



Strategic Water Information and Monitoring Plan, Western Australia

Prepared by the Department of Water

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Water Corporation

Department of Environment and Conservation

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Ord Irrigation Co-operative Ltd

AQWEST

Gascoyne Water Co-operative Ltd

Harvey Water

Forest Products Commission

Swan River Trust

Perth Region NRM

Wheatbelt NRM

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Foreword

- The issue* In recent years water has become a pressing public policy issue for Australian society. As water demand increases and supply dwindles, the strain on existing water supplies has reached new heights. Protracted drought and mounting evidence of climate change have added momentum behind a growing community and political will to see improvements in both our understanding of water resources and the way we manage them.
- The challenge* Better management of water poses a national challenge, requiring a coordinated response. Our ability as a community to reach agreement on the tough issues relies on access to accurate, reliable water information that is freely available and of the highest standards. Key to making these decisions and arriving at sound policy is a definitive water data source that stands above reproach.
- Australian Government response* Aligned with this need, the Australian Government assigned the Bureau of Meteorology (the Bureau) responsibilities under the *Water Act 2007* to compile and deliver comprehensive water information for the country. As part of the Australian Government's long term framework for water security, Water for the Future, \$450 million was allocated to the Bureau over 10 years to deliver the Improving Water Information Program. This program includes development and maintenance of an integrated, national water information system which will be freely accessible to the public. Details of the full suite of Bureau objectives and deliverables can be found at www.bom.gov.au/water.
- A partnership model...* Vital to the success of the Bureau's mission is the partnership and cooperation of all State and Territory Governments and all water data collecting organisations in each jurisdiction. One of the vehicles for effective collaboration is the Jurisdictional Reference Group for Water Information (JRGWI), established to provide regular input to the Bureau's activities, and bringing to the table the experience and wisdom of respected senior officials from across the water sector.
- ...and putting it into practice* The Modernisation and Extension of Hydrologic Monitoring Systems Program (the M&E Program) is an \$80 million fund administered by the Bureau and available to organisations named under the Water Regulations 2008. The M&E Program is aimed at improving technologies employed by those who collect water information, and enabling better approaches to data transfer and standardisation. Coordination activities are also supported through the M&E Program via funding for Strategic Water Information Coordinators (SWICs) in each State and Territory. SWICs have been tasked with bringing together key stakeholders in their jurisdiction to distil State/Territory priorities in water

data collection, and to set these out in a series of Strategic Water Information and Monitoring Plans (SWIMPs).

Strategic plans...

The SWIMPs provide a framework for describing where we are going and how we will get there. Each SWIMP has been produced with a whole of jurisdiction focus to encapsulate the current state of play in water information and monitoring, describe the gaps, issues and opportunities that exist, and articulate a series of priorities, strategies and actions that will bring us closer to the end vision of better water information for all.

...and how they contribute to the solution

Through the M&E Program the Bureau is able to assist the States and Territories to get closer to our agreed view of what constitutes a fit-for-purpose hydrologic observing system in each jurisdiction. The Bureau looks to the SWIMPs to provide guidance on how best to invest M&E Program funds to achieve this goal. In this regard, the SWIMPs are a vital product.

The future

In closing, the Bureau appreciates the energy and expertise that has been applied in the preparation of this SWIMP, and thanks all of the officers that have participated in its development and review. Our special thanks go to the lead authors of the SWIMP, Pauline Farrell and Glen Terlick.



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Executive Summary

Improving Water Information is one of the programs under the national water reform plan “Water for the Future”. Amongst the plan’s objectives is the delivery of national water accounts, supported by a ‘national water monitoring and data collection network’. Jurisdictional Strategic Water Information and Monitoring Plans (SWIMP’s) form key inputs to the strategic plan for, and development of, this network.

The Bureau of Meteorology has funded the development of the SWIMP in each jurisdiction under The Modernisation and Extension of Hydrological Monitoring Systems Program (M&E). The SWIMP informs investment under the \$80 million M&E program funds. A first draft of the SWIMP was produced in Western Australia in 2008/09 under the management of the Strategic Water Information Co-ordinator (SWIC). The first draft of the SWIMP was delivered to Bureau of Meteorology in June 2009.

Key outputs of the SWIMP include; a summary of jurisdictional water information questions/drivers; the fundamental reasons for requiring water information (Section A), a description of water monitoring networks and technologies and data management systems in place within the jurisdiction (Section B), an assessment and statement of gaps, issues and opportunities in existing jurisdictional water information and monitoring investment and systems (Section C) and a description of priorities, strategies and recommended actions (Section D).

The Western Australian SWIMP was developed with input from a wide range of stakeholders involved in water information in Western Australia. All named agencies, with the exception of the Department of Housing and the Natural Resource Management Agencies, contributed agency SWIMP’s which have been incorporated into the final Plan.

Section A gives an overview of Western Australian drivers, (including legislative), for collecting water information before describing individual agency drivers.

Section B (summaries) and Section C (gap analyses) of monitoring networks, technologies and data management systems are described on an agency by agency basis, information being derived from Agency SWIMPs. Section C2 (reporting of gaps addressed through M&E funding) reviews the extent to which network and system gaps have been addressed through M&E investment and highlights areas where further investment is required to address identified gaps.

The methodology for Section D’s gap prioritisation process was developed by the Western Australian Water Information (WAWI) group which consists of representatives from the Department of Water, Water Corporation, Department of Environment and Conservation and the Department of Agriculture and Food.

The 2010/11 final SWIMP report updates and builds upon information contained in the 2009/10 SWIMP. It continues to provide guidance for investment in water information, and in particular will assist the Bureau to target future rounds of the M&E program. This document further contributes toward a national picture of water information activities within Australia.

1 Introduction

1.1 Water Regulations 2008 Named Agencies

Under the Water Regulations established in 2008 the Bureau of Meteorology (“The Bureau”) nominated 19 “named persons” (or agencies) within WA who have specific categories of hydrological data within their possession, custody or control. These agencies include water utilities, regulators, catchment councils, research bodies and related specialist groups. Those nominated were:

[AQWEST \(Bunbury Water Board\)](#), WA (Category F)*

[Avon Catchment Council](#), WA (Category G)

[Department of Agriculture and Food](#), WA (Category B, Category H)

[Department of Environment and Conservation](#), WA (Category B, Category D)

[Department of Housing and Works](#), WA (Category B)

[Department of Industry and Resources](#), WA (Category B, Category D)

[Department of Water](#), WA (Category A, Category H)

[Forest Products Commission](#), WA (Category B)

[Gascoyne Water Co-operative Ltd](#), WA (Category E)

[Harvey Water](#), WA (Category E)

[Main Roads Western Australia](#), WA (Category B, Category H)

[Northern Agricultural Catchments Council](#), WA (Category G)

[Ord Irrigation Co-operative Ltd](#), WA (Category E)

[Rangelands NRM Co-ordinating Group Inc.](#), WA (Category G)

[South Coast Natural Resources Management Inc.](#), WA (Category G)

[South West Catchments Council](#), WA (Category G)

[Swan Catchment Council](#), WA (Category G)

[Swan River Trust](#), WA (Category B)

[Water Corporation](#), WA (Category D, Category F, Category H)

Of these named agencies, three have since been removed from the Water Regulations as not having related data in their possession, custody or control.

- Department of Industry and Resources
- Main Roads Western Australia
- Rangelands NRM co-ordinating Group Inc.

Three agencies have undergone a name change:

- Department of Housing and Works is now Department of Housing
- Avon Catchment Council is now Wheatbelt NRM Inc
- Swan Catchment Council is now Perth Region NRM

Four major agencies stand out as being involved in collection and management of the bulk of all known water information across WA. These are:

- Department of Water
- Water Corporation
- Department of Agriculture and Food WA
- Department of Environment and Conservation

A further three represent smaller cooperatives involved in delivery of irrigation supplies. These are:

- Harvey Water
- Ord Irrigation Co-operative Ltd
- Gascoyne Water Co-operative Ltd

Two provide potable water to townships or remote communities:

- Department of Housing and Works
- AQWEST

Six are catchment councils or co-ordinating groups:

- Wheatbelt NRM Inc
- Perth Region NRM
- Swan River Trust
- Northern Agricultural Catchments Council
- South Coast Natural Resources Management Inc
- Swan River Trust

One agency conducts hydrological trials to aid development of WA's timber resources:

- Forest Products Commission

Representatives from all named agencies have been invited to contribute to development of this Strategic Water Information and Monitoring Plan (SWIMP). All but two have attended at least one of the jurisdictional workshops hosted by the Department of Water (DoW).

1.2 Western Australian Drainage Divisions

Western Australia is a very large state spanning 2.53 million square kilometres in area. The four major drainage divisions in WA are:

South West Drainage Division (314 500 km²)

The South-west coast drainage division covers the most fertile part of Western Australia. It is one of the only two parts of mainland Australia that are both temperate and relatively fertile. The landscape is generally flat and sandy but there are several major features. The climate is temperate Mediterranean. Summers are warm to hot and dry, winters are cool and wet. Mountains near the coast concentrate rainfall in that area, with parts of the extreme south-western corner receiving as much as 1,400 mm per year. Away from the coast, however, precipitation drops rapidly, with inland areas averaging about 250 mm per year. Major environmental issues in the division include land clearing, climate change, rapid population growth, and severe dryland salinity.

Timor Sea Drainage Division (282 110 km²)

Much of the landscape forms a patchwork of harsh, dry escarpments and tablelands on the one hand, and low-lying river flats on the other: hot and dry in winter, often flooded during the wet season. The climate is tropical. Summers are hot and very wet; the long, warm dry season runs from about May to November. Nearly all rain falls during the short summer wet season, often in association with spectacular thunderstorms and tropical cyclones. Average rainfall in the division varies from less than 400 mm in the south to about 1500 mm in the north. Streams run generally north or west to the Indian Ocean and the Timor Sea and can be very large by Australian standards. On a streamflow/area basis, it is the second-wettest division in Australia (after the northeast coast drainage division). Key environmental issues are land clearing for a variety of purposes, rapid population growth, and the lack of a sustainable fire-management policy.

Indian Ocean Drainage Division (518 600 km²)

Rainfall is low and conditions harsh. The division falls naturally into two main areas. To the north, the Pilbara is composed of deeply weathered plateaus with many rock and river pools, and extensive coastal plains. Daytime temperatures regularly exceed 45° in summer; the opal mining town of Marble Bar once experienced a world record 161 consecutive days over 100° Fahrenheit (38°C). Yearly rainfall averages up to 400 mm and is more common in the summer months, when tropical cyclones can travel well to the south. As with most parts of outback Australia, however, yearly average figures are misleading: dry periods with little rain can last for months or years, yet a summer cyclone can deliver 200 mm of rain in a few hours. The Pilbara has fine soils and sand erosion during rain events can be severe.

The southern part of the division is known as the Gascoyne-Murchison, after its two largest river systems. All rivers in the region flow intermittently, contracting during dry periods to a series of semi-permanent waterholes. The Gascoyne River, for example, usually flows once or twice a year, but does not flow at all about once every five or six years. Rainfall is erratic but tends to be more common in the winter months. There are 11 listed wetlands of national importance in the Gascoyne-Murchison, and several significant coastal sites (notably Hamlin Pool), many of them protected by national parks. The rivers of the district contain a wide variety of small aquatic fauna, but at very low population levels, and just four native fish species. Most of the Gascoyne-Murchison is too arid to support agriculture, but some areas, mostly in the south, have been cleared for grazing and, in some cases, cropping.

Western Plateau Drainage Division (1415 700 km²)

Rain seldom falls in this region and aside from a handful of permanent waterholes, surface water is absent at all times except after heavy rain. Most of the territory is flat sandy or stony desert with a sparse covering of scrub or tussock grasses. Average rainfall varies from one area to another and is quoted at 100 to 350 mm per year (between 4 and 14 inches) but is highly unpredictable. There are no permanent watercourses. The general trend is for run-off to flow inland, but there is insufficient rainfall to produce any marked drainage pattern.



Figure 1 - Drainage Divisions of Western Australia

1.3 Western Australian Geological Divisions

In Western Australia there are three main aquifer types:

- Surficial aquifers: sand, gravel and limestone overlying sedimentary basins and fractured rock provinces
- Sedimentary aquifers: sandstone, limestone and conglomerate in sedimentary basins.
- Fractured rock aquifers fractures in granite, gneiss etc in fractured rock provinces.

The main geological divisions in Western Australia are the younger sedimentary basins and the fractured rock provinces shown in Figure 2. Groundwater occurs in both but particularly within the porous rocks of the sedimentary basins.

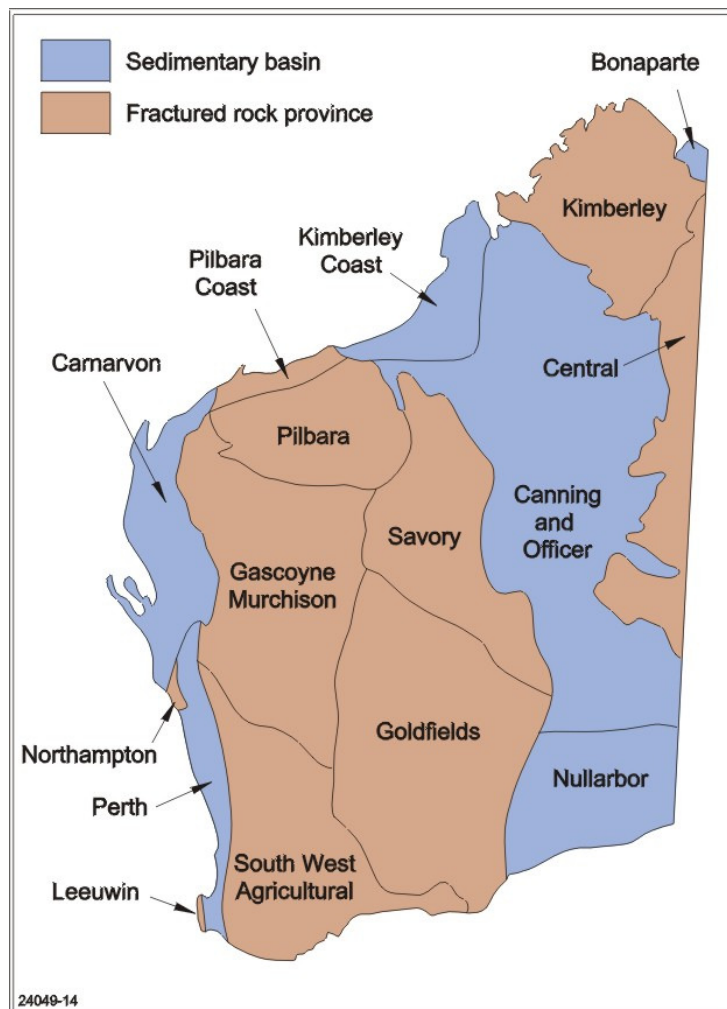


Figure 2 - Western Australian Geological Divisions

2 Section A – Drivers for Water Information

2.1 Whole of Jurisdiction

2.1.1 Governance

In Western Australia the Department of Water (DoW) has the responsibility for water policy and planning and the overall management of water resources. This includes:

- water resources investigation and assessment
- providing security for water for the environment and other uses
- planning for water management
- source protection
- drainage and floodplains

Department of Health – develops water quality drinking guidelines and ensures compliance.

Department of Water – undertakes water resources and water industry planning and policy, management and regulation.

Water Corporation – delivers water, wastewater and drainage services state-wide.

Environmental Protection Authority – provides overarching environmental advice, prepares environmental protection policies and assesses development proposals and management plans.

Department of Environment and Conservation - regulates wastewater discharges and promotes, protects and manages biodiversity.

Economic Regulation Authority – oversees urban and rural water pricing, licenses water service providers, monitors compliance with licence service standards.

2.1.2 Legislation

Western Australia's existing water legislation consists of multiple acts leading to duplication of resource management and service delivery provisions, creating complexity and hampering efficiency. Western Australia's water legislation is therefore currently under review. Amendments to water legislation are critical to the success of water reform in WA, particularly changes to water resource management legislation.

Water legislation in WA consists of the following:

COMMONWEALTH

Water Act 2007

An Act to make provision for the management of the water resources of the Murray-Darling Basin, and to make provision for other matters of national interest in relation to water and water information, and for related purposes

Water Regulations 2008

Select legislative instrument made under the Water Act 2007; requiring named persons to provide water information to the Bureau of Meteorology.

STATE

The Department of Water assists the Minister for Water in administering the following legislation:

Country Areas Water Supply Act 1947

An Act to make provision for the construction, maintenance and administration of reticulated supplies of water to country areas, to safeguard water supplies. The Act allows for the declaration of Public Drinking Water Source Areas and contains clearing controls of indigenous vegetation in catchment areas.

Country Towns Sewerage Act 1949

An Act to authorise the construction, maintenance and control of sewerage works in certain areas and districts; and for other purposes

Land Drainage Act 1925

An Act to provide for the drainage of land, the use of drains and drainage water and the constitution of drainage districts and for other relative purposes.

Land Drainage (Validation) Act 1996

An Act to validate certain rates made and levied under the Land Drainage Act 1925.

Metropolitan Water Supply, Sewerage, and Drainage Act 1909

An Act to constitute the Metropolitan Water, Sewerage, and Drainage Area; to establish the method of control and for other purposes incidental thereto

Metropolitan Water Authority Act 1982

An Act to provide for objections to valuations for certain water service charges and to authorize the provision of certain drainage works and services

Rights in Water and Irrigation Act 1914

The Rights in Water and Irrigation Act 1914 is the Western Australian State Government legislation governing the regulation, management, use and protection of water resources

Water Agencies (Powers) Act 1984

An Act to vest powers in the Water Corporation and the Water and Rivers Commission, to make other provision in respect of their functions, and for related and other purposes.

Water Boards Act 1904

Allows for the construction, maintenance, and management of works for the storage and distribution of water.

Water Corporation Act 1995

An Act to establish a corporation with the function of providing water services, and with functions necessary for and related to that purpose, and for connected purposes.

Water Efficiency Labelling and Standards Act 2006

An Act to provide for water efficiency labelling and for the making of water efficiency standards, and for related purposes.

Water Services Licensing Act 1995

An Act to establish a scheme for the licensing of water services, to confer functions on the Economic Regulation Authority in respect of that scheme and other matters, to establish a Board with functions related to the licensing of plumbers, to provide for regulation making powers in respect of the Board, licensing matters and the carrying out of plumbing work and to make related provisions.

Waterways Conservation Act 1976

Where management areas exist, Management Authorities can control and manage land within the area. Any developments within the Management Area must be referred to the Management Authority for approval.

Environmental Protection Act 1986

An Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection enhancement and management of the environment and for matters incidental to or connected with the foregoing.

2.1.3 Water Resource Management Drivers

- Water pricing and economic regulation
- Rural and regional water planning and management
- Metropolitan water planning and management
- Water markets
- Water supply and services
- Drinking water management
- Recycled water management
- Environmental water management
- Water accounting
- Episodic impact mitigation
- Environmental water requirements development

2.1.4 Water Planning Drivers

- National Water Initiative (NWI)
- Northern Australian Sustainable Yields (NASY) Water in the Timor Sea Drainage Division
- State Water Plan
- Regional Water Plans
- Strategic Water Issue Plans

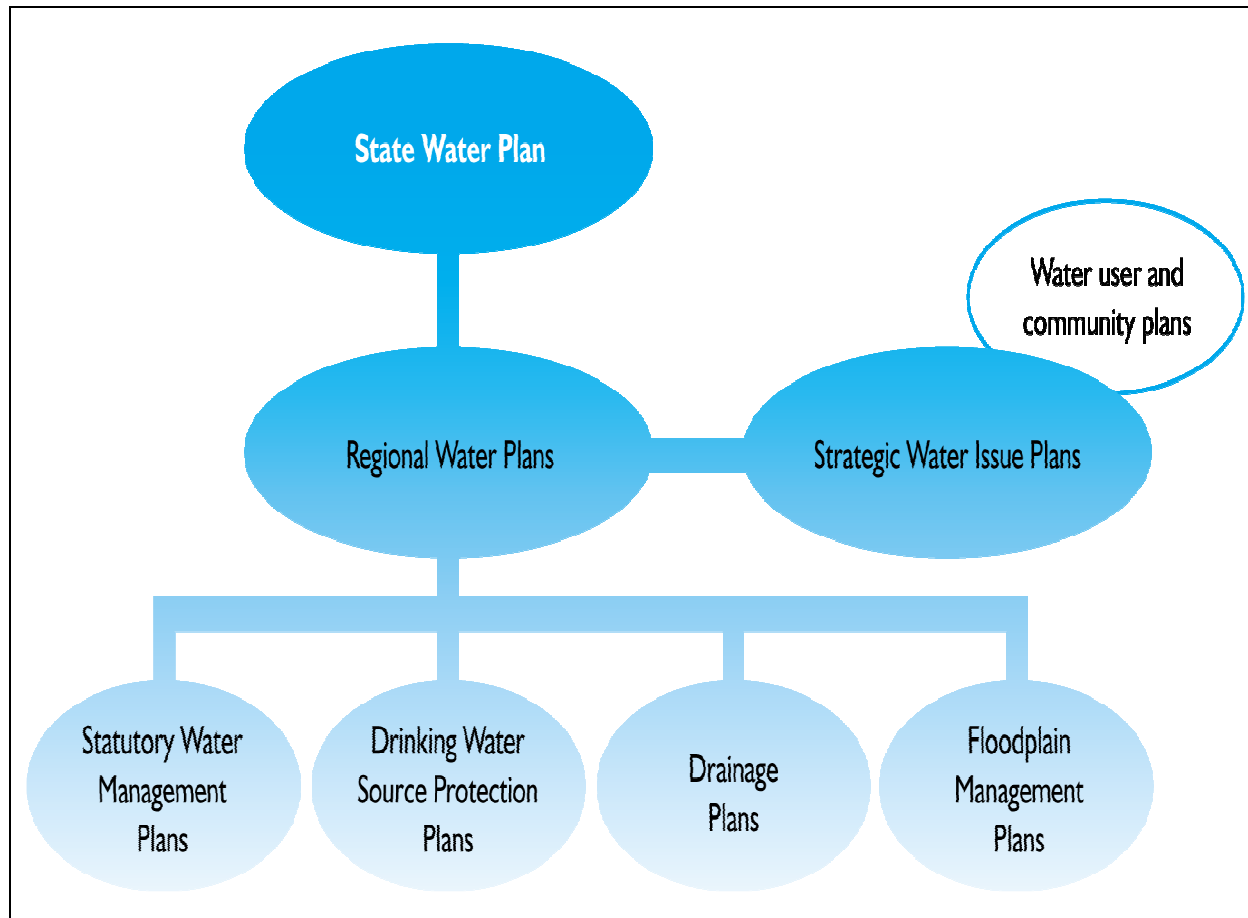


Figure 3 - State Water Plan Schematic

2.2 Major Agencies

2.2.1 Department of Water

The Department of Water's core business is to manage the State's groundwater and surface water resources and ensure adequate water services. It does this through adherence to sustainable development principles and a range of activities that include measurement, allocation and regulation. The Department is involved in measurement and allocation of the state's water resources. It sets the rules for the extraction of water, management of waterways and for water service providers.

As a named person under the Water Regulations, DoW collects information within:

- Category 1 - Surface water resource information
- Category 2 - Groundwater resource information
- Category 4 - Meteorological information
- Category 5 - Water use information
- Category 6 – Information about rights, allocations and trades
- Category 9 - Water quality information
-

DoW's Drivers for better water information include:

Drying climate

- While debate continues about the degree to which the decline in observed streamflow data since 1975 is a result of climate change or just natural variability, there is general agreement that the high streamflows recorded during the 1960s and early 1970s, are unlikely to be repeated in the coming decade.
- The south of Western Australia is experiencing less rainfall and reduced inflow to dams and groundwater systems. The north of Western Australia is experiencing variable rainfall.
- Environmental water requirements, water management outcomes, waterway restoration, floodplain management all need to take account of the drying climate

Increased water use

- Water demand has tripled in the past 25 years
- Increased demands on groundwater: now 2½ times greater than surface water use.
- Risks to sustainable management, particularly in regions where there are limited water supply development options
- Increased demand from resources sector: predicted rise from 1000 to 1400 gigalitres per year by 2030
- In 25 years water use increased by over 200%
- If current growth in water use continues, by 2020 water demand could reach 4600GL requiring identification of additional sources for public drinking water.

Environment

- Water regime modification
- Widespread loss or degradation of fringing vegetation occurring along many south-west rivers.
- Erosion and sedimentation degrading most of the State's major waterways
- Algal blooms, low oxygen and fish deaths being experienced in over 100 wetlands and waterways.
- Salinisation of many major south-west rivers

Growing urban demand for water and land

- Perth: Australia's fastest-growing capital city
- Bunbury: second fastest-growing population centre
- Driving ever-increasing need for urban land
- Increased demand for recreational access to drinking water bodies and catchments – greater need to protect drinking water supplies

Expanding plantations

- Increasing areas planted to plantations
- Growing concern about impacts on other users and environment
- Water use by forests generally higher than pastures or crops

Community demand for information

- Increasing demand from community, industry and political expectations for more information – accurate and timely

Water Accounting Drivers

- NWI water accounting requirements
- NWI national performance reporting
- Commonwealth water Act water accounting requirements
- Development of National water Accounting Standards
- Many systems in WA are at, or approaching, full allocation thus the need for good water accounts to promote water trading opportunities

2.2.2 Water Corporation

The Water Corporation is responsible for providing water supply and the treatment and disposal of wastewater to Perth and surrounding areas.

As a named person under the Water Regulations, the Water Corporation collects information within:

- Category 1 - Surface water resource information
- Category 2 - Groundwater resource information
- Category 3 - Information on major and minor water storages
- Category 4 - Meteorological information
- Category 7 - Information about urban water management
- Category 8 - Information about water restrictions
- Category 9 - Water quality information

Key drivers for better water information have been identified as part of the Water Corporation's Water Forever project. 'Water Forever' is a 50-year plan to make Perth and surrounding areas more climate resilient to ensure sufficient and sustainable water supplies for Western Australia.

The challenge is to provide water for all:

- in an even drier climate
- with twice as many people
- with less environmental impact

In this context it is important for the Corporation to better understand the impacts of:

- a drier climate on existing and potential water sources and the environment
- increasing population on use and distribution of water

To enable better understanding, an increased investment in metering, monitoring, reporting and targeted reductions in water use across the board is required. The Corporation recognises that it needs to measure and monitor resources in order to manage them.

The Corporation has an ageing workforce. This is a risk in terms of the retention of knowledge and skills. To address knowledge loss it is important for the Corporation to capture the knowledge of individuals in terms of metadata for assets. Skills shortages may be addressed by working smarter, for example better use of technology for operational purposes.

From an economic perspective the Corporation is under pressure to increase the life of assets. Good data about assets is required to better manage those assets. The use of technology such as telemetry, SCADA and low maintenance electronic instrumentation assists with operation and management of assets.

Drivers for capture of water information using electronic rather than manual methods are driven by (for example):

- Better management of drinking water quality: SCADA can be used for reporting on water quality and chemical dosing to ensure water quality is maintained;

- Better management of assets: SCADA can be used to report on operating conditions and status to ensure assets are operated according to required standards and;
- Better operating safety as sites can be monitored and operated remotely without the need for regular visits to remote sites.

