The Auditor-General
Audit Report No.18 2013–14
Performance Audit

Administration of the Improving Water Information Program

Bureau of Meteorology

Australian National Audit Office

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Executive Director
Corporate Management Branch
Australian National Audit Office
19 National Circuit
BARTON ACT 2600

Or via email:
publications@anao.gov.au

Australian National
Audit Office

Canberra ACT
5 February 2014

Dear Mr President
Dear Madam Speaker

The Australian National Audit Office has undertaken an independent performance audit in the Bureau of Meteorology in accordance with the authority contained in the *Auditor-General Act 1997*. Pursuant to Senate Standing Order 166 relating to the presentation of documents when the Senate is not sitting, I present the report of this audit to the Parliament. The report is titled *Administration of the Improving Water Information Program*.

Following its presentation and receipt, the report will be placed on the Australian National Audit Office's website—http://www.anao.gov.au.

Yours sincerely

Ian McPhee
Auditor-General

The Honourable the President of the Senate
The Honourable the Speaker of the House of Representatives
Parliament House
Canberra ACT

AUDITING FOR AUSTRALIA

The Auditor-General is head of the Australian National Audit Office (ANAO). The ANAO assists the Auditor-General to carry out his duties under the *Auditor-General Act 1997* to undertake performance audits, financial statement audits and assurance reviews of Commonwealth public sector bodies and to provide independent reports and advice for the Parliament, the Australian Government and the community. The aim is to improve Commonwealth public sector administration and accountability.

For further information contact:
The Publications Manager
Australian National Audit Office
GPO Box 707
Canberra ACT 2601

Phone: **(02) 6203 7505**
Fax: **(02) 6203 7519**
Email: **publications@anao.gov.au**

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Audit Team
Jennifer Eddie
Mark Simpson

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Abbreviations

ANAO	Australian National Audit Office
AWAS	Australian Water Accounting Standard
AWIAC	Australian Water Information Advisory Council
AWRA	Australian Water Resources Assessments
AWRIS	Australian Water Resources Information System
Bureau	Bureau of Meteorology
CAWCR	Centre for Australian Weather and Climate Research
CGGs	Commonwealth Grant Guidelines
COAG	Council of Australian Governments
CRC	Cooperative Research Centre
CRM	Customer Relationship Management (system)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSV	Comma Separated Values
ETL	Extract Transform Load
FMA Act	*Financial Management and Accountability Act 1997*
FTE	Full-Time Equivalent
GDE	National Groundwater Dependent Ecosystem (Atlas)
ICT	Information and Communications Technology
IFD	Intensity-Frequency-Duration (rainfall)

IT	Information Technology
JRGWI	Jurisdictional Reference Group on Water Information
KPI	Key Performance Indicator
LoU	Letter of Understanding
M&E Program	Modernisation and Extension of Hydrologic Monitoring Systems Program
NWA	National Water Account
NWC	National Water Commission
NWI	National Water Initiative
PBS	Portfolio Budget Statements
PEC	Project Evaluation Committee
PIN	Project Identification Number
QA/QC	Quality Assurance/Quality Control
SQL	Structured Query Language
SWIC	Strategic Water Information Co-ordinator
SWIMP	Strategic Water Information Management Plan
WDTF	Water Data Transfer Format
WIRADA	Water Information Research and Development Alliance
WISB Forum	Water Information Standards Business Forum
WRON	Water Resources Observation Network
XML	Extensible Markup Language

Glossary

Australian Water Resources Information System (AWRIS)	The information technology system designed by the Bureau to receive, store and report the data under the Improving Water Information Program.
Data ingest	Data ingestion is the process of importing, processing and storing data within a database.
Data mart	A data mart is a simple form of a data warehouse that is focused on a single subject or functional area. Within the Bureau, each data mart tends to be focused on particular products or services, such as water storages.
Extensible Markup Language (XML)	An information technology markup language that defines a set of rules for encoding documents.
Interoperability	Capacity of software or hardware on different computers from different manufacturers to share data.
IT Architecture	IT Architecture describes the information technology design that includes: specifications, models and guidelines within a coherent information technology framework.
Structured Query Language	A special-purpose programming language designed for managing data held in a relational database.
Water balance	In hydrology, a water balance model can be used to describe the flow of water in and out of a system or the water at a particular point in time. It can include landscape moisture, run-off, surface water flows and groundwater.

Summary and Recommendations

Summary

Introduction

1. Water resource policies in Australia have historically been focused on promoting economic development and employment. In 1994, the Council of Australian Governments (COAG) established a water reform framework to address the degradation of water resources and improve efficiency and sustainability in the water industry. In June 2004, following continuing drought conditions, COAG endorsed the *National Water Initiative* (NWI), in which all governments indicated a commitment to a range of measures to increase the efficiency of Australia's water use.

2. By 2006, concerns about water security were being expressed at the highest levels of government, with Premiers, Chief Ministers and the then Prime Minister meeting to discuss emergency measures for water supply in the Murray–Darling Basin.[1] At the time, however, the development of an appropriate and proportional policy response was constrained by poor quality information on water resources. An alliance, led by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and involving industry, research organisations and Australian Government agencies, was formed to review the availability of information on water resources. The alliance found significant limitations on the availability, comparability and quality of water information. Many datasets that were expected to be available were not and obtaining data required entering into restrictive licensing arrangements with some jurisdictions.

3. In January 2007, the then Prime Minister announced a $10 billion National Plan for Water Security, including a $480 million investment to improve water information.[2] Subsequently, the Australian Government announced the $12.9 billion *Water for the Future* initiative in May 2008, which maintained the investment in improving water information. While the drought conditions eased from the autumn of 2010, Australia's climatic variability

1 Vertessy, RA, 'Water information services for Australians', *Australian Journal of Water Resources*, 16 (2), 2013.

2 This was subsequently reduced to $450 million.

suggests a continuing need for water information to assist governments and communities in managing climate risks.

Improving Water Information Program

4. The Improving Water Information Program was designed to enhance the quality of water information systems in Australia. The *Water Act 2007* (the Act), which establishes the legal framework for the program, came into effect in March 2008 and provides the Australian Government with a specific mandate to enable water resources to be managed in the national interest. The objects and provisions of the Act are designed to enable the Government, in conjunction with the Murray–Darling Basin states, to manage Basin water resources in the national interest. It also provides for the collection, collation, analysis and dissemination of information about Australia's water resources and the use and management of water in Australia.

5. The Water Regulations 2008, which were established under the Act and came into effect on 30 June 2008, define those organisations that must give specified water information to the Bureau, and the timeframe and format in which this information must be given. As at October 2013, 232 water organisations were named under the Regulations. Typically, these organisations are state and territory water agencies, other state or Australian Government agencies, hydroelectricity generators, major water storage owners or operators, rural or urban water utilities, catchment management authorities and local councils.

6. The Bureau of Meteorology (the Bureau) was given responsibility for the administration of the Improving Water Information Program, with funding of $450 million that was originally budgeted over a 10-year period from 2007.

