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to surface water database to improve WDTF export functionality. |
| **Gap 28: Groundwater Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to groundwater database to improve WDTF export functionality.<br>**Action:** Assess requirements in overall database terms. Maybe appropriate to replace current systems. |
| **Gap 24: Lack of access to integrated datasets on the web** | **Strategy**: Integration of DECC's and DWE's networks to improve delivery to the community. Aim towards delivering all data from a catchment seamlessly to all clients.<br>**Action:** Currently the estuarine network is available through Manly Vale and the rest is through DWE. There is an opportunity to integrate these with metropolitan networks for flood management initially, and then for other uses. |
| **Gap 29: Groundwater Licensing and Usage Database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to water licensing database to improve WDTF export functionality. |

| Data gap | Strategies and actions |
|---|---|
| **Gap 30: Water quality database system unable to export data in WDTF** | **Strategy:** Implement WDTF routines for systems that are required to export data to the Bureau. Assess the suitability for using WDTF with agencies for internal data transfer.<br>**Action:** Undertake modifications to water quality database to improve WDTF export functionality. |
| **Gap 10: Insufficient quality attributes for data stored in Groundwater Database (GDS)** | **Strategy***:* Review and identify key issues with the current database. Prioritise the issues (e.g., archive data, GDS management, procedures review and update, quality assurance, training program, compatibility between recordings and systems) and develop a system to resolve them in a timeframe compatible with the Bureau regulations.<br>**Action:** Scope and design GDS data enhancement project.<br>**Action:** Develop project plan – resources, cost, timeline in Bureau funding application format. |
| **Gap 31: Insufficient redundancy in telemetry systems** | **Strategy:** Improve reliability of remote data capture by adoption of reliable systems and technologies. Obtain guarantees of service provision from external service providers, build redundancy between agencies.<br>**Action:** Process evaluation and identification of risks.<br>**Action:** Assessment of options and development of back-up system(s) for critical components. |
| **Gap 32: Inadequate water data QA system** | **Strategy:** Develop QA/QC system for the jurisdiction.<br>**Action:** Prioritise the data, and implement the system.<br>**Action:** Develop an automated quality coding of real time data within and across agencies. |
| **Gap 36: Core database unable to meet current and future data management and delivery needs** | **Strategy:** Evaluate system needs, and determine if best approach is to upgrade or replace.<br>**Action:** Evaluate systems, purchase and install where required. |

**Table 14: Improving the Australian Hydrologic Geospatial Fabric – Theme 5**

| Data gap | Strategies and action |
|---|---|
| **Gap 6: Inadequate spatial location of surface water monitoring sites** | **Strategy:** Improve geo-referencing of surface water network across NSW to enhance geospatial fabric functionality.<br>**Action:** Progressively locate sites spatially and also connect to AHD. |
| **Gap 16: Inadequate spatial mapping of groundwater network** | **Strategy:** Improve geo-referencing of groundwater network across NSW to enhance geospatial fabric functionality.<br>**Action:** Locate sites, measured to AHD. |
| **Gap 18: Inadequate spatial mapping of water quality network** | **Strategy:** Improve geo-referencing of water quality network across NSW to enhance geospatial fabric functionality.<br>**Action:** Locate sites, measured to AHD. |

**Table 15: Improving the national water account –Theme 6**

| Data Gap | Strategies and action |
| --- | --- |
| **Gap 27: Inability to collate and deliver water accounting data efficiently** | **Strategy:** Provide systems that enable water accounting data to be extracted in required formats.<br>**Action:** Develop systems that enable water accounting data to be extracted in required formats. |
| **Gap 5: Mass balance** | **Strategy:** Identify key information elements to improve system water balances for planning models and water accounting/assessment reporting through implementation of water accounting standards and pilot projects supporting development of NWAC. Match information needs with priority questions to be addressed for contemporary water management issues.<br>**Action:** Refer to Theme 1 and 2. These actions support an improvement to assessment of system water balances.<br>**Action:** Increase network coverage of ungauged tributaries into gauged rivers.<br>**Action:** Increase ‘paired sites’ monitoring of groundwater/surface water interactions for HNE project. This has begun within DWE (HNE, and Gaining/ Losing Streams Project). |
| **Gap 35: Insufficient knowledge of capacity of river storages** | **Strategy:** Bathymetric survey of key storages.<br>**Action:** Prioritise storages and undertake survey. |

**Table 16: Strategic Water Information Coordinators – Theme 7**

| Data gap | Strategies and actions |
| --- | --- |
| **Gap 21: Insufficient coordination for SWIMP activities at jurisdictional/lead agency level** | **Strategy:** Provide adequate funding for SWIMP activities.<br>**Action:** Identify necessary resources and seek funding.<br>**Action:** Seek major agency support for SWIMP and SWIC functions. |

**Table 17: Rescue of strategic data – Theme 8**

| Data gap | Strategies and action |
| --- | --- |
| **Gap 9: Water storage and surface water data not in electronic format** | **Strategy:** Assess data entry priorities based on the latest information and progressively make data and metadata available electronically to the national water database (with guidance from the Bureau).<br>**Action:** Entry of metadata into electronic format.<br>**Action:** Conversion of unprocessed prime data to digital format. |
| **Gap 11: Insufficient groundwater data in electronic format (data at risk)** | **Strategy:** Assess data entry priorities based on the latest information and progressively make data and metadata available electronically to the national water database (with guidance from the Bureau).<br>**Action:** Entry of metadata into electronic format.<br>**Action:** Conversion of unprocessed prime data to digital format. |
| **Gap 19: Insufficient water quality data in electronic format (data at risk)** | **Strategy:** Assess data entry priorities based on the latest information and progressively make data and metadata available electronically to the national water database (with guidance from the Bureau).<br>**Action:** Entry of metadata into electronic format.<br>**Action:** Conversion of unprocessed prime data to digital format. |

**Table 18: Summary of projects by theme**

| Project activity | Theme | Total projects | Indicative cost | Other organisations |
|---|---|---|---|---|
| Data delivery to Bureau (WDTF tools) | 4,6,8 | 6 | $0.98 m | $0..06 m |
| Water monitoring (infrastructure, instruments, includes existing research) | 1, 2, 3,4 | 18 | $3.87 m | $0.14 m |
| Database system upgrade (software, QA/QC) | 4, 6 | 5 | $2.68m | $0.39 m |
| Metadata, data rescue and data clean up | 2, 8 | 5 | $1.23 m | $0.03 m |
| AHD and Bathymetric survey | 5,6 | 2 | $0.92 m | $0.00 m |
| Additional monitoring (includes new research) | 2,3 | 4 | $0.58 m | $0.09 m |
| Coordinated data delivery (SWIC) | 7 | 1 | $0.34 m | |
| | | **53** | **$10.69 m** | **$0.71 m** |

# Priorities

The project activities in table D2 were ranked against priority water management strategies..

**Table 19: Priorities of project groupings**

| Project activity | Ranking | Water management strategies |
|---|---|---|
| Data delivery to the Bureau – WDTF, database system upgrades, QA, data rescue and clean up | High | Murray-Darling Basin Planning |
| | | Water sharing plans, e.g. regulated, groundwater, and unregulated including estuaries |
| | | Major urban water supply system monitoring |
| | | Flood warning and river operations |
| | Medium | Larger non-metropolitan urban water supply systems |
| | | Environmental – water quality data |
| | | Research data systems |
| | Low | Small non-urban water supply systems. |
| Water monitoring – infrastructure – instruments for existing network upgrades – new network installations (including research) | High | Murray-Darling Basin |
| | | Water sharing plans, e.g. regulated, groundwater, and unregulated including estuaries |
| | | Major urban water supply system monitoring |
| | Medium | Larger non-metropolitan urban monitoring |
| | | Environmental – water quality data and GDEs |
| | Low | Small non-metro monitoring |
| | | Flood warning monitoring funded from other areas |
| Surveys – AHD and Bathymetric surveys of river storages | High | Murray-Darling Basin storages |
| | | Water sharing plans, e.g. regulated, groundwater, and unregulated including estuaries |

# Conclusion

Around 50 per cent of the Murray-Darling Basin lies within NSW. A lack of hydrologic record in parts of the Basin has accelerated the water reform agenda. Along with this, concern about the prospects of climate change has further sharpened the focus for improved quantification, understanding and management of a finite resource.

Major urban centres across Australia have been severely affected by drought, with major government investments in new water sources and urban water demands placing increasing pressure on aquatic ecosystems.

These high profile issues mirror the major water management challenges facing NSW.

This is driving an imperative for taking water information to a higher plane, to match the level of sophistication necessary for modern water management. Reforms targeting the role of water markets require accurate and timely supply of information that can be backed up with confidence from robust accounting for water resources. These reforms will assist in improving the productive use of water, including for the environment, which is becoming a significant player in water markets.

With drought and possible climate change, the intense competition for water means that we must address environmental sustainability in how we plan for future water sharing arrangements.

Aside from the new challenges that we face in water management, there is a continual need to improve the performance of our systems that provide critical near real time data for flood and emergency management. Every flood situation provides new issues, particularly for instrumentation and systems that need to function through extreme climatic conditions.

The NSW SWIMP is attempting to match the highest priority investments in improved water information to the contemporary drivers for water management in this state.

While there is a significant level of water monitoring activity across the nation, the investments that NSW seeks from the M&E Program funding will provide for maximum utility from the water data collected by ensuring:

- we achieve efficient and reliable capture both in data retrieval and data quality, with appropriate frequency and timeliness through projects for instrumentation (e.g. loggers, sensors, telemetry), an improved quality assurance system and database management
- we can provide high quality data and information to the Bureau via efficient standardised and automated system functionality through projects on WDTF capability, and reduced delays in data provision and transmission
- we improve the value of the data that we capture, manage and deliver by spatial and vertical referencing through projects on AHD referencing, and improved groundwater database functionality to leverage all of the physical attributes available to groundwater data
- we recover the significant investments in water data made over long periods of history and improve its usefulness through better descriptive detail and context in electronic form, and projects on data recovery, metadata, and data clean-up
- we harness investments in data capture, coverage and reliability along with improved understanding and conceptualisation of water balance, for contemporary water accounting and water resource assessment reporting.

Given the scale and importance of this data, NSW modernisation activities have deliberately targeted data categories 1-4 to date. The next round of data categories for delivery to the Bureau (categories 5, 6 and 7) are more interpretative and therefore more complex than the water resources datasets forwarded for 2008-09. Due to the condition of the systems and the data, there will be some major challenges. Generally, these data types require significant intervention to achieve the required information. The projects for system and data enhancement (for categories 5, 6 and 7 data) have been given a high priority in this jurisdiction’s SWIMP.