External drivers for collection of water information include reporting to regulators and to meet legislative conditions. These include:

- Regulations enacted under the *Federal Water Act 2007* require the Water Corporation to provide available information to the Bureau of Meteorology.
- Reporting to the Department of Water as a condition of water abstraction and extraction licences.
- Reporting to the Department of Environment and Conservation as a condition of licences for discharge of wastewater.

2.2.3 Department of Agriculture and Food WA

The Department of Agriculture and Food WA (DAFWA) assists the state's agriculture, food and fibre sectors to be sustainable and profitable, with a clear focus on export-led growth.

As a named person under the Water Regulations, DAFWA collects information within:

- Category 1 - Surface water resource information
- Category 2 - Groundwater resource information
- Category 4 - Meteorological information

The Department aims to enhance the international competitiveness of the state's agribusiness by working to meet the increasingly demanding standards for sustainability, safety and quality of food and fibre production. DAFWA's bore network, automatic weather stations and stream gauging stations are purpose built to suit the needs of their agricultural and environmental studies. Each in its own right complements the multitude of aims across the jurisdiction's statewide networks.

2.2.4 Department of Environment and Conservation

The Western Australian Department of Environment (DEC) was established on 1 July 2006, bringing together the Department of Environment and the Department of Conservation and Land Management.

DEC has the lead responsibility for protecting and conserving the State's environment on behalf of the people of WA. This includes managing the State's national parks, marine parks, conservation parks, wetlands, state forests and timber reserves, nature reserves, marine nature reserves and marine management areas.

As a named person under the Water Regulations, DEC collects information within:

- Category 1 - Surface water resource information
- Category 2 - Groundwater resource information
- Category 4 - Meteorological information
- Category 9 - Water quality information

DEC's key responsibilities include broad roles in conserving biodiversity, and protecting, managing, regulating and assessing many aspects of the use of the State's

natural resources and environment (including pollution). DEC is no longer responsible for management of contaminated sites and coordination of pollution incident responses since establishment of the Office of the Environmental Protection Authority (OEPA).

2.3 Other Agencies

2.3.1 AQWEST (Bunbury Water Board)

AQWEST – Bunbury Water Board – is a Western Australian State Government Statutory Authority established in 1906, which supplies potable water to approximately 17,000 services within the City of Bunbury. Annual water production is approximately 6.5GL. Bunbury is situated in the south west of Western Australia, approximately 175km south of Perth.

AQWEST is one of two independent water supply authorities operating in regional WA. AQWEST employs approximately 32 full time staff and is managed by a Board consisting of 6 community members who are appointed by the Minister for Water.

As a named person under the Water Regulations, AQWEST collects information within:

- Category 1 - Surface water resource information
- Category 2 - Groundwater resource information
- Category 3 - Information on major and minor water storages
- Category 4 - Meteorological information
- Category 7 - Information about urban water management
- Category 8 - Information about water restrictions
- Category 9 - Water quality information

2.3.2 Gascoyne Water Co-operative Ltd

Gascoyne Water is an Irrigation Water Service Provider located in Carnarvon, WA. The business has been operated by the local growers since it was transferred from government ownership in 2001. The ownership of distribution assets was transferred in 2004. Gascoyne Water supplies local growers with irrigation water and also distributes stock and garden water to lifestyle blocks in the community.

As a named person under the Water Regulations, Gascoyne Water collects information within:

- Category 5 - Water Use information

Category 9 (water quality) data for the region is collected by the Water Corporation and the Department of Water. Key drivers for accurate water information within the system include:

- Providing for all irrigators needs whilst ensuring ongoing sustainability of supply
- Servicing irrigation requests in an accurate and timely manner
- Maintaining metering systems with reliable accuracy and traceable calibration.
- Providing a reliable and accurate water billing service

2.3.3 Harvey Water

Harvey Water is a private irrigators' cooperative delivering water to irrigators via a gravity pipe and channel system which it operates, maintains and improves. Harvey Water's core business is providing water delivery services to customers.

As a named person under the Water Regulations, Harvey Water collects information within:

- Category 4 - Meteorological information
- Category 5 - Water use information
- Category 6 - Information about rights, allocations and trades

Category 9 (water quality) data is collected from parts of the irrigation network by the Department of Water and from the dam supply sources by Water Corporation.

The irrigation season serves Western Australia's primary dairying and citrus fruit industries and runs from October to April – the precise dates dependent upon seasonal weather conditions.

Water is released to Harvey Water from seven Darling Scarp dams controlled and maintained by the Water Corporation. Water storage and dam safety fees are paid to the Corporation on a fixed annual cost basis as determined by the Economic Regulation Authority. Harvey Water has rights to its own water under its three Department of Water licences and does not buy water from the Corporation.

Because the scheme cannot supply all properties at once, a daily scheduling system is used to meet individual farmer's needs while maximising the efficiency of the distribution system and minimising water wastage.

As customers order water, water controllers (personnel) schedule supply to farms on the same delivery route. The 9 water controllers are based within one of seven areas of responsibility the Harvey Water Irrigation Area (HWIA) and are responsible for their own irrigators. They operate the automated distribution system via home computer using SCADA software to release and deliver the resource as scheduled.

Key drivers for accurate water information within this system include:

- Servicing on-line irrigation requests in an accurate and timely manner
- Maintaining release, flow and supply measurement systems with reliable accuracy and traceable calibration.
- Minimising water misuse or waste
- Minimising system down-time across the SCADA network
- Providing a reliable and accurate water billing service
- Providing robust meteorological and soil temperature information to irrigators to promote efficient and cost-effective irrigation practices.

2.3.4 Ord Irrigation Co-operative Ltd

Ord Irrigation Co-operative Ltd (OIC) operates and manages the business of providing water and drainage services to the farms across Stage 1 of the Ord River Irrigation Area (ORIA) within the Kimberley region of Western Australia.

OIC is a grower owned organisation whose charges directly reflect the cost of running the business.

OIC holds a licence for the diversion of 335 Gigalitres of water per year from Lake Kununurra. This annual water entitlement is authorised to be diverted at the M1 Supply Area Offtake and the Packsaddle Pump Station and distributed to the Co-operative's 63 shareholders.

As a named person under the Water Regulations, OIC collects information within:

- Category 5 - Water use information
- Category 6 - Information about rights, allocations and trades

As an irrigation provider within the Kimberley Region, there are many drivers for water information. These include:

- provision for all irrigators' needs whilst ensuring ongoing sustainability of supply
- servicing irrigation requests in an accurate and timely manner
- promoting improved irrigation practices so that risks to the lower Ord environment and continued agricultural production are minimised
- monitoring and subsequently improving the efficiency of water distribution to irrigators
- maintaining metering systems with reliable, accurate and traceable calibration
- providing a reliable and accurate water billing service
- ensuring the riverine environment is protected
- minimising the impact on natural groundwater levels to ensure related licence conditions are met
- ensuring water quality licence conditions are maintained

2.3.5 Forest Products Commission

The FPC is a government trading enterprise established to develop and market WA's renewable timber resources.

As a named person under the Water Regulations, FPC collects information within:

- Category 1 - Surface water resource information
- Category 2 - Groundwater resource information
- Category 4 - Meteorological information

Their strategic tree farming (STF) Monitoring, Evaluation and Reporting (MER) Plan has defined the Forest Science and Resources responsibility to monitor and report the

hydrological effectiveness of the STF tree plantings on water tables and recharge in landscapes representative of those targeted in the STF.

2.3.6 Department of Housing

The Department of Housing (DoH) covers public, community, regional and aboriginal housing. DoH is responsible for managing the bore asset and for collecting groundwater data from 60 remote Western Australian Aboriginal Communities.

As a named person under the Water Regulations, DoH collects information within:

- Category 2 - Groundwater resource information

2.3.7 Swan River Trust

The Swan River Trust (SRT) is a state government agency that protects, manages and enhances the Swan Canning Riverpark by working in partnership with government and the community.

The Swan River Trust collects, or out sources the collection of, water quality data from approximately 600 sites. This data is stored in the Department of Water's Water Information (WIN) database.

2.3.8 Natural Resource Management Agencies

There are six regional Natural Resource Management (NRM) groups in Western Australia, working in partnership with all tiers of government, regional organisations, industry, landowners, researchers, environmental and community groups.

These six community-based NRM groups are responsible for delivering the NAP and NHT programs throughout Western Australia. The following four of these regional catchment councils are named in the Water Regulations:

- Wheatbelt NRM
- Perth Region NRM
- Northern Agricultural Catchments Council
- South Coast Natural Resources Management Inc

The number and type of monitoring sites and the nature of sampling varies according to the projects and funding available. Most of the data collected by, or for, the NRM's is stored in the Department of Water's Water Information (WIN) database.

3 Section B – Existing Monitoring Networks

3.1 Major Agencies

3.1.1 Department of Water

The Hydrological monitoring networks owned and managed by the Department of Water (DoW) have been extensively reviewed in three components –

- Strategic Review of the Surface Water Monitoring Network Report (DRAFT)
- Improved Groundwater Resource Management through better Groundwater Monitoring: A Review of Groundwater Monitoring
- Telemetry Strategy with Flood Warning Review

These networks have been reviewed on a regional basis. DoW administers a variety of environmental services to the public through 8 regions and 18 regional offices throughout Western Australia. Figure 5 below shows the jurisdictional boundaries for DoW Regions. The state also comprises 52 groundwater and 22 surface water management areas, as proclaimed under the RIWI Act (1914).

3.1.1.1 Surface Water Stream Flow Monitoring

The measurement of stream flow in WA began in the late nineteenth century as part of investigations for the Goldfields Water Supply Scheme. In the early years gauging stations were established on rivers draining the hills near Perth and in 1939 monitoring of the larger rivers of the south-west commenced. The quality of early record was poor, characterised by long periods of missing data often at important times of high flow (Australian Water Resources Council, 1986). It was not until the 1960's that the state began to measure water in earnest with federal government support through the Australian Water Resources Council (AWRC). The state-wide approach was part of a national initiative to establish a stream flow network. Federal support for the state's surface water monitoring ceased in 1986. The State has been fortunate in that it was able to gain a considerable amount of data and information on the surface water resources during the 1960s, 70s and 80s as a result of this Commonwealth funding. Figure 4 shows the increase in river gauging which was achieved during this period.

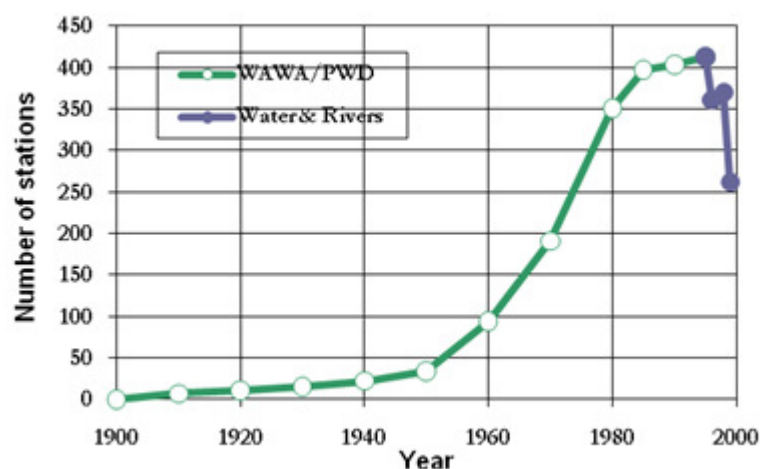


Figure 4 - Number of Gauging Stations in the State

Numbers of monitoring sites presently managed by DoW are tabulated below.

Table 1 - Surface Water Monitoring Stations

REGION	Stations Closed	Stations Open	Salinity Measured	Flood Warning	Rainfall Closed	Rainfall Open	Weather Stations
South Coast	47	52	22		22	21	
South West	120	90	43	31	85	41	
Kwinana Peel	3	37	8	7	28	13	
Swan Avon Gold	70	66	22	15	85	24	4
Mid West	12	26	5	25	17	18	
Pilbara	29	25			39	32	
Kimberley	49	24		11	20	28	
Total	330	320	100	89	296	177	4

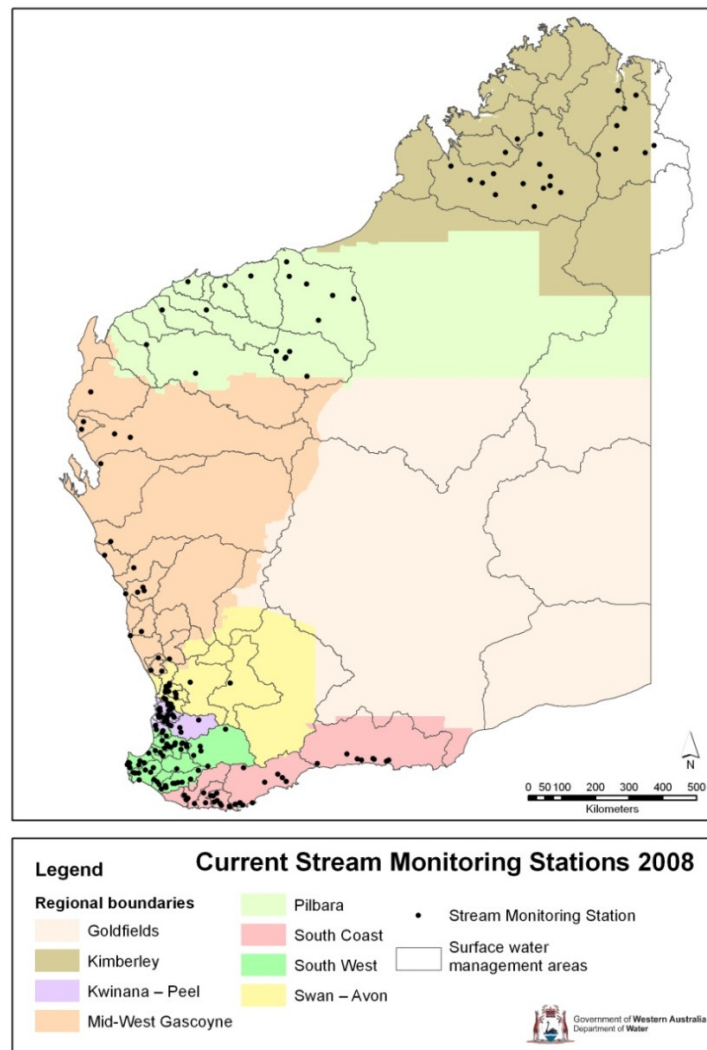


Figure 5 - Regional Boundaries Showing Streamflow Monitoring Stations

The Department of Water's Surface Water Monitoring Network comprises surface water sites that are continuously monitored for water level (stage height) and stream flow volumes. The numbers in Table 1 are derived from the Strategic Review of the Surface Water Monitoring Network Report. The above network represents continuously monitored sites with a well established gauging asset associated with a long term operating gauge. There have been many gauges open for periods of time that were closed or replaced by other gauges for a variety of reasons including unsuitability to measure flow, poor reliability of operation and temporary sites operated for specific short term project based investigations that did not qualify for the strategic review.

3.1.1.2 Groundwater level monitoring

Groundwater level monitoring began in Western Australia when approximately 40 artesian bores were drilled in the Perth metropolitan area at the turn of the last century. A further 175 bores were installed near lakes and wetlands in the 1940s. More systematic groundwater monitoring began in the early 1960s and increased sharply in the 1970s, helped by joint State and Federal groundwater assessment funding. There has been a significant reduction in funding since 1988 which coincides with an almost doubling in groundwater abstraction. Several State Government agencies have been responsible for the management and monitoring of the bore network in the past decades. The Department of Water, the current State's water resource manager established in 2006, has installed more than 100 monitoring bores under the long-term funded State Groundwater Investigation Program.

A recent review of the regional groundwater monitoring network has assessed more than 9000 bores owned by the Department of Water and looked at ways to improve groundwater resource management through better groundwater monitoring (Kern and Johnson, 2009). The review also identified the current regional monitoring bore network (or GWAN – Groundwater Assessment Network) consisting of 2457 bores in total. This comprises of 1978 bores (including 68 staff gauges) currently monitored with all data known, 312 bores currently monitored with data gaps and 167 new bores for inclusion (Table 1). A further 586 bores require further assessment to determine inclusion, while up to 194 bores could be removed due to overlap or position within water supply borefields.

Approximately 80% of the GWAN bores are located in the Perth Basin while the remaining bores are in Collie, Carnarvon and various locations in the Pilbara and Kimberley. The distribution of the GWAN is considered appropriate given the large volumes of groundwater allocation in these regions.

In addition, the Department of Water owns about 6200 project bores that were installed as short-term investigation bores that are not included in the GWAN.

The Department of Water also holds records of over 70,000 private bores (e.g. public water supply, mining, irrigated agriculture, parks and garden, domestic garden and livestock bores).

Table 2 - Groundwater Assessment Network Bores Currently Monitored

Region	Existing GWAN bores	GWAN bores with data gaps	New GWAN bores	Potential GWAN bores	Project bores
Swan	1103	90	121	55	1410
South Coast					466
South West	516	161	24	196	1103
Mid West - Geraldton	255	9	0	67	3
Mid West - Carnarvon	7	23	0	91	147
North West - Pilbara	17	0	0	84	45
North West - Kimberley	80	29	22	93	126
Remote Areas					~2900
Total	1978	312	167	586	6200

The Department of Water identified about 2,340 GWAN monitoring bores to be monitored in 2009-10, representing about 11,800 water level measurements.

Groundwater dependent ecosystem monitoring is presently being trialled in the South West groundwater areas. The monitoring of groundwater dependent ecosystems requires the integration of groundwater level and quality monitoring with ecological condition monitoring and is new to the Department of Water.



Figure 6 - Concentration Groundwater Assessment Monitoring Network Bores

3.1.1.3 Meteorological Monitoring

Historically, the Department of Water (and its predecessors) undertook climatological monitoring across the state for an array of specific projects. As funding ceased so did the monitoring. DoW's weather station network is now just four sites.

In parallel to this, the continuous rainfall monitoring network still exists, but with a reduction from 507 sites down to the present day 212.

3.1.1.4 Water Quality Monitoring

Surface Water

The Department of Water holds water quality data on approximately 6500 surface water sampling points in total. There are approximately 3,500 water quality sampling points owned and sampled by the Department of Water and of interest to the Bureau. The primary purposes of these sites are:

- Salinity Monitoring 276
- Surface Water Assessment 1172
- Urban Water 310
- Waterways Management 1537
- Groundwater Assessment 255

These sampling points are distributed throughout the regions as follows:

Table 3 - Water Quality Sampling Points - Department of Water

Region	Sampling Points	Number Projects	Open Projects
Kwinana Peel	476	32	12
Mid West	68	20	9
Kimberley	136	26	12
South Coast	461	80	42
Swan/ Goldfields	1143	147	55
South West	725	86	30
State wide	114	27	12
*SWIS HIST	455	N/A	N/A

**SWIS HIST refers to historical data that is a from a legacy system.*

The length of record ranges from one off sampling to decades of data and the number of sample readings per site from 1 to approximately 100 000.

Extensive long term continuous salinity monitoring has been undertaken in susceptible catchments. Collectively, these datasets total the equivalent of 2600 station-years of continuous (reliable) data, generally logged at 5 or 15 minute intervals. More than eighty of these sites continue to be monitored today.

Groundwater

Following their installation, most regional monitoring bores are sampled for physical parameters and standard (major ions) chemical analyses. These data are considered point-in-time data and can provide a baseline for comparing with future water quality data. However, the regional monitoring bores were not installed for on-going water quality monitoring. To date, very few monitoring bores have been re-sampled since their installation. The scope of monitoring groundwater quality is extremely broad. Monitoring programs need to be custom-designed to monitor specific analytes, usually over small areas where changes in water quality are suspected.

The development of a groundwater quality monitoring program was not addressed in the recent groundwater monitoring review; however, the review recommends that the Department of Water works towards an appropriate monitoring program for groundwater quality.

3.1.1.5 Monitoring technologies

Surface Water Monitoring Technologies employed by the Department of Water consist of:

- Float Operated Systems
- Pressure systems
- Doppler Systems
- Capacitance probes
- Water Quality Transducers (electrical conductivity measurement)
- Auto samplers
- Staff gauges (for manual WL readings)
- Peak Level Indicators
- Tipping Bucket Rain Gauges (pluvios)

Groundwater level measurements are currently mainly collected as discrete field measurements by manually dipping using water level probes. This process of manual measurement is time-consuming and involves substantial travelling time for field officers.

The use of automated groundwater measurement is seen as critical to improving understanding of water level changes. More frequent data collection will allow better groundwater model calibration, confirm aquifer performance and response, and determine connectivity between aquifers and groundwater dependent ecosystems.

Data loggers are being trialled under the Shallow Groundwater Systems, State Groundwater Investigation Program and also using Modernisation and Extension Program funding.

The recent review of groundwater monitoring proposes the implementation of an automated water level measurement to meet the future need of the Department of Water and State in groundwater assessment. There will be progressive installation of data loggers into the GWAN over a six-year period (Table 2)

Section B – Existing Monitoring Networks

The Department of Water proposes the use of telemetry for important groundwater management bores and bores in remote areas (provided there is good satellite coverage).

Table 4 - Proposed Schedule for Installation of Data Loggers

Region	Number of bores	Data loggers to be installed				
		2011/12	2012/13	2013/14	2014/15	2015/16
Swan Region	1217	500	300	300	117	
South West Region	677		200	200	301	
Mid West Region - Geraldton	264				82	182
Mid West Region - Carnarvon	30					30
North West Region - Pilbara	17					17
North West Region - Kimberley	131					131
Total	2336	500	500	500	500	360

3.1.1.6 Telemetry

One hundred and forty nine DoW hydrological monitoring sites are telemetered, with regional distribution specified below.

Table 5 - Telemetered Sites - Department of Water

South Coast	25
South West	26
Kwinana Peel	13
Swan/Avon/Gold	24
Mid West	27
Pilbara	13
Kimberley	21

Currently, the Department of Water employs predominantly “dial up” telemetry technology. The Department has this year, however, utilised M&E and core Departmental funding to purchase IP telemetry systems which will be rolled out to replace all “dial up” equipment in the coming year. The Department of Water plans to steadily install IP telemetry on all monitoring sites as funding becomes available.

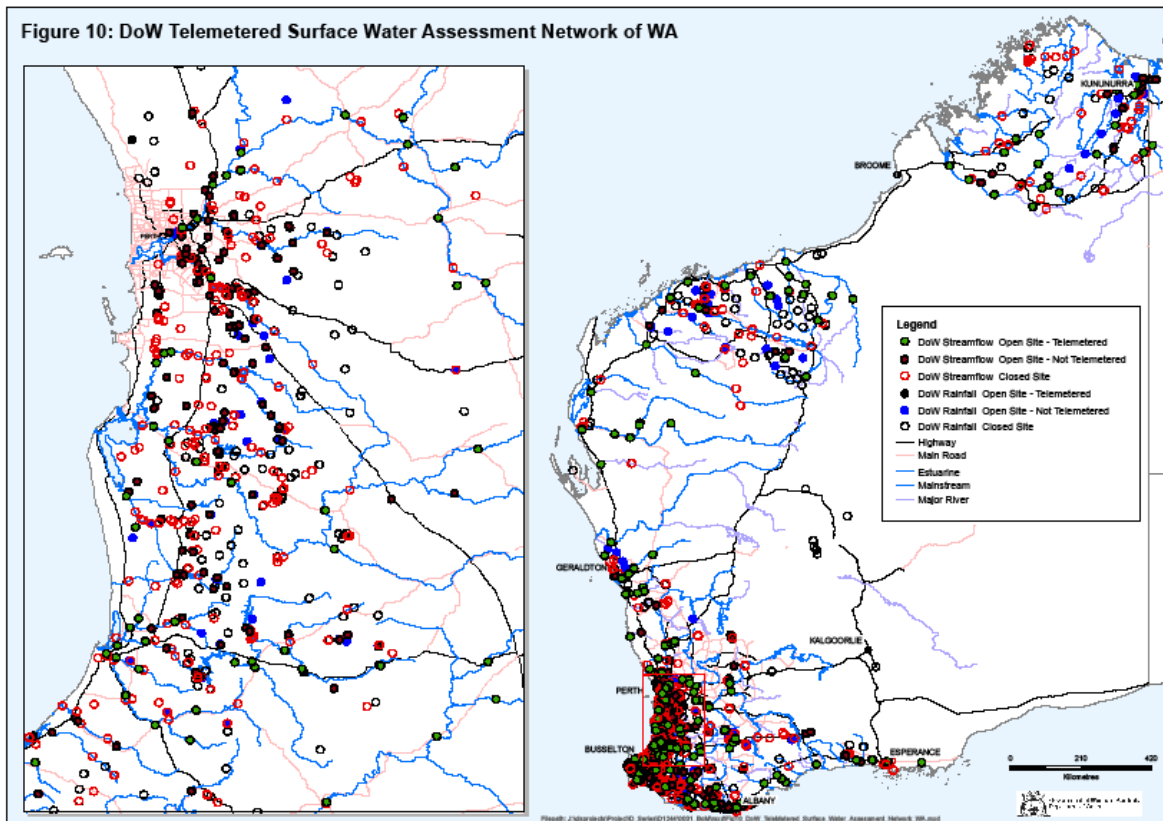


Figure 7 - Telemetered Surface Water Assessment Network of WA

3.1.1.7 Water Information, Systems and Accounts

Site Inventory

Each agency named in the Water Regulations has been required to provide an inventory of their monitoring site metadata. The Department of Water has provided their site listings as input to the Bureau's national Water Monitoring Network inventory (WMN09). Of particular note is:

- All historical continuous stream gauging stations, both open and closed, have been included.
- Only non estuarine surface water quality sites with the limited suite of physical parameters of interest to the BoM were included in the site inventory.
- The 70 000 domestic garden/mining/agricultural/livestock etc bores contained in the Department of Water WIN database have not been included in the site inventory, as there is no associated monitoring data.

Data Management and Transfer

The Department of Water currently has four water information and data management systems that provide water data to the Bureau:

- HYDSTRA: a commercial system that stores continuous time-series data from stream gauging and meteorological sites around the state. Both provisional

(telemetered) and archived (verified) data are stored. Historical data was delivered to BOM in csv format on DVD. Ongoing delivery in csv is occurring through Hydstra's HYBOMEXP tool. A future release of HYBOMEXP will allow delivery of data in WDTF format.

- Water Information System (WIN): an Oracle system that stores discrete sample measurements and groundwater information. Historical WIN data has been provided to BOM in WDTF format on CD ongoing delivery is now automated. WIN and Hydstra databases are linked.
- Water Resource Licensing (WRL): an Oracle system that stores water licensing and allocation information. Historical WRL data has been provided to BoM in WDTF format on CD, and ongoing data delivery is occurring through custom-built routines.
- Divertible Water Allocation Inventory Database (DWAID): a system for managing the administrative spatial definition and limits for water resources (aquifers). DWAID holds allocation limits for administrative resources and works in tandem with WRL. Two forms of data are employed within DWAID. They are: tabular data (stored in an oracle database, names of aquifers, subareas, allocation limits etc) and spatial data - a series of spatial definitions for the shape and extents of physical features that exist in the corporate Spatial Data Engine (SDE). These shapes detail the extent of aquifers, subareas, groundwater areas etc.