7. The program funds were primarily to cover Bureau expenses such as staffing, accommodation and information technology systems to: enable the collection and harmonisation of water data; produce new water-related products; provide improved forecasting services; and expand the data available to improve policy and infrastructure decisions and evaluation. There was also an allocation of $80 million in administered funding to assist water data providers to strengthen water monitoring arrangements through the Modernisation and Extension of Hydrologic Monitoring Systems Program (M&E Program). The Bureau provided funding of $78.1 million for 463 projects over five rounds of the M&E Program from 2007–08 to 2011–12. The majority of funding was allocated to projects that focused on modernising and

extending monitoring equipment and networks and improving water data management systems and the quality and accuracy of water data.

8. The water information products and services developed under the Improving Water Information Program were intended to improve the understanding of water availability, storage and flows in the landscape and to answer questions such as:

- How much water is available today, and how does that compare with the past?
- How is the quantity and quality of water in our rivers and aquifers changing? and
- What are the hydrologic impacts of land management changes and climate change?

9. Since the commencement of the program, the Bureau has released a range of new water information products and services, including: annual national water accounts; water resources assessments; water storage information; and seasonal streamflow forecasts.

Administrative arrangements

10. In 2007, water information was largely a new function within a new division of the Bureau focusing on the information shortfall that was constraining water management reform in Australia. The Bureau expected to address information shortfalls by:

- using the authority of the Act to obtain water data;
- establishing partnerships with research organisations (such as the CSIRO);
- enhancing water monitoring systems and data quality through financial assistance to water data providers across Australia; and
- developing and embedding national standards for water measurement.

11. A key consideration for the Bureau was that the vast majority of streamflow monitoring gauges for flood and water resources are the responsibility of the states, territories and local government. Consequently, the Bureau was largely dependent upon state and territory agencies, local government and other parties for critical data to meet the requirements of the Act.

Audit objective and criteria

Objective

12. The objective of the audit was to assess the effectiveness of the Bureau of Meteorology's implementation of the Improving Water Information Program.

Criteria

13. To form a conclusion against this audit objective, the ANAO adopted the following high-level criteria:

- sound planning processes and governance arrangements were established;
- effective arrangements for collaborating with water organisations and providing financial assistance to water data providers were developed; and
- arrangements for collecting and managing water data and for producing high-quality water information products were appropriate.

Overall conclusion

14. The Improving Water Information Program is a relatively new and complex area of activity for the Commonwealth. The program was introduced in 2007 as a key element of the wider national water reforms designed to improve water management in Australia. At the time, governments in Australia were under considerable pressure to address water supply problems that were accentuated by prolonged drought conditions. However, effective policy responses were constrained by poor water information and a lack of nationally consistent data in areas such as water availability, allocations and entitlements.

15. In the six years that the program has been in place, the Bureau has expended $186 million and collected more than 21 million water data files containing more than four billion time-series observations. This data covers thousands of water monitoring sites. From this data and meteorological information, the Bureau has introduced a range of new products and services that have improved the comparability and quality of available water information. These have included: annual national water accounts; water

resources assessments; tracking of water storages; and seasonal streamflow forecasts.

16. The Bureau has developed effective arrangements for collaborating with water data providers that supply much of this data, with these providers generally complying with the legislative provisions. High participation in data licensing arrangements has also helped to maximise the utilisation of the Bureau's water data by third parties and increased the availability of water data to the Australian community.

17. In addition, the Bureau has improved the collection of water information nationally through its collaboration with, and financial assistance to, water data providers. The Modernisation and Extension of Hydrologic Monitoring Systems Program (M&E Program) delivered financial assistance to eligible data providers to assist them in modernising and extending their hydrologic monitoring networks. The Bureau received a total of 789 applications across the five rounds of the program. Of the eligible applications, 60 per cent were awarded funding that totalled $78.1 million. The majority of funding was allocated to projects that focused on modernising and extending monitoring equipment and networks and improving water data management systems and the quality and accuracy of water data. The Bureau effectively administered the M&E Program, with funded activities collectively contributing to improved accuracy and quality of water data and better equipping policy-makers to manage Australia's water resources.

18. While stakeholders generally viewed the program and the effectiveness of the Bureau's implementation positively, there has been a gap between the expectations of users and the range and completeness of the Bureau's products and services currently provided. Stakeholders are seeking increased coverage and better quality products and services, including data downloads, so that they can address their own specific product and service needs. Services, such as data downloads, were included as a priority in the Bureau's 2008 strategic plan for improving water information, but have yet to be fully delivered. While the Bureau's forward work program is designed to address a number of these concerns, closer consultation with key agencies through established forums (such as the Jurisdictional Reference Group on Water Information) would further assist in managing expectations.

19. A key constraint on the effectiveness of the program's implementation and the capacity of the Bureau to meet expectations has been the limited functionality available through the system designed to manage national water

data—the Australian Water Resources Information System (AWRIS). The development of AWRIS was a key program objective and was fundamental to the Bureau delivering improved national water information. The functionality of AWRIS is severely limited and this has constrained the range and timely development and release of new products and services. Overall, the development of AWRIS was characterised by technical and governance shortcomings, changes in design and approach, unanticipated cost increases and delays. As a consequence, the Bureau has not achieved its vision for AWRIS as a reliable, national repository for water information. Further, the level of expenditure has not been proportional with the level of functionality obtained, with the Bureau expending $38.5 million on AWRIS and associated systems and applications as at 30 June 2013.

20. The issues encountered by the Bureau in this information technology implementation emphasise the importance of agencies understanding their business environment and the likely operational risks and challenges they will be facing when developing new systems. Clarity as to the requirements of users is important, along with the recognition that these may evolve or change over time requiring enhancements to functionality over and above planned business as usual processes. In the case of AWRIS 1, clearly defining business and system requirements and establishing governance arrangements that were commensurate with the risk profile of the project, would have better positioned the Bureau to develop and deliver a system with greater functionality within more reasonable timeframes. The limited functionality that led to the decision to decommission the data warehouse component of AWRIS 1, which is estimated to have cost $12.5 million, raises questions regarding the value for money achieved from the investment in new information technology.

21. Determining the extent to which the Improving Water Information Program is achieving its objectives has been affected by changes in performance measures over the course of program implementation. The program's early key performance indicators (KPIs) were broad and difficult to measure. While the KPIs have become more measurable over time, the program's current KPIs do not readily inform an assessment of the extent to which the program is achieving its outcomes. Having a set of specific, measurable and consistent KPIs that provide the basis for reporting on the program would better position the Bureau to inform stakeholders of program progress and the challenges involved in achieving program outcomes.

22. The ANAO has made two recommendations designed to strengthen the development and management of information technology systems and improve the measurement and reporting of program performance.

Key findings by chapter

Planning, oversight and reporting (Chapter 2)

23. Following the introduction of the Improving Water Information Program in 2007–08, the Bureau has developed and implemented planning processes to assist it to meet the requirements of the *Water Act 2007* and the policy outcomes expected by government. Management and advisory structures established by the Bureau were appropriate and consistent with a collaborative model of service delivery. The technical and scientific challenges in building capability in data management and producing a suite of water information products and services were substantial, requiring investment in applied research with a range of partner agencies, such as the CSIRO and the National Water Commission.

24. An appropriate approach to stakeholder communication and engagement has been established and will be enhanced through an overarching stakeholder framework planned for the period 2013–17. While the Bureau gave appropriate and early attention to risk management and compliance, some risks, such as a failure to develop effective systems for web-based delivery and data management, were underestimated. This risk was realised with functionality constraints adversely impacting on the Australian Water Resources Information System (AWRIS).