**Table 20: Projects grouped according to theme and NSW Gaps**

| Project groups | Gap in data and systems | Theme (the bureau) | Project number | Project name | Cost ($est.) | Comments |
|---|---|---|---|---|---|---|
| **Data delivery to Bureau; WDTF tools** | Gap 25 – Licensing data system unable to export data in WDTF format | Theme 8 | NSW 1.16 | Recovery of historical category 5 and 6 data from NSW Systems | 140,000 | |
| | | Theme 4 | NSW 1.18 | Water licensing system enhancement. | 130,000 | Also addresses Gap 29 – Groundwater WDTF |
| | | Theme 6 | NSW 2.4 | Water trading interoperability | 150,000 | New project |
| | | Theme 4 | NSW 16.1 | Collection and transfer of water level and storage data | 10,000 | |
| | Gap 28 – Groundwater database unable to export data in WDTF format | Theme 4 | NSW 1.05 | Upgrade of WQ and GW databases | 500,000 | Also addresses Gap 30 – Water quality WDTF |
| | Gap 26 – Surface water database system unable to export data in WDTF format | Theme 4 | 19.2 | Engineering database Bureau exports | 50,000 | Need to reduce staff time on AWIS |
| **Water monitoring (infrastructure, instruments, includes existing research)** | Gap 2 – Streamflow data not meeting all accuracy requirements | Theme 1 | NSW 1.01 | Modernisation of DWE Hydrometric Network – Stage 3 | 761,000 | |
| | | Theme 1 | NSW 1.04 | Menindee Lakes upgrades | 152,000 | |
| | | Theme 1 | NSW 1.08 | Low flow accuracy | 125,000 | |
| | | Theme 1 | NSW 1.09 | In-situ Doppler | 362,000 | |
| | | Theme 4 | NSW 2.6 | Development of a web tool for manual data entry | 40,000 | New project |
| | | Theme 1 | NSW 17.3 | Upgrade the existing hydrological instruments in Wyong Shire | 40,000 | NDMP flood warning |
| | Gap 4 – Data capture and transfer not meeting time requirements | Theme 2 | NSW 5.2 | Provision of real time IP telemetry solutions – stage 1 | 266,000 | Need total of 460K to upgrade 325 stations (water level and rainfall) over two years |
| | | Theme 4 | NSW 3.2 | Installation of data transfer management software | 195,000 | Partially applies to Gap 31 Lack of telemetry redundancy |

| Project groups | Gap in data and systems | Theme (the bureau) | Project number | Project name | Cost ($est.) | Comments |
|---|---|---|---|---|---|---|
| **Water monitoring (infrastructure, instruments, includes existing research) continued** | Gap 7 – Surface water sites no longer meet OHS and accuracy requirements | Theme 2 | NSW 2.7 | Upgrade instrumentation in float wells @ SCADA sites | 57,000 | New project |
| | | Theme 2 | NSW 8.4 | Remote communication upgrade of river drain sites | 53,000 | |
| | | Theme 2 | NSW 8.5 | Base & link radio upgrade to Narrandera Regular | 47,000 | |
| | Gap 8 – Height/flow calibrations do not meet accuracy requirements | Theme 2 | NSW 2.8 | Install pressure measurements gauges u/s of valves for storage discharge curves in light of HEPS operations | 315,000 | New project |
| | Gap 12 – Lack of adequate asset management and replacement for groundwater bores | Theme 1 | NSW 1.12 | Groundwater Monitoring Bore Rehabilitation Programme | 590,000 | |
| | Gap 20 – Inadequate number of water quality sensors in the surface water network | Theme 3 | NSW 7.3 | Upscaling water quality (salinity measurements) in central-west NSW | 134,000 | New project, but upgrades existing installations; research project. |
| | Gap 33 – Insufficient collection of meteorological data in electronic format | Theme 2 | NSW 1.19 | Liverpool Plains Reference Climate Station upgrade, Gunnedah Resource Centre | 26,000 | |
| | | Theme 2 | NSW 2.1 | Procurement and installation of automated weather stations in 12 SW storages | 359,000 | Continuation of 2008/09 NSW 2.1. New stations<br>Applies also to Gaps 4, 30 and 34 |
| | | Theme 2 | NSW 2.2 | Investigation, R&D report, procurement and installation of automated weather stations in remaining eight storages | 260,000 | New project. Some upgrades, some new stations<br>Applies also to Gaps 4 Not meeting time requirements, 30 Water quality WDTF, and 34 Insufficient hydro-meteorological stations |
| | | Theme 1 | NSW 7.1 | Improving the accuracy of Forests NSW hydro-meteorological monitoring network | 83,000 | |

| Project groups | Gap in data and systems | Theme (the bureau) | Project number | Project name | Cost ($est.) | Comments |
|---|---|---|---|---|---|---|
| **Database system upgrade (software, QA/QC)** | Gap 27 Inability to collate and efficiently deliver water accounting data | Theme 6 | NSW 1.13 | NSW groundwater modelling enhancement | 180,000 | |
| | | Theme 4 | NSW 3.1 | Water consumption data extract and transfer | 125,000 | |
| | | Theme 6 | NSW 1.14 | National Water Accounting systems | 150,000 | |
| | | Theme 6 | NSW 1.15 | National Water Accounting resourcing | 220,000 | Needs $110,000 next year |
| | Gap 32 Inadequate water data quality assurance | Theme 4 | NSW 1.06 | Development of water information standards | 139,000 | |
| | | Theme 4 | NSW 1.17 | Audit current work data | 190,000 | |
| | | Theme 4 | NSW 1.11 | Hydstra system enhancements | 200,000 | Also addresses Gap 26 – Surface water WDTF |
| | | Theme 4 | NSW 5.3 | Provision of automated real time quality coding of data | 60,000 | Re-submit, but with item for consultation with other NSW agencies |
| | | Theme 4 | NSW 3.4 | Pilot digital pen technology to improve metadata | 120,000 | |
| | | Theme 4 | NSW 3.5 | Add data quality checking application/reporting to LIMNOS system | 295,000 | |
| | Gap 36 Core database unable to meet current and future data management and delivery needs | Theme 4 | NSW 1.20 | Enhancement of the NSW water supply and sewerage performance monitoring database to report the 15 indicators required by the Bureau for urban water utilities | 300,000 | |
| | | Theme 4 | NSW 5.1 | Database content management upgrade | 306,000 | |
| | | Theme 4 | NSW 10.2 | Water data management software | 70,000 | |

| Project groups | Gap in data and systems | Theme (the bureau) | Project number | Project name | Cost ($est.) | Comments |
|---|---|---|---|---|---|---|
| **Database system upgrade (software, QA/QC) continued** | Gap 36 continued | Theme 4 | NSW 17.1 | Improve water data sharing and management | 120,000 | |
| | | Theme 4 | NSW 18.1 | Options for Bega Shire for improved data management for hydro and WQ data. | 20,000 | |
| | | Theme 4 | 19.1 | Engineering database reporting system development | 43,000 | Looks like Category 7 data |
| | | Theme 4 | 20.1 | Enable data transfer from SCADA to the Bureau via WDTF | 140,000 | Includes data rescue |
| **Metadata, data rescue and data clean up** | Gap 9 – Water storage and surface water data not in electronic format | Theme 8 | NSW 1.02 | Historic data recovery | 395,000 | |
| | | Theme 2 | NSW 2.3 Cont'd project from 08/09 | Upgrade of storage level recorders on 19 major SW storages | 530,000 | Applies to Gap 4 Not meeting time requirements and Gap 31 Lack of telemetry redundancy |
| | | Theme 8 | NSW 8.6 | Recovery of strategic water use data in Murrumbidgee Irrigation Area | 25,000 | |
| | Gap 19 – Insufficient water quality data in electronic format (data at risk) | Theme 8 | NSW 1.10 | SW quality data revitalisation and accessibility | 135,000 | |
| | | Theme 8 | NSW 3.3 | Restore historic water quality data from archived data source | 245,000 | |
| **AHD and Bathymetric survey** | Gap 6 – Inadequate spatial location of surface water monitoring sites | Theme 5 | NSW 1.07 | Connection of GW and SW sites to AHD | 570,000 | Includes surface water and groundwater locations. Also addresses Gap 16 – Inadequate groundwater spatial mapping |
| | Gap 35 – Insufficient knowledge of capacity of river storages | Theme 6 | NSW 2.5 | Bathymetric survey of eight priority storages | 345,000 | New project |

| Project groups | Gap in data and systems | Theme (the bureau) | Project number | Project name | Cost ($est.) | Comments |
|---|---|---|---|---|---|---|
| **Additional monitoring (includes new research)** | Gap 13 – In some catchments, the groundwater network coverage does not fully meet water information requirements (see information drivers, section A) | Theme 2 | NSW 1.03 | Information for managing high priority GDEs | 469,000 | |
| | Gap 33 – Insufficient collection of meteorological data in electronic format | Theme 3 | NSW 17.2 | Setting up weather station at Mardi Dam, Wyong Shire | 40,000 | |
| | | Theme 2 | NSW 27.1 | Weather installation and data link | 54,000 | NDMP, 14 new weather stations for forecasting |
| | | Theme 3 | 14.2 | Extend alert system for water level data, rainfall data and real time flood data monitoring – stage 2 installation | 19,000 | NDMP funding source |
| **Coordinated data delivery (SWIC)** | Gap 21 Insufficient coordination of SWIMP activities at jurisdictional/lead agency level | Theme 7 | NSW 1.00 | Strategic water information Coordination (NSW) | 335,000 | |
| **Total** | | | | | **10,685,000** | |

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# Appendix 1(a)
# Bureau of Meteorology NSW – Flood Forecasting

## NSW Flood Warning Centre – Input to SWIMP

**25 March 2009**

### Section A

Water information required is real time rainfall, river and tidal data which underpins the Bureau's flood forecasting service to 175 specific locations across NSW as well as other warning services. This information is currently published by the Bureau on http://www.bom.gov.au/hydro/flood/nsw/ Key stakeholders and clients of this data include:

- Bureau's NSW Flood Warning Centre (NSW FWC)
- Bureau's Regional Weather Forecasting Centre – severe thunderstorm and severe weather warning services utilise rainfall data. Marine and tsunami warnings rely on MHL tide data
- NSW SES
- government agencies, e.g. local councils, RTA, DECC
- recreational users, e.g. canoeists, school groups, campers
- landholders for property access, lifting of pumps, access to water
- boat operators, oyster farmers
- media
- consultants
- general public interest.

This list of stakeholders is based on experience and email feedback and is by no means exhaustive.

Key drivers for improvement include:

- demand for data to be up to date. Real time data is of more interest and value than historical data. The Bureau prefers event reporting data i.e. available data is updated with each increment of rain or a change in river level. If this is not possible, then to have data updated at least at one hour intervals for the catchments that are presently polled with telephone telemetry. Public feedback also indicates they would like data to be updated at least at hourly intervals across most areas of NSW in areas where the current routine polling practice is for only once a day readings
- reliability of data in terms of accuracy and availability. Inaccurate data is the major source of potential flood forecasting error if the problem is not discovered and is used in modelling. The Bureau relies on water agency data (DWE, MHL, SCA and ACT Ecowise) to be sent by FTP which requires robust systems at each end
- better network coverage is required in some areas of the state to facilitate more detailed modelling for warning services.

## Section B

Data collection systems:

a) EnviroMon – collects ALERT radio telemetry data – 40 EnviroMon base stations across NSW.

b) FTP – inter agency data transfer mainly from telephone polled sites.

c) Timestudio – collects data from the Bureau's telephone telemetry rain stations.

**NSW Flood Warning Network**

| SYSTEM/Agency | Rain | River |
|---|---|---|
| ENVIROMON ALERT DATA – Bureau and councils | 305 | 198 |
| FTP – Sydney Catchment Authority | 34 | 16 |
| FTP – ACT Ecowise | 28 | 30 |
| FTP – Hunter Integrated Telemetry System | 12 | 58 |
| FTP – Manly Hydraulics Lab | 61 | 150 |
| FTP – Dept of Water and Energy | 85 | 389 |
| TIMESTUDIO – Bureau | 116 | |
| **Totals** | **641** | **841** |

Additional rainfall data is collected in real time from 109 Bureau owned automatic weather stations. The distribution of all these rain and river stations can be viewed on http://www.bom.gov.au/hydro/flood/nsw/

## Section C

### Data issues and opportunities

a) There is the need to improve the timeliness of data, particularly during floods, so we can provide the public and SES real time data. This availability can be improved through upgraded communications such as Next G and ERTS radio.

b) Vulnerability of agencies that provide FTP data feeds with respect to disaster recovery, backup sites and support for 24/7/365 systems.

### Data gaps

The main larger scale areas where improved network coverage is required for flood warning purposes includes the following:

a) Castlereagh Valley

b) Bogan Valley

c) Lower Gwydir

## Section D

### Priorities

### Improved timeliness of data – funding for upgraded communications

a) Improved security of agency sites that provide FTP data feeds – funding for backup sites and other strategies that improve data security.

b) Data gaps – funding for additional gauges.

# Appendix 1(b)
# Department of Environment and Climate Change (DECC)

## Section A

The Department of Environment and Climate Change (DECC) is the NSW Government agency responsible for developing, coordinating and delivering policy and programs to deal with environmental, climate change, sustainability, natural resource and cultural heritage issues in NSW.

### DECC – Coastal and Floodplain Programs

DECC works closely with local councils, catchment management authorities and communities across the state to ensure the long-term protection, conservation and restoration of coastal, estuarine and floodplain environments by reducing the risks posed by coastal hazards such as extreme tides, sea level rise and floods.