Water Accounts

Water accounting work undertaken by Department of Water is outlined below.

Related NWI and DoW water accounting work includes:

- NWI requirements – development of water resource, water use and water market accounting to inform water planning, water markets, investment decisions and environmental management
- Working in collaboration with other state jurisdictions to develop water accounting, including determining means of measuring groundwater stocks, development of trading identification and quantification techniques and developing 'end user friendly' water accounting statements
- Reviewing the Exposure Draft Water Accounting Statement 1 (EDAWAS 1), assessing its suitability for preparing water accounts and preparing a submission on its functionality
- The Department of Water developed a pilot water account for the Lower Gascoyne (Carnarvon) water system and the Carabooda sub-area of the Gngangara mound.
- Development of an accounting system to prepare water accounts using Quickbooks

Gngangara Mound Water Account 2010:

Section B – Existing Monitoring Networks

- Development of improved data sets and methodology for the Perth Region Aquifer Modelling System (PRAMS)
- Preparation of a water account for the year to June 2010 in compliance with EDWAWS 1

BoM First National Water Account 2010:

- The Perth Region and Ord River Region were selected to prepare sub-accounts for the National Water Account 2010. Preparation of the account is nearing completion and is due for release in May 2010

Work is being done on developing a 'Best Estimate Abstraction Data Set' (BEAD) for licensed water consumption throughout the state.

3.1.1.8 Water Use Information

Currently the *Rights in Water and Irrigation Act 1914* (RIWI Act) and the *Rights in Water and irrigation Regulations 2000* (RIWI Regulations) are the primary legislative tools relating to the rights in water provision for the regulation, management, use and protection of water resources.

Western Australia's water use information is contextualised by the State's use of groundwater as a major source of supply. Metering the taking of water is a key area of advancement in W.A. DoW's policy statement on metering the taking of water states that: To effectively manage the state's water resources, the Department of Water will expand the requirements to meter the taking and use of water that apply to licences granted under the RIWI Act by:

- arranging for the installation of government-owned meters to water drawpoints in priority management areas where there is a high demand for accessing the water resources
- Imposing metering requirements on certain water licences (as shown in the table below) to install meters to the department's specifications in areas where government-owned meters are not being installed.

Thresholds for water metering requirements in Western Australia are tabulated below (self installed meters):

Table 6 - Installation of Privately Owned Water Meters in Western Australia

Category	Water entitlement metering threshold
New water licence entitlements (where special cases do not apply)	≥ 500 ML/yr
Existing water licence entitlements (where special cases do not apply)	≥ 500 ML/yr
Trading (transferring) entitlements	As determined by the Department of Water
Special cases (e.g. surface water systems, multiple aquifers, use of both surface water and groundwater, specific management regimes, certain water use activities)	As determined by the Department of Water
In priority management areas government-owned meters have been retrofitted to licences with entitlements ≥ 5 ML/yr.	

It is important to note that the Metering Policy is currently under review with a particular focus on re-examining metering thresholds. The review has stalled until the strategic direction for the Department of Environment's metering program is developed.

In March 2005 the Department of Water commenced installing meters on licensed bores and wells in key areas on the Gnangara Mound (The Gnangara Mound provides ~60% of Perth's drinking water). Licensees targeted for metering were those who have a licensed entitlement between 5 000 kilolitres per annum (kL/a) and 500 000 kL/a. To date more than 1250 meters have been installed and the department is committed to maintaining and monitoring these meters on a periodic basis.

The department also managed the Carnarvon Meter Replacement Program. The 186 metered sites in this area were physically inspected in December 2006 and all of the 186 meters were found to be beyond their serviceability and accuracy and were subsequently replaced in 2007 with new meters equipped with data logging technology.

Meter readings are submitted to DoW on meter water use cards by licensees to meet meter reading reporting requirements under the terms and conditions of their water licence or operating strategy. The conditions generally require that meters are read monthly and the water use cards submitted annually. The historical annual water consumption is calculated by a licensing officer and the meter reading record placed in the appropriate licensing file. In addition, government-owned water meters are also read on an annual basis by departmental staff and the meter readings stored electronically. It's important to note that the DoW's approach to collecting metering data, be it via private meter reading conditions or a DoW meter reading program, is currently under review. This information may no longer be valid at the conclusion of the review.

In 2009 the Department of Water prioritised the electronic storage of metering data and undertook programmes to collect and store data in centralised corporate systems – Water Resource Licensing (WRL) and Water Information System (WIN). Data for all government-owned meters (~1250) and for approximately 60% of private meters is stored electronically.

3.1.1.9 Rights, Allocations and Trades Information

Under the provisions of the RIWI Act the DoW has various powers of regulation and approval which include:

- granting, refusing, renewing and amending licences to take water
- granting or refusing to grant approval of transfer of licences or water entitlements

Currently there are 52 groundwater and 22 surface water management areas proclaimed under the RIWI Act. These cover the major water resources of the State, and licensing is active in most areas. Licences are required for all artesian groundwater wells throughout the State. The interests of existing users and the environment are protected by only issuing new licences if the total allocated volume issued in an area will not exceed the allocation limits for the resource. There are presently 20,000 licences existing across the State.

The RIWI Act makes provisions for the transfer of a 5c licence for either the whole or part of the water entitlement from a transferor to a transferee. Transfers involve changing legal possession and are permanent. Transfers can occur without any consideration taking place between the transferor and the transferee. Where transfers

involve payments between the transferor and the transferee, trading may be said to take place. In most cases a new licence is issued to the purchaser and the original licensee's water entitlement is amended accordingly. The term trading is not mentioned in the RIWI legislation. Return flows, riparian rights, stock and domestic, and environmental water provisions water cannot be transferred.

There is also a provision under the Act to agree to use/lease by a person all or part of the water entitlement, on a temporary basis. This agreement holder is then able to operate under the licence for the period of the agreement. The fundamental difference between agreements and transfers is that the agreements are temporary trades in contrast to transfers which are permanent.

Water licensing and allocation information is stored on the Departments Water Resource Licensing (WRL) Oracle system.

3.1.1.10 Urban Water Management Information

Water service providers such as the Water Corporation, AQWEST and Busselton Water provide information to the Department of Water as part of their annual reporting.

In relation to the Water Corporation it is required to provide, as part of licence conditions, an annual report. This report contains monthly production data from each surface water source (dam) associated with the Integrated Water Supply Scheme.

The Water Corporation has meters fitted to each production bore and monthly water use data is also provided to DoW in their annual report.

3.1.2 Water Corporation

The Water Corporation's monitoring network can be divided into these components:

- Sites for monitoring of resource condition
- Sites for management and measurement of asset operation
- Sites for monitoring resources as a condition of licence requirements

The Corporation has some 200,000 monitoring points with data from around 4000 points being supplied to Bureau of Meteorology as a condition of the Water Act.

3.1.2.1 Surface Water Stream Flow Monitoring

Surface water data is collected from around 100 gauging stations throughout the state. The purposes of these sites are for measuring dam inflow and outflow, drainage, and irrigation flows. Data for environmental water requirements (EWR) is reported to the Department of Water as a condition of licences. Water level data is also collected at wetlands to assess the environmental impact of groundwater extraction.

3.1.2.2 Groundwater Level Monitoring

Groundwater data is collected from 1000 production and monitoring bores. Water level data is used for managing abstraction from bore fields and is reported to Department of Water (DoW) as a condition of licences. Annual reports are provided to DoW detailing abstraction, water levels and water quality from bore fields.

3.1.2.3 Major and Minor Storage Monitoring

Storage level and volume data is collected from more than 100 dams and storages throughout the state. This includes data from 70 referable dams that are monitored to ensure that they are operated and maintained in a safe state.

3.1.2.4 Meteorological Monitoring

The Corporation operates 60 rainfall sites and 30 weather stations. Rainfall sites are mainly installed at dam and major storage sites whilst weather stations are near wastewater treatment plants. These are used for monitoring wind speed and direction for assessing odour.

3.1.2.5 Water quality

Water quality data from around 11,000 monitoring points is collected from surface water catchments, dams, bore fields and integrated water supply systems on a regular basis.

3.1.2.6 Monitoring Technologies

The majority of sites and monitoring points operated by the Corporation are for operation of assets, management of integrated water supply schemes and wastewater networks. These sites may have local control systems for managing water supply schemes and/or be integrated with the Corporations SCADA network. Data captured through the SCADA network is stored in the PI Data Historian database for data management and reporting.

There are around 200,000 monitoring points with data in PI. These range from analogue data such as tank storage levels, to digital data such as alarms.

As well as SCADA some systems are managed by local control systems, with no SCADA or feedback mechanisms. Some sites operate with alarms only, consequently operation is reactive rather than strategic. Additional sites operate based on manual readings only, whereby operation is reliant on visits by field staff. These low technology solutions constitute risks in terms of reliability or supply and quality and effective maintenance of assets.

3.1.2.7 Water Information, Systems and Accounts

The Water Corporation has provided an inventory of sites along with metadata for those sites to the Bureau. Note that:

- Only sites that meet reporting criteria identified in the Water Act have been included.
- The Corporation operates substantially more sites than are reported to BoM, predominantly for operation of assets, management of integrated water supply schemes and wastewater networks.
- There are gaps in some of the metadata supplied, particularly site coordinates and this is being addressed by a BoM funded project.

3.1.2.8 Data Management and Transfer

The Water Corporation uses four key data management systems that provide water data to the Bureau:

- **HYDSTRA:** (see DoW description). The Corporation uses HYDSTRA for managing data from stream gauging stations, rainfall sites and weather stations. Data from around 180 sites is managed in HYDSTRA. This data is transferred to PI as the corporate data repository for time series data.
- **SAP:** SAP is used for storage of static data about assets (including sites and monitoring points). SAP is the Corporation's primary Asset Register. The key area of SAP used for data about assets is AMPS (Asset Management Planning System). AMPS provides a single entry point to all asset management planning information in the Corporation's information systems. The Functional Location (FL) of an asset is used to link data between other corporate systems (ODSS and PI).
- **ODSS (Operational Data Storage System):** ODSS provides data storage for low-volume time series data, for example water and waste water quality, dam levels and meter readings. The data in ODSS is primarily from manually read sites, where there is no SCADA or telemetry or where no adequate communication infrastructure is available. Summarised and calculated data is also provided via ODSS, for example dam storage volumes. ODSS is the key reporting system for data provided to regulators – summary reports are provided via standard reports in ODSS. Some data for BoM is provided by ODSS. Data from around 11,000 sites and 41,000 monitoring points is stored in ODSS.
- **PI (Data Historian):** PI integrates SCADA data and other high-volume time-series data, into the Corporation's IT infrastructure. The system is the Corporation's primary system for the storage of long term temporal data. PI provides data manipulation and summarization capability, as well as a means of viewing, reporting on and graphing data. The long term aim is for PI to be the sole system for storage of temporal data. PI is the main provider of temporal data for BoM. Data from around 200,000 monitoring points is stored in PI.
- **FMS (Facilities Mapping System-Smallworld):** FMS is the used by the Corporation for capturing and maintaining asset and land related spatial data. Spatial data can also be displayed using desktop GIS packages such as LiteSpatial, NetMaps and ArcGIS.
- **GRANGE:** Grange is the Water Corporation's system used for customer billing. It is used to capture meter reading and use data from customers serviced by the Corporation. This includes approximately 3.5 million accounts/advice to 1.7 million customers across 817,000 properties annually. For reporting purposes, summarised data from Grange is updated in ODSS.
- **BoM Data Transfer:** The Corporation uses a system based in SAP for transferring data, in WDTF format, to the Bureau from its ODSS and PI systems.

3.1.2.9 Telemetry and SCADA

SCADA (Supervisory Control and Data Acquisition) is used for operation and monitoring of assets, management of integrated water supply schemes and wastewater networks. The aim of the SCADA network is to provide centralised operation of the Corporation's state-wide assets in line with its vision for integrated service delivery.

Section B – Existing Monitoring Networks

SCADA communications is provided using a radio network and the Corporate WAN. Operational and historical data from SCADA systems is stored, managed and reported using PI (Data Historian).

Telemetry, mainly dial-up, is used on some gauging stations and rainfall sites. Sites are interrogated as required using the HYDSTRA dial-up telemetry module.

3.1.2.10 Water Accounts

Water accounting work undertaken by the Water Corporation includes:

- Provision of water account data to Department of Water and Bureau of Meteorology
- Pilot water account for Gngangara Mound in conjunction with the Department of Water
- Provision of water account data to Bureau of Statistics for compilation of national water accounts.
- The Corporation, through the Water Accounting Standards Board, is involved in the development of the Preliminary Australian Water Accounting Standard.

3.1.2.11 Water Use Information

Water use information from properties serviced by the Corporation is stored in the GRANGE system. For water use reporting purposes, summarised data from GRANGE is updated in ODSS. Water use data from meters on the Corporation's integrated water supply systems is captured in the ODSS system. This is used for both internal reporting and reporting to Department of Water for licence compliance.

3.1.2.12 Urban Water Management Information

Some major drains have gauging stations installed to monitor water levels and flows. For wetlands that are connected by the urban drainage network inflows and outflows are measured as well as water levels.

3.1.3 Department of Agriculture and Food WA

3.1.3.1 Monitoring

DAFWA's current hydrological monitoring network across WA consists of:

- 1394 bores
- 40 stream gauging stations, 11 with Autosamplers
- 69 AWS

Section B – Existing Monitoring Networks

The network is predominantly rural based, aimed at recording and evaluating hydrological performance impacted by a diverse range of agricultural activities implemented across the Western Australian jurisdiction.

Hydrological data is captured via a variety of means, ranging from discreet single point in-situ monitoring of ground water levels on a monthly basis to comprehensive logging of streamflow record at 5 minute intervals to data loggers. Data is collected by a number of research groups across the department.

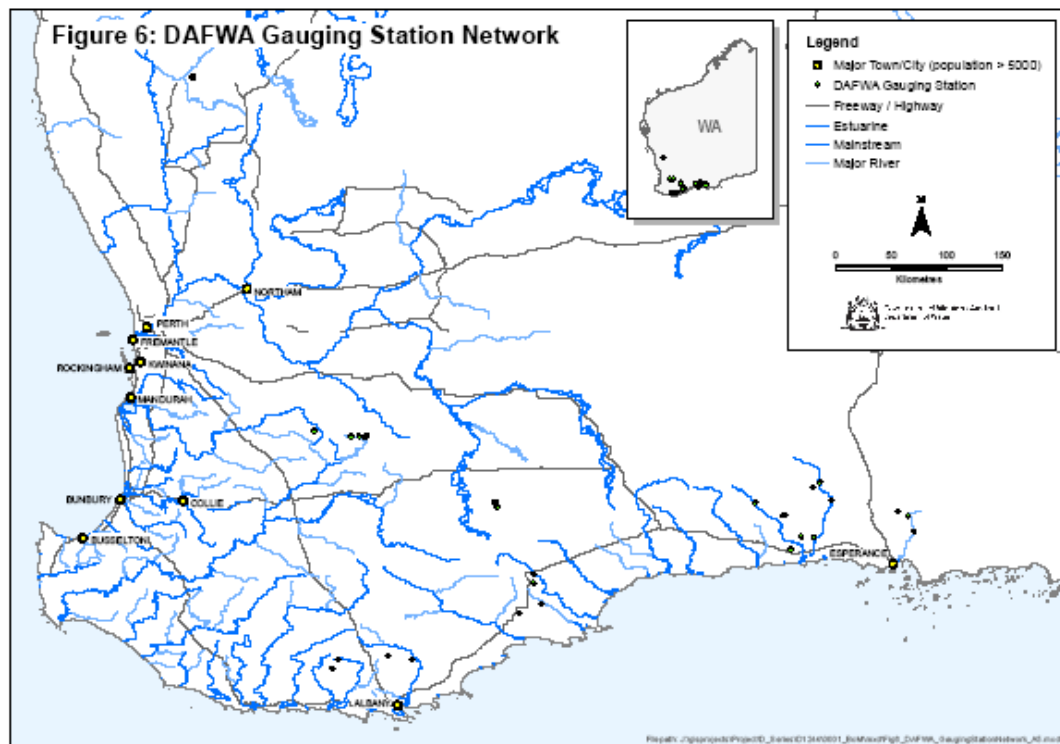


Figure 8 - DAFWA Gauging Station Network

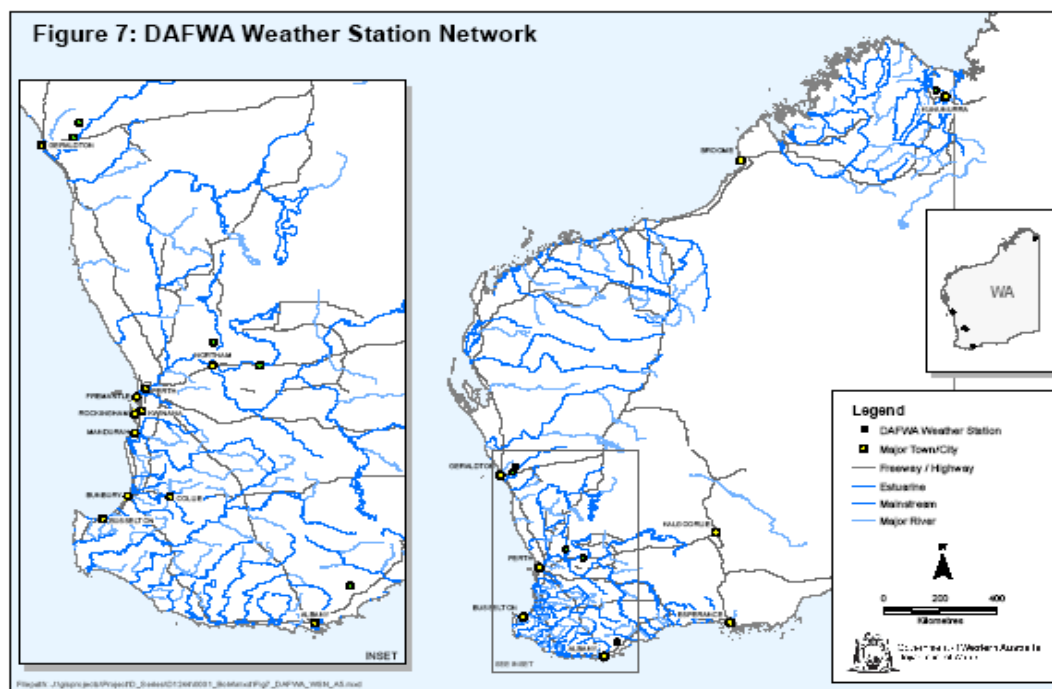


Figure 9 - DAFWA Weather Station Network

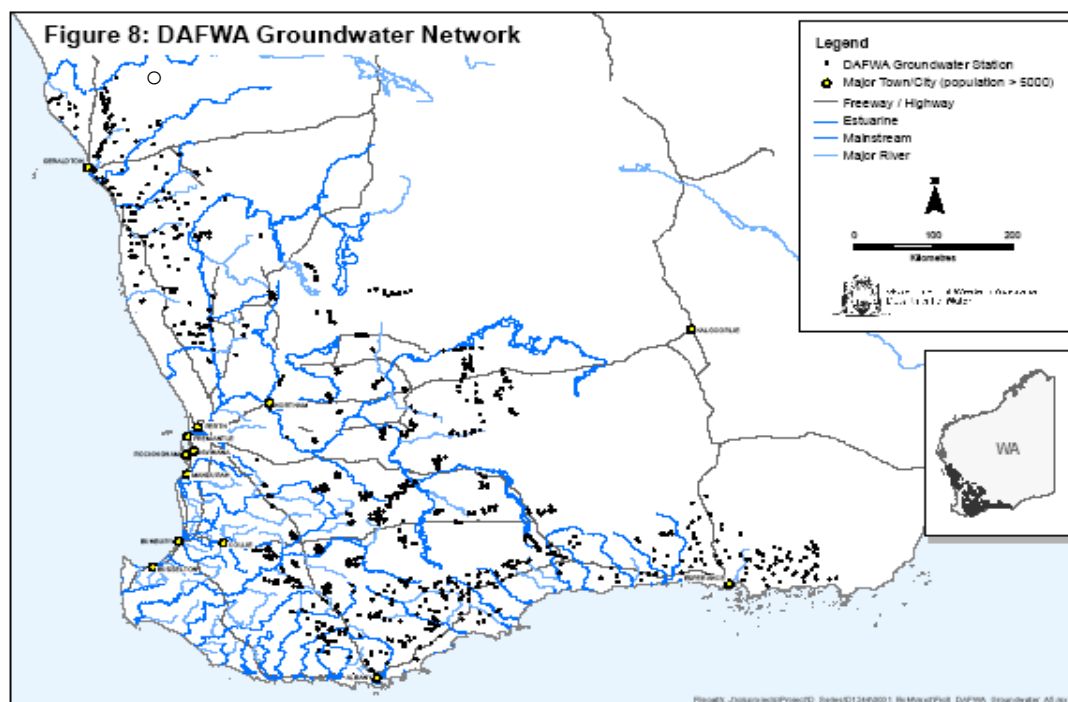


Figure 10 - DAFWA Groundwater Network

3.1.3.2 Monitoring Technologies

- Unidata loggers are used for monitoring surface water around towns.

- Automatic Weather stations: Hydro Services RIMCO
- Rain gauges are Hydro services (TB3) with HSmini log data loggers)
- Surface and Ground water are measured via:
 - pressure transducers (Insitu sensors and loggers),
 - capacitance probes with data logger
 - electrical conductivity measured with:
 - Insitu sensors and loggers
 - Unidata sensors
 - STS loggers (pressure transducers)
- Telemetry is limited to:
 - AWS on Next G modem
 - trial SW and GW sites using Campbell scientific radio loggers

3.1.3.3 Data Management and Transfer

DAFWA uses two key data management systems that provide water data to the Bureau:

- HYDSTRA: DAFWA use the industry standard HYDSTRA software for management and archiving of time series data. Its use is not widespread across the 1500 strong workforce but is used by the department's hydrologists and technical field staff. The Department is collaborating with Department of Environment and Conservation (DEC) to standardise the HYDSTRA variable codes utilised in monitoring groundwater and surface flows in biodiversity recovery catchments. This will enable (and greatly simplify) data sharing across the two agencies and is to be commended. Groundwater rest level data (for regional bore network and the rural towns network) is imported directly into HYDSTRA, for those sites that are located on public lands or for which an agreement exists with local landholder, thereby enabling direct delivery to the Bureau in synch with streamflow and weather station time series files. DAFWA's automatic weather station network is currently telemetered with data being delivered direct to the Bureau and via HYDSTRA.
- Agbores: Non-continuous data, in particular groundwater rest levels, groundwater sample information and related metadata have historically been stored in DAFWA's own *Agbores* database (Oracle backend/Access front-end). This is the major repository for groundwater monitoring data collected for research purposes in the agricultural region of WA. The number of sites for which data is collected and archived in AgBores was significantly expanded (400 new sites) through the Resource Condition Monitoring (RCM) project for salinity in WA – jointly funded by the Australian and WA Governments and implemented in partnership with the Centre for Excellence in Ecohydrology UWA.

Section B – Existing Monitoring Networks

All data delivery processes are automated to comply with the data delivery legislation. Funding obtained from the Bureau's M&E program has enabled the Department's database to be upgraded and standardised enabling the direct transfer data in xml format to BoM via the following schedules:

- Hydstra surface water (levels, Water quality data etc) and rainfall data goes to BoM daily;
- Hydstra time series groundwater data goes weekly;
- Flood warning data goes to BoM daily;
- Discrete point data is consolidated into Hydstra time series data from AGBORES and is sent monthly.
- All WIN data for DAFWA was removed from the DoW database and is now stored in HYDSTRA.

Some Agbores data is not yet being sent to BOM as is stated in the DDP. This data is historical and not yet fully quality assured (especially in relation to location data) and is located on Private lands for which no data transfer agreement exists as yet for third parties.

DAFWA have been funded under 2009/10 M&E funding to address the requirements of the Water Regulations 2008 to develop a more robust data export and exchange capability. A new set of database tables is being established, and some modification to existing tables is being made and tested to quality assure and prepare (package) data for export in WDTF. DAFWA has recently established new infrastructure to support the delivery of data to a range of stakeholders through (spatial and non-spatial) web services. This infrastructure is being used to establish a trial web service to facilitate future data delivery and access.

3.1.4 Department of Environment and Conservation

3.1.4.1 Monitoring

DEC captures a considerable amount of hydrological and meteorological data for hundreds of sites across Western Australia to service its management programs related to, air quality, natural resource utilisation, contaminated sites, fire, biodiversity conservation, wetlands and other land management responsibilities. Many sites are still active with ongoing data collection.

Monitoring points that have so far been identified include more than 700 bores, 13 automatic weather stations and 50 wetlands. This is only a portion of DEC's current monitoring network across WA. A data census driven by the Water Regulations has resulted in the collation of considerably more data than was the case initially.

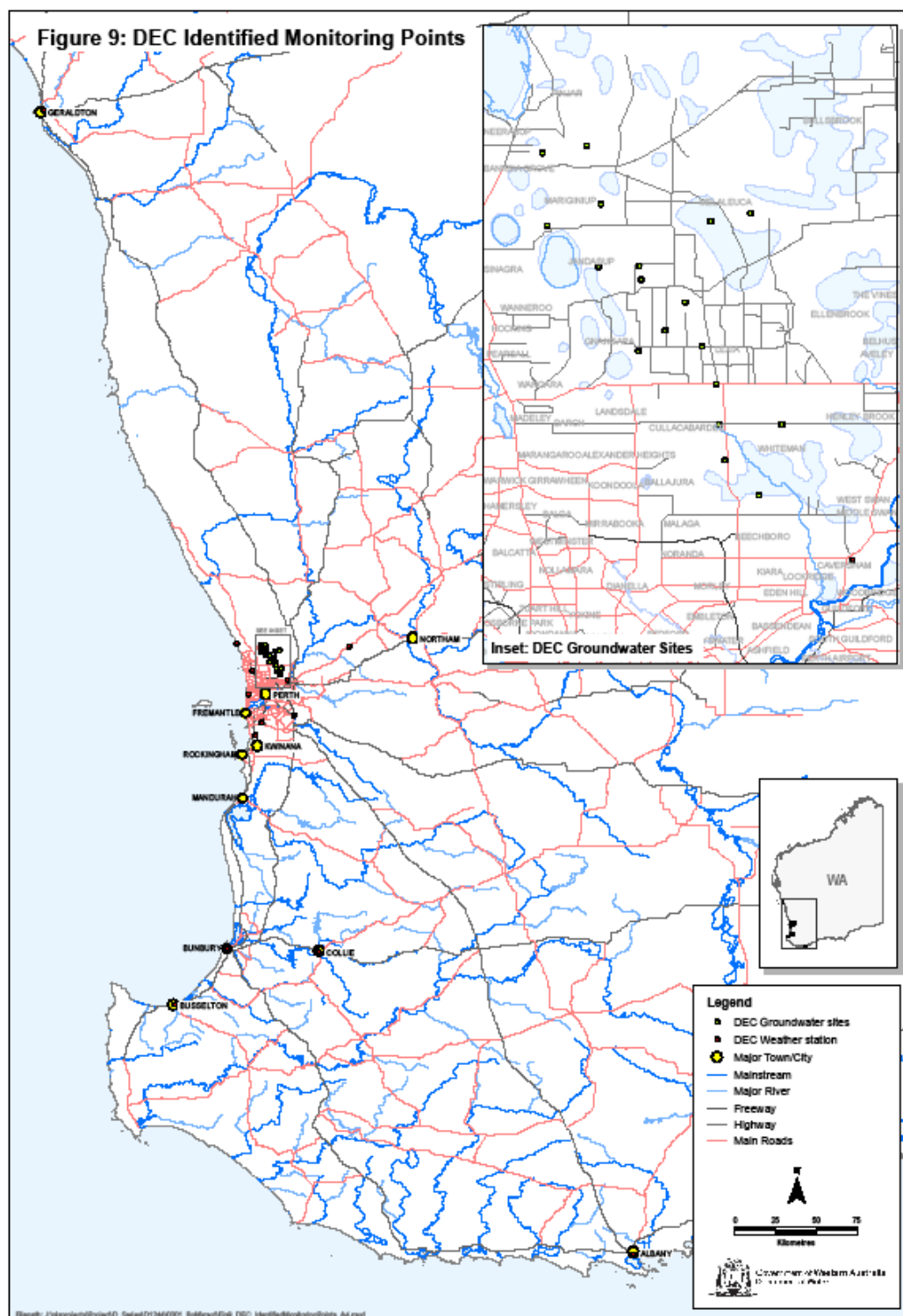


Figure 11 - DEC Identified Monitoring Points

3.1.4.2 Monitoring Technologies

Most of DEC's monitoring is done manually, i.e., manual bore dipping and manual staff gauge readings. Water quality sampling is primarily undertaken through the use of probes and best practise calibration procedures are not always as rigorously followed as should be the case. Some rigorous quality assured and controlled water quality sampling is undertaken, however, where best practise sampling and analysis procedures are followed. This is primarily done in the Natural Resources and Contaminated Sites branches. Automated loggers, from a variety of manufacturers are used for collecting water level and quality information across a number of sites.