25. The program's early KPIs were broad and difficult to measure, but have become more specific and measurable over time. However, the program's current KPIs do not readily inform an assessment of the extent to which the program is achieving its outcomes. In addition, the performance indicators for the program have changed over time making it difficult to gain an understanding of program performance over the six years of the program. Having a set of specific, measurable and consistent KPIs from year to year would better position the Bureau to inform stakeholders of program progress. A greater coverage of the challenges and constraints in progress reports would also assist stakeholders to better understand the implementation issues facing the Bureau.

Collaboration and compliance management (Chapter 3)

26. The Bureau has provided sufficient guidance to water organisations on their responsibilities under the *Water Act 2007* and the Water Regulations 2008, with water organisations generally expressing satisfaction with the level of communication and guidance received from the Bureau.

27. The development of national water information standards is continuing, with the Bureau engaging with stakeholders through the Water Information Standards Business Forum. The Bureau has taken a three-tiered approach to standards development, with a small number of standards to be mandated and others to be adopted on a voluntary basis. The development of standards and guidelines assists with harmonising water data collection, analysis and reporting across Australia and ultimately improves the quality of the data provided to the Bureau.

28. The licensing of water data under Creative Commons Attribution licences[3] has been effective in allowing users to freely copy, distribute, transmit and adapt water data. The Bureau has negotiated with water data providers and, as at October 2013, had achieved a 90 per cent participation rate in the Creative Commons Attribution licensing arrangements. The Bureau's achievement of high participation in these licensing arrangements has helped maximise the utilisation of the Bureau's water data by third parties and has increased the availability of water data to the Australian community.

29. The Bureau has developed and implemented a compliance strategy and an escalated response policy to manage identified non-compliance by water data providers. Initially, the focus of compliance activities was on establishing a data-provision relationship with each named organisation. Since the commencement of the Regulations, there have been only three cases of non-compliance identified by the Bureau where a formal response has been required. In each case, the compliance issues were resolved after the first formal response level and no further escalation was required. As at October 2013, all of the non-exempt named organisations had provided data to the Bureau.

3 Creative Commons Attribution licences allow material to be copied, distributed and adapted as long as the ownership of the data is attributed to the data provider.

Financial assistance to water data providers (Chapter 4)

30. The M&E Program was a key component of the implementation of the Improving Water Information Program as it provided grant funding to enable data providers to modernise and extend their hydrologic monitoring networks and to improve the accuracy and quality of the water data submitted to the Bureau. The Bureau provided appropriate information to potential applicants and published funding guidelines for each round of financial assistance under the M&E Program. These guidelines provided detailed information for stakeholders and generally aligned with the requirements of the Commonwealth Grant Guidelines. The assessment and recommendation of applications was conducted in an open and accountable manner, with assessment documentation generally being retained and the decision-maker making reasonable inquiries before approving funding.

31. A robust monitoring regime was established to assist the Bureau to determine if grant recipients had met agreed milestones, and the arrangements established by the Bureau to manage grant payments were generally appropriate. In some cases, however, the extent of monitoring was not proportionate to the amount of funding provided. The monitoring arrangements could have been more streamlined within the context of a risk-based approach.

32. The M&E Program has assisted grant recipients to modernise and extend their water monitoring systems and improve the accuracy, quality and frequency of the data transferred to the Bureau. In particular, the replacement of obsolete mechanical water gauges with electronic systems and the upgrading of water data management and transfer systems have enhanced the Bureau's access to more timely and accurate water information from data providers.

Data systems, collection and management (Chapter 5)

33. The development of the Australian Water Resources Information System (AWRIS) was a key objective of the Improving Water Information Program. AWRIS was to enable the Bureau to receive, store and manage national water data and to underpin the delivery of high-quality water information. The Bureau is receiving approximately 10 000 new data files containing time-series observations each day. It has been managing more than 21 million water data files containing more than four billion time-series observations since the Water Regulations came into effect on 30 June 2008. This

data relates to 105 parameters across 10 categories and covers thousands of hydrologic monitoring sites.

34. While the Bureau has been receiving and cataloguing this data, there have been major challenges and constraints in using AWRIS to manage the data for the production of new products and services. The development of AWRIS has been problematic with unclear business and system requirements, inadequate technical solutions, shortcomings in governance arrangements, changes in design and approach and unanticipated costs and delays that have limited the functionality of the system.

35. At the outset, project planning, governance and management did not follow established IT system design, development or implementation practices. Decisions were also taken that increased the complexity of the system to such an extent that it is difficult to maintain and is constrained in its functionality. Further, the level of expenditure on AWRIS, particularly when contrasted with planned expenditure and functionality has also raised questions regarding the value for money achieved. As at 30 June 2013, the Bureau had expended $38.5 million on AWRIS and associated IT systems and applications. This included $23.2 million that has been capitalised and $15.3 million in operational expenses. The Bureau has advised that, in the preparation of its financial statements, the accounting treatment for the $12.5 million in expenditure capitalised during the development of the AWRIS 1 data warehouse will be reviewed to take into account its limited functionality and early decommissioning.

36. The achievement of operational requirements for a national information technology system with maximum interoperability and flexibility has not been achieved. There have been significant consequences with delays in the rollout of products and services and 'work-arounds' to enable key products and services to be produced. In the case of AWRIS 1, clearly defining business and system requirements and establishing governance arrangements commensurate with the risk profile of the project, would have better positioned the Bureau to develop and deliver a system with greater functionality within more reasonable timeframes.

37. The decision to decommission AWRIS 1 and build a new AWRIS 2 system has enabled the Bureau to review and enhance its approach to IT development, with AWRIS 2 based on accepted industry standards for data warehousing. On the basis of the results of early testing, AWRIS 2 is progressing towards its performance and functionality targets for data ingest

and storage. However, the effective implementation of AWRIS 2, planned for December 2014, and the expected enhancement to functionality will depend upon a clear understanding of user requirements, strong strategic IT planning, executive oversight and project management.

38. The comprehensive data quality approach originally envisaged for end-to-end water data collection, management and analysis, has not yet been realised. The challenge of standardising data from a large number of sources, and with considerable variation, has been a significant task even after six years of program implementation. While the Bureau has been progressively introducing improvements to data quality, extensive and time-consuming product-specific manual checking on the quality of data remains necessary because of the limitations of AWRIS. Extension of the Water Data Transfer Format (a standardised data transfer format developed by the Bureau and the CSIRO for water data providers)[4] would assist the Bureau to achieve greater consistency. However, an ongoing risk for the Bureau relates to decisions by data providers to reduce the number of monitoring stations that they maintain. Deterioration in the monitoring network has the potential to affect the capacity of the Bureau to maintain or enhance data quality over time. This risk will need to be considered in the context of the future directions of the program.

Water information products and services (Chapter 6)

39. Since the inception of the Improving Water Information Program in July 2007, the Bureau has introduced a suite of new products and services with nationally consistent data, such as annual national water accounts, water resources assessments, water storage information and seasonal streamflow forecasts. As a result, a broader range of better quality water information is available.