The Coastal and Floodplains Programs Branch of DECC is responsible for the management of the NSW Coastal Environmental Data Network. The provision of coastal/estuary data collection services covering eastern NSW is currently defined in an annual contract between DECC and the Department of Commerce, Manly Hydraulics Laboratory. For historical reasons, environmental data collection west of the Great Dividing Range is undertaken by the Department of Water and Energy by their Hydrometric Unit whilst east of the divide, in the coastal zone, this function is a DECC responsibility via an annual performance based contract.

The data collected is primarily used by DECC to underpin the delivery of the floodplain management, coastal management and estuary management programs. The data program aims to minimise risk to life and property due to natural hazards (storm and flood) in the coastal zone of NSW. The real time data is used extensively by the Bureau of Meteorology, SES and local councils to generate emergency warnings and delivery of services during extreme events.

The historical archives of data are used in natural disaster mitigation investigations, environmental studies and to develop land use planning instruments as well as for coastal, estuary and floodplain management plans and design. The data network is used to monitor long term changes in flooding, wave and tidal characteristics as a result of climate change and associated sea level rise.

The NSW Coastal Environmental Data Network is used for a wide range of purposes. These include:

- predicting tides and storm surges
- monitoring sea level rise
- monitoring of wave heights
- monitoring of river heights
- flood warnings and flood studies
- coastal hazard definition and erosion studies
- estuarine hydrodynamic and water quality modelling
- state of the environment reporting
- monitoring long term trends (including climate change) in flooding, wave and tidal characteristics.
- determination of Mean High Water Mark used in property definition.

The current network provides data capture, installation, operation and maintenance of 235 River and Estuary Water Level Recorders, 72 rain gauges, 17 ocean tide gauges, four offshore tide and storm surge and seven deepwater waverider buoys. The current performance of the water level network is achieving 99 per cent data recovery. Information is freely made available on the internet with the database currently servicing over 1,000,000 requests annually.

DECC/MHL are listed in the Regulations (under the *2007 Water Act*) as a water data supplier under Category B and Category H (Flood Warning). MHL currently supplies the Bureau with an extensive amount of near real time flood warning, severe weather warning and storm surge data in the required format.

## DECC – Scientific Services Division

The Scientific Services Division within DECC undertakes scientific research, investigation, monitoring, analysis, evaluation and reporting on a wide range of natural resource and environmental issues. This helps DECC achieve its corporate goals and responsibilities based on the best available scientific information.

Broadly, the Scientific Services Division has the following functions:

- Provides information and technical support to the other Divisions of DECC, Catchment Management Authorities and other clients.
- Undertakes long-term research to improve knowledge.
- Develops expertise to address immediate priorities.
- Provides links between environment protection and resource management through improved knowledge of catchment processes.
- Develops information management systems to enable multiple uses for departmental data.
- Gathers information to map and assess changes in environmental attributes.
- Assesses the impacts of contaminants on the environment.

## Monitoring evaluation and reporting

The NSW Government adopted targets (developed by the Natural Resources Commission in September 2005) to maintain or improve the condition and trend of the State's biodiversity, water, land and community assets. The targets are now a priority in the NSW State Plan.

In August 2006, NSW Cabinet adopted the NSW Natural Resources Monitoring, Evaluation and Reporting (MER) Strategy. The Strategy announced a NSW Monitoring, Evaluation and Reporting Program that would collect data on statewide resource condition of the assets covered by the 13 targets and the pressures on those assets. The Program is to report at both the CMA regional scale through the production of 13 State of the Catchment reports and at the NSW state scale through statewide assessments published in the NSW State of the Environment Report. The State of the Catchment reports are designed to provide a science-based analysis of Natural Resource condition and pressures that will assist CMAs in revising their Catchment Action Plans and refocus their Natural Resource Investment Strategies.

To meet the requirements of the Strategy, NSW Natural Resource Agencies have reprioritised their resources to accommodate the MER Program; additional start-up money has also been made available through the Joint Steering Committee for NAP/NHT2.

There is a statutory obligation to publish the next NSW SoE Report at the end of 2009; that will contain the statewide assessments based on MER data.

In December 2008, draft State of the Catchment reports were submitted for each of 13 targets for all 13 CMAs in the State:

- Native vegetation (led by DECC)
- Native fauna (led by DECC)
- Threatened species (led by DECC)
- Invasive species (led by DPI)
- Riverine ecosystems (led by DWE)
- Groundwater dependent ecosystems (led by DWE)
- Wetlands (led by DECC)
- Estuaries and coastal lakes (led by DECC)
- Marine waters (led by DPI)
- Soil condition (led by DECC)
- Land capability (led by DECC)
- Economic sustainability and social wellbeing (led by DPI)
- Natural resource manager capacity (led by DECC)

The draft State of the Catchment reports are now with the Natural Resource and Environment CEO Cluster group, the Natural Resources Commission and all 13 CMAs for review. They will be published later in 2009.

*More General Areas identified in DECC's Annual Report 2007-2008 which have direct or indirect links to water quality (water-related excerpts only.*

**Climate change and its impacts are minimised to protect the environment, the economy and community wellbeing**

**Outcomes**

DECC aims to minimise the impacts of climate change by:

- reducing greenhouse gas emissions
- encouraging the NSW community to introduce measures to adapt to climate change
- minimising and managing increased risks to life, property and the environment from coastal erosion, flooding and bushfires.

**Key drivers**

DECC's work in the area of climate change is informed by the:

- NSW Greenhouse Plan (www.environment.nsw.gov.au/climatechange/greenhouseplan.htm)
- *State Plan – A New Direction for NSW* (www.nsw.gov.au/stateplan/)
- *NSW Biodiversity and Climate Change Adaptation*
- *Framework* (www.environment.nsw.gov.au/threatenedspecies/climatechange.htm)
- Climate Change Fund (www.environment.nsw.gov.au/grants/ccfund.htm)

**Performance indicators**

DECC measures performance in the area of climate change through the following performance indicators:

- Approved energy savings action plans and water savings action plans.
- Approved floodplain risk management plans.
- Approved coastal and estuary management plans.
- Businesses participating with DECC to improve resource recovery and sustainability.

# Section B

## Investment in water information assets

### DECC – Coastal and Floodplain Programs

Details on the individual stations that make up the DECC coastal water level network are included in a Table in the Appendix. Over the past two funding rounds, DECC has been successful in securing BoM funding to upgrade the data loggers and telemetry systems for the entire water level network. It is expected that this instrumentation upgrade will be completed by the end of June 2009.

### DECC – Scientific Services

Within Scientific Services Division investment in the storage and provision of water quality information has been facilitated by a grant from BoM to migrate, update and improve DECC's water quality database. The end product will be a water quality database (SQL server) which provides easy access to metadata, raw water quality data and identification of quality assurance procedures applied to the data. Rather than continuous monitoring much of DECC's Water Quality data has been generated through scientific projects of approximately two to three years duration. The resulting data has been catalogued and stored and the aim of the migration, update and improvement of DECC's water quality database is to make this information more readily available. This database will form part of DECC's corporate IT strategy, which covers a wide range of issues including automatic backup and security. Water Quality data from current and future projects will be stored in this database.

# Section C

### DECC – Coastal and Floodplain Programs

Over the last three years DECC has undertaken a comprehensive review of the entire Flood, Estuary, Ocean Tide and Storm Surge programs. The review has resulted in a number of changes to the overall network which are currently being implemented by MHL. The work includes a limited number of new high priority stations, relocation of stations to provide superior information and the decommissioning of redundant sites. The review included consultation with the main stakeholders in data use regarding the proposed changes to the network. As part of the review process there was no overall increase in the size of the network due to budgetary constraints.

### MHL review of Data Management and Support systems

MHL is currently undertaking an extensive review of its IT system. The review has identified a number of outdated and vulnerable components.

MHL's telemetry and data management systems were developed in the early 1980s. Although MHL's systems were once state-of-the art, and have continued to satisfy key data management needs, the telemetry system are unable to communicate with new loggers. MHL's systems also reside on redundant technologies that are no longer well supported and there is an increasing risk of irrecoverable systems failure that could result in disruption of current data provision to DECC and the Bureau.

### DECC – Scientific Services

Current Gaps in the output from Section B include:

- long-term administration of databases (i.e. ongoing resourcing)
- database standardization (parameter, units etc)
- coordination of Water Quality Data Sharing within and across Government Agencies
- agreements for the release/use of DECC water quality data (other than those covered under legal requirements to provide data)
- NSW State-wide clearing house for water quality (and ecological) data

# Section D

**DECC – Coastal and Floodplain Programs**

The overall Strategic objectives for the monitoring system are based upon the current drivers and current investment. Also the network vision is flexible enough to cater for the future, expected demands. Outlined below are the targeted objectives:

- Exceed 99 per cent data recovery for events and long term data sets.
- Provide all data in real time.
- Provide all data in a secure and accessible format.
- Quality code all data.
- Provide a monitoring system that is:
    - compliant and compatible with best practice with State and Federal Water Authorities
    - robust, responsive but flexible
    - low powered
    - that minimises OHS&R risks
    - optimises resource allocation via low maintenance
    - discrete in design with minimal environmental impact
    - sound data security, storage and access.

To achieve the strategic jurisdiction vision, the areas for highest priority investment are:

- data base content management upgrade
- provision of real time IP telemetry solutions
- provision of Real time quality coding of data.

These priority investments are salient to the Bureau’s water information mission in that they improve water availability forecasting, improve information provision to the public and will improve the flood and severe weather services.

**DECC – Scientific Services**

The Strategic Plan for the Water Quality Database is much more modest. As identified above, in the short-term it simply aims to provide easy access to metadata, raw water quality data and identification of quality assurance procedures applied to the data. This database would form the repository for water data collected by DECC and be made available on request to other stakeholders (providing there are no legal/IP issues associated with the release of such data). It is one component of a ‘work in progress’.

# Appendix 1(c). Department of Primary Industries

## DRAFT: NSW DPI Strategic Water Information and Monitoring Plan 2008/09

### Section A

Water is a critical ingredient in primary production. Striking the balance between extractive uses and environmental water requirements is an incredible challenge - not only for governments but for all primary industry enterprises. Farmers, foresters, fishers and miners know the value of water to their businesses and equally the importance of sustaining the environment from which water is extracted.

This challenge is made all the more complex as governments and communities come to understand the impacts of climate change upon water resource availability. New South Wales primary producers require secure access to water resources. This needs to be matched with commitment by primary industries to adopting best practice methods and technologies to continually improve water management.

To service the diverse needs of primary industries stakeholders, NSW DPI has a substantial science and research capacity and has also established itself as a leader in the provision of advice, information, education and training services. The water activities of NSW DPI are often focused at the farm to paddock scale and our expertise here is recognised. These functions set NSW DPI apart from other natural resource management agencies, which are primarily focused on the larger catchment scale and the use of regulatory approaches. This capacity, in combination with water policy and socioeconomic expertise, gives credibility to the Department’s role as a strong voice for primary industries in Government decision making processes.

NSW DPI collects water information to allow efficient use of water, better management of water losses, maximising returns from available water and water quality issues are addressed. DPI also leads research to ensure the impact of landuse at the point scale on water is understood, and that recommendations and policy to support new land management systems are based on this knowledge.

NSW DPI has statutory responsibility for the management of areas that affect and/or are influenced by (either directly or indirectly) water quality and quantity.

NSW DPI (Mineral Resources) is responsible for water issues as part of the impact assessment of certain activities including exploration and underground mining. Operational focuses include maintaining water quality and quantity for surface and groundwater. For surface mining operations, expertise is focused on rehabilitation. NSW DPI will maintain the role of assessing the impacts of underground mining until the end of 2010 when companies are required to have approval under Part 3A, or development consent under Part 4, of the *Environmental Planning and Assessment Act 1979*.

From a fisheries ecosystems perspective, these functions include aquatic habitat protection and rehabilitation, threatened species conservation, management of commercial and recreational fisheries and aquaculture. Key areas of interest include maintaining or improving sustainable flow regimes for aquatic habitats and fisheries resources, including threatened species in order to maintain or improve aquatic ecosystem health.