3.1.4.3 Data Management and Transfer

Much of DEC's monitoring is "fit for purpose" and the data collected do not have the same rigorous quality assurance and quality control that specialist water agencies such as the Department of Water data would have. However most of the data in the Natural Diversity Recovery Catchments and some of the Science Division programs is of sufficient quality to be useful to third parties such as BoM.

Data are currently stored in many forms (both electronic and hard copy) and kept in various repositories. In particular, a significant proportion of data in biodiversity conservation, research and natural resource monitoring has been collected, organised and stored in a very ad hoc way. For example, data collected for research have been primarily traditionally stored on individual computers in spreadsheets and databases. The current state and volume of our hydrological data have prevented DEC from complying with the Water Regulations except in a limited way.

A number of individual programs in DEC have submitted data to BoM in compliance with the Water Regulations Act 2008. This current arrangement is unsatisfactory due to inherent shortcomings such as poor documentation of methodology, data formatting, quality control, and the inconsistent and erratic delivery of data to BoM. It is therefore preferable for both DEC and BoM that data be provided through one link, and via one structured database. DEC believes that an agency-wide Hydstra database would greatly simplify compliance for both DEC and BoM.

HYDSTRA: DEC's establishment of a centralised Hydstra database for the Natural Diversity Recovery Catchments (NDRC) program is being extended to other areas within DEC, including programs relating to biodiversity conservation, research and on-ground land management that have at this stage no resources or capacity for collation or centralisation of their hydrological data. These data represent the majority of DEC's total hydrological data but many have sensitivity issues.

DEC is currently receiving M&E round three funding for the development of a centralised DEC database for ongoing data capture and historical data collation of a substantial proportion of data transfer.

Automated weather stations are used across the department by Air Quality Management Branch, Fire Management Branch, Natural Resources Branch and Regional Services Division.

All of this data that come under the Water Information Act 2007 will be supplied to BoM as soon as possible via the Hydstra database under development in Natural Resources Branch.

3.2 Other Agencies

3.2.1 AQWEST (Bunbury Water Board)

AQWEST's water treatment, storage and distribution system consists of 6 water treatment plants (12 bores), 4 water storage reservoirs, one water storage tank, 7 booster stations and approximately 361km of water distribution mains. All sites are remotely monitored.

The network provides water supply and groundwater assessment data for management of the groundwater resource.

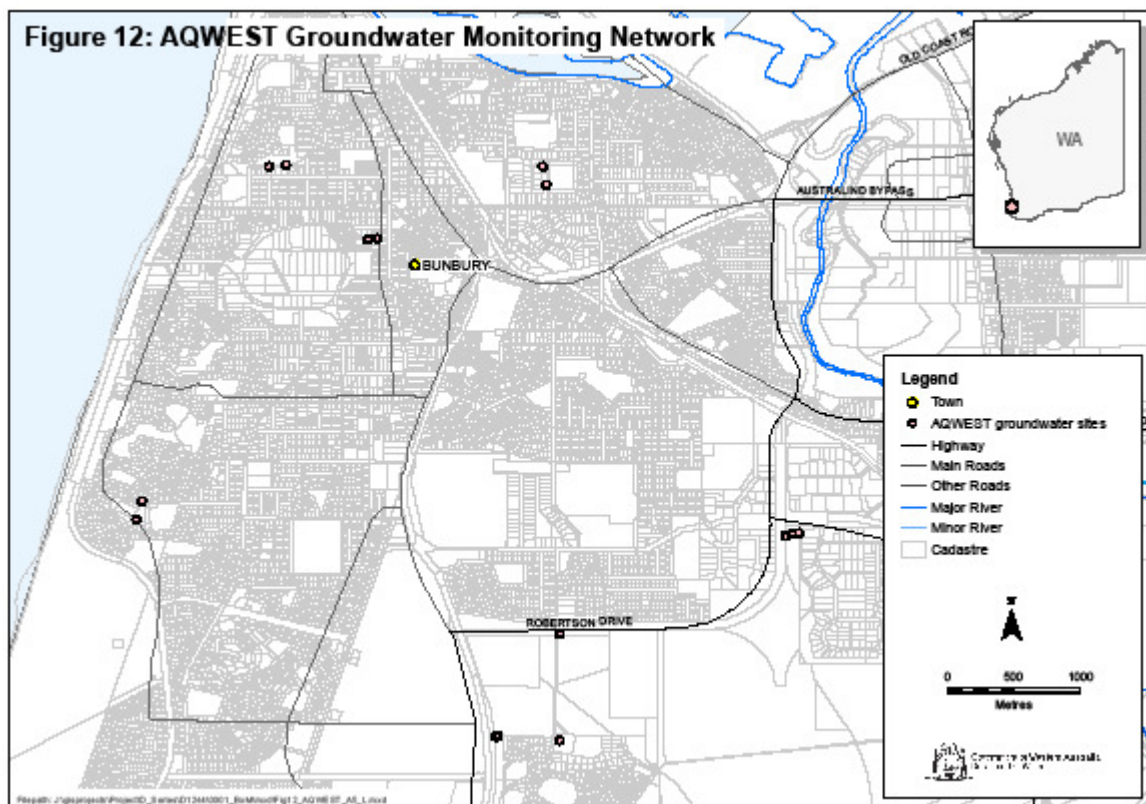


Figure 12 - AQWEST Groundwater Monitoring Network

3.2.1.1 Monitoring Technologies

AQWEST's water treatment, storage and distribution system is presently monitored and controlled by a SCADA system (Citect) to accommodate both operational management and ongoing data capture. All of AQWEST's remote sites are connected via radio telemetry and are either operated or monitored by this system.

Data validation is generally undertaken on a six monthly basis along with periodic preventative maintenance tasks, including aquifer draw down tests, in order to monitor aquifer performance. Water source data provides key operational data for annual performance indicator reporting obligations to the Office of the Auditor General and the National Water Commission.

3.2.1.2 Data Management and Transfer

AQWEST currently store monitoring, testing, maintenance and operational data throughout various systems, all of which have the capability to export this data in.xls or .csv formats (Microsoft Excel).

All data required by the Bureau of Meteorology from these systems are exported to .xls format and are then uploaded via the preferred File Transfer Protocol method.

3.2.1.3 Urban Water Management Information

AQWEST extracts, treats and distributes approximately 6.5GL of groundwater per annum. Groundwater is the sole water source for AQWEST.

3.2.2 Gascoyne Water Co-operative Ltd

3.2.2.1 Monitoring

The water supply for Carnarvon is extracted from the Water Corporation's bore field upstream of Lower Basin A of the Gascoyne River. The current monitoring network consists of 183 manually read water meters and one telemetered site (The Brickhouse).

The Carnarvon Groundwater Area (Basin A to L below in figure 10) is also monitored quarterly for water level and salinity in a cooperative arrangement by the DoW and Corporation. This monitoring provides important data for the DoW, Corporation and the irrigation scheme suppliers (Gascoyne Water) in managing the groundwater resources for the horticultural industry, town water supply and environmental provisions. This monitoring network comprises 70 monitoring bores in transects across Basins A to L (from the ocean to approximately 45kms upstream) and takes about a week to sample. High frequency monitoring is labour-intensive, especially in regional areas.

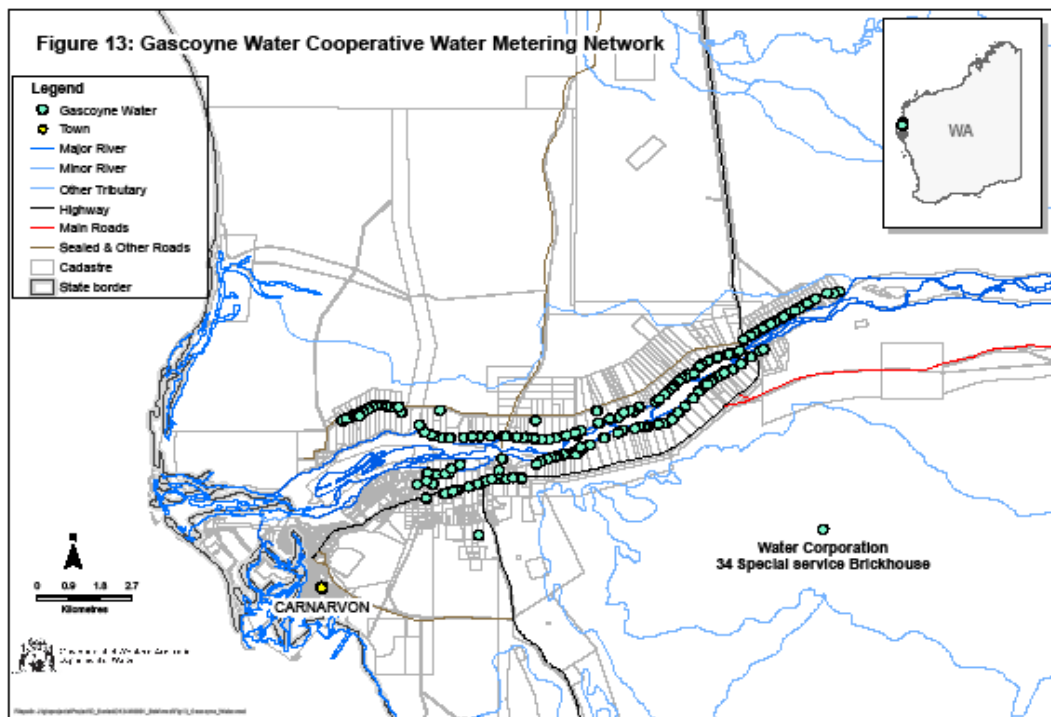


Figure 13 - Gascoyne Water Co-operative Water Metering Network

3.2.2.2 Monitoring Technologies

Water levels are currently measured manually by dipping a water level probe; groundwater salinity is measured via use of a WTW meter from an evacuated sample.

3.2.2.3 Telemetry

The DoW has recently installed a small network of telemetered data loggers to enhance the local monitoring program and to provide value added information on performance of the aquifer. The Bureau of Meteorology funded this project during 2008/09.

3.2.2.4 Data Management and Transfer

Manual meter readings are collected monthly from the 183 sites to align with the financial billing cycle. Totalised data from the Brickhouse Pump Station is telemetered via a SCADA system and delivered to the Co-operative's website. Monthly water quality results (TDS) are also presented.

3.2.3 Harvey Water

The HWIA is located to the west of the Darling Scarp on the Swan Coastal Plain, 100 km south of Perth. It covers an area of 112,000 hectares (around 75 km long and 15 km wide) in three Irrigation Districts: Harvey, Waroona and Collie. There are currently around 10,000 ha of land under permanent irrigation for dairy farming, beef grazing and horticulture, with a total surface irrigable area of approx 30,000 ha.

The HWIA is different from most Australian irrigation areas because it does not have a longitudinal river system(s) from which water is diverted or pumped. Water has historically been supplied by gravity flow from dams in the hills to farms along a network of open concrete lined and earthen channels. The slopes are quite short and relatively steep and feed water laterally across the system to the irrigation farms.

The number of supply points exceeds 1350.

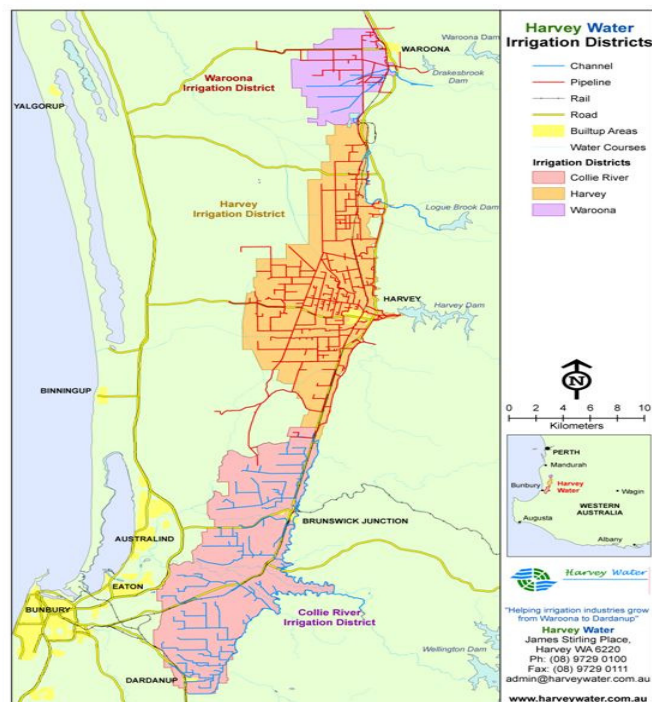


Figure 14 - Harvey Water Irrigation Network

3.2.3.1 Meteorological Information

Three Automatic Weather Stations (AWS) presently exist, serving the needs of users within the HWIA. These are located at Waroona, Uduc and Dardanup. Weather data is delivered to Harvey Water's website to provide irrigators with current weather and soil temperature conditions.

3.2.3.2 Monitoring and Delivery Technologies

AWS instruments have recently been upgraded.

Development of a delivery system which provides irrigators the flexibility to continue to surface irrigate from an open supply point or use the pressure available to irrigate more precisely using a closed system and to move between one or the other, with water available 24x7x365, is certainly unique.

Some of the more technical aspects of the system include metering using MagFlow meters and a unique constant flow valve for each supply point.

But perhaps the most unique part of the system is its capture of gravity pressure to deliver water both to and onto the farm, driving any known irrigation system, without any external energy. This advantage is not available to other irrigators in Australia.

3.2.3.3 SCADA

Water releases are actively managed using an automated Supervisory Control and Data Acquisition system (SCADA) system.

3.2.3.4 Data Management and Transfer

- **BILL:** Water use data is stored within the central data base at Harvey Water in software named BILL. This system has been developed within SQL and is maintained by contractors. BILL is currently being revised and upgraded since it is now 13 years old and showing its age. One of the requirements of the new BILL will be the ability to simply and accurately deliver data for the many reporting functions with which Harvey Water is now required to comply.
- **Excel:** In accordance with the Water Regulations, data is presently exported manually into Excel format and delivered to the Bureau of Meteorology. Harvey Water is reviewing its ability to deliver the data in WDTF and expects to seek funding support from BoM in the next funding round to allow this to be achieved.

3.2.3.5 Water Use Information

Continuous flow monitoring using SCADA is undertaken at 22 permanent gauging locations throughout the Harvey, Waroona and Collie networks. These are in place to ensure compliance to licence conditions and provide discharge figures for managing the system.

Customers order irrigation water to their local supply points via **OSI On-line Water Ordering**. Their orders are viewed by their water controllers who aggregate the orders for their area of responsibility over a 6 day window. Each day they send these to a central computer which aggregates all the orders for each particular dam supply source and, taking into account delivery losses, organises the timing and volume of releases to satisfy orders in the most efficient way.

The Water Corporation controls the water release points from the dams and provides the release data to Harvey Water, with variable efficiency and accuracy.

Actual water usage is determined by metering at the supply point. In the open channel system, Dethridge wheels are used. In the pipe system, the older meters are of the mechanical type while the newer ones are MagFlow type.

These meters are read by water controllers at the end of each month for billing purposes as well as taking meter readings when turning the supply points on and off for each service.

3.2.3.6 Rights, Allocations and Trades Information

Water entitlement and trading data has been collected since 1997. This has been delivered to the Bureau in Excel format – including both temporary and permanent transfers. This information is managed and stored within the BILL database.

Summarised trades information is available on Harvey Water's website (www.harveywater.com.au) but not all detail is up to date.

3.2.4 Ord Irrigation Co-operative Ltd

The ORIA delivery system was built in the early 1960s and was considered state of the art technology at that time. Very little was done to introduce new technology into the system until the late 90's when the state handed irrigation responsibility to the Irrigation Co-operative. Today water efficiency and channel automation are key priorities. Automated channel gates are being introduced throughout the irrigation area in key locations for better system management, more accurate water accounting and improved delivery system efficiency.

Water is released from Lake Argyle through the Ord Hydro power supply and through controlled releases via Water Corporation regulating valves at the base of the dam. An additional flow is also released through the Spillway Plug into Spillway Creek to provide a dry season flow. These combined releases comprise the inflow into Lake Kununurra which, through the operation of the Kununurra Diversion Dam, provides the head required to supply the gravity channel network of the Ivanhoe Plains system and the Packsaddle pumping station.

Water is gravity fed to farms via a series of earth lined open supply channels, using a range of flow regulating structures.

The drains in the Irrigation area are designed to:

- Carry the high wet season flows from runoff within the Stage 1 area including adjacent Crown land; Shire roads and reserves, airport, and private holdings.
- Remove excess tail water from on-farm irrigation watering.
- Convey operational "float" water from supply channels to the Ord River. The main channel and supply channels include provision for excess water to be diverted directly to the drainage system through waste-ways and relief points. Excess water is run to waste through these points.

The combined delivery system consists of 159 kilometres of earth lined channels and is controlled by approximately 120 flow regulators. Water is delivered through the supply channels by manual operation of the channel control and check-structures to reach supply points, where water enters individual farm lots.

Customers order water the day before it is required and supply points are scheduled to receive water at times that facilitate ease of operation and distribution efficiency. Water Distribution Officers manually adjust the control structures and attempt to provide water at the required supply points within four hours of a customer's request.

Water is diverted from supply channels via Dethridge Wheels and other diversion/measuring devices at the supply points.

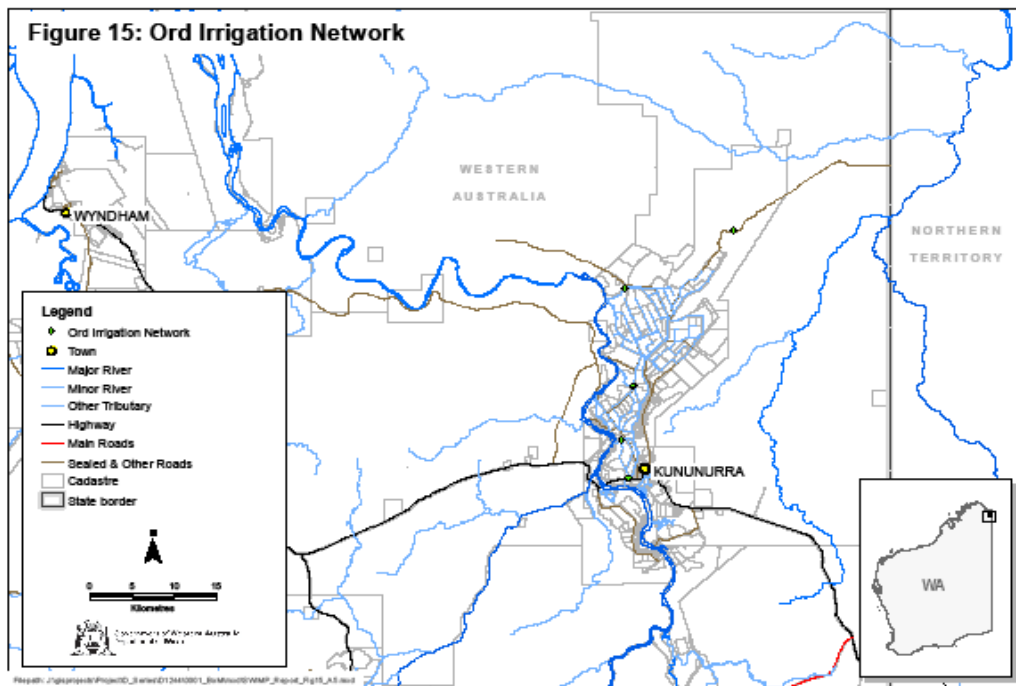


Figure 15 - Ord Irrigation Network - Mainstream Gauging Station Network

3.2.4.1 Groundwater Monitoring

Under the terms of its water allocation licence, Ord Irrigation is the primary monitoring agency for groundwater systems beneath Packsaddle Plain and Ivanhoe Plain in the Irrigation area.

In 2005, CSIRO and DOE (now DOW) performed a rationalisation project of the 275 existing DOE, CSIRO, and DAFWA bores. Out of the 275 bores, 103 groundwater sites were determined to be the minimum acceptable to be able to accurately determine effects to groundwater from irrigation.

Active bores are monitored for Water level (relative to Australian Height Datum) and EC ($\mu\text{S}/\text{cm}@25\text{DegC}$) at least twice per year and according to the following schedule:

- once at the end of the wet season, preferably in April but no later than 15 May
- once at the end of the dry season, just prior to the wet season, preferably in late October but no later than 15 November.

Prior to 2005, there were 50 installed piezometers logging continuous water level. Currently there are less than 30 reliable piezometers actively monitoring. Current Ord Irrigation managed bores are shown in the following map:

Section B – Existing Monitoring Networks

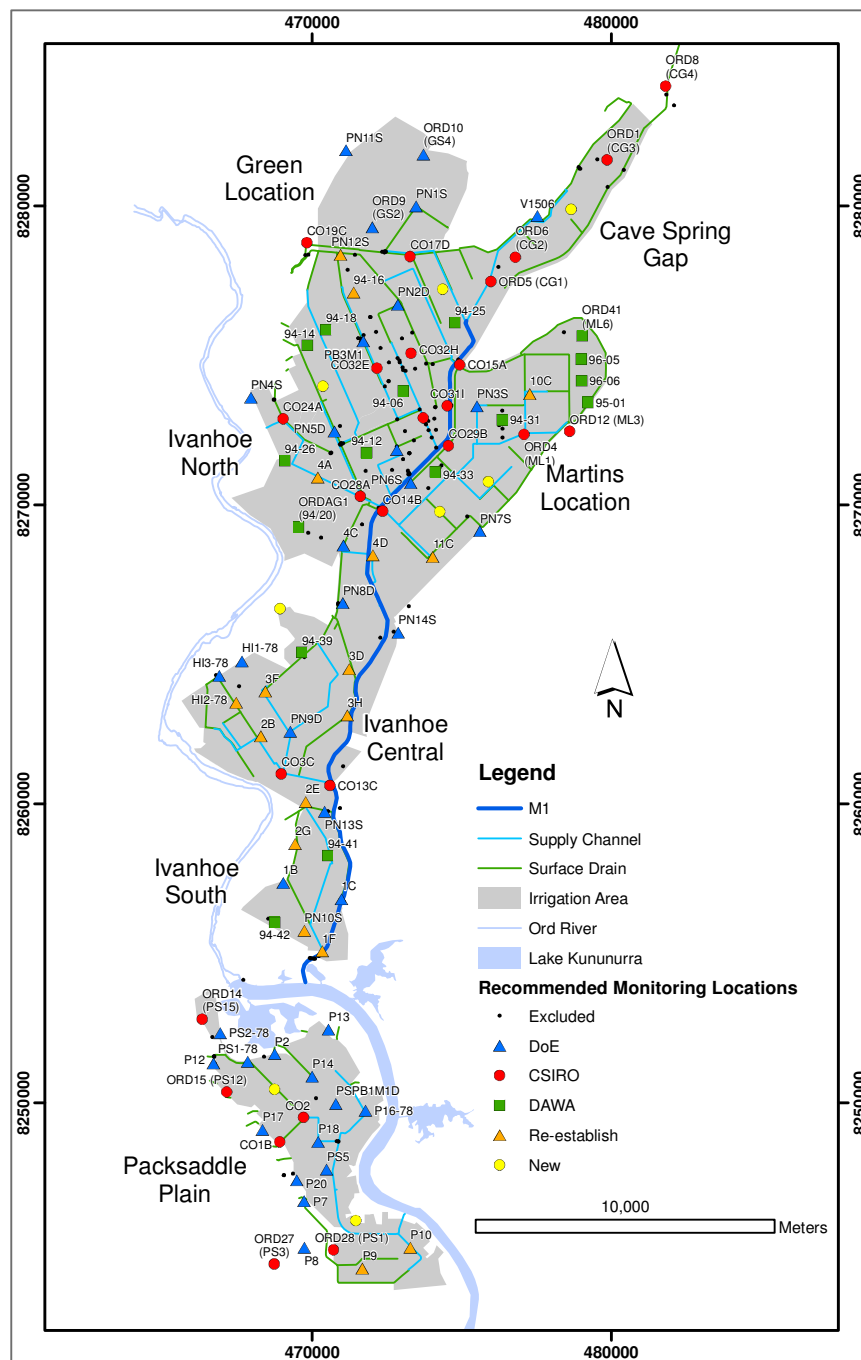


Figure 16 - Ord Irrigation Groundwater Monitoring Network

3.2.4.2 Meteorological Monitoring

Ord Irrigation Co-operative doesn't currently collect Meteorological data, all data used locally is currently managed by the Department of Water, Kununurra Airport and the DAFWA Research Institute.

3.2.4.3 Monitoring Technologies

Instrumentation presently includes:

- Acoustic Doppler site technology, for open channel flow measurement. The site is managed in accordance to ISO standard 6416, has three survey reference points, is concrete lined for stable cross-section, and has accurate water level measurement. The site is independently verified by Water Regulators four times per year during the irrigation season.
- Rubicon FlumeGate Flow measurement, a rated discharge structure which is managed in accordance to ATS 4747. The sites are commissioned utilising a Micrometer (survey instrumentation accurate to 1/10th of a millimetre). Yearly water level and gate position checks are performed relative to the surveyed benchmark.
- Monitoring sites, primarily used in irrigation operation as indicative only. Sites are accurate to within 15% of calculated flow. Sites utilise a Mannings flow calculation and multiple gate position and water level sensors to determine area and head components for flow measurement. All sensors have relative bench marks for accurate verification of measurements, and reliable co-efficient of discharge values are utilised to best meet structure properties. Level and gate position measurement meets performance class 3 of ISO 4373.
- Gauging Station Measurement sites utilise an accurate mechanical Shaft Encoder to measure water level within performance class 1 of all requirements as specified in ISO 4373. The Sites are managed according to regulator best practice; sites have an accurate rating history and are gauged yearly to ensure that the level to discharge relationship is maintained.