40. However, most products have been introduced later than originally planned by the Bureau with varying degrees of coverage and completeness. There have also been considerable challenges in managing data from approximately 200 providers, with the Bureau needing to undertake or commission research to develop its products and services because of the absence of acceptable models that could be readily applied. Further, as outlined earlier, the limitations of the Bureau's information technology system

4 The Water Data Transfer Format is currently used by 66 of the 232 named water organisations.

as a national repository for water information has contributed to delays in the release of new products. Although the Australian Water Resources Assessment has national coverage, the Bureau does not envisage full national coverage for the National Water Account (NWA). The Bureau has advised that the capacity of reporting partners, the availability of data and resources and the priorities of stakeholders have determined the order in which regions have been included in the NWA.

41. The level of collaboration with many different agencies across Australia reflects well on the Bureau's approach and suggests a wide degree of commitment to the program and its products and services. Although not complete, the Bureau's current suite of water information products and services provide governments with important data to inform better policy decisions in relation to water services and infrastructure investment.

42. In general, stakeholders have indicated a positive view of the Improving Water Information Program. There is, nevertheless, a gap between the expectations of users and the capacity of the Bureau to deliver. Services such as data downloads, were a priority in the Bureau's 2008 strategic plan for improving water information, but have yet to be fully delivered. Stakeholders have also suggested a need to increase the coverage and quality of products and services available. While the Bureau's forward work program has been designed to address a number of these concerns, closer consultation with key agencies through established forums would further assist in managing expectations.

Summary of Bureau response

43. The Bureau's summary response to the proposed report is provided below, with the full response at Appendix 1:

> The Bureau welcomes the Audit Report and is implementing the two recommendations:
>
> - Key performance indicators have been redesigned, at enterprise and program levels; reported to management and in the Annual Report. Major IT projects (including AWRIS) are now identified as major deliverables in the Bureau's operational plan and progress reported to senior management.
> - From July 2013, the Bureau established an Information Systems and Services Division to enhance capability and increase flexibility and responsiveness. An enterprise-level Portfolio Management Board is being implemented to enhance project governance and provide regular reviews of the status, cost and overall progress.
>
> The Bureau was pleased with the ANAO assessment that the Bureau has developed effective arrangements for collaboration with water data suppliers, and will continue engagement with stakeholders to deliver product and services and manage expectations having regard to available resources.

Recommendations

Recommendation No. 1

Paragraph 2.40

To strengthen the reporting of performance information on the Improving Water Information Program, the ANAO recommends that the Bureau of Meteorology:

- develop relevant, reliable and complete key performance indicators; and
- report against these indicators on the extent to which the program's outcomes are being achieved.

Bureau's response: *Agreed*

Recommendation No. 2

Paragraph 5.41

To improve the management of, and value for money from, information technology (IT) delivery, the ANAO recommends that the Bureau of Meteorology:

- strengthen strategic IT planning and project management to guide the delivery of IT projects and inform monitoring activities; and
- implement governance arrangements for all IT projects that are commensurate with the documented risk profile of each project.

Bureau's response: *Agreed*

Audit Findings

1. Background and Context

This chapter provides the context for implementing the Improving Water Information Program within the Bureau of Meteorology, including the Bureau's role and business environment. The audit approach is also outlined.

Water management in Australia

1.1 Water resource policies in Australia have historically been focused on promoting economic development and employment. By 1990, most of the available water resources had been exploited and an ageing infrastructure was contributing to increased operation and maintenance costs. The demand for water resources was also increasing in scale and diversity—particularly in regard to environmental objectives and concerns for improved water quality.[5]

1.2 In 1994, the Council of Australian Governments (COAG) established a water reform framework to address the degradation of water resources and improve efficiency and sustainability in the water industry. Subsequently, in June 2004, following continuing drought conditions, COAG gave further consideration to water reform and endorsed the *National Water Initiative* (NWI), in which all governments indicated a commitment to a range of measures to increase the efficiency of Australia's water use.

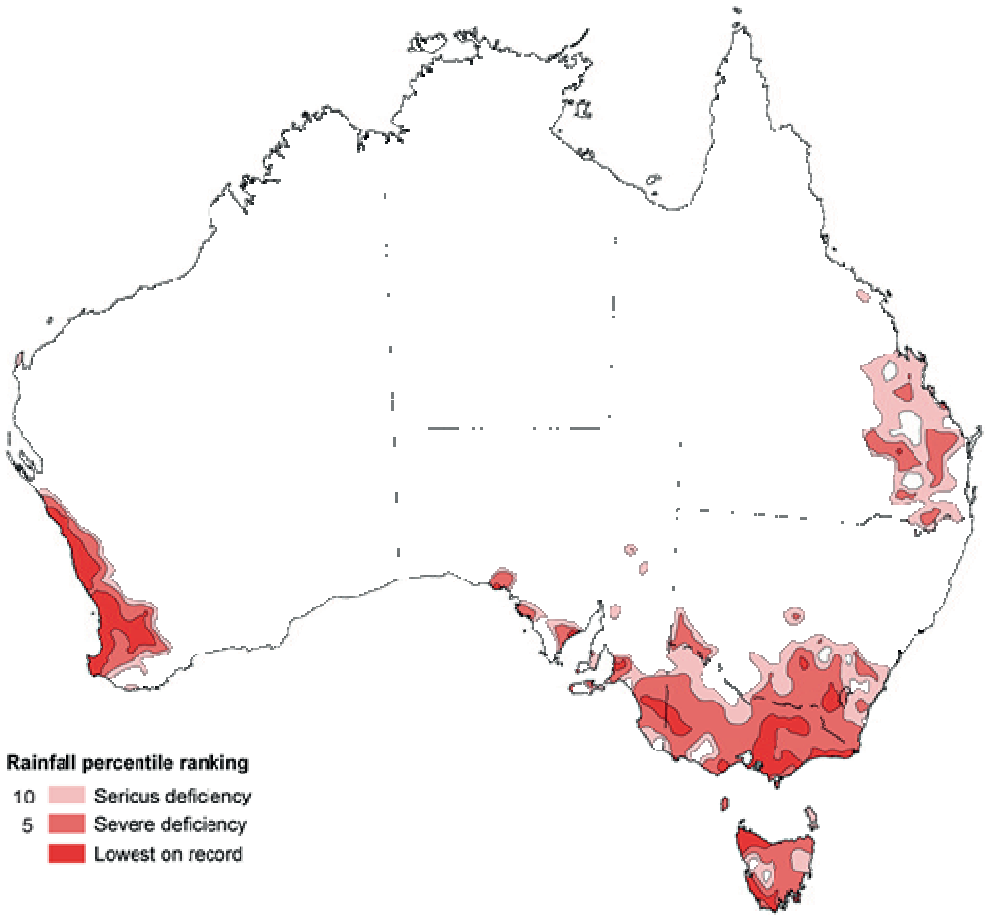
1.3 The 'Millennium Drought' (as it became known) was one of the worst droughts since European settlement, with dams across the Murray–Darling Basin at 25 per cent of total capacity and intense bushfires affecting rural communities. To manage low water levels, capital cities imposed strict water restrictions, and there was significant growth in the construction of new desalination plants.[6] While the economic impact of the drought was difficult to accurately calculate, the Reserve Bank of Australia estimated a reduction in Gross Domestic Product of one per cent in 2006. Large parts of Western Australia's south-western coast, western Tasmania and Victoria received the

5 Tisdell J, Ward J, Grudzinski T, (2002) Cooperative Research Centre for Catchment Hydrology. *The Development of Water Reform in Australia*, Technical Report 02/5.