Forests NSW (a public trading enterprise and Division within NSW DPI) is required to monitor and manage water quality to comply with obligations under the Integrated Forestry Operations Approvals. Forests NSW expertise includes water quality monitoring and understanding of the water needs of native forestry (particularly flooding forest types). NSW DPI (the Forests NSW and Science and Research Divisions) is also involved in projects that monitor plantation usage of water.

From an agriculture perspective, there is no statutory responsibility specifically related to water management. Instead expertise is focused on applied research, education and training in areas such as improved crops requiring less watering; greater water-use efficiency; recycling and reuse of waste waters; and also reducing salinisation, waterlogging and polluted accessions to surface and groundwater sources.

## Section B

### Forestry streamflow monitoring

Forests NSW collects water information predominantly at the small catchment scale. It operates a network of 35 stream gauging stations in catchments that are between 0.1 and 45 $km^2$ in area. Stage is measured at these stations with a combination of optical shaft encoders and pressure transducers, all upgraded to either Druck pressure transducers or Unidata shaft encoders as a result of the first round of BoM funding. All field data are recorded on dataloggers, which are in the process of being upgraded to Campbell CR800 loggers as a result of the first round of funds. At this stage all loggers are downloaded at site in the field as none have telemetry installed.

Additionally, FNSW operates turbidity probes at its gauging stations and at most sites stage-activated water samplers (Isco and Gamet) are used to collect water samples for laboratory analysis of turbidity and suspended sediment concentration. Manual storage rain gauges are situated within the majority of catchments monitored and supplemented by a smaller number of tipping bucket pluviometers.

All of Forests NSW water information is held within a Hydstra database. FNSW has a licence for both the Time Series and Water Quality modules within Hydstra. It has been successfully using the HyBoMexp program since November 2008 for sending the required data to the BoM via its FTP site.

### Weather stations

There are weather stations located on 17 NSW DPI Research Stations around NSW, some manual, some automatic, sometimes both. There are various combinations of data being automatically or manually fed into the Bureau of Meteorology (BoM) or not linked at all. Five are directly linked to the BoM data base (Gosford, Grafton, Trangie, Tocal and Yanco) with a further six being manually downloaded to BoM. Data collected usually depends on research needs at the site or is based on some community or historical need. The reading can be once or twice daily (0900 and possibly 1500). On most stations the process is labour intensive and takes a trained operator up to an hour a day, seven days a week. Storage and use of data varies from site to site.

Six new automatic weather stations have been installed over the past five years and data downloads from these stations via GSM modems is currently a ‘manual’ operation.

### Monitoring impact of land use on water in upland catchments

NSW DPI has a network of 10 highly instrumented upland dryland catchments in NSW, in which components of the water balance are being measured from Wagga Wagga in the south to Quirindi in the North. The project addresses the need for long term high quality and high resolution hydrological data. The sites are all well described and measurements are being taken at strategic locations within the catchments for up to 15 years.

Traditional hydrology methods are used to monitor soil water with automatic loggers and neutron probes, evapotranspiration by Bowen ratio instrumentation, piezometers for groundwater levels and Electrical Conductivity (EC), stream gauging for streamflow and EC and climate station. The data is collected by automated dataloggers and manual sampling, especially important for calibration procedures which guarantee data quality and comparability across a range of sites. The data is quality assessed and collated into common data sets and analysed and reported by a small team of Research Hydrologists with specialised expertise.

In addition to the areas above where DPI is currently registered as a provider of water data with the BoM, NSW DPI has been collecting water quality and drainage volume data at research sites on farms with coastal acid sulphate soils. The aim of this water monitoring has been to evaluate the effectiveness of management practices to reduce down stream acid export and water deoxygenation. This research has provided some of the most detailed data of acid drainage processes of any site in Australia. Currently, this monitoring has been suspended due to completion of research grants. However NSW DPI has considerable skill and investment in equipment to employ in relation to acid drainage monitoring. There is currently a gap in knowledge of water quality processes associated with strategies which aim to retain excess water in wetlands for grazing.

## Section C

The management of water in a primary industries context is a clear priority of DPI. Water management is recognised as one of the four strategic priorities of both the Divisions of Science & Research and Agriculture, Biosecurity & Mine Safety. Water is also the focus of one of four internal actions plans of the department, which pull together the work that is being done across the divisions into a cohesive, consolidated and strategic approach. This is a cross-divisional plan that coordinates and directs DPI's collective efforts. Monitoring is an essential element of any approach to improve water management.

**Forests NSW** has recently negotiated a five year strategy for the continuance of its water monitoring network to at least 2013. Within budgetary and resourcing constraints, the existing network will adequately provide the types of water information required, i.e. there are no identified data gaps in that sense. However, upgrades to some of the infrastructure, monitoring equipment and supporting equipment are required to increase data collection efficiency, minimise data loss and further increase the accuracy of recorded information.

The first round of BoM funds has enabled Forests NSW to upgrade its data logging and stage recording infrastructure. This initial investment focussed on improving the reliability of water quantity (*Q*) data collected and transferred to the BoM. Areas identified for future upgrades are those relating to the introduction of automated data collection and remote transfer, increased reliability of rainfall and *in-situ* water quality measurements, and investment in ancillary equipment required to improve the accuracy of velocity-area gaugings and station rating curves.

### Weather stations

During 2007 DPI conducted a comprehensive review of the network of 17 weather stations located at research facilities. This review has resulted in a new strategy for weather stations within DPI. The strategy will see a network of fully automated weather stations with finer data resolution than can presently be collected. This network will be fully compatible with the BoM standards and facilitate the contribution of data under the BoM Survey for Water Regulations Online. In addition it will allow DPI scientists real time access to comprehensive weather data for water research and monitoring projects. This strategic approach was the basis of Project 7.2 that has been supported under the 2008/09 round of the Modernisation and Extension of Hydrologic Monitoring Systems Programme Fund.

### Water monitoring in upland catchments

This activity (Key Sites) commenced under the NSW Salinity Strategy and has continued with the support of the National Action Plan for Salinity and Water Quality. It is now conducted using internal resources of DPI and in collaboration with DECC. It commenced in recognition of a lack of credible scientific data on which to make decisions about land use recommendations and practices. It is collecting, analysing and reporting data for one of the only comprehensive and scientifically credible studies in Australia that is validating conceptual and computer models for hydrology under a range of common landuses. The research is challenging much of the commonly held conceptual understanding of hydrology processes that are used as the basis for investment of public funds and natural resource policy development.

## Section D

The activities of DPI that are registered under the *BoM Survey for Water Regulations Online (Category B)* continue as priorities for DPI water information and monitoring. Forests NSW have identified the following priorities:

- increased reliability of rainfall networks
- increased reliability of in-situ water quality data
- installation of telemetry
- improved station ratings.

Additional priorities include monitoring in regard to:

- acid sulphate soils in coastal catchments
- flow regimes and impact of land use on fish populations
- increased adoption of water efficient practices
- understanding and reducing the impact of mining on aquatic ecosystems
- water management risks that threaten water dependant ecosystems and aquatic industries
- development of water accounting and reporting standards including MER.

The points above must not be considered to be in order of priority. Further actions within DPI are required to put these multi divisional activities into an order of priority.

# Appendix 1(d) – Sydney Catchment Authority

## Draft Strategic Water Information Management Plan

March 2009 (See also 'Draft Water Monitoring Plan – 4 March 2009) attached separately)

### Background

The SCA has numerous obligations under its Operating Licence regarding reporting and reviewing its water monitoring program, and the identification and implementation of actions to improve the program.

Two specific obligations are particularly relevant to the contents of the Strategic Water Information Management Plan (SWIMP). There are:

- the annual production of a Water Balance and Leakage and Loss report, including progress against identified improvement actions
- the requirement to undertake a complete review of the water monitoring program. A draft report outlining the outcomes of the review thus far and proposed future steps has recently been prepared and circulated to stakeholders (including the Department of Water and Energy) for comment and endorsement. This report, and the process for further development of the Review, largely satisfy the requirements of the SWIMP. The draft report is currently being restructured in response to feedback on the draft, and the opportunity will be taken to incorporate the suggested format for the SWIMP where appropriate.

The following section identifies those parts of the current draft Water Monitoring Program 2010–2015 that fulfil the requirements for the SWIMP.

Where necessary, reference to other initiatives is included briefly below to supplement the content of the draft report.

### Section A

Chapter 1 of the draft Water Monitoring Program 2010 – 2015 outlines the various drivers for water monitoring and the management questions the SCA seeks to answer using the water monitoring data.

### Section B

Chapters 2 to 8 of the report outline the monitoring program, with each chapter focussing on monitoring at particular 'locations' (or water quality protection barriers) or for particular purposes. Of most relevance to the current scope of the SWIMP is Chapter 5 – Monitoring of Lakes and Storages, Chapter 6 – Catchment Monitoring, and Chapter 7 – Monitoring Downstream of Storages.

Chapter 10 discusses data storage and management.

## Section C

The draft Water Monitoring Program 2010 – 2015 represents the outcomes of the ongoing review of the SCA’s water monitoring program, for *routine* monitoring. Chapter 13 of the draft report outlines the scope, process and timing for the further steps of the ongoing review.

The draft report therefore represents the outcome of a critical assessment of the routine water monitoring currently undertaken by the SCA. The report identifies a number of initiatives that have been identified in response to gaps or changes required, including:

- Section 5.4 – recent, current and proposed improvements to on-line monitoring systems in *lakes and storages*
- Section 6.4 – recent, current and proposed improvements to on-line monitoring systems in *catchments*
- Section 8.3 – the current review of the *Cryptosporidium* and *Giardia* monitoring program
- Section 10.1 & 10.2– objectives of a review of the SCA's water monitoring data handling and storage systems, currently being scoped.

## Section D

The outcomes of the ongoing phases of the review of the Water Monitoring Program, in particular those aspects outlined above, will influence the future priorities and direction of future investment in water monitoring capability and systems within the SCA.

Key aspects of the current investment program relevant to water monitoring include:

- expansion of the SCARMS monitoring and modelling system to the Shoalhaven System
- proposals to incorporate algal modelling into existing reservoir models
- the ongoing Hydrometric Renewals program – this rolling program aims to replace aging assets, introduce new technology and standardisation across the system in order to maintain, and where appropriate, increase accuracy and reliability
- review of the SCA’s Communications Strategy, including telemetry
- ongoing review of the SCA’s SCADA strategy, including moving the telemetry and water monitoring data onto a common platform where appropriate
- ongoing research into best practice for evaporation estimation methods
- ongoing calibration of meters and hydrometric equipment
- replacement of thermistor chains at strategic locations with state of the art systems and technology.

# Appendix 1(e) – State Water Corporation

## Draft Strategic Water Information Management Plan

**March 2009**

### Background

As a stand-alone State Owned Corporation, State Water Corporation (SW) is identified as a water management authority and a major utility. It incorporates, into a single business, all of NSW's bulk water delivery functions outside of the areas of operation of the Sydney Catchment Authority, Sydney Water Corporation and other water supply authorities. SW owns 20 major storages, 280 weirs and delivers water to about 6,200 customers along some 7,000 km of river delivering on average 5,500 GL/year.

SW delivers water to irrigation corporations, country town water supply authorities, farms, mines, and electricity generators by releasing water from its dams and storages into rivers to be accessed by water users. In the process of achieving efficient delivery of this water it make use of a network of stream flow gauges owned by the Dept of Water and Energy (DWE) and storage recorders and SCADA systems owns by SW.

Under the Operating Licence and Water Management Act 2000 SW has numerous obligations regarding its bulk water delivery business. Some of these responsibilities are river operation including water delivery, short term forecasting, wetland monitoring, flood forecasting and emergency planning. SW also facilitates the compliance procedures established by regulators such as DWE, NWI and MDBA by collecting, collating and analysing water information and providing the necessary information and reports.

### Section A

There are two major types of water information that are required for efficient bulk water delivery, monitoring and reporting: viz. hydrological data and water order and usage data. In NSW the hydrological data are managed within the corporate Hydstra database shared by DWE and SW and the water order and usage data are managed within State Water's Water Accounting System.

Most of the hydrological data are telemetered and are electronically available. However, there are still a number of sites where daily readings are taken manually and are not electronically available. By upgrading the gauging network it will improve the quality of water information, it will help efficient transfer of data to BoM and it would provide reliable readily available information to stakeholders.