3.2.4.4 Telemetry/SCADA

Flow data is captured via the SCADA Telemetry system. A number of different flow measurement sites and instruments are utilised in the irrigation area; all sites are maintained to OIC QA/QC procedures that are based on Australian and International standards and procedures.

Ord Irrigation Co-operative intends to extend its telemetry capability to improve the coverage and bandwidth of communications to existing and future water monitoring/metering sites, thereby enhancing their automation of data delivery in WDTF format.

In order to have an entire water balance for water released back into the lower Ord River water course from the Packsaddle and Ivanhoe operating areas there are three drains that need to be monitored - the D3, D6 and the Packsaddle accumulated drainage. Monitoring of these sites has been seen as an important step in the Water Use improvement plan.

3.2.4.5 Data Management and Transfer

An Independent qualified Hydrographer verifies and processes data from these sites twice yearly to ensure reliable information is maintained. These sites are reported to WA's water regulator (Department of Water), Bureau of Meteorology, Water Corporation and utilised internally for management/operational purposes.

- HYDSTRA software has been installed to enhance long term data management on the continuously monitored locations and to streamline the data integration and reporting process.

3.2.4.6 Water Use Information

During 2004/2005 the major distribution control structures were automated. This is a key aspect of the OIC's Water Use Improvement Plan and involved the Automation and Monitoring of most control structures, the installation of SCADA to provide optimal delivery, real time data and an associated upgrade of water ordering and scheduling software.

During 2007/2008 all spur channel relief structures were automated to allow a complete water balance of the system by measuring all inflows/outflows.

During 2008/2009 all regulator structures in Packsaddle were automated to promote greater control, designed to improve distribution efficiencies, provide optimal delivery and allow remote monitoring and control of the entire channel system.

3.2.4.7 Rights, Allocations and Trades Information

Ord Irrigation Water Allocation is currently managed by the National Irrigation Corporations Water Entitlement Register (NICWER). NICWER is a central point of access to water entitlement information; the register includes seven Australian irrigation organisations Water Entitlements.

Irrigation water in the Ord is not yet traded as water is currently secured to the land. All water usage and entitlement is also recorded in the Irrigation Management System, which is an Ingres database that records all aspect of Irrigation; water orders, delivery, entitlement, and billing.

3.2.5 Forest Products Commission

3.2.5.1 Monitoring

FPC's monitoring network includes approximately three years of groundwater information collected from 90 sites, data from a growing network of automatic weather stations and four continuously logged surface water runoff sites.

The four intensively monitored sites are being used to evaluate catchment responses to plantings using total water balance analysis.

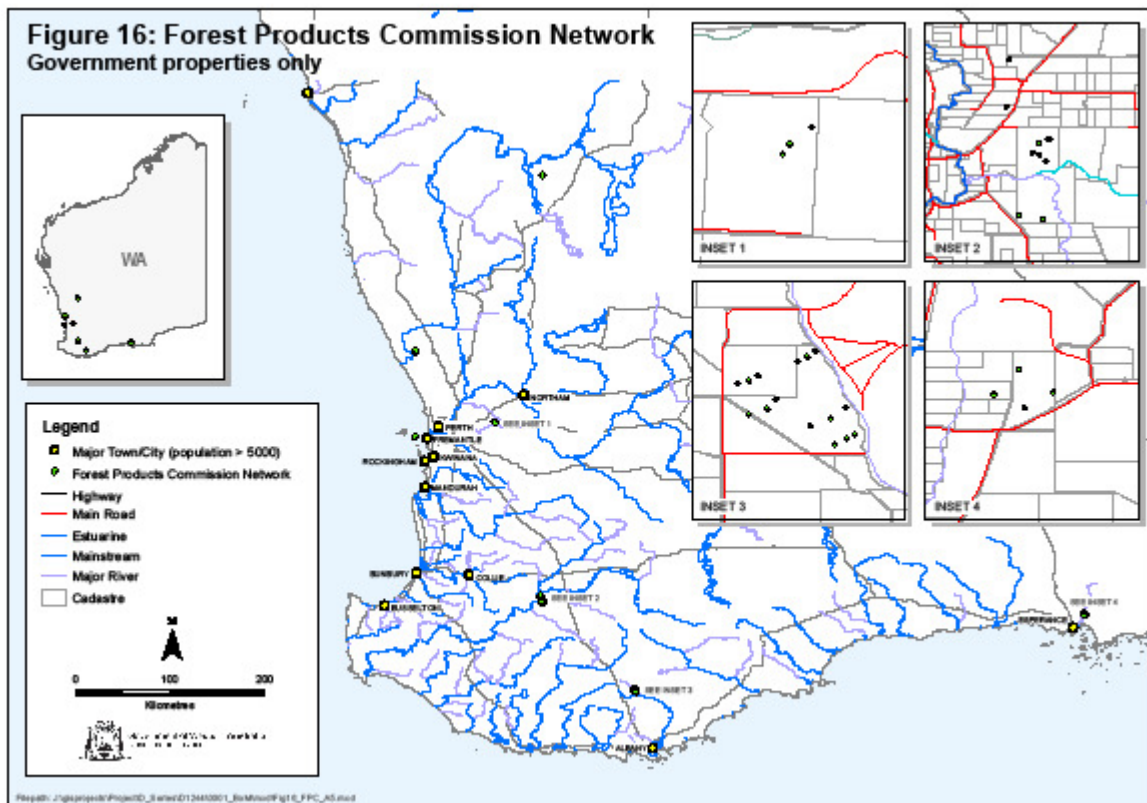


Figure 17 - Forest Products Commission Network (Govt Properties only)

3.2.5.2 Monitoring Technologies

Sites are instrumented with transects of piezometers and are/or will be equipped with auto logging weather stations. FPC's intention is to continue expansion of instrumentation across studied catchments to enhance existing monitoring and reporting.

In the four Intensive Monitoring Sites, the following instrumentation is currently installed:

- Vaisala weather stations
- Ultrasonic doppler data loggers measuring stream flow
- Water quality loggers
- Odyssey downhole data loggers measuring water table.

Details of the equipment are as follows:

- Weather stations: Vaisala WXT510 10-channel weather module. Measuring parameters: wind direction x3, wind speed x3, temperature, relative humidity, barometric pressure and rainfall. Power: (Battery/solar powered)
- Ultrasonic doppler data loggers: Unidata/Starflow flow monitoring loggers
- Measuring parameters: depth, velocity. Power: (Battery/solar powered)
- Water quality data loggers: 4-electrode conductivity recorder. Measuring parameters: temperature compensated electrical conductivity, temperature. Power: (Battery/solar powered)
- Odyssey capacitance downhole data loggers: measuring at a minimum, twice daily water level readings. Measuring parameters: water level. Power: (Battery powered)
- FPC proposes to install and use Mini-Divers, in conjunction with or in some sites in place of, the Odyssey loggers. Mini-Diver pressure membrane sensor, downhole data loggers: hermetically sealed, stainless steel; measuring at a minimum, twice daily water level readings Measuring parameters

3.2.5.3 Data Management and Transfer

- MS-Access and Excel: Data is managed and stored to local MS-Access databases and Excel. FPC is in the process of automating data delivery to the Bureau in accordance with the Water Regulations. FPC is currently using an MS Access database to store groundwater information only. Funding has now been approved under the Modernisation and Extension of Hydrological Monitoring Systems Programme to facilitate a substantial re-development of this database to capture all water related data including: groundwater levels (from manual observations and loggers), stream discharge, climate data from weather stations, water quality and metadata. The re-developed database will also incorporate FTP capability via XML as preferred by the Bureau for data transfer.

FPC will go to reasonable lengths to ensure that data entered onto our database has undergone a basic quality checking process. This is likely to consist of a simple graphing process for logger data or visual check for manual observations to identify any anomalous data.

3.2.6 Department of Housing

The Department of Housing collect groundwater data from 163 bores across 60 remote Western Australian communities. The bores are not equipped with automated instrumentation.

4 Section C – Gap Analyses

4.1 Major Agencies

4.1.1 Department of Water

4.1.1.1 Surface Water Stream Flow Monitoring Network

The Strategic Review of the Surface Water Monitoring Network undertaken for the Department of Water in 2009 identified desired surface water monitoring stations for important water resource management catchments throughout Western Australia. Priority Surface Water Management Sub Areas have been identified in the Department of Water's Management Area Prioritisation (MAP) process.

Table 7 - Surface Water MAP Priority Areas by Region

Region	Priority Area	Drivers/ Issues
South Coast	Albany Coast	Drying Climate Growing Urban Demand for Increased Water Usage (Potable Water Supply)
	Denmark	Growing Urban Demand for Increased Water Usage (Potable Water Supply) Environment (Water Quality)
	Nornalup	Increased Water Usage (Potable Water Supply)
South West	Busselton Coast	Environment (Water Quality)
	Harvey (Upper)	Increased Water Usage (Irrigation) Environment (Water Quality)
	Muir Unicup	Environment (Salinity)
	Preston Area	Environment (Salinity, Water Quality) Increased Water Usage (Irrigation)
	Capel River	Rural and Regional Water Management (Water Allocation Planning)
	Upper Blackwood	Environment (Salinity, Water Quality)
	Middle Blackwood	Environment (Salinity, Water Quality)
Kwinana-Peel	Harvey (Lower)	Economic Productivity (Mining)
	Serpentine River Catchment	Increased Water Usage (Potable Water Supply)
	Dandalup River System	Increased Water Usage (Potable Water Supply)
	Murray River & Tributaries	Increased Water Usage (Potable Water Supply)
Swan-Avon	Canning River	Environment (Water Quality)

Section C – Gap Analyses

Region	Priority Area	Drivers/ Issues
	Swan River & Tributaries	Environment (Water Quality)
	Avon River Catchment	Environment (Salinity, Water Quality)
	Helena River	Environment (Salinity, Water Quality)
Mid-West Gascoyne	Gingin Brook & Tributaries	Economic Productivity (Agricultural Expansion)
	Gascoyne River & Tributaries	Environment (Salinity) Rural and Regional Water Management (Flooding)
	Arrowsmith River	Drying Climate
Pilbara	DeGrey	Economic Productivity (Mining)
	Upper Fortescue	Economic Productivity (Mining)
	Lower Fortescue	Economic Productivity (Mining)
Kimberley	Ord River & Tributaries	Increased Water Usage (Irrigation/Potable Water Supply)
	Fitzroy River & Tributaries	Rural and Regional Water Management (Water Allocation Planning)

The methodology employed in the Network Review included identifying the highest priority surface water areas for each region and Surface Water Management Area, defining the priority area drivers for data collection and applying a primary purpose use classification to each station. Identified use classifications are tabulated below.

Table 8 - Surface Water Use Classifications

Use Classification	Explanation	Includes :
Urban Water	Measures drainage flow and water quality from catchments with urban development	Urban Drainage, Wastewater Treatment, Stormwater
Water Quality & Salinity	Measures stream flow and quality from catchments associated with salinity management	Nutrient Loads & Eutrophication, Salinity Management, Industry Discharge, Mining Impact
Waterways	Measures water quality and quantity to assess waterway health	Landuse Management, Forest Management, Impact from Agriculture, Wetland & Estuary Management
Flood	Measures flood flow and flood mapping, a requirement for Statutory land planning purposes	Flood Information
Water Assessment	Measures quantity of water for the assessment of a sustainable resource as well as quality and catchment condition	Surface Water Assessment, Environmental Water Requirements, Surface & Groundwater Interaction, Potential Potable Supplies
Climate Change	Measures changes in flow yield from catchments with little or no anthropological impact	Benchmark Catchments, Classified Wild Rivers, Climate Change

The Network Review identified the current stream monitoring network across Western Australia. It recommended several existing sites for closure and proposed the re-opening of strategic stream flow monitoring stations which have potential to significantly contribute to the current and future understanding of each region's water resource management, allocation and planning requirements. The review was undertaken with the assumption that funding was available. It is important to note that the Department of Water presently has limited economic resource capacity for growing the surface water monitoring network.

The sites identified for re-opening are presented in Tables 9 through 15.

SOUTH COAST

Table 9 - South Coast Stream Monitoring Stations Proposed to be Re-Opened

Station No.	Site name	Years of Data	Use Classification Site Essential For:
601005	Young River Tributary - Cascades	25yr	Water Assessment, Salinity Management in Agriculture
601006	Young River - Munglinup	33yr	Salinity Management in Agriculture
602002	Fitzgerald River - Jacup	30yr	Water Assessment, Salinity Management in Agriculture
602600	Jackitup Creek - Hinkleys Farm	28yr	Water Assessment, Salinity Management in Agriculture
603006	Quickup River - Mount Leay	14yr	Water Assessment, Potential Potable Supply
605013	Frankland River - Trappers Road	5yr	Salinity Management in Agriculture Waterways
615018	Lake King Creek - Gardner	23yr	Climate Change, Long Term Benchmark Catchment

GAP 1: Gap in number of stream monitoring stations in the South Coast Region
Gap partially closed during 2010. Strategy: Re-open 7 stream monitoring stations.

SOUTH WEST

Table 10 - South West Stream Monitoring Stations Proposed to be Re-Opened

Station No	Site name	Years of Data	Classified Use
607002	Lefroy Brook - Channybearup	29	Water Assessment, Landuse Management
606004	Noobijup Brook - Upstream Muir Way	8	Salinity Management in Agriculture
607010	Six Mile Brook Trib - March Road Catchment	23	Water Assessment, Landuse Management
607012	Quininup Brook Trib - April Road South Catchment	23	Water Assessment, Landuse Management
607014	Four Mile Brook - Netic Road	20	Water Assessment, Landuse Management
607155	Dombakup Brook - Malimup track	38	Water Assessment, Environmental Water Requirements
608001	Barlee Brook - Upper Iffley	28	Water Assessment, Environmental Water Requirements
608004	Easter Brook Trib - Lewin North catchment	21	Water Assessment, Landuse Management
608005	Easter Brook Trib - Lewin South catchment	21	Water Assessment, Landuse Management
608007	Record Brook - Boundary Road	13	Water Assessment
609003	St Paul Brook – Cambray	26	Climate Change, Environmental Water Requirements
609004	St Paul Brook - Dido Road	25	Climate Change, Landuse Management
609006	Weenup creek - Balgarup	25	Water Assessment,
609007	Blackwood river - Nannup	46	Flood Water Assessment Environmental Water Requirements
609008	Apostle brook – Millbrook	24	Climate Change, Landuse Management
609016	Hester brook - Hester Hill	22	Water Assessment
610005	Ludlow river - Happy Valley	26	Water Assessment, Environmental Water Requirements
610007	Ludlow river – Claymore	22	Water Assessment, Landuse Management

Section C – Gap Analyses

Station No	Site name	Years of Data	Classified Use
612005	Stones brook - Mast View	27	Climate Change, Benchmark Catchment
612006	Collie river - Mt Lennard	24	Water Assessment, Environmental Water Requirements, High yielding to Pipehead (Potable Supply)
612011	Salmon brook - Salmon catchment	27	Water Assessment, Landuse Management
612019	Bussell brook - Duces Farm	22	Water Assessment
612021	Bingham river - Stenwood	21	Salinity Management in Agriculture
612023	Lunenburg River - Silver Springs	19	Water Assessment, Environmental Water Requirements
612024	Augustus river – Worsley refinery	17	Water Assessment, Mining Impact

GAP 2: Gap in number of stream monitoring stations in the South West Region Strategy: Re-open 25 stream monitoring stations.

KWINANA-PEEL

Table 11 - Kwinana-Peel Stream Monitoring Stations Proposed to be Re-Opened

Stn No	Site Name	Years of Data	Use Classification
614013	Peel Drain – Hope Valley	25	Nutrient Loads and Eutrophication
614028	Dirk Brook – Hopelands Road	28	Waterways Management

GAP 3: Gap in number of stream monitoring stations in the Kwinana Peel Region Strategy: Re-open two stream monitoring stations.

SWAN-AVON

Table 12 - Swan-Avon Stream Monitoring Stations Proposed to be Re-Opened

Stn No	Site Name	Years of Data	Classified Use
614035	Serpentine River - River Rd	17yr	Water assessment, Potable Supply Catchment
614038	Big Brook - West Cameron	12yr	Mining Impact
614039	Big Brook - Central Cameron	6yr	Mining Impact
614040	Big Brook - East Cameron	1yr	Mining Impact
615014	Avon River - Brouns Farm	26yr	Flood, Salinity Management in Agriculture
615222	Dale River South - Brookton Highway	33yr	Flood, Management in Agriculture
616007	Rushy Creek (Mannes Gully)- Byfield Rd	42yr	Water Assessment
616014	Piesse Brook - Furfaros Orchard	32yr	Landuse Management, Impact from Agriculture
616025	Canning River East Br - Rocky Valley	17yr	Water Assessment, Potable Supply Catchment
616039	Canning River - Millars Road	26yr	Water Assessment, Potable Supply Catchment
616040	Susannah Brook - Gilmours Farm	20yr	Waterways Management
616097	Jane Brook - James Road	1yr	Waterways, Nutrient Loads and Eutrophication
616098	Strelley Brook - Dalgety Road	8yr	Waterways, Nutrient Loads and Eutrophication
617165	Lennard Brook - Molecap Hill	39yr	Water Assessment, Landuse Management, Impact from Agriculture

GAP 4: Gap in number of stream monitoring stations in the Swan Avon Region
Gap partially closed during 2010. Strategy: Re-open 14 stream monitoring stations.

MID-WEST

Table 13 - Mid-West Stream Monitoring Sites Proposed to be Re-Opened

Station No	Site name	Years of Data	Classified Use
701005	Arrowsmith River - Robb Crossing	31	Water Assessment, Surface & Groundwater Interaction
701006	Buller River - Buller	27	Water Assessment, Mining Impact
701017	Oakagee River - Pig Swamp	1	Water Assessment, Waterways Management
701601	Nokanena brook Catch - Wearbe	27	Water Assessment, Landuse Management
705002	Lyndon River - Badyeeda Pool	26	Flood Information

GAP 5: Gap in number of stream monitoring stations in the Mid West Region Strategy: Re-open 5 stream monitoring stations.

PILBARA

Table 14 - Pilbara Stream Monitoring Stations Proposed to be Re-Opened

Station No	Site name	Years of Data	Use Classification
708003	Fortescue River- Jimbegnyinoo Pool	34	Water Assessment, Surface & Groundwater Interaction
708006	Fortescue River - Goodiadarrie Crossing	14	Water Assessment, Surface & Groundwater Interaction
708007	Fortescue River - Bunje Well	13	Water Assessment, Surface & Groundwater Interaction
708008	Fortescue River - Roy Hill	13	Water Assessment, Mining Impact
708004	Sthn Fortescue River- Hamersley Gorge	16	Water Assessment, Surface & Groundwater Interaction
709003	Sherlock River - Coonanarrina Pool	30	Water Assessment, Surface & Groundwater Interaction
709012	South West Creek - Boodarie	7	Flood Information
707004	Robe River - Ngalooin Pool	23	Water Assessment, Flood Information
709007	Harding River - Marmurrina Pool u-s	25	Water Assessment, Potable Supply Catchment
706001	Gorge Creek - near Mt Vernon	13	Climate Change, Benchmark Catchment
706002	Cherrybooka Creek - Blue Bar	13	Climate Change
706004	Turee Creek - Broken Springs	7	Climate Change, Mining Impact
710002	Five Mile Creek - Quartz Hill	11	Water Assessment, Surface & Groundwater Interaction
707001	Robe River - Palra Springs	32	Climate Change, Classified Wild River
709006	Tanberry Creek - Blue Dog Pool	27	Climate Change, Benchmark Catchment

GAP 6: Gap in number of stream monitoring stations in the Pilbara Region Strategy: Re-open 15 stream monitoring stations.

KIMBERLEY

Table 15 - Kimberley Stream Monitoring Sites Proposed to be Re-Opened

Station No.	Site name	Years of Data	Classified Use
802197	Fitzroy River - Alligator Pool	15	Water Assessment, Flood Information
803002	Lennard River - Mt Herbert	32	Water Assessment, Flood Information
803003	Fletcher River - Dromedary	32	Water Assessment, Climate Change
806003	Crystal Creek - Crystal Head	46	Water Assessment, Mining Impact
806004	Carson River - Old Theda	29	Water Assessment, Mining Impact, Flood Information
806005	Morgan River - Moondoolnee (Theda)	28	Water Assessment, Mining Impact, Flood Information
806006	King Edward River – Mt Reid	26	Water Assessment, Flood Information, Classified Wild River
807001	Drysdale River - Solea Falls (Horseshoe)	27	Water Assessment, Mining Impact, Flood Information
808001	Durack River - Nettopus Pool	33	Water Assessment, Flood Information
808005	Pentecost River - Pentecost Ford		Water Assessment, Flood Information, Environmental Water Requirements
809317	Black Elvire River Tributary - Koongie Park	31	Water Assessment, Flood Information, Potential Potable Supply

GAP 7: Gap in number of stream monitoring stations in the Kimberley Region Strategy: Re-open 11 stream monitoring stations.

4.1.1.2 Surface Water Quality Monitoring

The number of sites continuously monitoring salinity and also nutrient sampling in rivers and estuaries is currently under revision by the Department of Water. Also, while the Department of Water manages some state legislation relating to water quality there are additional responsibilities in Acts managed by others. An internal review of Department of Water's role in managing water quality is currently underway. Stage one of this review - outlining the Department of Water's current roles and responsibilities in managing water quality and how the Department interacts with other agencies, and stage two - gaps and opportunities are currently both in draft form.

4.1.1.3 Surface Water Monitoring Technologies

More than 50% (220) of sites in the Department of Water's Surface Water Monitoring network have no telemetry. A recent review conducted by the Department of Water recommended in order of priority:

- Identification of those hydrometric stations, which provide a flood warning role in the priority flood warning catchments (as identified by the Flood Warning Consultative Committee) and which are not serviced by ERRTS telemetry. Upgrade of these stations with IP technology
- Commission all non-telemetered sites with IP technology on a region by region basis.
- During the regional roll out, any new station commissioned, in any region, to be equipped with IP telemetry.

GAP 8: Statewide stream monitoring stations: nil or cost prohibitive "Dial Up" telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP Telemetry
GAP 9: Flood Warning stream monitoring stations without ERRTS telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP telemetry
GAP 10: Gascoyne Region stream monitoring stations nil or cost prohibitive telemetry. Gap partially closed during 2010. Strategy: Continue with upgrade to IP telemetry
GAP 11: Pilbara Region stream monitoring stations nil or cost prohibitive telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP telemetry
GAP 12: Kimberley Region stream monitoring stations nil or cost prohibitive telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP telemetry
GAP 13: South Coast Region stream monitoring stations nil or cost prohibitive telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP telemetry
GAP 14: Kwinana Peel Region stream monitoring stations nil or cost prohibitive telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP telemetry
GAP 15: South West Region stream monitoring stations nil or cost prohibitive telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP telemetry
GAP 16: Swan Avon Region stream monitoring stations nil or cost prohibitive telemetry. Gap partially closed during 2010. Strategy: Continue with Upgrade to IP telemetry

The Department has experienced difficulties over many years undertaking high flow gaugings on rivers in remote regions of the state. Flows are unpredictable or fleeting, and access to sites with the necessary gauging equipment at critical times is often not

possible. The department is no longer able to establish manned gauging camps at priority sites to measure flows for the duration of a wet season.

There are many opportunities for improving the flow ratings at gauging stations across Western Australia using Light Detection and Ranging (Lidar) surveys. These can be flown to capture high resolution bare earth 3D digital data sets of the river reaches at some inadequately rated sites.

GAP 17: Flow rating data at priority sites.

Gap partially closed during 2010. Strategy: Continue with Light Detection and Ranging (Lidar) surveys as funds become available.

4.1.1.4 GROUNDWATER LEVEL MONITORING

Since the mid-1990s, the decline in groundwater level monitoring is counter to the trend of increasing groundwater abstraction. An improved groundwater monitoring program will provide increasing knowledge of groundwater resources, confidence in monitoring data, and offer better monitoring data to stakeholders.

Regional groundwater monitoring gaps have been identified in the 2009 review of groundwater monitoring (Kern and Johnson, 2009). Outlined below are the identified gaps in each Region.

SWAN REGION

- Sustained abstraction from the confined aquifer system will require additional monitoring bores to appropriately monitor potential saltwater intrusion, particularly along the coast to the north of Perth.
- There is a need to consider the use of automated water level measurement to collect more frequent water level data, which will improve efficiency of data collection with less field time required for regional measurement staff.

GAP 18: Swan Region saltwater intrusion inadequately monitored. Strategy: requires additional monitoring bores

GAP 19: Swan Region groundwater level measurement frequency is inadequate.

Gap partially closed during 2010. Strategy: consideration for expanding use of automated water level measurement

SOUTH WEST REGION

The high priority of the groundwater areas and increasing dependency of the SWAMS groundwater model will require increased data collection into the future; hence, the use of automated water level measurement must be considered.

GAP 20: South West Region has a gap in groundwater data collection. Strategy: consideration for use of automated water level measurement

MID WEST (GERALDTON) REGION

- The current level of groundwater monitoring in the Mid West (Geraldton) Region is poor and not adequate for groundwater management purposes.
- The ad-hoc and inconsistent approach to the collection of water level data is unsatisfactory with nearly half of the regional bore network not monitored at the recommend frequency of twice per year. The southern portion of the region is currently not monitored for water levels due to funding limitations.

GAP 21: Mid West (Geraldton) Region groundwater monitoring is inadequate for groundwater management purposes. Strategy: Implement identified monitoring program.

MID WEST (CARNARVON) REGION

- There are many occasions when measurements are not collected or not stored in WIN database, it will be important that this situation is addressed.
- There is a need for the DoW to ensure that all monitoring data collected up-gradient of the horticulture area by the Corporation since 1996 is captured and stored into the WIN database. This data is important for ongoing calibration of the groundwater model and any potential expansion of the water supply.
- Following a successful trial of data loggers in the horticultural area of Carnarvon in 2009 there is a need to equip additional bores with data loggers in this area.
- There is potential that rehabilitated bores within the Carnarvon Artesian Basin may have to be monitored by the Department.

GAP 22: Mid West (Carnarvon) Region groundwater measurements are not collected or not stored in the Water Information (WIN) database.

Gap partially closed during 2010. Strategy: Equip additional bores with data loggers and implement identified monitoring program.