6 The Bureau of Meteorology has estimated that in 2002 there were fewer than 10 desalination plants across Australia, while in 2009, there were around 50 plants with capacities exceeding 10 kilolitres per day.

lowest rainfall on record for the 13-year period.[7] Figure 1.1 shows rainfall deficiencies from April 1997 to March 2010.

Figure 1.1: Rainfall deficiencies in Australia 1997–2010



Source: Department of the Environment (based on Bureau of Meteorology data and analysis).

1.4 The severity of the drought resulted in renewed impetus for water reform. By 2006, concerns about water security were being expressed at the highest levels of government, with Premiers, Chief Ministers and the then Prime Minister meeting to discuss emergency measures for water supply in the

7 In many locations, the severity and duration of drought were unprecedented, with profound environmental, social and economic implications. In southern Australia, the drought lasted from 2000 to 2010, although in some areas it began as early as 1997. For parts of the country, the drought broke in 2010 (in some cases, with extreme flooding); in other places, such as the south-west of Western Australia, the extended drought deepened further.

Murray–Darling Basin.[8] The development of an appropriate and proportional policy response was, however, constrained by poor quality information on water resources. An alliance led by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) was requested to assess water availability in Australia.[9] The alliance found that the availability, comparability and quality of information made undertaking the assessment difficult. Many datasets that were expected to be available were not and obtaining data required entering into restrictive licensing arrangements with some jurisdictions.[10] Furthermore, there was variability in key water measurement attributes and definitions between jurisdictions, which made using and comparing the data for modelling and analytical purposes very time-consuming and challenging.

1.5 In January 2007, the then Prime Minister announced a $10 billion National Plan for Water Security, including a $480 million investment to improve water information.[11] The plan noted:

> Australia's water information base is in poor shape and deteriorating because of diminishing state and territory investments and gross inefficiencies in the way that water information is managed across more than 100 different water data collecting agencies nationwide. … It has not been possible to conduct timely, rigorous and independent assessments of water resources, seriously impeding the ability to forecast future water availability and make wise water allocation decisions. The lack of accurate measurement has made it impossible to estimate how much water is being diverted to irrigation and being used on farms, and how much is being lost or wasted.[12]

1.6 Importantly, water scarcity was not just a consequence of a decline in rainfall. Factors such as a drying and warming climate, growing urban demand, over-allocation of water to irrigation, bushfire recovery impacts and the environmental flow imperative also contributed to water scarcity.

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8 Vertessy, RA, 'Water information services for Australians', *Australian Journal of Water Resources*, 16 (2), 2013.

9 Members of the Alliance included: CSIRO; eWater Cooperative Research Centre; Bureau of Rural Sciences; Australian Bureau of Statistics; National Land and Water Resources Audit; and Sinclair Knight Merz.

10 For example, some jurisdictions required signed licence agreements before data could be obtained, with some imposing conditions, for example, that data be stored only on a single computer or be destroyed after one year.

11 This was subsequently reduced to $450 million.

12 The Hon John Howard MP, Prime Minister, *A National Plan for Water Security*, 25 January 2007, p. 16.

1.7 In May 2008, the then Australian Government announced the $12.9 billion *Water for the Future* initiative that maintained the investment in improving water information. This resulted in an increase in funding for water reform of around $3 billion.

1.8 The weather pattern of continuing drought conditions across Australia changed from the autumn of 2010.[13] By late 2010, extensive rainfall over large areas of Queensland and Victoria, coupled with already saturated catchments, led to flooding of historic proportions.[14] These weather patterns highlighted Australia's climatic variability and the importance of water information to assist governments and communities in managing changing risk profiles. Climate variability is predicted to accentuate the intensity of extreme climate events. In these circumstances, comprehensive and accurate water information will have increasing importance because of the potential risks and consequences for Australia.

1.9 The Government's $450 million investment to improve water information, the Improving Water Information Program, was designed to address the shortfall in information that had previously constrained effective water policy reform.

Improving Water Information Program

1.10 The Improving Water Information Program commenced in July 2007 as a $450 million, 10–year initiative. It provides the Australian Government with a specific mandate to enable water resources to be managed in the national interest. The Bureau of Meteorology (the Bureau) was assigned responsibility for the administration of the program. While the Government did not establish specific objectives at the start of the program, 10 key program objectives were developed by the Bureau and endorsed by the Minister in 2010. These are outlined in Table 1.1.

13 The Bureau found that 2010 began with dry conditions in the Pacific region followed by a rapid transition into a wetter weather pattern during autumn. From January to May 2010 rainfall was generally above average in most areas except the western half of Western Australia and southern Tasmania.

14 In Queensland in particular, more than 78 per cent of the state was declared a disaster zone with over 2.5 million people affected. The estimated cost of these flood events in both states was estimated to be in excess of $6 billion.

Table 1.1: Improving Water Information Program objectives

Objectives	
Establish enduring national water data sharing and licensing arrangements	Develop and disseminate national water information standards
Build and maintain the Australian Water Resources Information System to underpin all of the Bureau's water information products and services	Collate, standardise and archive water data collected by over 200 water organisations named under the Water Regulations 2008
Support water data collecting organisations to improve coverage, currency and accuracy of water data collected around Australia and to enable its ready transmission to the Bureau	Provide the Australian public with free online access to reliable water information
Analyse trends in water availability and quality across the nation, and convey this information to the public via Australian Water Resources Assessments	Publicly disclose water entitlements, allocations, trades and take for all major urban and rural water supply systems in an annual National Water Account
Provide effective and reliable streamflow forecasting services for high priority water supply systems	Enhance the science and technology base of the Bureau's water information products and services by supporting strategic research and development

Source: Bureau of Meteorology, 2012 Progress Report, p. 5.

1.11 The Program funds were primarily for Bureau expenses such as staffing, accommodation and information technology systems to: enable the collection and harmonisation of water data; produce new water-related products; provide improved forecasting services; and expand the data available to improve policy and infrastructure decisions and evaluation. There was, however, an allocation of $80 million included in administered funding to assist water data providers to modernise and extend their hydrologic monitoring systems through the Modernisation and Extension of Hydrologic Monitoring Systems Program (M&E Program). The Bureau provided funding of $78.1 million to 463 projects over five rounds of the M&E Program from 2007–08 to 2011–12.

1.12 The water information products and services developed under the Improving Water Information Program were intended to improve the understanding of water in the landscape and answer questions such as:

- How much water is available today, and how does that compare with the past?
- How is the quantity and quality of water in our rivers and aquifers changing? and

- What are the hydrologic impacts of land management changes and climate change?

1.13 Since the commencement of the program, the Bureau has released a range of new water information products and services, including: annual national water accounts; water resources assessments; water storage information; and seasonal streamflow forecasts.