The main SW Drivers in achieving efficient and reliable water delivery would be:

- review accuracy of current monitoring system and enhance it to achieve optimum efficiency – In a draft report produced by the consultants have suggested to increase the spatial distribution of gauging network to increase the water delivery efficiency
- rationalisation and automation of data distribution systems
- closing gaps in current monitoring network
- compliance with Water regulations 2008 and BoM Requirements.

## Section B

Meteorological data in many sites are currently gathered manually. By installing automatic weather stations on main storages under State Water control, it would facilitate the timely delivery of Meteorological data for water delivery purposes. The implementation of this equipment will provide more accurate, timely and effective information for the management of storages enhancing the management of water resources around the state.

Collection of storage level and other relevant storage data are currently made using several methodologies, varying from manually read staff gauges to telemetered SCADA data. Upgrading instrumentation on major storages level recorders will enable SW/DWE/BoM to collect more detailed and accurate storage measurements in a timely manner increasing the accuracy and efficiency, particularly in times of floods and low flow conditions.

Thiess Survey of Menindee Lakes storages in 2003 revealed that the available water at Wetherell was 60,000 ML less than what DWE/SW believed to contain in Wetherell that time. By improving accuracy of existing water storage measurement networks through the development or improvement of storage capacity tables would enhance the efficiency of water delivery.

## Section C

Recent studies undertaken by Rivers Environmental Restoration Programme (RERP) and other interest groups have identified gaps in:

- accuracy of current monitoring network
- hydrological data due to sparsely populated gauging networks in some parts of the State - this may lead and Accuracy gap as well
- transmitting information due to non-availability of telemetered gauges in some parts of the network – Technological gap
- diversion data. It is recommended the installation of improved diversion meters, including facilities for flow verification audits, considered to be necessary for the effective management of available water resources in all regulated rivers.

**Data distribution**

- Category 5 and 6 data due to non-availability of storage information in electronic format – Inventory Gap.
- Timely delivery of gauging and metered diversion data.
- Menindee data due to manually read, sparsely populated gauging network.
- Accuracy of current monitoring network.

## Section D

The future priorities and direction of investment in water monitoring capability within the SW will depends on the outcomes of the current investment programme proposed by SW.

Key aspects of the current investment program relevant to SW's water delivery and monitoring programme include:

- identification of data requirement of BoM and automate the systems to transfer data/information to BoM
- automation of meteorological monitoring
- upgrade instrumentation of storage and weir level recording equipment

- upgrade the accuracy of storage capacity tables
- software development to automate the transfer of TT figures to BoM;
- installation of accurate measuring devices monitoring equipment
- identification of isolated manual data management systems and automation of the same
- automation of data collation and transfer systems to BoM
- improvement to forecasting of water demands and river ‘losses’ to improve water delivery efficiency
- better event forecasting for effective environmental releases
- improvement to management of transfer between storages to achieve better environmental outcomes
- providing improved water monitoring networks to meet objectives of NWI.

# Appendix 1(f) – Sydney Water Corporation

## Draft Strategic Water Information Management Plan

### Section A

#### The organisation

Sydney Water supplies drinking water, recycled water, wastewater services and some stormwater services to over four million people in Sydney, the Illawarra and the Blue Mountains. An area of operations covering around 12,700 km$^2$.

#### Water

Sydney Water supplies more than 1.4 billion litres of water to more than 1.7 million homes and businesses each day. Water is treated at nine water filtration plants and distributed to customers via a network of 266 service reservoirs, 148 pumping stations and nearly 21,000 kilometres of water mains.

#### Wastewater

Sydney Water collects and treats more than 1.2 billion litres of wastewater from homes and businesses each day. The sewerage network includes about 23,700 km of sewer pipes and 669 sewage pumping stations transporting wastewater to 31 sewage treatment plants.

#### Recycled water

Sydney Water has many recycling schemes in place that reduce discharges of treated wastewater to the environment and reduce demand on water supplies. These schemes currently produce approximately 25 billion litres a year. This is planned to increase to 70 billion litres a year by 2015.

#### Stormwater

Sydney Water maintains 443 kilometres of stormwater drains serving around 25 per cent of metropolitan Sydney and operates 65 Stormwater Quality Improvement Devices (SQIDs), which include devices such as trash racks, litter booms and sediment traps.

#### Water information drivers

Timely and accurate water information is essential for operating such a large and complex system. Key drivers for improved water information include regulation, strategic planning and water efficiency. Four examples of these drivers are detailed below.

#### Operating Licence

The Independent Pricing and Regulatory Tribunal (IPART) is an independent body that oversees regulation in the water, gas, electricity and public transport industries in NSW. IPART oversees the implementation of the Sydney Water Operating Licence. The objective of this licence is to enable and require Sydney Water to lawfully provide services within its area of operations. Consistent with this objective, the licence requires Sydney Water to:

- meet the objectives and other requirements imposed on it in the Sydney Water Act
- comply with the quality and performance standards in the licence
- recognise the rights given to customers and consumers
- be subject to operational audits of compliance with the licence.

Within six months from the commencement of each five-year licence, Sydney Water must develop and provide to IPART a monitoring and reporting protocol that includes how Sydney

Water will record, compile, monitor, measure and report against the service quality and system performance indicators (Schedule 1), customer service indicators (Schedule 2) and environmental performance indicators (Schedule 3).

Compliance with these requirements requires Sydney Water to maintain sophisticated monitoring and data systems. Regular audits and reviews of these systems by IPART and third parties drive continuous improvement.

**Environment Protection Licences**

The NSW Department of Environment and Climate Change licenses Sydney Water's networks that transport wastewater to 31 sewage treatment plants. Treated wastewater is reused or discharged to rivers or the ocean in accordance with strict licence conditions. Inland plants discharging to the rivers treat waste to high levels. These licences include requirements for comprehensive monitoring and data collection that are also linked to licence fees (through load based licensing) and the prioritisation of future investment through Pollution Reduction Programs.

**Strategic planning**

Sydney Water supplies water to 4.3 million people. The NSW Department of Planning projects that the population will increase to 5.3 million by 2031. This growth increases the demand on existing water and wastewater systems and leads to a need for new assets, including new sources of water.

The NSW Government's *Metropolitan Water Plan* outlines the measures that ensure Sydney, the Illawarra and the Blue Mountains have enough water now and in the future. The Plan is adaptive and takes account of emerging information and circumstances. It seeks to make wise investments in water supply and water efficiency programs. The Plan's progress is reviewed every year and is updated every four years based on the latest information, including water information collected and reported by Sydney Water, to ensure the most effective and appropriate solutions are in place.

**Leak management**

Sydney Water is investing over $400 m between 2006 and 2009 to reduce leaks. In 2008-09 Sydney Water will inspect 21,000 km of pipes for hidden leaks – that's equivalent to the entire network. Sydney Water will also replace over 100 km of water mains and install 60 water pressure management schemes. It is easily the largest leak reduction program in Australia and has reduced Sydney's total real losses from 188 ML/day in 2002-03 to 117.5 ML/day in 2007-08. Successful implementation of the program requires detailed and accurate water information.

## Section B

Water information is collected and managed in the following critical areas of Sydney Water.

**Hydraulic Systems Services**

Hydraulic Systems Services is responsible for the delivery of integrated hydraulic and telemetry operations services of the water and wastewater systems. This includes:

- operation of the System Operations Centre, which monitors and controls 1,100 of Sydney Water's water assets ranging from dams, reservoirs, river and rain gauging stations, pumping stations, major valves and water quality and pressure monitoring stations in the water reticulation network
- optimisation of the trunk water and wastewater systems operation to achieve least $/ML cost (including energy management)
- management of monitoring and control systems such as IICATS and SCADA
- administration and utilisation the HYDSTRA Database.

IICATS is an acronym for Integrated, Instrumentation, Control, Automation and Telemetry System. Sydney Water Corporation (SWC) uses the IICATS as the means of efficiently monitoring and controlling its operating facilities.

SCADA is an acronym for Supervisory Control And Data Acquisition. SCADA is a control system that allows operators at a central site to remotely monitor and control equipment in the plant.

Sydney Water's HYDSTRA Database is currently being upgraded and will be utilised for the provision of water information to the BOM.

**Monitoring Services**

Monitoring Services role is to deliver approved monitoring programs and to support the delivery of Research and Development projects. It is responsible for sampling, field testing, laboratory analysis, and associated data and information management of Sydney Waters environmental and water monitoring and hydrometric services. It also delivers some external environmental and water monitoring programs, primarily for the Sydney Catchment Authority and local government.

Sydney Water's Monitoring Process Management System (MPMS) is certified to Quality Standard ISO 9001. Analytical and field services are accredited by NATA to ISO 17025 in the fields of biological and chemical testing and sampling. The MPMS is included in Sydney Water's certification under ISO 14001 for its Environmental Management System.

**Business Intelligence**

Business Intelligence (BI) encompasses a broad range of applications, technologies, and processes that support the analysis and interpretation of information in order to understand and manage the business better. By integrating the data from a variety of Sydney Water's operational applications into one central repository (the Enterprise Data Warehouse), Sydney Water is able to gain better awareness of its assets and business processes. From this awareness comes the ability to incorporate changes that will improve efficiency while minimising risks. BI provides:

- a single **centralised, and trusted source of quality business information** thus eliminating the need for individual, unsupported applications that have limited availability and usability
- an **integrated view of the business** so that analysis can be done across functional areas of information
- **self-service from the desktop** so that individuals throughout the business can conduct their own analysis and reporting rather than having a heavy reliance on people in other business units
- **more timely information** as the data will be current as of close-of-business on the previous day.

To date there are four BI projects that have been completed. These projects have seen the following information captured in the Enterprise Data Warehouse (EDW):

- IICATS (**telemetry information** from IICATS including events, alarms, flow rates, water pressure levels)
- Monitoring (**biological, chemical and other sampling and testing information** from LIMS and other monitoring applications)
- EKAMS (**effluent sampling and testing information**)
- Finance (**financial information** from FMIS & AURION)
- The Enterprise Data Warehouse will be utilised for the provision of water information to the BoM.

## Section C

The benefits to Sydney Water through improved water information include:

- prioritisation of capital expenditure
- optimisation of operating costs
- energy savings
- improved maintenance programs through the availability of better operational information
- better response to emergencies
- improved strategic planning
- reliable reporting mechanisms for regulatory and Operating Licence reporting.

While Sydney Water implements a process of continuous improvement in the gathering and management of water information, there is a need to:

- ensure data management systems and software and up to date
- improve processes for the transfer of data to the BOM
- explore opportunities for the use of web services for data provision
- improve the quality of metadata, including geo-location of monitoring sites and standardisation of definitions and descriptions
- expand the use of quality assurance procedures across all categories of information
- pilot improved field procedures, especially metadata and real-time data transfer.

## Section D

Priorities and strategies for improving Sydney Water's water information include:

- completion of data extraction and transfer routines to export information from Customer BI within the Enterprise Data Warehouse for reporting categories 7h through 7l
- allocation of IT personnel to improve data integrity and work with the BOM on queries relating to data errors or data quality
- develop and implement a data management application to manage data transfers between Sydney Water and the BOM, allowing the tracking of all files sent and allow business users to report on success and failures and manage re-sends and errors
- review existing quality procedures and implement a quality management framework
- evaluate historic water quality data to investigate opportunities to import pre-2008 data for reporting category 9.

# Appendix 1(g) – Hunter Water Corporation

## Draft Strategic Water Information Management Plan

### Section A

**The organisation**

Hunter Water Corporation (HWC) is a State-owned Corporation providing water and wastewater services for over half a million people in the lower Hunter region. There are 220,600 properties connected to the water network and 208,660 to the wastewater network.

The HWC area of operation covers 5,366 $km^2$ with a population of 517,273 in the local government areas of Cessnock, Lake Macquarie, Maitland, Newcastle, Port Stephens, Dungog and small parts of Singleton.

Bulk water is supplied to small parts of the Great Lakes area and there is capacity to supply up to 35 megalitres (ML) of water per day to the Central Coast. HWC also provides some stormwater services to the lower Hunter, with 100 km of stormwater channels in Cessnock, Newcastle and Lake Macquarie.