PILBARA REGION

- Groundwater monitoring has been sporadic in the North West (Pilbara) Region due to lack of dedicated funding and poor access. This is not considered appropriate nor suitable for groundwater management requirements. There is a need to fully assess the condition of monitoring bores and address access problems. The focus of this should initially be at Millstream and selected alluvial aquifers along the Pilbara Coast.
- It is recommended that 17 monitoring bores at Robe and Fortescue Rivers are monitored biennially. This new monitoring data will support existing Water Smart projects being undertaken to support the development of a future statutory management plan. There are potentially 84 bores (including 10 at Millstream and 32 in the West Canning Basin) in the region that can be added to improve the network.
- There is need for a comprehensive evaluation of monitoring bore condition. The condition of the bores previously used for monitoring is uncertain, and there are many access issues due to infestation of weeds and damaged tracks.
- There is a need to consider re-establishment of monitoring bores in the West Canning Basin. The increasing interest in this groundwater resources and potential as a town water supply for Port Hedland requires a baseline level of regional groundwater monitoring.

GAP 23: North West Pilbara Region groundwater monitoring has been sporadic and the condition of monitoring bores is unknown. Strategy: Implement identified monitoring program and evaluation of other monitoring bore condition with a view to implementing monitoring.

GAP 24: North West Pilbara Region monitoring bore network gaps. Strategy: addition of potentially 84 bores to improve the network.

KIMBERLEY REGION

- The level of groundwater monitoring by the Kimberley Region is not adequate for current needs. Given the sensitivity of the Broome groundwater area to potential saltwater intrusion, it is important this groundwater resource is better monitored.
- There has been no groundwater monitoring of the 22 bores in the Broome groundwater area since 2007 due to no dedicated funding for groundwater monitoring.
- Outside of the main abstraction areas, there is no recommended groundwater monitoring program. It will be necessary for a comprehensive review of potential groundwater monitoring bores and assessing the need for any additional regional groundwater monitoring.

GAP 25: North West Kimberley Region groundwater monitoring is inadequate. Strategy: improved monitoring. Strategy: Implement identified monitoring program.
GAP 26: North West Kimberley Region has no recommended monitoring program outside of the main abstraction areas. Strategy: comprehensive review and assessment of the need for additional monitoring.

SOUTH COAST REGION

- There is currently no regional groundwater monitoring in the South Coast Region because it is generally considered that Albany and Esperance are adequately monitored by the Water Corporation.

4.1.1.5 Groundwater Level Monitoring Technologies

- Presently limited water level systems are in use as part of the groundwater monitoring program. The use of automated groundwater measurement is seen as critical to improving understanding. More frequent data collection will allow better groundwater model calibration, confirm aquifer performance and response, and determine connectivity between aquifers and groundwater dependent ecosystems.
- Wireless groundwater monitoring systems could be useful in areas difficult to access.
- There may be site specific or important management criteria bores that could be included in a real time groundwater monitoring system.

Table 16 - Proposed Schedule for Installation of Groundwater Data Loggers (subject to funding)

Region	Number of bores	Data loggers to be installed				
		2011/12	2012/13	2013/14	2014/15	2015/16
Swan Region	1217	500	300	300	117	
South West Region	677		200	200	301	
Mid West Region - Geraldton	264				82	182
Mid West Region - Carnarvon	30					30
North West Region - Pilbara	17					17
North West Region - Kimberley	131					131
Total	2336	500	500	500	500	360

GAP 27: Groundwater level monitoring technologies are limited.

Gap partially closed during 2010. Strategy: Complete a full assessment of the value of expanding the groundwater data logger network.

4.1.1.6 Data Management and Transfer Systems

- **HYDSTRA:** there are some significant backlogs in the processing of Hydstra archive data, and in the quality of ratings and number of gaugings taken. However, while there may be the possibility of introducing some efficiency by automation, the major cause of delays and lack of data is staff under-resourcing. This can only be addressed by providing more staff, reviewing standards for data collection or reducing networks.

GAP 28: Significant backlogs in processing of Hydstra surface water archive data and in the number of ratings reviewed and gaugings taken. Strategy: Continue to target productivity improvements through widespread implementation of IP telemetry, adjustments to operational programs and widespread implementation of recently developed semi auto data validation process with the inclusion of more complex hydrologic parameters.

GAP 29: Backlog of time series data from 400 groundwater sites with potential for significantly increasing backlog. Strategy: Continue with incorporation of recently developed semi auto data validation process for use with groundwater parameters and implement statewide.

- **Water INformation system (WIN):** With the implementation of AWRIS there is an emerging need for more metadata to be collected and stored with the associated measuring site/station. The current WIN system is now over 10 years old and is not capable of storing all of the information that is (and will be) required to support systems like AWRIS. The WIN system is now designated a legacy system so no minor changes will be made to it, however a new module is currently being developed using modern technologies and this can be built upon when and if additional funding is sourced.

GAP 30: Insufficient site metadata collected and stored to support AWRIS.

Strategy: Continue with collection and collation of disparate metadata and the electronic securing of at risk paper based metadata as funds become available.

GAP 31: WIN system is now designated legacy system. Strategy: source funding to develop a new system based on prototype module.

- There is a clear requirement and need to match information between the current WIN system and the department's Water Resource Licensing system (WRL) in order to better and more fully support the national water account being undertaken by the Bureau. This is a labour intensive process that will require additional funding; currently small areas are being matched where specific project funding is available.

GAP 32: Unmatched data in the WIN and WRL systems to fully support the national water account. Strategy: Continue addressing priority areas as funding becomes available.

- 90% of surface water sites have not been surveyed in to AHD (instead they have been surveyed in to a local datum). Having all sites surveyed into AHD datum would be a vast improvement for both DoW and Bureau of Meteorology purposes.

GAP 33: 90% surface water sites are not surveyed to AHD. Strategy: Survey sites as funding becomes available.

- WRL: COGNOS reporting from WRL is very inefficient. WRL will be replaced by the Common Registry system when developed. M&E funding provided by the Bureau has enabled an upgrade of WRL for the interim period. This upgrade allows seamless data updates from WRL to WIN for licensed sites with a single drawpoint and single meter on the one licence. Multiple drawpoints still need to be managed manually.

GAP 34: Reporting from WRL is inefficient.
Strategy: Utilise the newly developed interface for single licences. WRL will ultimately be replaced by the Common Registry system.

- DWAID: Was developed in-house in the 1990's and has become increasingly difficult to maintain and develop. It is becoming less supported e.g. the graphical interface is no longer functional due to the upgrade of departmental servers. DWAID does not currently store surface water resource data however WRL and DWAID enhancements currently underway will remedy this. DWAID has no reporting ability (COGNOS is utilised as the reporting tool and this is very inefficient), has limited archiving ability (it is extremely difficult to 'rewind' and see historical information having instead to refer to paper records) and has limited flexibility. The Department is presently scoping a plan to replace DWAID with a suite of tools to manage Total Aquifer Allocation.

GAP 35: DWAID increasingly difficult to maintain and develop. Strategy: system replacement.

Spatial data:

- Surface hydrology datasets were captured many years ago and were considered to be unreliable in many locations. Improvement of the consistency and attribution of surface hydrology dataset (rivers and streams network dataset) was funded through the Bureau's Round 2 M&E funding program. The project managed to update 65% of the Department's statewide river network.
- Groundwater aquifer contours in many locations across the state are incomplete and/or unreliable.

Section C – Gap Analyses

- No complete dataset for farm dams currently exists for the South West Division of Western Australia.

GAP 36: Incomplete surface hydrology data. Unreliable groundwater aquifer contours. Strategy: Finalise surface water dataset . Review and update groundwater datasets.
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GAP 37: Incomplete farm dam dataset. Strategy: Update dataset
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4.1.1.7 Water Accounts

- Priority water resource systems need to be identified for progressive expansion of regular water accounting.
- Alignment of water accounting with water allocation and management plans to provide useful information
- Data and systems:
 - Need 'best estimate water abstraction module' as a key input into water accounting – (NWC project milestone 4)
 - Groundwater modelling – there is still much work to be done to get groundwater models to work in 'Water Accounting' mode. These models include PRAMS, the Peel Harvey Regional Aquifer Modelling System (PHRAMS), models for Carnarvon, South West Region and Albany
 - Surface water modelling – there is a good model for the Ord however this needs to be modified to run in water accounting mode.
 - System needs – a number of key gaps and upgrades have been identified in the DoW System enterprise architecture work
 - Metering needs – expansion of metering is vital and so too are regular readings and digital entry to systems.
 - Monitoring needs – improved groundwater, surface water and rainfall network monitoring is required in key areas.

GAP38: Information systems gaps. Strategy: Identified in DoW enterprise architecture review, upgrades planned.

GAP39: Gap in number of meters and frequency of readings

4.1.1.8 Water Use information

As a signatory of the NWI, the Department of Water is committed to improving metering and as such has developed a water metering programme within its Metering Implementation Plan. The planned numbers of meters to be installed in priority meter areas are tabled below:

Table 17 - Western Australia's Priority Area Metering Requirements

Priority water-resource planning areas	Number of meters to be installed or replaced
Gnangara Mound groundwater system ⁱ	565
Bunbury groundwater system	175
Busselton-Capel groundwater system	491
Canning River surface water system	160
Cockburn groundwater system	229
Gingin surface water system	129
Gingin groundwater system	600
Ord surface water system	108
Whicher surface water system	123

Gaps in metering data systems have been referred to elsewhere in this document; Water Accounting (4.1.1.6) and Data systems (4.1.1.5) gaps. A large percentage of WA's metering data is not presently electronically stored. Some of this metering data is currently being captured on a (water accounting) project by project basis and entered into the corporate water information database.

GAP 40: Large percentage of Metering data is not stored electronically.

4.1.1.9 Information about rights, allocations and trades

Completion of Western Australia's legislative reform process is a pre-requisite for implementing the key actions in the Water Access Entitlements and Planning Framework detailed in the NWI. As stated in Western Australia's Implementation Plan for the NWI: it is anticipated that in WA, three main forms of water entitlement will co-exist to varying degrees; water licences, water access entitlements and basic rights.

Statutory water management plans will be the mechanism to define which of these water entitlements will exist, reflecting the nature of the resource and its use. A water licence arrangement similar to the existing arrangements will continue to apply in those areas not covered by a statutory water management plan in preference to a water access entitlement for certain types of water use.

For example, to meet the needs of specific forms of water use in areas where a consumptive pool is not or is unlikely to be established, or before the resource investigation and planning has reached a stage where it is appropriate to set the size of the consumptive pool in a particular area. Water access entitlements will be issued as unit shares of the consumptive pool. The amount of water available in any given period will reflect the amount of water that is available in that period. It will be declared through an allocation announcement and subject to any locally applicable water access rules expressed through the statutory water management plan. New shares will be issued only when pool boundaries are changed or a new source of water is added to the pool.

Water access entitlements will be freely tradable, subject to any localised trading rules expressed through statutory water management plans. It will not be necessary to have legal access to land to hold a water access entitlement, as there will be separate titles for land and water. Approvals for works and site use will be ‘unbundled’ from the water access entitlement.

GAP 41: Outdated legislation. Strategy: legislative reform

4.1.1.10 Information about urban water management

The Department of Water is not certain on the method of measurement (i.e. are water meters installed, or some other measuring method used) applied to measuring water taken from its surface water storage dams. The Department has, therefore, requested the Water Corporation to collate and provide metering information for each dam. The Corporation is currently compiling this information.

The Department of Water is unable to provide data on the total weekly volume of commercial, municipal and industrial water supplied as many licensed commercial, municipal and industrial water users are not metered. For those that are metered, the department's requirements are for them to provide monthly data and submit annually. The majority of meters fitted by licensees are manually read as data loggers are not fitted to capture start and finish times.

4.1.2 Water Corporation

4.1.2.1 Instrumentation and communications for monitoring sites

4.1.2.1.1 DAM AND STORAGE SITES

Around 50 dams and storages have been manually read with no electronic instrumentation or SCADA/telemetry for communications. These sites were identified during 2009/10 as part of project WA 6.1 to survey the communication options for gathering dam storage data remotely. The survey was funded under the Bureau's M&E scheme and fully completed.

GAP 42: Lack of instrumentation or communications - dams/storages Strategy: Stage 1: Survey completed Stage 2: Installation of telemetry equipment is underway with 50% of storages expected to be completed during 2010/11. Hardware has been funded through the Bureau's M&E scheme.

4.1.2.1.2 SURFACE WATER AND GROUNDWATER SITES

Many surface water monitoring sites do not have communications available for telemetering of data. Very few bore fields have any instrumentation and are reliant on manual reading of water levels.

Metadata for surface water and groundwater sites is still stored in hard copy drawings and files. Consequently it is not readily available for reporting and analysis. Additional data, in terms of meter calibration, is also not readily available for data validation

GAP 43: Lack of instrumentation or communications – surface water monitoring sites

GAP 44: Lack of instrumentation or communications – groundwater monitoring sites

4.1.2.1.3 WEATHER STATION AND RAINFALL SITES

Develop strategy for data sharing between agencies. Expand Water Corporation network based on availability of other agencies data and Corporation requirements.

GAP 45: Lack of instrumentation or communications – rainfall and climate monitoring sites.
Strategy: data sharing between agencies and network expansion.

4.1.2.1.4 WATER ABSTRACTION, EXTRACTION AND USE MONITORING SITES

The capture of data from monitoring sites is becoming more sophisticated in terms of the increased use of technology for entry and communication of data using PDA's. However this is still a labour intensive process and the use of electronic meters would enable more efficient, detailed and timely capture of data for managing and reporting water abstraction, extraction and use. Electronic meters would benefit the management of resources from a local (household or business), operational and water accounting perspective by giving better data on water use and movement.

GAP 46: Lack of instrumentation or communications – water abstraction and extraction sites
Strategy: use of electronic meters

4.1.2.2 Groundwater Level and Quality Monitoring

Groundwater level monitoring in the vicinity of Water Corporation bore fields has reduced substantially since the mid-1990's. This was as the result of loss of resources and IP in the area of groundwater monitoring. Given the increasing reliance on groundwater resources for water supply the Corporation needs to better understand the impacts of groundwater use on resources and the environment. An increased investment in monitoring is required to gain this understanding.

GAP 47: Insufficient groundwater level monitoring.
Strategy: increased investment in monitoring

4.1.2.3 Geofabric

Many surface water, groundwater sites, dams and storages do not have elevations in mAHD, consequently data can only be reported in a local datum. Surveying of these sites is required so that data can be provided in mAHD to tie in with BoM's Geofabric. For example groundwater levels need to be provided on mAHD to provide a relationship with topographic data.

A gap also exists in the location and boundaries of dams and drains.

GAP 48: Geofabric – surface water and groundwater sites not surveyed to AHD.
Strategy: Survey sites.

4.1.2.4 Data management

4.1.2.4.1 CONSOLIDATION

Data for some assets is stored on non-corporate databases. For example Dams and Dam Safety data is stored in spreadsheets. Need to capture this data to SAP and provide data management and reporting capabilities.

GAP49: Data management - data managed in non-corporate databases.
Strategy: capture this data to SAP

Section C – Gap Analyses

4.1.2.4.2 ACCURACY

Meters used to measure water abstraction, extraction and use are not regularly calibrated, nor is the calibration data readily available.

GAP 50: Data management - meters are not regularly calibrated and calibration data unavailable

4.1.2.4.3 QUALITY

- Data in some databases is of unknown quality.
- Mechanisms for correcting erroneous data are required (e.g. Bore levels in ODSS).
- Requirement to develop a data quality coding system

GAP 51: Data management - data of unknown quality in corporate and non-corporate databases Strategy: This gap has been partially filled through M&E funding provided by the Bureau. The PI ANT tool has been developed to provide the ability for quality assuring (validating/modifying) data managed within the Data Historian. The Water Corporation have also targeted 25 priority water storage sites across Western Australia and are implementing the developed PI ANT data cleansing tool to enable audit and validation of water storage data prior to publishing on the Bureau's website.

4.1.2.4.4 DATA COLLECTION SYSTEMS

Integration between SAP, ODSS, PI

GAP 52: Data management - lack of integration between corporate databases. Strategy: This gap has been partially filled through M&E funding provided by the Bureau. The Water Corporation has developed a system which integrates between their PI, ODSS and SAP databases prior to delivery to the Bureau. Further work is required to automate site selection and to deal with data quality issues.

4.1.2.4.5 DATA TRANSFER

Ability to transfer data between agencies

GAP 53: Data management - lack of data transfer mechanisms between agencies. Strategy: This gap has been partially filled through the M&E funded project mentioned at Gap 52 above.

4.1.3 Department of Agriculture and Food WA

It is considered that improvements in the next five years could consist of telemetering weather stations where there is no 3G network e.g. Kimberley, Desert Regions, near Cascade & Eucla (in south-east WA); sites where field personnel visit only annually and where no other agencies are collecting weather station data.

GAP 54: Insufficient data for those weather stations with no 3G network and where field staff only visit annually. Strategy: telemetering these stations.

The Eco Hydrology Research workgroup have no telemetered sites, two sites are currently being trialled with telemetry. Data is collected manually (via loggers and downloaded quarterly).

GAP 55: Eco Hydrology Research sites have no telemetry.

Network gaps are many however this work is research driven and without research funding and money to continue to maintain sites, extending the network is not presently feasible.

GAP 56: Many network gaps in semi- arid and rangeland areas

Without on-going base monitoring operational funding, DAFWA's current data collection activities will reduce (even cease) for most surface water and ground water sites. Alternative funding mechanisms and collaborative agreements with other government agencies are being actively pursued to ensure long term viability of the resource condition network. However the network's role is primarily for research to understand changing hydrology under dynamic climatic conditions and the impact that land use changes have on hydrological function. The network is not used for water resource evaluation or as a flood warning system but could be incorporated into a state-wide or national network to provide spot coverage in areas with limited data or instrumentation.

GAP 57: Risk that lack of base monitoring funding will reduce (even cease) monitoring of most surface and groundwater sites. Strategy: a) Pursue alternative funding and collaborative agreements b) The network could be incorporated into a statewide or national network to provide spot coverage in areas with limited data or instrumentation.

Significant manual work is required to quality assure and package water information data. To address the requirements of the Water Regulations 2008 an investment in developing a more robust data export and exchange capability is needed.

GAP 58: Lack of resources to quality assure water information data

GAP 59: A robust data import-export and exchange capability is needed for non-standard datasets (including water quality and metadata). Strategy : One project is underway to consolidate bore metadata and water quality information from individual databases into Hydstra. A second project will provide some level of quality assurance as data is imported. Both projects have been funded by the Bureau's M&E scheme (2010/11).

4.1.4 Department of Environment and Conservation

One of DEC's key gaps is hydrological expertise. This reduces the capacity for data collection quality assurance (often being undertaken by staff without a strong background in hydrology) and meeting best practice standards. DEC is developing internal expertise in this area but progress is slow.

GAP 60: Hydrological expertise. Strategy : The Bureau's M&E funding programme has enabled installation of HYDSTRA for consolidation of data and standards, along with some training across the regions in its use. Through the established WAWI Group, DEC and DAFWA have standardised on most hydrological codes greatly simplifying sharing of data. Further work is required.

Many of the areas being monitored need to have more monitoring and more rigorous standards applied. However with existing resources this is impracticable.

GAP 61: Lack of monitoring and standards.

One key knowledge gap which impacts significantly on DEC's ability to complete its functions is the current state of Ecological Water Requirement (EWR) information in Western Australia. Many hydrological systems have little or no information about EWR's, hence managing or predicting impacts from development and changing land/water use can be very difficult. Another knowledge gap is a better understanding of water movement in semi arid environments and the conversion of water level to water volume information for areas in broad braided valley floor systems typical in the Wheatbelt. Very little rating information exists for these types of systems.

GAP 62: Knowledge gaps in EWR information, water movement in semi arid environments and rating information for those systems typical in the Wheatbelt.

Other gaps exist but most are beyond the scope of this document.

4.2 Other Agencies

4.2.1 AQWEST (Bunbury Water Board)

AQWEST is continuously monitoring opportunities to expand its distribution area. Expansion and development depends heavily on changes to current government legislation

In line with AQWEST's drive for sustainability of the resource and recent recommendations provided by the Department of Water (Bunbury Water Reserve drinking water source protection plan), significant capital works programs have been carried out in recent financial years, these include:

- Construction of the new City Waterlink transfer main (and pump station)
- Exploration and construction of a new production bore in Glen Iris
- Design of a Pump station and Storage facility (Glen Iris)
- Design of new a Water Treatment Plant (Glen Iris)
- Scheduled decommissioning of water treatment plants and bores along Bunbury's coast (unconfined aquifer).
- Water mains installations, upgrades and/or augmentations as identified.

The projects outlined above have been designed to secure future water source requirements and to also minimise saltwater intrusion through long term continuous use of coastal bores. It is understood that the current monitoring and data capture network satisfies most existing needs, however will require expansion as the system develops.

4.2.1.1 Gap Analyses and Strategy for Improving Monitoring of Information about Urban Water Management:

Reporting from AQWEST's existing SCADA system is subject to continuous improvement. Data can sometimes be lost during power outages. AQWEST is currently completing the first major upgrade of this system in ten (10) years, which once

4.2.2 Gascoyne Water Co-operative Ltd

Gascoyne Water have stated that their current monitoring network does generally meet present demands but may not in five years time as population and water demand increases. They would recommend an upgrade to the functionality of their telemetry and data acquisition system at that time.

4.2.3 Harvey Water

Piping to replace 60% of the open channel supply network in the HWIA has been completed, along with installation of related infrastructure and instrumentation.

Potential still exists for improvement in the following areas:

- Some small lengths of open channel could be completed in Harvey and Waroona Irrigation Districts.
- The whole of the Collie River Irrigation District needs to be piped.
- The measurement and transmission of data from meters could be upgraded to provide real time information by radio link to the central database for many supply points.
- Upgrade of database to achieve reliable and more efficient delivery of data required for reports in a simple and efficient way.
- Automation of data export routines to satisfy ongoing commitments to the Water Regulations, thereby eliminating much of the manual reporting effort, including adopting WDTF.
- An external audit of the calibration and accuracy of selected field instruments and flow meters, to complement existing QA/QC procedures.

The Collie River Irrigation District still exists as an open channel system. A major review has been undertaken to upgrade, similar to the Harvey pipe network. This was at the invitation of DEWHA and significantly funded by them under the Irrigation System Modernisation Program. There has been no real advice given by DEWHA on any process or timetable for considering or approving funding although Harvey Water is hopeful this may occur around the middle of 2010.

The potential for long term water savings in this project is 22 GL of which 50% must go to the Commonwealth Environmental Water Holder. The project construction is expected to run for 3 to 5 years, with funding provided on an 80:20 split of the project cost of \$165 million.

Allied to this Collie project is another project in the Upper Collie River Basin which has the objective of reducing salinity of the irrigation water in the Wellington dam thereby making the Collie piping project a more logical and viable proposition.

GAP 63: Incomplete channel in Harvey and Waroona Irrigation districts
GAP 64: Collie River Irrigation District is still an open channel system. Strategy: Collie River irrigation district needs to be piped
GAP 65: Many supply points could be upgraded to provide real time information. Strategy: radio link to central database
GAP 66: Reliability and efficiency of data delivery for reporting. Strategy: Upgrade of database

GAP 67: Efficiency in Water Regulations data delivery. Strategy: Automating data export routines and adopting WDTF

GAP 68: QA/QC of some field instruments and flow meters. Strategy: external audit of the calibration and accuracy of selected field instruments and flow meters.

4.2.3.1 Meteorological Information

The Bureau's Modernisation and Extension funding has been utilised to upgrade the three automatic weather stations located at Waroona, Harvey and Dardanup.

Data is now available live via telemetry. It is logged and stored on site as a backup and is available via both Harvey Water's website and that managed by the Department of Agriculture and Food WA.

DAFWA operate and maintain the weather stations in return for an annual fee paid by Harvey Water.

GAP 69: Ageing automatic weather stations. Strategy: This gap no longer exists due to provision of M&E funding by the Bureau of Meteorology.

4.2.3.2 Water Use information

Harvey Water consider there are no major gaps really except they want to move towards more real time measurement of water use by customers, probably by the use of radio links. Obviously Dethridge Wheels are a pretty crude meter compared to modern systems. There is some concern with the reliability of the system used by Water Corporation to measure and provide water volumes released from the dams.

4.2.3.3 Information about Rights, Allocations and Trades

No perceived gaps – information is real time and documented as it comes in over the front counter.

4.2.4 Ord Irrigation Co-operative Ltd

4.2.4.1 Water Balance

The Surface water drainage system consists of six Real-time Gauging Stations collecting, processing and automatically delivering data to the BOM in WDTF format. For a complete water balance, there are three additional Drains that discharge water back into the Watercourse that are not yet monitored. The D3, D6 and Packsaddle drains account for 18% of unmonitored land drainage.

GAP 70: Incomplete water balance, no monitoring on three drains. Strategy: Real time gauging stations on these three drains.

4.2.4.2 Groundwater

Groundwater water level and EC measurements are performed manually twice per year, many bores used to have piezometer dataloggers that would record continuous level data that would be unloaded manually by the Dept of Water. Over the years the 50 loggers that covered the bore network has declined to less than 30. Problems with manually unloading data loggers twice per year includes; loss of data from battery failures between visits, damage caused by lightning during the wet season, damage to bores and equipment during seasonal fires, and damage caused by agricultural implements and development in the area.

Improvements to the bore network require the installation of a real-time monitoring system to interface with the OIC's existing real-time surface water management system. Upgrading the 20 damaged loggers with robust pedestal housings to protect the bore casing, and installation of new water level and EC sensors interfaced to the Ord Irrigation SCADA system will ensure continuous measurements are better maintained and reduce downtime with alarms being sent to relevant support personnel when a bore parameter is outside acceptable values.

GAP 71: Data gaps due to 20 damaged data loggers. Strategy: Installation of real time monitoring system, housing upgrades and installation of new water level and EC sensors

4.2.4.3 Meteorological

Ord Irrigation utilise local meteorological data from the Kununurra Airport or the Dept of Agriculture Research Institute. The coverage is not adequate, and due to the vast irrigation area many farmers rely on their own weather stations or manual read instrumentation to determine farm management information. The installation of two weather stations (Packsaddle and Ivanhoe North) to better cover the irrigation area is being considered.

The weather stations should monitor wind speed and direction, solar radiation, rainfall, air temperature and relative humidity; and should be located in the two areas (Packsaddle Operating area and Ivanhoe North Operating area).

The sites to be connected to the Ord Irrigation SCADA system will allow easy transfer of information to the BOM. As well as interfaced with the Ord Irrigation Web portal will mean that local farmers and business will be able to easily access the information. SMS facilities are also available to send farmers information to better manage their watering routines.

GAP 72: Inadequate coverage of weather stations. Strategy: installation of two weather stations (Packsaddle Operating area and Ivanhoe North Operating area).

4.2.4.4 Telemetry

Currently the OIC has a single telemetry tower, which provides reliable coverage of the Packsaddle Plain but only half of the Ivanhoe Plain. However, in order to achieve total irrigation area coverage, and therefore meaningful water balance data, a new communications repeater is required at the northern end of the irrigation area. A major benefit of a new repeater will be the greatly improved signal strength that will, for the first time, enable all data to be automatically obtained and transferred to the OIC base station for processing and relay to the Bureau.

When constructed the intention is for the proposed tower to be made available to other groups with obligatory water reporting obligations. Expansion of the telemetered network is a high priority.

GAP 73: Meaningful water balance data. Strategy: New communications repeating/telemetry system.