Legislative framework

1.14 The *Water Act 2007* (the Act) was intended to provide the Australian Government with a specific mandate to enable water resources to be managed in the national interest. The Act provides the Bureau with specific powers to obtain water information in addition to its weather and climate functions under the *Meteorology Act 1955*. The objects and provisions of the Act are broader than water information alone and are designed, among other things, to enable the Government to manage the Basin water resources in the national interest. They also provide for the collection, collation, analysis and dissemination of information about Australia's water resources and the use and management of water in Australia.

1.15 The Act came into effect in March 2008, while the associated Water Regulations came into effect in June 2008. The Regulations define the organisations that must give specified water information to the Bureau, and the timeframe and format in which this information must be given. As at October 2013, 232 water organisations were named under the Regulations and were required to provide the Bureau with specified water information that was in their possession, custody or control. Typically, these organisations are state and territory water agencies, other state or Australian Government agencies, hydroelectricity generators, major storage owners or operators, rural or urban water utilities, catchment management authorities and local councils. A series of amendments have also been made to the Regulations over time, including revisions to reflect changes to named water organisations.

Administrative arrangements

1.16 In 2007, water information was largely a new function within a new division of the Bureau focusing on the information shortfall that was constraining water management reform in Australia. The Bureau planned to address the information shortfall by using the authority of the Act, enhancing water monitoring systems and data quality through financial assistance to

water data providers across Australia and developing and embedding national standards for water information. As at June 2013, 201 full-time equivalent (FTE) staff were engaged in water functions within the Bureau. This represents around 13 per cent of total Bureau staff.

1.17 Establishing partnerships with research organisations was an important consideration because of gaps in water information science and technology. The Bureau developed a range of research partnerships with organisations such as the CSIRO, the Centre for Australian Weather and Climate Research and the eWater Cooperative Research Centre.

1.18 A key consideration for the Bureau was that the vast majority of streamflow monitoring gauges for flood and water resources are the responsibility of the states, territories and local government. Consequently, the Bureau was largely dependent upon state and territory agencies, local government and other parties for critical data to meet the requirements of the Act.

Parliamentary interest

1.19 Water-related issues have been the subject of several recent parliamentary inquiries and reports, including:

- House of Representatives Standing Committee on Regional Australia, 2012, *Report into certain matters relating to the proposed Murray–Darling Basin Plan*;
- House of Representatives Standing Committee on Regional Australia, 2011, *Of drought and flooding rains: Inquiry into the impact of the Guide to the Murray–Darling Basin Plan*;
- Senate Legal and Constitutional Affairs References Committee, 2011, *A Balancing Act: provisions of the Water Act 2007*; and
- Senate Standing Environment and Communications References Committee, 2010, *Sustainable management by the Commonwealth of water resources*.

1.20 While the scope of these reviews was wider than the role of the Bureau and the Improving Water Information Program, they highlight the interest of Parliament in water management issues and the importance of accurate and reliable water information in addressing many of the complex water management challenges.

Audit objective, criteria, scope and methodology

Objective

1.21 The objective of the audit was to assess the effectiveness of the Bureau of Meteorology's implementation of the Improving Water Information Program.

Criteria

1.22 To form a conclusion against this audit objective, the ANAO adopted the following high-level criteria:

- sound planning processes and governance arrangements were established;
- effective arrangements for collaborating with water organisations and providing financial assistance to water data providers were developed; and
- arrangements for collecting and managing water data and for producing high-quality water information products were appropriate.

Scope

1.23 The audit focused on the Bureau and its implementation of the Improving Water Information Program. The program is currently six years into its 10–year implementation and, therefore, it was not possible for the ANAO to assess all of the program's achievements. However, the audit assessed progress to date against the funding provided and examined those priorities of government that had been (or were being) addressed.

Methodology

1.24 The audit methodology considered key implementation risks and core compliance requirements of the Act and the associated regulations. The methodology included:

- interviewing senior and operational Bureau staff, state and territory government agencies and non-government stakeholders;
- writing to water organisations that had responsibilities under the Act to seek their comments in relation to the implementation of the program (56 organisations responded);

- reviewing documents relevant to the development and administration of the program and analysing performance and financial data;
- reviewing of the program's data collection, storage and analysis system (AWRIS); and
- assessing the extent to which grant recipients were selected in an open, accountable and transparent manner in accordance with the Commonwealth Grant Guidelines.[15]

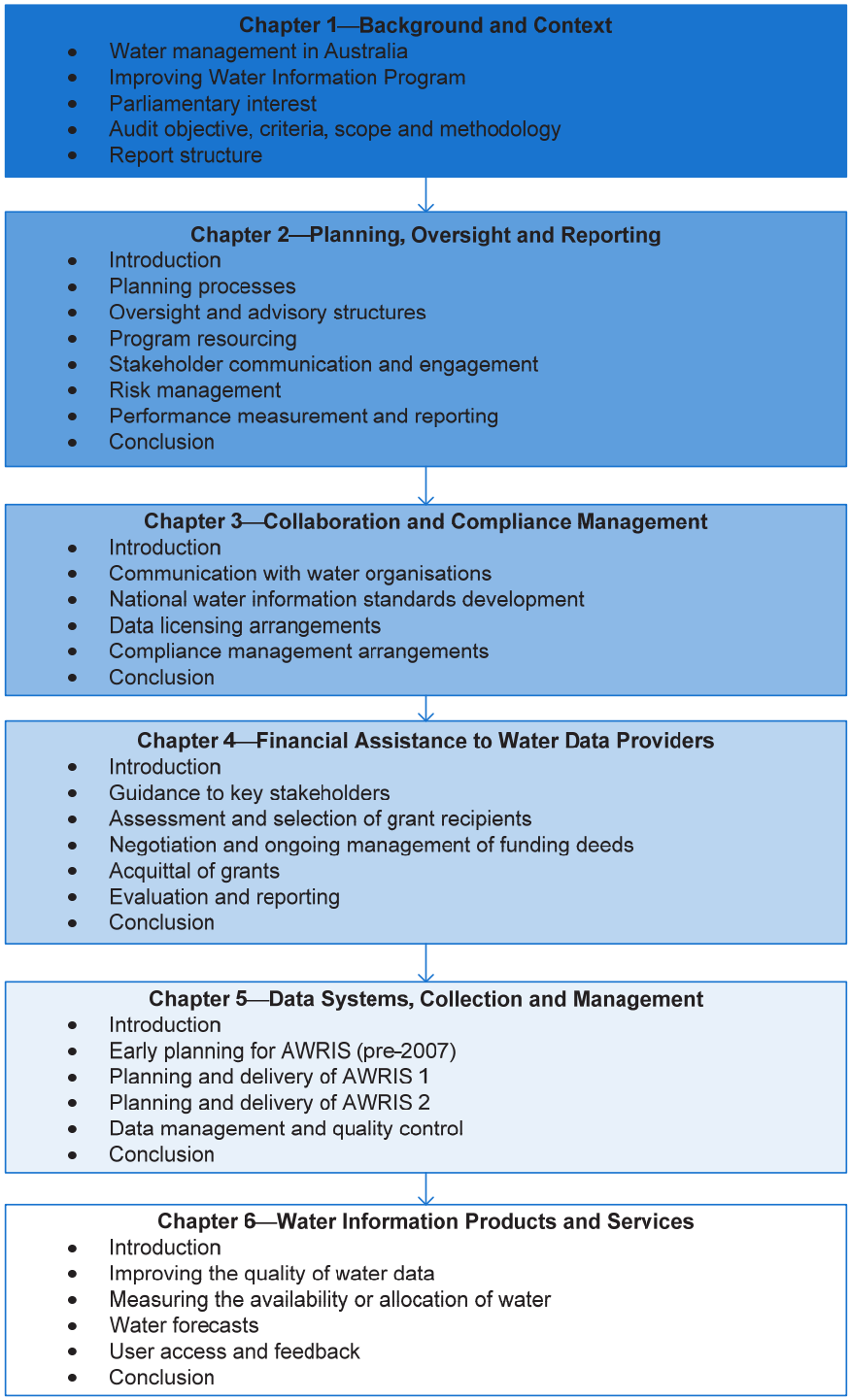
1.25 The audit was conducted in accordance with ANAO Auditing Standards at a cost to the ANAO of $463 571. Vista Advisory Pty Ltd provided the ANAO with assistance in the conduct of the audit.