HWC delivers an average 205 ML (one megalitre equals one million litres) of water per day. Its raw water sources are: Grahamstown Dam (190,000 ML capacity), Chichester Dam (21,500 ML), Tomago Sandbeds (60,000 ML) and Anna Bay Sandbeds (16,000 ML).

HWC collects, treats and then delivers drinking water to its customers and then transports, treats and disposes of the region's wastewater.

Wastewater is collected and treated to a very high standard and clear effluent is discharged to waterways or reused where it is economically and environmentally beneficial.

**Water information drivers**

Timely and accurate water information is essential for operating an urban water supply network. Key drivers for improved water information include regulation, strategic planning and water efficiency. Five examples of these drivers are detailed below.

**Strategic planning**

HWC supplies water to over 520,000 people. The NSW Department of Planning projects that the population will increase to 680,000 by 2031. This growth increases the demand on existing water and wastewater systems and leads to a need for new assets, including new sources of water.

Planning for this growth is outlined in the $H_2$50 Plan, which describes the range of demand and supply side actions that will be implemented over time to ensure an adequate supply of water to the people of the Lower Hunter. Long time series of rainfall data, streamflow data, evaporation data and historic demand and storage behaviour are required to accurately understand and thus predict future behaviour of HWC catchments, dams and customers. The development of accurate mathematical models to simulate these systems, which depend heavily on quality water information being available, has never been more important than it is now, with the emerging challenges associated with climate change and climate variability.

**Energy management**

Quality water information is an essential ingredient when planning for and operating systems to minimise energy usage. Energy usage is a major consideration when planning for pumped water supply systems, when designing treatment processes for both potable water supply and waste water disposal and when considering new water source options such as desalination and recycling.

### Operating Licence

The Independent Pricing and Regulatory Tribunal (IPART) is an independent body that oversees regulation in the water, gas, electricity and public transport industries in NSW. IPART oversees the implementation of the Hunter Water Operating Licence. The objective of this licence is to enable and require HWC to lawfully provide services within its area of operations. Consistent with this objective, the licence requires HWC to:

- comply with the quality and performance standards in the licence
- recognise the rights given to customers and consumers
- be subject to operational audits of compliance with the licence.

Compliance with these requirements requires HWC to maintain complex monitoring and data systems. Regular audits and reviews of these systems by IPART and third parties drives continuous improvement.

### Environment Protection Licences

The NSW Department of Environment and Climate Change licenses HWC’s networks that transport wastewater to 18 waste water treatment plants. Treated wastewater is reused or discharged to rivers or the ocean in accordance with strict licence conditions. Inland plants discharging to the rivers treat waste to high levels. These licences include requirements for comprehensive monitoring and data collection that are also linked to licence fees (through load based licensing) and the prioritisation of future investment through Pollution Reduction Programs.

### Water Management Licence

The NSW Department of Water and Energy (DWE) licenses HWC to extract groundwater and surface water for urban water supply. There are extensive data collection and reporting requirements listed in the HWC Water Management Licence, including the monitoring of extraction rates, the monitoring of groundwater levels, and the monitoring of reservoir behaviour. The WML also includes a range of operating requirements, such as environmental water releases from dams and weirs, and constraints on the extraction of water at various locations, that necessitate the collection of water information for both operational and compliance reasons.

## Section B

The current water information systems in place at HWC are described in the following paragraphs. A full listing of HWC sites will be provided separately in excel format.

### Scada system

HWC uses the Serck Controls Ltd SCX scada system to monitor and operate its network of reservoirs, pumping stations, pipelines, water treatment plants, waste water treatment plants and other telemetered systems. This system acquires and stores operational data from an extensive telemetry network. While the scada system does store historic operational data, it is not generally used to store long term historic data. In terms of water data, the primary focus of the scada system is to accurately collect and store data, which is then transferred to another database for secure storage. Water data collected by the scada system includes rainfall data, flow rates in pumps, pipes and rivers, water levels in dams, rivers and reticulation reservoirs, and appliance operations (e.g. weir gate operations, pump run times, etc). The scada system also includes basic reporting of integrated 24 hour flows at a number of points.

### Hydstra system

The HWC Hydstra V9.3 system is used to store data from the scada system at raw resolution. It is also used to store river flow data collected by DWE. The Hydstra system includes a range of data manipulation tools that allow easier access for data users than can be provided by direct access to the scada system.

### ENINQ system

This is an in-house database that was developed in the mid 1970s for the purpose of recording key water resource and water supply data on a daily basis. Data is input to ENINQ via a combination of automatic daily download from the scada system and manual data entry of manually recorded data. The ENINQ system runs on a VMS platform that is no longer supported with HWC. HWC is in the process of developing a new database to replace ENINQ. The new database is referred to as EDRS.

### EDRS system

The EDRS system is currently under development and will replace the ENINQ system. EDRS will become the primary database of key daily water resource and water supply data. As with ENINQ, EDRS will continue to store a combination of manual monitoring and automatic monitoring. Scada will be linked to EDRS to allow transfer of data from automated monitoring sites. HWC is investigating options to incorporate a WDTF module into EDRS to facilitate transfer of data from HWC to BoM in line with the Water Information regulations.

### Telemetry system

HWC uses a radio telemetry system to transfer data from monitoring equipment in the field into the scada system.

### Monitoring network

#### *Surface water data*

HWC relies on the services of DWE to provide flow monitoring and streamflow gauging services at a number of key locations on the Williams River, Chichester River and Wangat River. High quality river flow data exists from 1930s onwards at the key sites. HWC records continuous water level data at Chichester Dam, Grahamstown Dam and Seaham Weir, and discharge data from Chichester Dam. HWC calculates inflow to Chichester Dam by back calculation. HWC records water extraction from the Williams River at Balickera WPS.

#### *Groundwater data*

HWC collects groundwater level data from an extensive network of piezometers throughout the Tomago, Anna Bay and Stockton sandbed systems. The groundwater data is collected manually at a variety of timescales. Most of the data is collected quarterly or monthly, with a small number of sites monitored weekly or daily.

#### *Climate data*

HWC also owns and operates an extensive network of tipping bucket rain gauges that supply data via the telemetry network into the scada system. HWC also relies heavily on the BoM network for high quality meteorological data for the purpose of water resource planning. Some of the weather stations in the BoM network are operated by HWC.

#### *Potable water consumption*

HWC operates telemetered flow meters an all water treatment plants that record water supply into the water reticulation networks. In addition, HWC monitors water storage in all reticulation reservoirs and thus determines, by calculation, the daily water usage from the water reticulation network. HWC uses a combination of magnetic flow meters and ultrasonic transit time flow meters to monitor the flows being produced by the various water treatment plants.

#### *Recycled water supply*

The volume of recycled water supplied is metered at a small number of locations. At most locations, however, recycled water supply is generally estimated from pump run times and nominal pump capacities.

#### *Waste water discharge*

Waste water flows are metered either entering or leaving waste water treatment plants.

### Customer metering

All HWC potable water customers are metered. Domestic water meters and smaller non-domestic water meters are read 3 times per year. The meters for larger customers are read monthly. There are a small number of customers with telemetered water use meters that supply continuous data real time. The customer types (e.g. Residential, commercial, etc) are recorded for each customer in the billing system.

### Urban water use breakdown

Water use for individual customers is calculated for a particular period using a pro rata distribution of customer metering information. Urban water usage is broken down into consumption categories by aggregating customer consumption based on the customer type. Unmetered consumption is the difference between the total supply from the sources (ENINQ/EDRS) and all metered customer consumption.

## Section C

Section C contains a critical assessment of each of the system components identified in Section B.

### Scada system

The HWC Scada system provides a fit for purpose data acquisition and storage system. It is a relatively modern Scada system and offers a wide range of flexibility with respect to input and output of data. The Scada system will supply water information directly to the new EDRS system.

### Hydstra system

While the HWC Hydstra system is not the latest version, HWC considers that it is an effective data management tool for a range of in-house purposes.

### ENINQ system

The ENINQ database is an out of date system that is difficult to use. The system provides very little flexibility in terms of in-build functions, changes to data lists and changes to data reporting. The ENINQ system is due for replacement by the EDRS system in late June 2009.

### EDRS system

The EDRS system is nearing completion. The EDRS system, as it stands, does not include provision to supply water information to BoM in line with the Water Information Regulations. The development of a WTDF add-on is being considered.

### Telemetry system

The HWC radio telemetry network is considered to be a fit for purpose mechanism for transferring data from field sites to the Scada system.

### Monitoring network

#### *Surface water data*

The HWC network of surface water monitoring, in conjunction with the DWE network, provides adequate data for the water resource planning activities undertaken by HWC. The data that is collected is adequate in terms of both spatial coverage and accuracy. HWC is currently planning the construction of a new dam at Tillegra on the Williams River, and the need for expansion of relevant aspects of the surface water monitoring network have been included in design considerations for the dam.

#### *Groundwater data*

The HWC groundwater monitoring network is characterised by excellent spatial coverage and poor temporal resolution. It is a large network with data available for most sites since the mid 1970s. The HWC groundwater data network has proven to be adequate for past hydrogeological modelling exercises, and provides adequate data to monitor aquifer performance though time.

#### *Climate data*

The HWC rain gauge network provides reasonable quality data for over a large area of operations. Operation and maintenance of the HWC rain gauge network could be improved. HWC is investigating options to improve the quality of rainfall data collected by its network.

#### *Potable water consumption*

The flow meters used by HWC are fit for purpose.

#### *Recycled water supply*

HWC measurement of recycled water supply is less accurate than the methods used to measure flows in other parts of the business. There is considerable scope to improve the accuracy of recycled water supply measurement through the installation of telemetered flow metering.

#### *Waste water discharge*

HWC measurement of waste water discharges is considered to be fit for purpose.

#### *Customer metering*

HWC metering of customer water use is considered to be fit for purpose.

#### *Urban water use breakdown*

The methods currently used by HWC to reconcile overall water supply with customer water use records from the billing database involve considerable manual data manipulation. This process could be streamlined to improve ease and minimise the risk of errors by improvements to HWC data handling methods. HWC is in the process of developing business intelligence (BI) tools for this purpose.

Another deficiency in the process is that the breakdown of urban water used into various consumption categories, including the assessment of unaccounted for water, cannot be calculated explicitly over short time intervals due to the length of time between customer water meter readings. The calculation is considered to be reasonably accurate over longer time-frames, and is considered to be as good as is practically possible for the current technology of customer water metering.

## Section D

Priorities and strategies for improving HWC's water information include:

- develop and implement a data management application to manage data transfers between HWC and the BOM
- develop BI tools to assist HWC extraction of customer billing data for the purpose of calculating urban water use breakdown into categories 7h through 7k
- install telemetered meters on recycled water supply systems that aren't currently metered and/or telemetered
- upgrading Hydstra to ensure ongoing supportability.

# Appendix 1(h) – Bega Valley Shire Council

## Draft Strategic Water Information Management Plan

### Section A

Bega Valley Shire Council is listed as Category D (owners or operators of major storages) and Category F (urban water utility) under the Water Regulations 2008. Therefore, it is responsible for providing the Bureau of Meteorology with the following types of hydrologic monitoring data:

- Surface water resource information
- Groundwater resource information
- Information on major and minor water storages
- Meteorological information
- Information about urban water management
- Information about water restrictions
- Water quality information
- Descriptive and reference information about water information in the other categories.

The main monitoring requirements for Bega Valley Shire Council include:

- Water supply and sewerage system operations, control and analysis.
- Water supply and sewerage system licences.
- Water supply and sewerage system performance reporting to the NSW State Government.
- Water quality for the NSW Drinking Water Quality Program.
- Water quality for receiving environments associated with effluent re-use and disposal schemes.

### Section B

Our current data management system comprises manual data collection (e.g. water levels, grab samples) and input into spreadsheet files for storage and analysis. Radio telemetry and SCADA is also used for operational control and monitoring.

### Section C

Bega Valley Shire Council's existing data management systems for hydrologic monitoring data require improvements to enable more efficient and timely data capture. Integration of monitoring systems would improve the timeliness of hydrologic data for analysis and/or transfer to the Bureau of Meteorology. The efficiency and reliability of Council's data management system would also be improved by direct import of water quality monitoring data from the laboratory.