4.2.4.5 Water Use information

Water use is measured through a number of Dethridge wheel emplacements and automated ATS 4747 meter outlet emplacements.

All meter readings, client entitlements, client contact details and billing details are entered into an Irrigation Management System (IMS). Goulburn Murray Water and Rubicon Systems (IMS supplier) have been building an automated WDTF format extraction and delivery tool. Once complete Ord Irrigation will require the tool and an Oracle database upgrade to meet their reporting obligations.

GAP 74: Water regulations data delivery capacity. Strategy: acquire WDTF extraction and delivery tool. This project has been funded through the Bureau's M&E scheme and is expected to be completed by June 2011.

4.2.4.6 Information about rights, allocations and trades

Current information about rights, allocations and trades are all stored through other service providers - no gaps currently exist. Information that will be provided to BOM in terms of allocations is covered above in the IMS data extraction and delivery tool for water use information.

4.2.5 Forest Products Commission

FPC's monitoring network is still in its infancy, but expanding. Automated data collection and delivery is consistent with the aims of the Water Regulations. Planned installation of 43 groundwater piezometers with automated water pressure sensing and logging equipment will complement automated weather station and stream discharge monitoring instruments to acquire data to study the relationship between farm forestry plantings and local hydrology across four farm properties. These are in the Swan/Avon, Frankland and Gordon River catchments. The intention to expand into water quality sampling will complement what little sampling is presently undertaken by other agencies.

5 Section C2 - Reporting of gaps addressed through M&E investment

Since 2007/08, M&E funding has been provided to the four major Western Australian water agencies, the Water Corporation, Department of Water, Department of Agriculture and Food and the Department of Environment and Conservation. Three of the smaller agencies have also received specific financial support. These are: Forest Products Commission, Harvey Water and Ord Irrigation Co-operative.

Funded projects have been many and varied. The following section reports on the benefits of M&E investment with the objective being to show how specific gaps have been addressed and 'closed' (or expected to be closed) through the completion of M&E projects, and the extent to which this has occurred in each case. The report will also attempt to identify outstanding gaps and issues.

Section C2 will:

- Review the extent to which network and system gaps have been addressed through M&E investment.
- Highlight areas where further investment is required to address identified gaps.
- Provide the Bureau with another means of demonstrating the value of the M&E program, consistent across jurisdictions.
- Link M&E funded projects undertaken in Rounds 1, 2 and 3, and also those projects currently being undertaken in Round 4, with gaps identified in the 2010 SWIMP;
- Depict, for each gap, the level to which it has been addressed from an agency and/or whole of State/Territory perspective.

5.1 Grouping of major gaps

A total of 74 individual gaps have been identified within the SWIMP document. As is described in more detail in Section D, these gaps have been broadly grouped for simplicity. Each of these gap groups have then been aligned with the primary water resource management drivers in W.A. and then prioritised by the Western Australian Water Information (WAWI) working group (*Group a through Group m, Table 18 below*).

Table 18 - Grouping of major Western Australian gaps - listed in order of importance as identified by the Western Australian Water Information working group.

Group a	Tools (Technologies, e.g. pH meters, data loggers, modelling tools, etc)
Group b	Surface water / Groundwater interaction
Group c	Environmental water requirements
Group d	Site data/data management and transfer
Group e	Insufficient temporal density - Specifically Water Use Sites
Group f	Insufficient spatial density - Specifically Water Use Sites
Group g	Insufficient temporal density - Other Sites
Group h	Insufficient spatial density - Other Sites
Group i	Telemetry
Group j	ASS/PASS/Podzolic soils
Group k	Arid zone hydrology
Group l	Staff
Group m	Expertise

M&E funds invested to date across Western Australia are presented at Figure 18 - Gap vs Amount of M&E Funding Invested

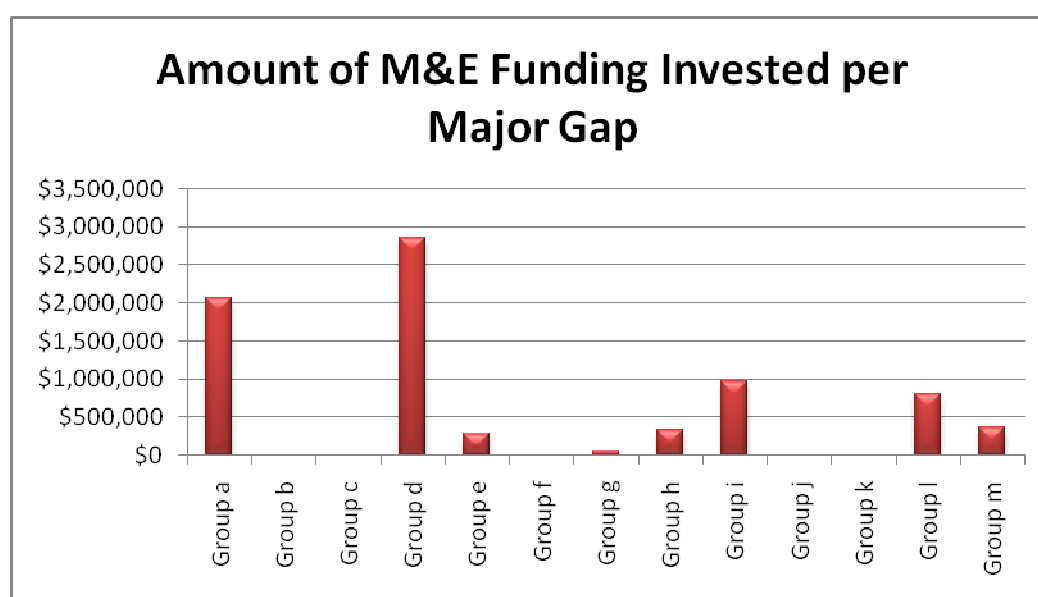


Figure 18 - Gap vs Amount of M&E Funding Invested

Clearly Group “d” has attracted the most funding over the 4 year term, with \$2.8M utilised for collation of site data, related data management and transfer of information to the Bureau.

Group “a” is next with \$2.1M used for purchase of new tools, technologies and instrumentation.

Group “i” follows with purchase of equipment aimed at provision of modern telemetry systems thereby expediting the availability of data to all concerned.

Group “l” covers the funding made available by the Bureau for co-ordination of works across the WA jurisdiction by their Strategic Water Information Co-ordinators.

The Bureau defined ten specific themes for investment as follows:

	Theme	Expenditure Rounds 1 - 4
1	Improving the accuracy of existing water storage measurement, stream flow, groundwater, meteorological, and water quality networks.	\$ 1.94M
2	Installation of telemetry.	\$ 0.81M
3	Extending the coverage of the monitoring network to address critical information gaps.	\$ 0.43M
4	Improving water data (and metadata) management procedures.	\$ 2.23M
5	Recovery or rescue of water information, including metadata.	\$ 0.49M
6	Improving the Australian Hydrologic Geospatial Fabric's (AHGF) national surface water foundation data set.	\$ 0.71M
7	Improving the Australian Hydrologic Geospatial Fabric's (AHGF) national foundation groundwater data set.	\$ 0.06M
8	Participating in the cooperative planning and production of the National Water Account (NWA).	\$ 0.42M
9	Engagement of Strategic Water Information Coordinators.	\$ 0.62M
10	Development and application of best practice guides or standards for the collection, monitoring, measurement and storage of water information and or metadata.	\$ -

Total expenditure across Western Australia for M&E rounds 1 to 4 is presented graphically in Figure 19.

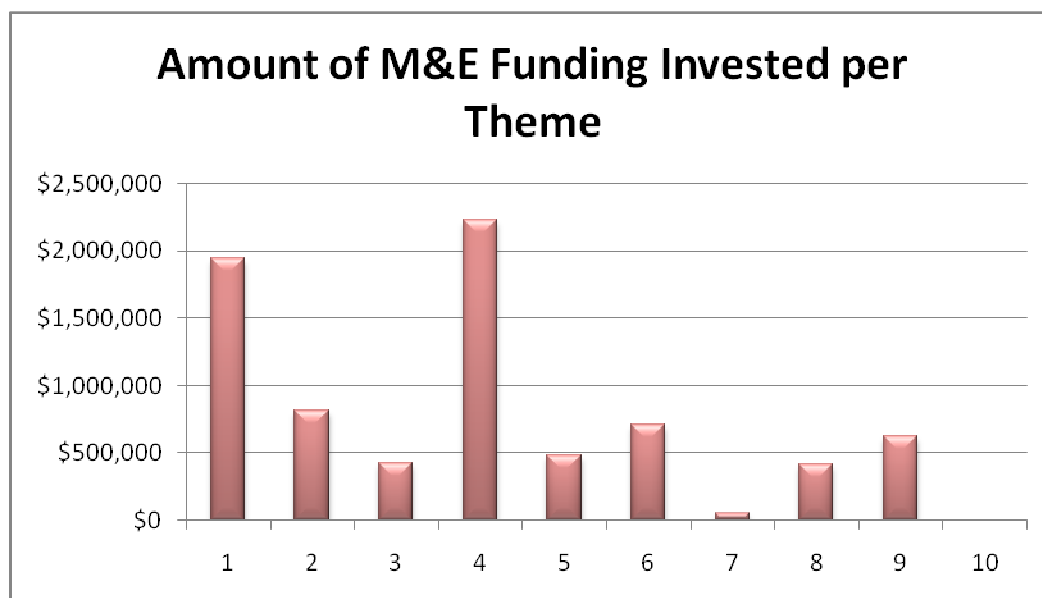


Figure 19 - Theme vs Amount of M&E Funding Invested

All but Theme 10 have received investment support across Western Australia, with Themes “4” and “1” clearly attracting the most funding.

5.2 Success with closure of gaps grouped by agency

Of Western Australia’s 16 named agencies, just 6 have sought M&E funding. This is predominantly because a further 6 (of the remaining 10 agencies) deliver their datasets to the Department of Water. i.e. The Department of Water will deliver water information to the Bureau on their behalf.

Referring to Table 19, clearly the Department of Water (DoW) has embarked on the majority of projects to fill specified gaps.

Of these:

- 33 have had their gap 100% filled,
 - 9 are 75% filled,
 - and 2 are considered 50% complete
- A further 10 are considered less than 50% complete

The 33 filled gaps range from purchase of stream gauging, data logging and telemetry equipment (distributed across WA), re-instatement of monitoring sites that had been closed due to budget shortfalls and streamlining of data validation processes. Also included were enhancement of hydrogeological, reservoir and river network spatial datasets, co-ordination of Water Regulation activities across all agencies and provision of support to the National Water Account.

Nine gaps that have been 75% filled include expansion of the groundwater investigations network, enhancements to the Department’s water licensing and reporting databases, expansion of the flood gauging capability within the Kimberley Region and removal of a significant portion of the unvalidated time series data backlog.

The remaining 12 gaps relate to upgrade of telemetry systems to Internet Protocol (IP), audit and upgrade of key groundwater metadata, further expansion of continuous groundwater measurement, improvements to the capture of water metering data, and further use of LIDAR in development and understanding of large rivers in a flood situation.

These gaps will require further work.

The Water Corporation has reported 100% completion of their communications assessment gap by defining communication options for gathering data from selected remote sites.

Two gaps related to development of a data cleansing tool and transfer from their PI historian database has been 75% filled.

The project for validation of location co-ordinates for sites nominated within the Water Regulations has been 50% completed.

Installation of SCADA/Telemetry at selected dam and storage sites has been undertaken through provision of M&E funding. This project is considered to be <50% complete.

The Department of Agriculture and Food report 100% completion of their Agbores groundwater database upgrade project to enable direct delivery of groundwater status data to the Bureau.

Their development of a Hydstra import tool to consolidate water quality and bore site metadata from MS Excel spreadsheets and MS Access databases is now 75% complete. Similarly, provision of quality assurance to selected Surface and Groundwater Databases is nearing completion.

Validation of bore sites and formalising landholder data agreements is partially complete and requires further work.

The Department of Environment and Conservation received M&E funding for development and finalisation of a centralised DEC database for data capture and ongoing historical data collation, geared primarily to efficiency gains and subsequent data delivery to the Bureau. The project is considered to be between 50% and 75% complete.

Ord Irrigation has been successful in M&E funding bids for two projects related to upgrade of their Irrigation Management System (IMS) and production of a WDTF automated export tool. Both projects are 100% complete and fully operational.

Harvey Water have managed to 75% fill the gap caused by ageing instrumentation at their remote weather stations. Instrumentation has been upgraded and sites are now regularly serviced and maintained. Weather data is readily accessible by irrigators and the community on-line.

Forest Products Commission has reported 100% completion of their three M&E funded projects, as follows:

- Installation of four streamflow monitoring sites
- Development of Data Management Tools and Protocols
- Instrumentation of four catchment water balance monitoring sites with automatic ground water level sensors and loggers.

Section C2 – Reporting of gaps addressed through M&E investment

Person category	organisation name	Number of gaps addressed through M&E funding																																															
		Number of gaps, 100% addressed															Number of gaps, 75% addressed										Number of gaps, 50% addressed										Number of gaps, <50% addressed												
		1	2	3	4	5	6	7	8	9	33	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	10			
F	AQWEST (Bunbury Water Board)																																																
B,H	Department of Agriculture and Food																																																
B,D	Department of Environment and Conservation																																																
B	Department of Housing																																																
A,H	Department of Water																																																
B	Forest Products Commission																																																
E	Gascoyne Water Co-operative Ltd																																																
E	Harvey Water																																																
G	Northern Agricultural Catchments Council																																																
E	Ord Irrigation Co-operative Ltd																																																
G	Perth Region NRM																																																
G	South Coast Natural Resources Management Inc.																																																
G	South West Catchments Council																																																
B	Swan River Trust																																																
D,F,H	Water Corporation																																																
G	Wheatbelt NRM Inc																																																

Table 19 - For each named organisation, this table shows how many gaps have been addressed through M&E funding and to what extent.

5.3 Success with closure of gaps grouped by funding theme

Table 20 - For each gap, the following suite of tables (Themes 1 – 10) show how many M&E projects have been funded and to what extent the gap has been closed for the organisation.

Note that Gap ref "0" refers to projects undertaken in earlier M&E funding rounds prior to formal definition of statewide gaps.

Theme 1. Improving the accuracy of existing water storage measurement, stream flow, groundwater, meteorological, and water quality networks																																																							
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																																			
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed													Number of projects which part addressed gap for the funded organisation(s), 75% closed													Number of projects which part addressed gap for the funded organisation(s), 50% closed													Number of projects which part addressed gap for the funded organisation(s), <50% closed												
				1	2	3	4	5	6	7	8	9	13	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#		
69	Ageing automatic weather stations	1	1																																																				
47	Insufficient groundwater monitoring	0	1																																																				
44	Lack of instrumentation or communications - groundwater monitoring sites	0	1																																																				
42	Lack of instrumentation or communications - dams/storages	1	1																																																				
27	Groundwater level monitoring technologies are limited.	1	1																																																				
19	Swan Region water level measurement frequency is inadequate.	1	1																																																				
17	Flow rating data at priority sites	2	3																																																				
12	Kimberley Region stream gauging stations nil or cost prohibitive telemetry.	1	1																																																				
11	Pilbara Region stream gauging stations nil or cost prohibitive telemetry.	1	1																																																				
"0"	Projects not directly linked to a 2010 SWIMP Gap	15	33																																																				

Sub-table for Theme 1

Section C2 – Reporting of gaps addressed through M&E investment

Projects with 100% completion include provision of instrumentation to selected dam storages (Water Corporation) and to a Swan Region groundwater network. These relate directly to Gaps 42 and 19. Another 15 funded projects were undertaken prior to definition of the SWIMP gaps (Ref Gap “0” above.)

Theme 2. Installation of telemetry.																																										
		Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																						
Gap ref. #	Gap			Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed	Number of projects which part addressed gap for the funded organisation(s), 75% closed									Number of projects which part addressed gap for the funded organisation(s), 50% closed									Number of projects which p addressed gap for the funde organisation(s), <50% close																			
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9
8 - 16	Statewide stream gauging stations: nil or cost prohibitive telemetry in place.	1	1																																							
42	Lack of instrumentation or communications - dams/storages	1	1																																							
73(i)	Meaningful water balance data (Round 2 bid - Ord Irrigation)	0	1																																							
73(ii)	Meaningful water balance data (Round 4 bid - Ord Irrigation)	0	1																																							
71	Data gaps due to 20 damaged data loggers	0	1																																							
13	South Coast Region stream gauging stations nil or cost prohibitive telemetry.	1	1																																							
22	Mid West (Carnarvon) Region groundwater measurements are not collected or not stored in the Water Information (WIN) database.	1	1																																							
55(i)	Eco Hydrology sites have no telemetry (Round 2 Bid WA_DAFWA_2.2.1)	0	1																																							
55(ii)	Eco Hydrology sites have no telemetry (Round 2 Bid WA_DAFWA_2.2.2)	0	1																																							
9	Flood Warning stream gauging stations without ERRTS telemetry.	0	1																																							

Sub-table for Theme 2

Gaps 8 – 16 refer to the statewide network of DoW stream gauging stations. Once 2010/11 is complete, just less than half of the regional network will be telemetered using current technology.

Section C2 – Reporting of gaps addressed through M&E investment

Gap 42 refers to the required upgrade to dam/storage sites – predominantly instrumentation still required by the Water Corporation.

Gap references 13 and 22 have been funded and completed.

Theme 3. Extending the coverage of the monitoring network to address critical information gaps.																																															
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																											
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed										Number of projects which part addressed gap for the funded organisation(s), 75% closed										Number of projects which part addressed gap for the funded organisation(s), 50% closed										Number of projects which part addressed gap for the funded organisation(s), <50% closed													
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#				
70	Incomplete water balance, no monitoring on three drains	0	1																																												
1	South Coast Region Surface Water Network	1	1																																												
4	Swan Avon Region Surface Water Network	0	1																																												
61	Lack of monitoring and standards.	0	1																																												
2	South West Region Surface Water Network	0	1																																												
4	Swan Avon Region Surface Water Network	1	1																																												
4	Swan Avon Region Surface Water Network	1	1																																												
"0"	Projects not directly linked to a 2010 SWIMP Gap	4	10																																												

Sub-table for Theme 3

Items presented as 100% complete reflect smaller individual projects within each Department of Water region, as opposed to the entire monitoring network. The department is presently undergoing a major review of its purpose and structure. Hence detail above may require re-assessment at a later date.

Section C2 – Reporting of gaps addressed through M&E investment

Theme 4. Improving water data (and metadata) management procedures.																																													
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																									
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed										Number of projects which part addressed gap for the funded organisation(s), 75% closed										Number of projects which part addressed gap for the funded organisation(s), 50% closed										Number of projects which part addressed gap for the funded organisation(s), <50% closed											
				1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10		
28	Significant backlogs in processing of Hydstra surface water archive data and in the number of ratings and gaugings taken.	3	3																																										
30	Insufficient site metadata collected and stored to support AWRIS.	1	1																																										
32	Unmatched data in the WIN and WRL systems to fully support the national water account.	1	1																																										
34	Reporting from WRL is very inefficient.	1	1																																										
35	DWAID increasingly difficult to maintain and develop.	1	1																																										
39	Gap in the number of meters and frequency of readings	1	1																																										
40	A large percentage of metering data is not stored electronically	2	2																																										
51	Data management - data of unknown quality in corporate and non-corporate databases	2	2																																										
52	Data management - lack of integration between corporate databases	1	2																																										
53	Data management - lack of data transfer mechanisms between agencies	0	1																																										
57	Risk that lack of base monitoring funding will reduce (even cease) monitoring of most surface and groundwater sites.	1	1																																										
59	A robust data import-export and exchange capability is needed for non standard datasets (includes water quality and metadata).	1	1																																										
60	Hydrological expertise.	2	2																																										
67	Efficiency in water Regulations data delivery.	0	1																																										
74	Water regulations data delivery capacity	1	1																																										
"0"	Projects not directly linked to a 2010 SWIMP Gap	3	4																																										

Sub-table for Theme 4

The significant number of gaps and funded projects directly related to Theme 4 re-enforce the importance of establishment and maintenance of robust and reliable data management systems within the water industry. Sub-Table for Theme 4 above clearly demonstrates the high degree of success across WA in improving these data management systems across agencies, with 6 reaching 100% completion and 10 reaching 75% completion.

Section C2 – Reporting of gaps addressed through M&E investment

Theme 5. Recovery or rescue of water information, including metadata.																																													
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																									
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed										Number of projects which part addressed gap for the funded organisation(s), 75% closed										Number of projects which part addressed gap for the funded organisation(s), 50% closed										Number of projects which part addressed gap for the funded organisation(s), <50% closed											
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#		
59	A robust data import-export and exchange capability is needed for non standard datasets (includes water quality and metadata).	1	1																																										
30	Insufficient site metadata collected and stored to support AWRIS.	1	2																																										
29	Backlog of time series data form 750 groundwater sites with potential for significantly increasing backlog.	1	1																																										
49	Data management - data managed in non-corporate databases	0	1																																										
28	Significant backlogs in processing of Hydstra surface water archive data and in the number of ratings and gaugings taken.	2	2																																										

Sub-table for Theme 5

M&E funding has contributed significantly to the rescue of specific water information across Western Australia. Some of this data may well otherwise have not become available for distribution. Partial closure of specific gaps is presented in Sub-Table for Theme 5 above.

Projects have included:

- Development of a Hydstra import tool to consolidate water quality and bore site metadata from Excel spreadsheets and MSAccess databases
- Incorporation of time series rest level data from ~300+ groundwater sites into DoW's long term Hydstra database
- Validation of a backlog of continuous river level data and discharge ratings from southern regions.

Section C2 – Reporting of gaps addressed through M&E investment

Theme 6. Improving the Australian Hydrologic Geospatial Fabric's (AHGF) national surface water foundation data set.																																														
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																										
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed										Number of projects which part addressed gap for the funded organisation(s), 75% closed										Number of projects which part addressed gap for the funded organisation(s), 50% closed										Number of projects which part addressed gap for the funded organisation(s), <50% closed												
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#			
17	Flow rating data at priority sites	1	1	■																																										
30	Insufficient site metadata collected and stored to support AWRIS.	1	1																																											
36	Unreliable surface hydrology data. Update dataset	1	2	■																																										
37	Incomplete farm dam dataset.	0	2																																											
"0"	Projects not directly linked to a 2010 SWIMP Gap	3	4	■	■																																									

Sub-table for Theme 6

Six funded projects contributed directly to improvement of the Australian Geospatial Fabric for surface water. Four of these reached gap closure through 100% completion, including improving the state's linear hydrography dataset (2 projects), improving the reservoirs geo-database and capture of specific surface geometry for 4 Pilbara catchments.

Theme 7. Improving the Australian Hydrologic Geospatial Fabric's (AHGF) national foundation groundwater data set.																																											
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																							
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed									Number of projects which part addressed gap for the funded organisation(s), 75% closed									Number of projects which part addressed gap for the funded organisation(s), 50% closed									Number of projects which part addressed gap for the funded organisation(s), <50% closed												
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#
30	Insufficient site metadata collected and stored to support AWRIS.	1	1	■																																							

Sub-table for Theme 7

One project was funded during Round 1 of the M&E Program to enable capture of hydrogeological metadata from selected sites. This project was completed in its entirety.

Section C2 – Reporting of gaps addressed through M&E investment

Theme 8. Participating in the cooperative planning and production of the National Water Account (NWA).																																															
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																											
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed										Number of projects which part addressed gap for the funded organisation(s), 75% closed										Number of projects which part addressed gap for the funded organisation(s), 50% closed										Number of projects which part addressed gap for the funded organisation(s), <50% closed													
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#				
32	Unmatched data in the WIN and WRL systems to fully support the national water account.	1	1																																												
"0"	Projects not directly linked to a 2010 SWIMP Gap	2	2																																												

Sub-table for Theme 8

Data Transfer between DoW's WIN and WRL databases has been streamlined as a direct result of M&E funding. This will enhance the Department's ability to contribute to the National Water Account. At the same time, provision of funding has allowed a full-time resource to be allocated to the project.

Theme 9. Engagement of Strategic Water Information Coordinators.																																													
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																									
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed									Number of projects which part addressed gap for the funded organisation(s), 75% closed									Number of projects which part addressed gap for the funded organisation(s), 50% closed									Number of projects which part addressed gap for the funded organisation(s), <50% closed														
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#		
-	Provision of SWIC in Western Australia	4	4																																										

Sub-table for Theme 9

Section C2 – Reporting of gaps addressed through M&E investment

The role of the SWIC position has been successfully filled within Western Australia for each financial year.

Theme 10. Development and application of best practice guides or standards for the collection, monitoring, measurement and storage of water information and or metadata.																																												
Gap ref. #	Gap	Total Number of funded projects	Total number of project applications submitted	Number of M&E funded projects																																								
				Number of projects which fully addressed gap for the funded organisation(s), ie 100% closed										Number of projects which part addressed gap for the funded organisation(s), 75% closed										Number of projects which part addressed gap for the funded organisation(s), 50% closed										Number of projects which part addressed gap for the funded organisation(s), <50% closed										
				1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	1	2	3	4	5	6	7	8	9	#	
	Nil for Theme 10 from Western Australia																																											

Sub-table for Theme 10

No “Theme 10” projects have arisen from within Western Australia.

5.4 Gaps remaining

The \$7.7M in M&E funding that has been made available to Western Australian water agencies throughout 2007 – 2011 has contributed significantly to the ongoing availability of data to the Bureau through specific validation and auditing of datasets, engagement of improvements in technology and provision of resources to eliminate backlogs. However, such improvements will need to continue to ensure commitments to the Water Regulations are met by all agencies. Similarly, it is evident that in order for water data to be usable, its related metadata must be available and correct. More work is required across all agencies to achieve the standards dictated by the regulations.

The information below presents the gaps remaining across all WA agencies. These have been sorted by percent completion to date (of the “gap”) followed by level of importance, as defined by the Western Australian Water Information group.