Report structure

1.26 The structure of the report is set out in Figure 1.2.

15 A sample of 75 of the 276 grants from the latter three years of the program was assessed. Grants from the first two years of the program were not included in the sample as the first two rounds were subject to a review and an internal audit, which resulted in changes to administrative practices.

Figure 1.2: Report structure



2. Planning, Oversight and Reporting

This chapter examines the planning, oversight and reporting arrangements established by the Bureau for the Improving Water Information Program.

Introduction

2.1 Implementation and delivery of Australian Government policy initiatives is one of the key responsibilities of public sector agencies. In recent years, there has been an increasing focus on, and a community expectation of, sound implementation and seamless delivery of government policies—on time, within budget and to an acceptable level of quality.[16] The implementation of the Improving Water Information Program represented a substantial and challenging undertaking that necessitated sound planning and effective management oversight and reporting to achieve progress against the Government's policy objectives.

2.2 The ANAO examined the Bureau's:

- planning processes;
- oversight and advisory structures;
- program resourcing;
- stakeholder communication and engagement;
- risk management; and
- performance measurement and reporting.

Planning processes

2.3 The *Water Act 2007* and the Water Regulations 2008 established the basis for the Bureau's implementation of the program. The legislation also specifies the categories of data requirements and the broad purposes for which they were intended, such as providing regular reports on the status of Australia's water resources, providing regular forecasts on the future availability of Australia's water resources or issuing National Water

16 ANAO Better Practice Guide—Implementation of Programme and Policy Initiatives, October 2006, Canberra, p. 1.

Information Standards.[17] While the compilation of the annual national water account is the only mandatory requirement under the legislation, the Bureau's Director has discretion regarding the range of products or services to be delivered. The Director is, however, obliged to consult with the states in the preparation of the National Water Information Standards.[18]

2.4 While the Bureau did not develop an overarching implementation plan for the Improving Water Information Program, consideration of implementation requirements was outlined through the Bureau's Operational Plan 2008–12 and a divisional strategic plan (2008). The ANAO examined these key planning documents to assess their coverage and relevance to implementing the program.

Operational Plan 2008–12

2.5 The Bureau's Operational Plan 2008–12 was designed as an organisational level plan that sets out: government expectations; vision, missions and objectives; priorities, needs and targets; planned expenditure; investments; staffing; and asset management. It also illustrated how the new water function would be integrated within the organisation. The Operational Plan was designed to document the Bureau's business environment and priorities and how they would be addressed over a five-year period. The Bureau has recognised that it 'operates in a dynamic environment and adjusts its operations ... to meet the changing demands of governments, business and the community'. The Operational Plan discussed emerging challenges and opportunities, such as technological change, the benefits from collaborative partnerships with other agencies and the scope for maximising public access to the extensive Bureau weather data.

2.6 In relation to the water function, the plan noted that the Bureau was, 'recruiting around 110 new staff into a newly established Water Division, developing the Australian Water Resources Information System[19], and acquiring supporting information technology'. A new Bureau office was created in Canberra for the water function to facilitate closer working relations with the key stakeholders, such as the Department of the Environment and the

17 Section 120, *Water Act 2007*.

18 Section 132, *Water Act 2007*. The Act does not specifically refer to the territories.

19 The Australian Water Resources Information System is the information technology system within the Bureau to manage water data received from providers. It is discussed further in Chapter 5.

National Water Commission. The Bureau also needed to develop administrative capability to manage the grant program designed to provide financial assistance to water data providers to improve their water monitoring systems. This was important as the Bureau had no prior experience in managing grant programs. Overall, the plan provided a strategic overview of the Bureau's business environment and provided a coherent, high-level focus for the introduction and integration of the new water function within the Bureau.

Divisional planning

2.7 The Bureau completed a Water Division Strategic Plan (the plan) in November 2008.[20] The plan was designed to provide specific information relating to the implementation requirements for the Improving Water Information Program within the new division. The objective was: 'to create an integrated national system of water information serving government and community needs.' The vision statement was that:

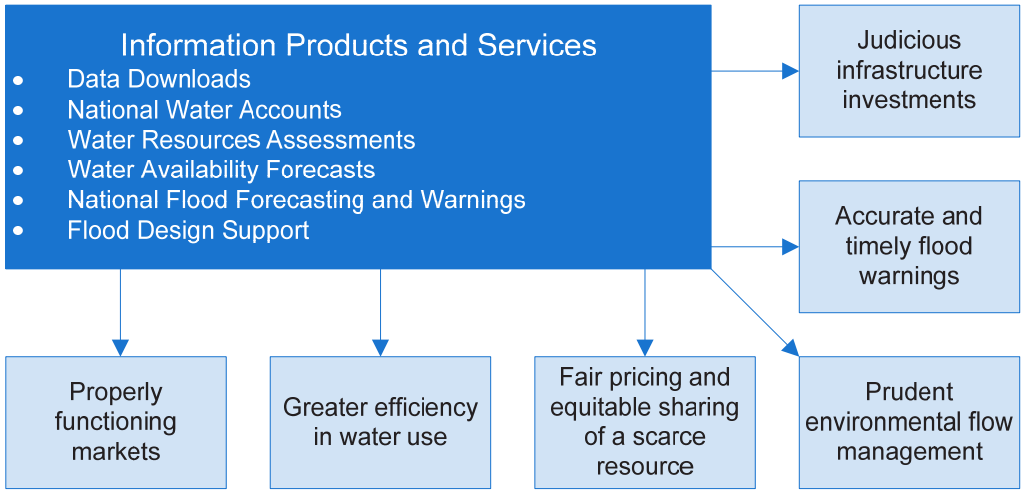
> Australia is better equipped to manage water scarcity and flood risk through ready access to high-quality water information provided by the Bureau of Meteorology.

2.8 The plan included key business management considerations such as vision, objectives, strategies, planned products and services, partnerships, performance indicators, an outline of a communication and adoption strategy, risks and key milestones.

2.9 The Bureau acknowledged in the plan that the program was being undertaken 'in cooperation with water information managers in all states and territories' and 'will transform Australia into a best practice provider of water information, using state-of-the-art technology'. The Bureau focused on developing information products that would contribute to important policy outcomes and meet the requirements of the *Water Act 2007* (including the National Water Account), as illustrated in Figure 2.1.