### Section D

The first priority of Bega Valley Shire Council is to identify which commercially available data management system (or combination of) is most suited to Council's monitoring, data management and reporting requirements. The selection of a data management system that best suits Council's requirements will ensure funds are allocated effectively when purchasing such a system. It will also maximise the efficiency and reliability of data management and data transfer to organisations such as the Bureau of Meteorology.

# Appendix 1(i) – Wyong Shire Council

## Draft Strategic Water Information Management Plan

### Section A

The Central Coast is one of the fastest growing areas in Australia. Being North of Sydney and part of the Greater Sydney Metropolitan Area, the region is heavily influenced by population growth in Sydney. The Central Coast is close enough to the city to make it possible to commute there for work. It is also popular to those looking for a change in lifestyle and for retirees wanting to move out of the city. Population growth of the Central Coast during 1991-2001 was 2.1 per cent per annum, nearly double that of Sydney and NSW as a whole.

Water supply on the Central Coast is provided by Gosford City Council and Wyong Shire Council. Both Councils are designated as water supply authorities under the *Water Management Act 2000*. The water supply system is a joint system within both local government areas and is managed by a strategic advice from the joint committee of the two Councils called the Gosford-Wyong Councils Water Authority (GWCWA) formed in April 1977.

The Water supply system currently in operation is the result of long term planning for the future water supplies for the Central Coast as a whole which dates back to 1975. The Gosford and Wyong Councils, in conjunction with the NSW Government developed the Joint Water Supply Scheme which was reviewed in 1985, forms the basis of the system currently in operation.

The Joint Water Supply Scheme depends on four coastal streams, three dams and three weirs. These comprise of:

- Mangrove Creek Dam and Mangrove Creek Weir on Mangrove Creek.
- Mooney Mooney Dam on Mooney Mooney Creek
- The Wyong River Weir on Wyong River that supplies water into Mardi Dam (an off-stream storage)
- Ourimbah Creek Weir on Ourimbah Creek that also supplies water into Mardi Dam.

Water from the Mangrove Creek catchment downstream of the dam and water released from Mangrove Creek Dam is captured at Mangrove Weir. Water captured at the weir and water from Mooney Mooney Dam is pumped to the Somersby Water Filtration Plant for treatment. Water captured from Wyong River Weir and Ourimbah Creek Weir is pumped into Mardi Dam for storage and then released into the Mardi Filtration Plant for Treatment. Water from Mangrove Creek Dam can also be released into the Wyong River from a tunnel linking the two systems called the Boomerang to Bunning Creek Tunnel to supplement low flows in the Wyong River. Treated water from the Somersby and Mardi Water Treatment Plants is then fed into the water reticulation systems for delivery to customers.

The water supply system is designed around capturing the stream flow from the rivers and creeks with the dams providing backup storage during periods of low stream flow. Stream flow records show that the average annual flow in these streams is about 180,000 ML per year, well in excess of the water supply requirements for the Central Coast community. While for the most part, all of the water requirements can be drawn directly from the streams. There are periods, when stream flows are too low. When this occurs water is released from Mangrove Creek Dam to Mangrove Creek Weir or to the Wyong River Weir via the Boomerang to Bunning Creek Tunnel.

Table below shows the capacities and catchment sizes for each of the elements forming the Gosford-Wyong Joint Water Supply Scheme.

| | Catchment Area km$^2$ | Dam Storage Capacity Megalitres (ML) | Average Percentage Contribution to Water Supply (1993 to 2003) | Average Historical Stream flow 1885-2004 (Simulated using historical rainfall) ML/y |
|---|---|---|---|---|
| Wyong River Weir | 355 | NA | 31.3% | 86,100 |
| Ourimbah Creek Weir | 88 | NA | 11.1% | 26,700 |
| Mardi Dam (receives pumped water from Wyong R and Ourimbah Cr) | NA | 7,400 | NA | NA |
| Mooney Mooney Dam | 39 | 4,600 | 14.9% | 17,200 |
| Mangrove Creek Dam | 101 | 190,000 | 30.8% | 18,400 |
| Mangrove Creek Weir | 140 | NA | 11.9% | 30,500 |
| **Total** | **723** | **210,000** | **100.0%** | **179,500** |

**Section B**

The Gosford City Council and Wyong Shire Council which manage the Central Coast' water supply system has adopted Water Plan 2050. The Water Plan 2050 is the result of extensive technical studies and exhaustive community involvement. It sets out the strategy to secure and sustain our water supply systems over the next 45 years. Linking of Mardi and Mangrove Creek Dams by 21 km pipeline is the highest priority project under this plan for which designs are being finalised. This pipeline would enable water harvested from Ourimbah Creek and Wyong River during high flows to be temporarily stored in Mardi Dam before transfer through to Mangrove Creek Dam. This project is planned to be commissioned in the year 2011. This project would entail the establishment high precision stream gauge at the site of weir on Wyong River for monitoring the extracted flows and those allowed to flow down stream of the weir as environmental flow as per the Environmental Sharing Plan being finalised with Department of Water and Energy.

GWCWA (Gosford Wyong Councils Water Authority) is working on the idea of integrating the water information (hydrological and other water data) from both councils to ensure the data collection process is automated, accurate, and current and also has sufficient coverage. For this purpose three new automatic rain gauge stations are proposed to be setup. It is also proposed to build in house capability for calibration of flow valves particularly which monitor the flow extraction from rivers/ creek and transfer between both councils. There is only one weather station at the central coast and it also not fully connected to the council's telemetry system. It is proposed to improve the telemetry link for this weather station to provide current information to the BoM. Two more automatic weather stations are proposed to be set up; one each at Mooney Mooney and Mardi Dam. This would improve the meteorological coverage of the area.

Any flow release from Mangrove Creek Dam down in the creek has to traverse about 20 km before it reaches the Mangrove Creek Weir. It is proposed to set up a stream gauge station some where near Dubbo Gully on the Mangrove Creek.

## Section C

### Data Gaps and improvement Opportunities

| Sr. no | Gap/potential improvements | Comments |
|---|---|---|
| 1 | Improvement and development of processes for collection, storage of data from both Gosford and Wyong Councils at central location and providing water information to BoM. | Water data management improvement |
| 2 | Establishing Telemetric Stream Gauge on Wyong River to monitor the site for environmental and water accounting purposes:<br>• Design and selection of equipment.<br>• Purchase of equipment.<br>• Installation of equipment.<br>• Commissioning. | It will improve the control over extraction of water from the river, particularly in the light of Environmental Water Flows. |
| 3 | • Telemetric link for Mangrove Creek Dam (MCD)<br>• Weather Station Data<br>• Dam Level | This data is not received through telemetry at the moment but it will be useful to link this to telemetry. |
| 4 | Installing Stream Gauge to monitor releases From Mangrove Creek Dam to Weir and connecting to telemetry | This will improve the data for environmental flow monitoring. |
| 5 | Improving Rainfall Gauge network by installing rain gauges at three sites: Bucketty (MCD catchment), Kooree (Mangrove Creek Catchment) and Hay (Wyong River Catchment) | The rainfall gauges scoping study done by Manly Hydraulic Laboratory has recommended installation of these gauges to improve the coverage of rainfall data for GWCWA catchments. |
| 6 | Establishing weather stations at Mardi and Mooney Mooney Dams | To improve weather information at the dam sites |

## Section D

### Priorities

- Improving Wyong River flow measurement for monitoring of environmental flows.
- Improving data management system by integrating the input from both councils.
- Improving meteorological information dataset by installing weather station and improving communication for the existing weather station.
- Improving rainfall gauge coverage for Wyong River and Mangrove Dam catchments.

# Appendix 1(j) – Shoalhaven City Council

## Section A

Water information required by Shoalhaven City Council includes real time flood information such as rainfall data and stream level information. This data enables Council to monitor flood events and provide early warning to residents via the SES. The Council's flood ALERT system also serves as a backup system to the BoM Enviromon System for the Shoalhaven Area and provides the SES with flood intelligence as required.

Shoalhaven Water also collects water source data as required under section 7(a) via telemetry and this information is provided to BoM via an FTP site.

Shoalhaven City Council's Environmental Services Section collects water quality data from regular tests undertaken in rivers, estuaries and coastal lakes.

Key stakeholders and clients of the data collected by Shoalhaven City Council are (please note this list is an indication only):

- Shoalhaven City Council.
- Bureau of Meteorology.
- State Emergency Services.
- Local Emergency Management Committee.
- Government agencies, e.g. RTA, DECC.
- Landholders of property in flood prone areas.
- Consultants.
- General public interest.

Key drivers for wanting to improve the system are:

- Better network coverage is required as the Shoalhaven has a large number of flood prone catchments. Many areas are prone to flash flooding and real time data is vital in providing information to the SES.
- Many gauges are being placed in catchments where no historical data exists and the collected new data can feed into flood studies that are about to be undertaken.
- Increased interest in real time data by Emergency Services as well as the Media.

## Section B

Shoalhaven City Council runs the following data collection systems:

- Enviromon – collation of ALERT radio telemetry data (the system currently includes 35 rainfall gauges and 18 water level gauges – the distribution of gauges can be viewed on the BoM website).
- FTP – inter agency data transfer for water source data from SCC to BoM.
- Access database – water quality data recording.

## Section C

**Data issues and opportunities**

- There is a need to continuously expand Council's network of rainfall and stream gauges in order to enable real time flood data collection in catchments that currently have no historical records. This information is vital for future flood studies as well as the calibration of existing flood models.
- Estuary and coastal lakes entrance management is an increasingly contentious issue in many of the city's catchments. Water level and rainfall data to inform entrance management strategies are vital.
- Automation of data transfer is a high priority in order to streamline data sharing procedures with the BoM.
- Maintenance of hardware in the field to collect data is also an ongoing issue for Council as it puts pressure on budgets and staff resources to enable the required maintenance to be undertaken.
- As stated above, data gaps exist as there are a large number of catchments within the Shoalhaven Council area. Council runs a long-term flood program and investigations are progressively undertaken in order to identify data gaps and the corresponding priorities to fill those gaps. The current grant funding application to fill data gaps for rainfall data in Currarong, Porters Creek Dam, Milton and Foxground as well as stream level data for Currarong, Millards Creek and Broughton Creek are based on such completed flood studies.

## Section D

**Priorities**

- Improved timeliness of data for catchments currently unmonitored.
- Data gaps – funding for additional rain and stream gauges.
- Keeping the system up to date – funding for maintenance and upgrades of existing gauges.
- Training of staff and local SES volunteers in the use of Enviromon.
- Upgrading data transfer capabilities for water source data.