Table 21 – Gaps that have reached 75% completion

Agency	Description	Gap No.	% Completion	Importance (a – m)
Department of Water	08-09 WA 6.1l - Equip sites to enable high flow discharge measurements for discharge ratings at selected long term Kimberley sites	-	75%	Group a
Department of Water	DOW NWI - Improved Remote Site Gauging Capacity - Kimberley	-	75%	Group a
Department of Agriculture and Food	4WA04.03 - Development of a Hydstra import tool to consolidate Water Quality and Bore Site Metadata from MS Excel spreadsheets and MS Access databases	GAP 59	75%	Group d
Department of Agriculture and Food	08-09 WA 3.1 - Surface and Groundwater Database Consolidation by providing quality assurance to the databases	GAP 59	75%	Group d
Department of Water	Improving the Rivers and Streams network geofabric dataset for WA	GAP 36	75%	Group d
Department of Water	08-09 WA 6.4b - Improving the River Networks and Streams Geo-database for Western	GAP 36	75%	Group d

Section C2 – Reporting of gaps addressed through M&E investment

	Australia in compliance with relevant ISO standards			
Department of Water	DOW NWI - WIN & WRL Discrete Data Transfer Streamlining	GAP 32	75%	Group d
Department of Water	DOW NWI - Backlog of Continuous River Level Data and Flow Ratings SCR	GAP 28	75%	Group d
Department of Water	DOW NWI - Backlog of Continuous River Level Data and Flow Ratings SAR	GAP 28	75%	Group d
Department of Water	09-10 WA 4.4 - Develop a Semi-automated Data Validation Process for Hydstra Files, Aimed at Vastly Improving the Timeliness of Data Availability and Eliminating Future Backlogs	GAP 28	75%	Group d
Department of Water	09-10 WA 4.27 - Enhancements to the Water Licensing and Water Information Network System to Improve Data Quality, Entry, Access and Retrieval of Water Metering Data	GAPs 34 35 39 40	75%	Group d
Water Corporation	08-09 WA 4.1 - Develop a data cleansing and annotation tool for improved data quality and reliability	GAP 51	75%	Group d
Water Corporation	08-09 WA 4.2 - Develop a system to transfer data from the PI data historian	GAP 52	75%	Group d
Department of Water	09-10 WA 4.7 - Establish Groundwater Investigations and Monitoring for Priority Groundwater Aquifers in the Albany/Denmark Areas	-	75%	Group e
Department of Environment and Conservation	4WA02.01 - Finalisation of DEC-wide database for ongoing data capture, historical data collation and centralisation of all data transfer - Stage 2	GAP 60	75%	Group m

Table 22 – Gaps that have reached 50% completion

Section C2 – Reporting of gaps addressed through M&E investment

Agency	Description	Gap No.	% Completion	Importance (a – m)
Department of Water	08-09 WA 6.4e - Capture of drainage data set for the Swan-Canning catchment	-	50%	Group d
Department of Water	4WA01.09 - Incorporation of Time Series Rest Level Data From ~600+ Groundwater Sites into DoW's Long Term Hydstra Database	GAP 29	50%	Group d
Water Corporation	09-10 WA 6.6 Plot missing Location coordinates in GIS and link to SAP	-	50%	Group d
Department of Agriculture and Food	4WA04.02 - The validation of bore sites and formalising landholder data agreements	GAP 57	50%	Group h

Table 23 – Gaps that have reached <50% completion

Agency	Description	Gap No.	% Completion	Importance (a – m)
Department of Water	08-09 WA 6.1f - Design for upgrade of the gauging station at Punrak Drain (614094) in the Peel-Harvey catchment monitoring network		<50%	Group a
Department of Water	09-10 WA 4.1 - Installation of Data Loggers in Gngara Mound	GAP 27	<50%	Group a
Department of Water	09-10 WA 4.6 - Spatial Data Capture Using Global Navigation Satellite System for Theoretical Rating Curve Development	GAP 17	<50%	Group a
Department of Water	DOW NWI - Salinity Management Spatial Data Capture & Presentation	GAP 30	<50%	Group d
Department of Water	DOW NWI - Water Metering Data Capture	GAP 40	<50%	Group d
Department of Water	DOW NWI - Surface Geometry Data Capture for Developing Flow Ratings	GAP 17	<50%	Group d
Department of Water	4WA01.05 - Collation of key groundwater	GAP	<50%	Group d

Section C2 – Reporting of gaps addressed through M&E investment

	metadata	30		
Department of Water	09-10 WA 4.24 - Groundwater Assessment Network - Bore Details Audit	GAP 30	<50%	Group d
Water Corporation	09-10 WA 6.2 - Implementation of the Data Cleansing and Annotation Tool for Improved Data Quality and Reliability	GAP 51	<50%	Group d
Department of Water	08-09 WA 6.3i - Provision and installation of 5 Neon satellite telemetry systems for Technology Centres at Kimberley and Pilbara Regions	GAPS 11 12	<50%	Group i
Department of Water	4WA01.02 - Replacement of existing dial-up telemetry systems with IP telemetry system	GAPs 8 9 10 11 12 13 14 15 16	<50%	Group i
Water Corporation	4WA06.04 - Installation of SCADA/Telemetry at dam and storage sites	GAP 42	<50%	Group i
Department of Environment and Conservation	09-10 WA 2.1 - Development of a Centralised DEC Database for Ongoing Data Capture and Historical Data Collation of a Substantial Proportion of Data Transfer	GAP 60	<50%	Group m

A further 21 issues have been identified by Western Australian agencies as having potential to contribute to improvement of the state's water resource data. These have not yet been awarded funding, hence little or no progress has been made.

Table 24 – Gaps that have had nil progress

Agency	Description	Gap No.	% Completion	Importance (a – m)
Water Corporation	Groundwater site data capture and instrumentation	GAPs 44 47	0%	Group a

Section C2 – Reporting of gaps addressed through M&E investment

Department of Water	Aerial Laser Surveying to capture river geometry at gauging stations used for flood and water resource assessment	GAP 17	0%	Group a
Ord Irrigation Co-operative Ltd	Communications Repeater Station in the northern Ivanhoe Plains district of the Ord River Irrigation Area	GAP 73	0%	Group d
Harvey Water	Development of an application to enable data transfer to BoM in WDTF	GAP 67	0%	Group d
Water Corporation	BoM XI Data Transfer Tool Enhancement	GAP 53	0%	Group d
Water Corporation	Modification to MCS and interface between SAP and ODSS to allow metadata collected in the field using MCS PDA to be stored in ODSS. Conduct field trials and programme to collect metadata.	GAP 52	0%	Group d
Water Corporation	Consolidation of dam and storage metadata into corporate systems	GAP 49	0%	Group d
Department of Water	Farm Dams capture for the South West division of the Western Australian hydrographic catchments	GAP 37	0%	Group d
Department of Water	Improving Farms dataset	GAP 37	0%	Group d
Department of Water	Busselton-Capel data capture	GAP 30	0%	Group d
Department of Water	Upgrading the Swan-Canning Flow Gauging Network: defining gauging station design parameters	GAP 4	0%	Group g
Department of Water	Instruments for March Rd & April Rd GSTNs	GAP 2	0%	Group g
Ord Irrigation Co-operative Ltd	Increase monitoring of drainage water return to the lower Ord River to enable a water balance for the Ord River Irrigation Area to be calculated.	GAP 70	0%	Group h
Department of Environment and	Upgrade 6 AWS, install 4 New	GAP	0%	Group h

Section C2 – Reporting of gaps addressed through M&E investment

Conservation		61		
Department of Water	Narembreen Gauging Stations	GAP	0%	Group h
Department of Water	Develop floodwarning telemetry plan	GAP 9	0%	Group i
Ord Irrigation Co-operative Ltd	Expand telemetry network for Ord Stage 2	GAP 73	0%	Group i
Ord Irrigation Co-operative Ltd	Upgrade to Groundwater Monitoring Network in the Ord River Irrigation Area	GAP 71	0%	Group i
Department of Agriculture and Food	Extension of surface water telemetry network to IP	GAP 55	0%	Group i
Department of Agriculture and Food	Addition of telemetry and logger upgrades at Lake Bryde, Marchagee, Upper Lort, Upper Young, Bandy Creek - Warden Catchment & Lake Toolibin Catchment	GAP 55	0%	Group i
Department of Agriculture and Food	40 TELS units for rural towns liquid assets	GAP 55	0%	Group i

6 Section D – Priorities for Investment

6.1 Whole of Jurisdiction

The Western Australian Water Information (WAWI) group (consisting of representatives from the Department of Water, Water Corporation, Department of Environment & Conservation and the Department of Agriculture and Food) reassessed the process, adopted by WA in 2009, for prioritising gaps in WA's water information and monitoring systems. The WAWI group then reviewed methodologies adopted by other jurisdictions and subsequently developed a new methodology to prioritise those gaps tabled in Section C of the SWIMP document.

The steps involved in this new method consisted of the WAWI group:

1. Evaluating and allocating a level of importance to each of the jurisdictional water resource management drivers (Table18)

The WAWI group discussed, and further developed, the Water Resource Management Drivers outlined in Section A of the SWIMP document. Consensus decision making was then employed to attribute a level of importance (out of ten) to each of the drivers.

Table 18: Jurisdictional Water Resource Management Drivers – Level of importance out of ten

Driver	Level of Importance
Water pricing and economic regulation	3/10
Rural and regional water planning and management	7/10
Metropolitan water planning and management	9/10
Water markets	1/10
Water supply and services	7/10
Drinking water management	8/10
Recycled water management	4/10
Environmental water management	8/10
Water Accounting	6/10
Episodic impact mitigation	6/10
Environmental water requirements development	8/10

1/10=low level of importance, 10/10=high level of importance

2. Grouping the gaps tabled in Section C

For simplicity, the seventy-four gaps tabled in Section C were broadly grouped into the thirteen generalised gaps listed in Table 19 below.

3. Aligning each gap group to three primary drivers (table19)

Each member of the WAWI group then, independently as an agency, aligned each of the thirteen gap groups with three primary water resource management drivers.

For example, a gap in Telemetry may align primarily with episodic impact mitigation, metropolitan water planning & management and water markets drivers.

4. Adding the values of the three primary drivers to arrive at a sum value and subsequent priority ranking for each gap group (Table19)

The level of importance values (out of ten as shown in Table 18), attributed to each of the three primary drivers aligned to the gap groups by agencies, were then added to give each gap a sum value. For example the gap in Telemetry may look like this:

Agency A: Driver 1 value **9**; Driver 2 value **8**; Driver 3 value **6** Sum value = 23

Agency B: Driver 1 value **6**; Driver 2 value **6**; Driver 3 value **8** Sum value = 20

Agency C: Driver 1 value **8**; Driver 2 value **9**; Driver 3 value **8** Sum value = 25

Agency D: Driver 1 value **6**; Driver 2 value **3**; Driver 3 value **8** Sum value = 17

Total sum value = 85

The total sum value was then converted into a ranking thus prioritising the grouped gaps.

Table 19: Grouped Gaps with Sum Values and Priority Rankings

Description of Grouped Gaps	BoM Theme	Sum value	Priority Ranking
Tools (Technologies, e.g. pH meters, data loggers, modelling tools, etc)	1	92	1
Surface water / Groundwater interaction	-	91	2
Environmental water requirements	-	90	3
Site data/data management and transfer	4,5	90	3
Insufficient temporal density - Specifically Water Use Sites	3	88	4
Insufficient spatial density - Specifically Water Use Sites	3	86	5
Insufficient temporal density - Other Sites	3	85	6
Insufficient spatial density - Other Sites	3	85	6
Telemetry	2	83	7
ASS/PASS/Podzolic soils		76	8
Arid zone hydrology	-	73	9
Staff	-	67	10
Expertise	-	67	10

1=high priority, 10=low priority

Gaps in tools (technologies such as loggers etc) and surface groundwater interaction information as examples, therefore, are rated as high jurisdictional priorities whereas gaps in staff, expertise and arid zone hydrology are rated as low jurisdictional priorities.

6.1.1 Summary Table of Jurisdictional Gaps

GAP NO.	AGENCY	GAP	STRATEGY
GAP 1 Group f, h	DoW	South Coast Region Surface Water Network	Reopen 7 stream gauging stations (under review)
GAP 2 Group f, h	DoW	South West Region Surface Water Network	Reopen 25 stream gauging stations (under review)
GAP 3 Group f, h	DoW	Kwinana Peel Region Surface Water Network	Reopen 2 stream gauging stations (under review)
GAP 4 Group f, h	DoW	Swan Avon Region Surface Water Network	Reopen 14 stream gauging stations (under review)
GAP 5 Group f, h	DoW	Mid West Region Surface Water Network	Reopen 5 stream gauging stations (under review)
GAP 6 Group f, h	DoW	Pilbara Region Surface Water Network	Reopen 15 stream gauging stations (under review)
GAP 7 Group f, h	DoW	Kimberley Region Surface Water Network	Reopen 11 stream gauging stations (under review)
GAP 8 Group i	DoW	Statewide stream gauging stations: nil or cost prohibitive “Dial Up” telemetry.	Upgrade to IP Telemetry
GAP 9 Group i	DoW	Flood Warning stream gauging stations without ERRTS telemetry.	Upgrade to IP Telemetry
GAP 10 Group i	DoW	Gascoyne Region stream gauging stations nil or cost prohibitive telemetry.	Upgrade to IP Telemetry
GAP 11 Group i	DoW	Pilbara Region stream gauging stations nil or cost prohibitive telemetry.	Upgrade to IP Telemetry
GAP 12 Group i	DoW	Kimberley Region stream gauging stations nil or cost prohibitive telemetry.	Upgrade to IP Telemetry
GAP 13 Group i	DoW	South Coast Region stream gauging stations nil or cost prohibitive telemetry.	Upgrade to IP Telemetry
GAP 14 Group i	DoW	Kwinana Peel Region stream gauging stations nil or cost prohibitive telemetry.	Upgrade to IP Telemetry
GAP 15 Group i	DoW	South West Region stream gauging stations nil or cost prohibitive telemetry.	Upgrade to IP Telemetry

Section D – Priorities for Investment

GAP NO.	AGENCY	GAP	STRATEGY
GAP 16 Group i	DoW	Swan Avon Region stream gauging stations nil or cost prohibitive telemetry.	Upgrade to IP Telemetry
GAP 17 Group a	DoW	Flow rating data at priority sites	Strategy: Light Detection and Ranging (Lidar) surveys
GAP 18 Group h	DoW	Swan Region saltwater intrusion inadequately monitored.	Requires additional monitoring bores
GAP 19 Group a	DoW	Swan Region groundwater level measurement frequency is inadequate.	Consideration for use of automated water level measurement
GAP 20 Group a	DoW	South West Region has a gap in groundwater data collection.	Consideration for use of automated water level measurement
GAP 21 Group e, g	DoW	Mid West (Geraldton) Region groundwater monitoring is inadequate for groundwater management purposes.	Implement identified monitoring program.
GAP 22 Group a COMPLETED 2010	DoW	Mid West (Carnarvon) Region groundwater measurements are not collected or not stored in the Water Information (WIN) database.	Equip additional bores with data loggers. Implement identified monitoring program.
GAP 23 Group e, g	DoW	North West Pilbara Region groundwater monitoring has been sporadic and the condition of monitoring bores is unknown.	Evaluation of monitoring bore condition and Implement identified monitoring program.
GAP 24 Group f, h	DoW	North West Pilbara Region monitoring bore network gaps.	Addition of potentially 84 bores to improve the network.
GAP 25 Group f, h	DoW	North West Kimberley Region groundwater monitoring is inadequate.	Implement identified monitoring program.
GAP 26 h	DoW	North West Kimberley Region has no recommended monitoring program outside of the main abstraction areas.	Comprehensive review and assessment of the need for additional monitoring.
GAP 27 Group a	DoW	Groundwater level monitoring technologies are limited.	Installation of groundwater data loggers.
GAP 28 Group d	DoW	Significant backlogs in processing of Hydstra surface water archive data and in the number of ratings and gaugings taken.	Productivity improvements through widespread implementation of IP telemetry, adjustments to operational programs and widespread implementation of semi auto data validation process with the inclusion of more complex hydrologic

Section D – Priorities for Investment

			parameters
GAP NO.	AGENCY	GAP	STRATEGY
GAP 29 Group d	DoW	Backlog of time series groundwater data	Process with semi auto data validation tool
GAP 30 Group d	DoW	Insufficient site metadata collected and stored to support AWRIS.	Collection and collation of disparate metadata and the electronic securing of at risk paper based metadata.
GAP 31 Group d	DoW	WIN system is now designated legacy system.	Source funding to develop a new system based on prototype module.
GAP 32 Group d	DoW	Unmatched data in the WIN and WRL systems to fully support the national water account.	Match priority sites as funding becomes available.
GAP 33 Group d	DoW	90% surface water sites are not surveyed to AHD.	Survey sites as funding becomes available.
GAP 34 Group d	DoW	Reporting from WRL is very inefficient.	WRL will be replaced by the Common Registry system when developed.
GAP 35 Group d	DoW	DWAID increasingly difficult to maintain and develop.	System replacement
GAP 36 Group d	DoW	Incomplete GIS datasets for surface hydrology. Incomplete or unreliable groundwater aquifer contours.	Finalise surface water dataset Update groundwater aquifer contour datasets
GAP 37 Group d	DoW	Incomplete farm dam GIS dataset.	Update dataset
GAP 38 Group d	DoW	Information systems gaps	Identified in DoW enterprise architecture review, Upgrades planned
GAP 39 Group a, e f	DoW	Gap in the number of meters and frequency of readings	
GAP 40 Group d	DoW	A large percentage of metering data is not stored electronically	
GAP 41	DoW	Outdated legislation	Legislative reform
GAP 42 Group a, i	Water Corporation	Lack of instrumentation or communications - dams/storages	Stage 1: Project WA 6.1 survey and produce options matrix. Stage 2: Installation

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GAP 43 Group a, i	Water Corporation	Lack of instrumentation or communications - surface water monitoring sites	
GAP 44 Group a, i	Water Corporation	Lack of instrumentation or communications - groundwater monitoring sites	
GAP NO.	AGENCY	GAP	STRATEGY
GAP 45 Group a, i	Water Corporation	Lack of instrumentation or communications - rainfall and climate monitoring sites	Data sharing between agencies and network expansion
GAP 46 Group a, i	Water Corporation	Lack of instrumentation or communications - water abstraction and extraction sites	Use of electronic meters
GAP 47 Group f	Water Corporation	Insufficient groundwater monitoring	Increased investment in monitoring
GAP 48 Group d	Water Corporation	Geofabric - surface water and groundwater sites not surveyed to AHD	Survey sites
GAP 49 Group d	Water Corporation	Data management - data managed in non-corporate databases	Capture data to SAP.
GAP 50 Group d	Water Corporation	Data management - meters not regularly calibrated and calibration data unavailable	
GAP 51 Group d	Water Corporation	Data management - data of unknown quality in corporate and non-corporate databases	Develop mechanisms for correcting erroneous data (e.g. bore levels in ODSS) and a data quality coding system
GAP 52 Group d	Water Corporation	Data management - lack of integration between corporate databases	
GAP 53 Group d	Water Corporation	Data management - lack of data transfer mechanisms between agencies	
GAP 54 Group i	DAFWA	Insufficient data for those weather stations with no 3G network and where field staff only visit annually.	Telemetry these stations.
GAP 55 Group i	DAFWA	Eco Hydrology sites have no telemetry	
GAP 56 Group h	DAFWA	Many network gaps in semi arid and rangeland areas.	
GAP 57 Group h	DAFWA	Risk that lack of base monitoring funding will reduce (even cease) monitoring of most surface and groundwater sites.	A) Pursue alternative funding and collaborative agreements B) The network could be incorporated into a state-wide or national network to provide spot coverage in areas with limited data or instrumentation.

Section D – Priorities for Investment

GAP NO.	AGENCY	GAP	STRATEGY
GAP 58 Group l	DAFWA	Lacks of resources to quality assure water information data.	
GAP 59 Group d	DAFWA	A robust data import-export and exchange capability is needed for non standard datasets (includes water quality and metadata).	
GAP 60 Group m	DEC	Hydrological expertise.	
GAP 61 Group f, m	DEC	Lack of monitoring and standards.	
GAP 62 Group c	DEC	Knowledge gaps in EWR information, water movement in semi arid environments and rating information for those systems typical in the Wheatbelt	
GAP 63 Group	Harvey Water	Incomplete channel in Harvey and Waroona Irrigation districts	
GAP 64 Group b	Harvey Water	Collie River Irrigation District is still an open channel system	Collie River irrigation district needs to be piped
GAP 65 Group i	Harvey Water	Many supply points could be upgraded to provide real time information	Radio link to central database
GAP 66 Group d	Harvey Water	Reliability and efficiency of data delivery for reporting	Upgrade of database
GAP 67 Group d	Harvey Water	Efficiency in water Regulations data delivery.	Automating data export routines and adopting WDTF
GAP 68 Group	Harvey Water	QA/QC of some field instruments and flow meters	External audit of the calibration and accuracy of selected field instruments and flow meters
GAP 69 Group a COMPLETED 2011	Harvey Water	Ageing automatic weather stations	Replacement of four weather stations
GAP 70 Group h, i	Ord River Irrigation	Incomplete water balance, no monitoring on three drains	Real time gauging stations on these three drains
GAP 71 Group a, i	Ord River Irrigation	Data gaps due to 20 damaged data loggers	Installation of real-time monitoring system, housing upgrades and installation of new water level and EC sensors

GAP 72 Group f, a	Ord River Irrigation	Inadequate coverage of weather stations	Installation of two weather stations (Packsaddle Operating area and Ivanhoe North Operating area).
GAP NO.	AGENCY	GAP	STRATEGY
GAP 73 Group d	Ord River Irrigation	Meaningful water balance data	New communications repeating/telemetry system.
GAP 74 Group d COMPLETED 2010	Ord River Irrigation	Water regulations data delivery capacity	Acquire WDTF extraction and delivery tool.

6.2 Major Agencies

6.2.1 Department of Water

The Department of Water's priorities for investment in information and monitoring for the 2011/2012 financial year have been determined by the Department of Water's Measurement and Monitoring Steering Committee. The Steering Committee is responsible for overseeing the general direction and progress of the Department's measurement function and is comprised of:

- Director Regional Management and Water Information (Chair)
- Director Water Resources Management
- Manager Regional Coordination
- Manager Water Information
- Principal Water Resources Officer
- Manager Allocation and Planning
- Regional Manager (representing all regions)

DoW's priorities for monitoring and information investment for 2011/12 are:

- Coordination of Water Information – Hydstra, Metadata, Standards, Technical Working groups
- IP telemetry connection to priority existing non-telemetered sites..
- 3D visual modelling of aquifer systems
- Metadata collection of DoW licensed bore information
- Linking Farm Dams to Linear Hydrography
- WDTF upgrade
- Water Accounting

6.2.2 Water Corporation

6.2.2.1 Instrumentation and Communications for Monitoring Sites

Dam and storage sites

- Funding for infrastructure based on outcome of WA 6.1 – Survey communication options for gathering remote logging data.

Surface water and groundwater sites

- Assessment of instrumentation systems for the collection and remote download of continuous groundwater data.
- Telemetry on surface water sites
- Capture metadata for sites

Weather and rainfall sites

- Telemetry on weather stations and rainfall sites

Water abstraction, extraction and use monitoring sites

- Conversion of manually read meters to electronic meters.
- Calibration of existing meters.
- Replacement of obsolete equipment.

Groundwater level monitoring

- Assess groundwater monitoring requirements for the Corporation

Geofabric

- Spatial data – follow up on WA 6.6
- Elevations – survey where required (bores, storages etc.)
- Location and boundaries of dams and drains.

6.2.2.2 Data management

Consolidation

- Dam safety data to SAP
- Implement NGIS database for digital bore log data collected by Water Corporation

Quality

- How to collect data – extension of data standards to detail how (bores, other) data should be collected (as well as what)
- Data quality improvement – ODSS (bores, other)

- Data quality coding system

Data collection systems

- Integration between SAP, ODSS, PI

Data transfer

- Modifications to BoM XI data transfer application Upgrade to cater for changed BoM category and metadata requirements.
- Ability for agencies to transfer data via WDTF
-
- Update data transfer mechanism to automate list of sites based on data in SAP; PI; ODSS

6.2.3 Department of Agriculture and Food WA

- Upgrading the existing systems using telemetered technologies to ensure better coverage, real time access to data and reduce cost associated with manual monitoring systems.
- Finalise development of agreements with landholders to ensure that data collected on private land is made available to the public.
- Development of a water quality monitoring network as part of water resource assessment program and impact assessment of agricultural activities on runoff and water quality in coastal, pastoral and semi-arid regions.

6.2.4 Department of Environment and Conservation

Key priorities for investment are in order:

- Recruiting and developing more hydrological expertise.
- More monitoring (temporally, spatially and across more water quality parameters) in critical areas such as Ramsar wetlands and wetlands listed in [A Directory of Important Wetlands in Australia](#), Natural Diversity Recovery Catchments, national parks (particularly those with active mining in them) and urban areas with regard to nutrient discharge and eutrophication. This needs to be undertaken in tandem with the collection of biological information to improve our understanding of EWRs.
- Implementation of data collection standards, centralised data capture and coordination.
- Collection of more meteorological information consistent with the two points above.

Again other priorities exist but it is beyond the scope of this document to detail them all fully.

6.3 Other Agencies

6.3.1 AQWEST (Bunbury Water Board)

AQWEST is currently completing the first major upgrade of the SCADA system in ten (10) years, which involves the replacement of software and hardware at all remote sites, including telemetry.

- Once construction has commenced at the proposed Glen Iris Pump station / Storage facility and the proposed Glen Iris WTP, it is envisaged that the new SCADA system outlined above will be extended to these sites, to provide consistency across the system.

6.3.2 Gascoyne Water Co-operative Ltd

Should funding become available, Gascoyne Water's priorities for investment would include potential expansion of data logging (water rest level and salinity) with telemetry.

6.3.3 Harvey Water

- Collie River Irrigation District is an important project to both save water and provide for a major improvement in the efficiency of use to and on-farm leading to greater economic activity.
- An essential precursor to piping is the improvement in water quality in Wellington dam by means of a project to divert the saltiest water to prevent it entering the body of the dam. Harvey Water is working with Department of Water and other stakeholders on the implementation of this project and expects to take a financial stake in it because of its critical importance to our irrigators.
- Upgrade of HWIA database to achieve easier and more efficient extraction of information required in reports.
- Automation of data export routines to satisfy ongoing commitments to the Water Regulations, thereby eliminating much of the manual reporting effort.
- An audit of calibration and accuracy of selected field instruments and flow meters, to complement existing QA/QC procedures.

6.3.4 Ord Irrigation Co-operative Ltd

Should funding become available, Ord Irrigation priorities for investment will include:

- A new communications tower and associated hardware for the northern end of the irrigation area (Ivanhoe Plain). This can also serve the approved M2 region due for commissioning in 2011.
- Increase drainage water return monitoring to the lower Ord River to enable a water balance for the Ord River Irrigation Area to be calculated
- Upgrade of groundwater monitoring to improve data collection of 20 sites. Located throughout the irrigation area.

- New Weather Stations to better cover the irrigation area.

6.3.5 Forest Products Commission

- Improving reliability of instrumentation in-field and reducing labour requirements for data collection and instrument array maintenance are major priorities. Current piezometric water level dataloggers (Odyssey capacitance type) have unacceptably high failure rates mainly due to water ingress. While more recent models of the Odyssey are more reliable than earlier ones it is desirable to change instrumentation to fully sealed units with contactless data transfer (the Troll or Diver pressure membrane sensor type) with their expected lower failure rates, longer battery life, quicker field installation and easier data transfer. The Troll and Diver sensor units also minimise labour and maintenance costs as they require fewer field trips for data retrieval and maintenance. Further progression to remotely downloaded dataloggers (using mobile phone technology) is desirable but is currently too expensive to justify.
- Maintenance of existing borehole monitoring networks and streamflow gauging established by Western Australian government agencies including the Forest Products Commission, the Western Australian Department of Agriculture and the Department of Water in the medium rainfall zone of the south-west of Western Australia (roughly the area from the Great Southern Highway through Northam/Brookton/Wagin/Katanning/Cranbrook to the western and southern coasts) is highly desirable but generally not possible with current resources. Continued monitoring or re-activation of currently un-monitored assets in the vicinity of agroforestry plantations is highly desirable to inform discussions of the effectiveness of trees in controlling water tables.

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