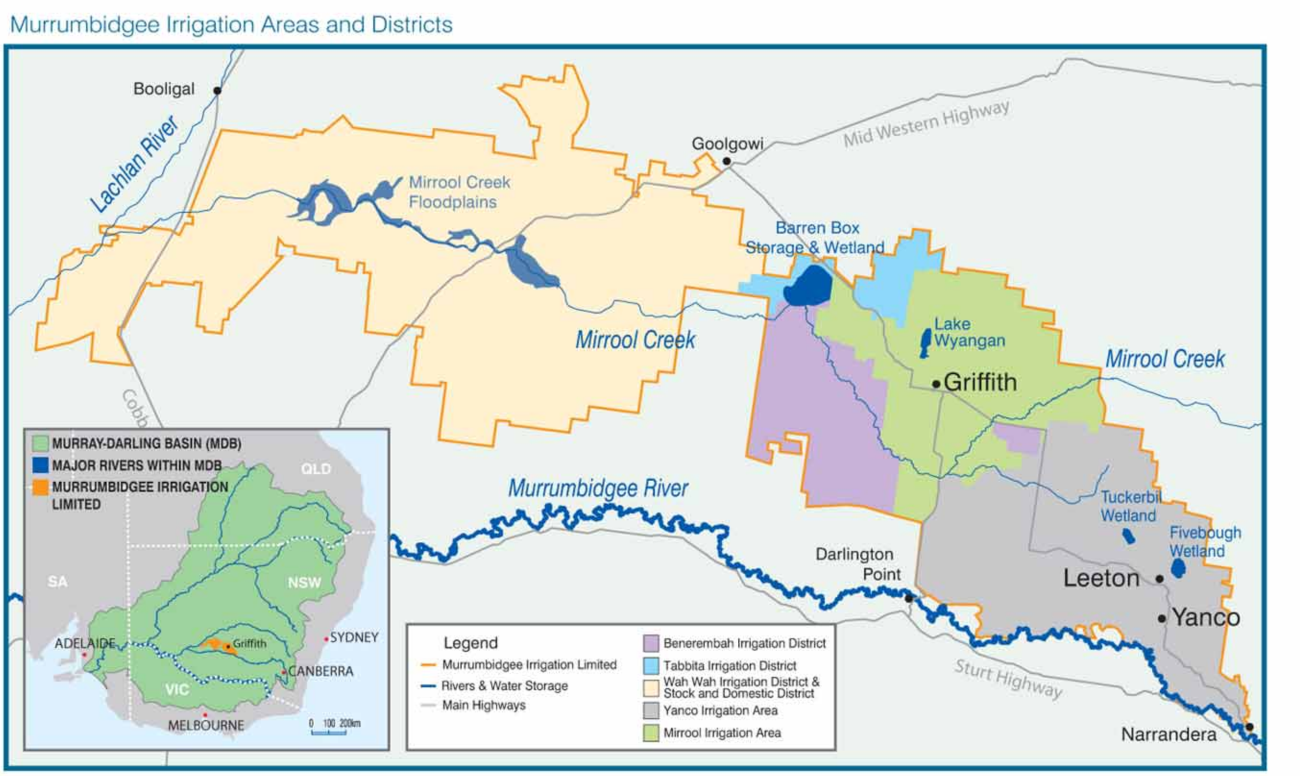
# Appendix 1(k) – Murrumbidgee Irrigation

## Section A

### Murrumbidgee Irrigation Area

The Murrumbidgee Irrigation Area (MIA) is one of Australia's premier agricultural regions located in southern central NSW covering an area of approximately 660,000 hectares of intensive irrigation with around 3,350 farms. It consists of the irrigation areas of Yanco around Leeton, and Mirrool around Griffith, and the irrigation districts of Benerembah, Tabbita and Wah Wah. A map of the MIA is shown in Figure 1. The MIA falls within the Murrumbidgee catchment and forms part of the Murray-Darling Basin.

**Figure 6: Map of the Murrumbidgee Irrigation Area**




*(Source: Murrumbidgee Irrigation)*

The MIA includes the city of Griffith (population 25,000), the town of Leeton (population 12,000) and many smaller regional centres. Water for the MIA is sourced from the Murrumbidgee River through the main canal east of Narrandera and the Sturt Canal at Gogeldrie near Leeton. The water is distributed predominately in open supply channels to customers in the MIA and in several small irrigation districts downstream to Barren Box Storage and Wetland as well as to local government.

### Murrumbidgee Irrigation (MI)

Murrumbidgee Irrigation is a not-for-profit, customer-owned irrigation corporation (unlisted public company) responsible for providing irrigation water to around 1,800 shareholder/customers in the MIA. It is also responsible for water pricing, the development and maintenance of infrastructure, and pollution control. Murrumbidgee Irrigation is a committed partner with the community to ensure the sustainability of the region.

Murrumbidgee Irrigation operates under the legal and regulatory framework established by the *Water Management Act 2000 (NSW)* (the Act), the Water Sharing Plan for the Murrumbidgee Regulated River Source 2003 made under section 50 of the Act, and the *Protection of the Environment Operations Act 1997 (NSW)*. Other key legislation that applies includes the *Water Act 2007 (Cth)* that will enable water resources in the Murray-Darling Basin to be managed in the national interest, optimising environmental, economic and social outcomes.

Murrumbidgee Irrigation has a number of licences and approvals for water supply works, drainage works, flood control works, and to divert water from the Murrumbidgee River for distribution to customers as follows:

- Water Use and Water Supply Works approvals issued by the NSW Department of Water and Energy under the *Water Management Act 2000* – to ensure that any impact on the environment and other water users is minimised
- Environment Protection Licence issued by the NSW Department of Environment and Climate Change under the *Protection of the Environment Operations Act 1997* – sets prescribed environmental standards.

**Water information drivers**

Accurate and timely water information is critically important for the efficient operation of any irrigation area. In the MIA, we collect water information for a number of reasons, which have been explained in more detail below.

***Efficient operation of the area***

Water information is being collected at numerous places within the MIA to ensure that water delivery to our customers is timely and efficient. It also helps us identify priority areas for infrastructure upgrade, including channel lining and replacement of open channels with pressurised pipes.

***Licence compliance***

As mentioned above, MI has a number of licences with State Government departments. Parts of these licences require MI to collect specific information such as water quality at certain key points in our system, collected at key times throughout the season. Some of this information is used to ensure that our drainage water quality is within EPA guidelines. Other information is about the amount of water we drain out of our area of operation.

***Billing***

As part of the ACCC review, new rules have been put in place in regards to fixed and variable charges associated with our water products. The water information we have collected over time helps us better understand where our costs are, particularly in the recent drought years.

## Section B

MI has an extensive flow metering and monitoring network throughout the Murrumbidgee Irrigation Area (MIA). This includes Dethridge wheels or Doppler meters or other electronic metering devices at most irrigation outlets (approx 3,000), irrigation escape flows and flows through regulators and off-takes within our supply system are monitored at approximately 220 sites, while AFFRA meters at our two River Off-takes measure the amount of water that enters the MIA. In addition, we have flow gauging stations at various critical points within as drainage system as well as at the five discharge points (four river drains and one floodway) from which water can leave the MIA. Further to that we have a network of seven weather stations within our area.

The information collected is stored and analyses in various systems, including:

- Rubicon's Irrigation Management System (IMS)
- SCADA
- US Utility Services website

## Section C

MI is currently implementing a new Information Management System called Enterprise Resource Planning (this will be soon be branded/marketed as 'EziWater' internally and externally). This system will allow a much more enhanced integration of the various data management systems we currently have in place. Included in this upgrade is an upgrade of our IMS (mentioned above). We have also identified the following opportunities for improvement in our water information data:

- Upgrade of flow gauging stations at our river drain sites to allow much more accurate water balance calculations.
- Upgrade of the radio link between our main river off-take and our office to increase the accuracy and reliability of data.
- Installation of a SCADA historian to allow analysis of past flow records (recently completed).
- Improvement of metadata, particularly the geo-location of our flow monitoring sites.

MI is committed to continuously improving its data and metering capabilities, as such we have commenced the replacement of all Dethridge wheels with Doppler meters and also replaced our River Off-take flow meters with AFFRA units. MI, in association with Thiess Services, uses a 'Rivercat' for the efficient and accurate calibration of our River Off-take sites.

## Section D

From a Water Information point of view, MI's vision is that:

- Water information will be available to Irrigation and Customers Services staff on a near real-time basis, using the Internet and SCADA to ensure our system is run at the highest level of efficiency.
- We operate beyond Licence compliance by implementing a risk-based water quality monitoring program, which includes risk mitigation strategies such as the capacity to prevent discharge of contaminated water to the river.
- We are able to provide important water information, including historic data, to the BoM.
- We are able to participate in the process of developing the Pilot National Water Account. Since the Murrumbidgee Catchment is one of the pilot areas, it is important that the irrigation provider responsible for the majority of irrigation water delivery in that catchment is involved in ensuring that the National Water Account becomes a useful exercise.

# Appendix 1(l) – Cabonne Shire Council

## Section A

Apart from information required by Council for its own water supply purposes, Council is required to provide information to the following organisations:

- Bureau of Meteorology – daily water level and storage volume at both dams for the purpose of national water information collection.
- Department of Water and Energy (Dubbo Office) – information relating to water restrictions, dam water levels, quality of treated water and rainfall on a four weekly basis for the purpose of monitoring regional water supply status and performance.
- Department of Water and Energy (Sydney Office, Dam Safety section) – quarterly report detailing weekly observations of dam water levels, rainfall, seepage flows in gallery drains and piezometer readings for the purpose of monitoring dam safety.

## Section B

At Molong Creek Dam, Council has in place the following information collection technologies:

- Ultrasonic and pressure based water level detection.
- Telemetry system linked to master station at Molong.
- Rainfall – manual reading only on weekly basis.
- Seepage flows measured manually on a weekly basis.
- Piezometer readings read manually on twice weekly basis.

At Borenore Creek Dam, Council has in place the following information collection technologies:

- Ultrasonic and pressure based water level detection.
- Telemetry system linked to master station at Molong.
- Rainfall – manual reading only on weekly basis.

## Section C

Data transferred by telemetry to the Molong master station can be read on an instantaneous or historical basis only. The system allows for alarms to be raised under certain circumstances. The data is not used for conversion to other data at this stage nor can it be transferred to other authorities automatically.

Improvement is needed in the following areas:

- Instantaneous dam water levels need to be converted to storage volume data at a regular time every day and automatically sent to the Bureau of Meteorology in order to comply with water information requirements.
- A remote monitoring system should be installed at Molong Creek Dam for the purpose of providing dam safety information (seepage flows and piezometer readings) on at least a three times a week basis as required by the NSW Dam Safety Committee and DWE.
- Telemetry monitored rainfall recording systems providing real time rainfall readings at Molong Creek and Borenore Creek Dams are needed for closer monitoring of that parameter, particularly for flood warning purposes.
- A remote monitoring system should be installed at Borenore Creek Dam for the purpose of monitoring and measuring sharp increases in seepage flows from the dam wall as required by the NSW Dams Safety Committee and DWE.

- A seismic monitoring station is to be established in the vicinity of the two dams in order to closely monitor seismic events in the region. This is a requirement of the NSW Dams Safety Committee and DWE

## Section D

Council's highest priority for investment in water information monitoring is to install a system that will:

- extract dam water level information from telemetry readings at both dams at a set time every day
- convert this data to storage volume data
- automatically send both sets of data immediately to the Bureau of Meteorology electronically.

The following projects are Council's lower priorities in order of priority:

- Borenore Creek Dam – remote seepage monitoring including installation of a pluviometer.
- Molong Creek Dam – remote monitoring of seepage flows and piezometer readings including the installation of a pluviometer.
- Establishment of a seismic monitoring station in the vicinity of the two dams.

# Appendix 1(m) – Port Macquarie Hastings Council

## Section A

Port Macquarie-Hastings Council is a Local Water Utility supplying reticulated water to and collecting sewage from approximately 28,000 properties within the Hastings area on the mid-north coast of NSW.

Council requires raw water information such as river flow, water quality, water extraction volumes to manage the water supply system within its water licence conditions while ensuring that water supplied to customers will meet Australian Drinking Water Quality Guidelines. Council monitors rainfall at 29 sites to assist it manage the sewerage systems during wet weather events. Council provides rainfall and river level information to the BoM via their 'EnviroMon' System.

Key stakeholders and clients of this data include:

- Council
- NSW Department of Water and Energy
- National Water Commission, National Performance Reporting
- Bureau of Meteorology, Flood Warning Services

## Section B

Data collection systems:

- Council's Water Supply System SCADA – ELPRO SCADA 2000 (over 100 sites).
- Council's Sewerage System SCADA – AZEDA WIZCON (approx 250 sites).
  Council already has comprehensive monitoring and control systems which monitor and store almost all of BoM's required water data. The main shortcoming for Council (and priority for funding) is that one of the systems is old and cannot derive information or export files.
- EnviroMon – collects rainfall (19) and water level (6) information at 19 sites across the Hastings.

## Section C

### Data issues and opportunities

Council has two SCADA systems; the older system (ELPRO SCADA 2000) monitors all the water supply assets. It is a DOS based system and is not capable of exporting data without significant human input and manipulation. It also cannot calculate derived data such as dam volumes from dam water levels. Council proposes to upgrade this system to a Windows based version which can accommodate an add-on report server which has the capacity to calculate derived data and create XML reports.

The current historical database has a rolling five-year storage. It is Council's intention to transfer as much relevant historical data as soon as possible to avoid data being overwritten.

## Section D

Council's objective is to provide BoM with all Council's currently monitored water data in the nominated WDTF. To achieve this Council will need to upgrade one of its two SCADA systems and develop compliant reports and appropriate data transfer protocols for both SCADA systems.