20 The Water Division Strategic Plan (November 2008) was designed as an internal document for the water division, whereas the Operational Plan (2008–12) is a public document and covers the whole organisation.

Figure 2.1: Anticipated outcomes from the Improving Water Information Program



Source: ANAO analysis of the Bureau of Meteorology's Water Division Strategic Plan (2008).

2.10 The products and services foreshadowed in the plan included:

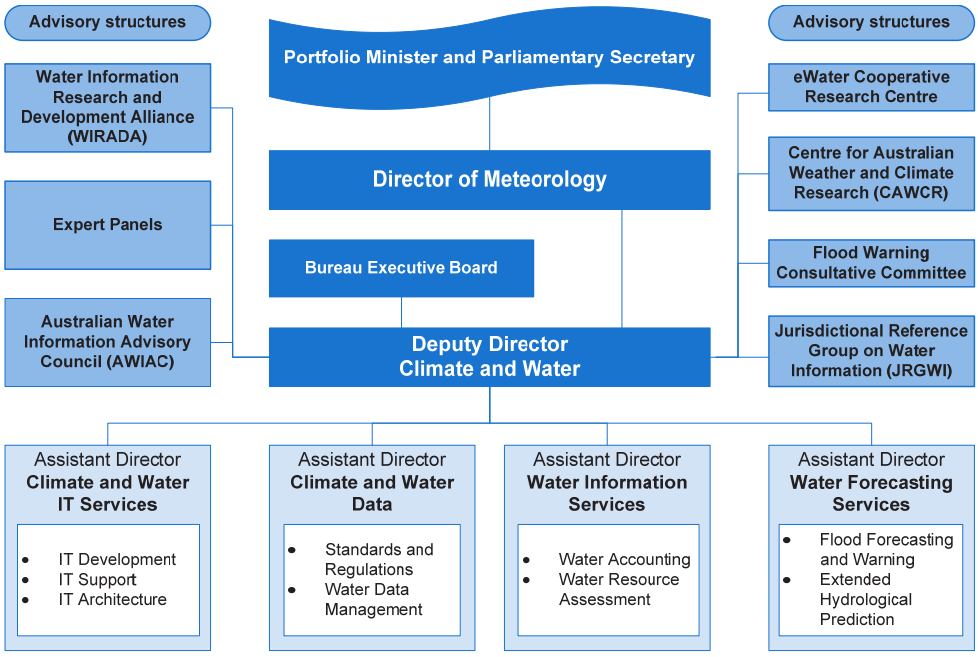
- **Data downloads** to provide both raw and interpreted data for stakeholders seeking to develop their own specific water information products;
- **National Water Accounts,** which are sets of annually reconciled water accounts for all the managed water resource systems in Australia;
- **Water resources assessments,** which were expected to offer high-quality, interpreted data on the availability and condition of water resources;
- **Water availability forecasts**, which were intended to cover river flow forecasts, seasonal water availability forecasts and extended water availability projections; and
- **Flood design support,** which is the Intensity-Frequency-Duration (IFD) information on rainfall that is used to design public infrastructure, such as dams, gutters, culverts, bridges and stormwater drains.

2.11 The planning process adopted by the Bureau was appropriate to implement a new and complex program. The business environment was dynamic and challenging given the need to address a range of water information priorities for over 200 external stakeholders involved in program delivery. The importance of meeting a range of priorities was explicitly recognised along with the requirement for collaborative research in the development and delivery of the program.

Oversight and advisory structures

2.12 The oversight and advisory structures for the Bureau's primary water information management responsibilities and the advisory and consultative bodies that have assisted in program delivery are set out in Figure 2.2.

Figure 2.2: Improving Water Information Program—oversight and advisory structures



Source: ANAO analysis of the Bureau of Meteorology's Climate and Water division structure (June 2013).[21]

2.13 The primary oversight responsibility and accountability for the administration of the Improving Water Information Program rests with the Deputy Director, Climate and Water. The Bureau's Executive Board also provides high-level oversight and governance across the Bureau, with the Director of Meteorology retaining responsibility for management across all

21 The Climate and Water Division also includes Climate Information Services and Environmental Information Services. These have not been included as they fall outside of the primary focus of the audit. As at 30 June 2013, the Climate and Water IT services and Water Data Management branches were subject to a restructure to improve the integration of IT with the Bureau-wide services. The Director of the Bureau of Meteorology generally reports to the Parliamentary Secretary for Environment and Urban Water. On particular matters since 2007–08, such as financial expenditure of administered items, the Minister for Water or the Portfolio Minister has been the decision-maker.

Bureau functions. The advisory and consultative bodies support the primary oversight role of the Director and Deputy Director.

2.14 In developing its strategic plan and work program, the Bureau recognised that it needed to establish a range of key partnerships to:

- expand its access to research expertise—such as through the Water Information Research and Development Alliance (WIRADA) with the Commonwealth Scientific and Industrial Research Organisation (CSIRO)[22], the Centre for Australian Weather and Climate Research (CAWCR) and the eWater Cooperative Research Centre (CRC); and
- engage with organisations and people with water management expertise—such as through the Australian Water Information Advisory Council (AWIAC), the Jurisdictional Reference Group on Water Information (JRGWI) and the Water Information Standards Business (WISB) Forum.

2.15 Collectively, these partnerships with new, as well as existing bodies (such as the eWater CRC and the CAWCR), provided the Bureau with the additional capability necessary to build a national water information function.

Expanding access to research expertise

2.16 The research partnerships were required to address shortcomings or gaps in water information science and to build on the existing work being undertaken by other research and development organisations in the field of hydrology and information sciences. WIRADA was established as a $50 million, five-year partnership with CSIRO to 'transform the way Australia manages water resources by linking CSIRO's expertise in water and information sciences with the Bureau's operational role in hydrologic analysis and prediction'. Since its inception, the Bureau has reported that WIRADA has developed:

- better techniques to predict short-term river flow and floods, and seasonal inflows to river systems across Australia;
- new methods and technologies to help the Bureau provide integrated surface water and groundwater resource assessments, water accounts and water resource outlooks; and

22 The Alliance was a partnership to conduct joint research into agreed water information priorities.

- a national standard for the transfer of water information.

2.17 WIRADA was guided by an implementation strategy that included investment priorities, risk management and quality control along with specific timeframes and deliverables. The partnership highlighted the basic research that needed to be conducted before the Bureau could effectively undertake its water information functions, such as collecting the water data in a consistent format and producing accurate streamflow forecasts. The Bureau also placed a high importance on collaboration with the CAWCR and the eWater CRC as a means to develop greater accuracy in streamflow forecasting. The relationship has continuing importance as the Bureau endeavours to improve its forecasting capability and coverage.[23]

2.18 Research partnerships have provided the technical and scientific skills and knowledge to enhance the quality of specific Bureau products. They were important because of the technical challenges in producing the required national water products. In particular, substantial gaps in the scientific knowledge base and the variability of water information management and practice across jurisdictions made the task more difficult for the Bureau. Through the establishment of research alliances, the Bureau has been able to progressively address a number of technical and scientific constraints on progress with program implementation.

Engagement with organisations and people with water management expertise

2.19 The establishment of the AWIAC and the JRGWI provided the Bureau with advice and oversight in the implementation of the Improving Water Information Program. The AWIAC was designed to provide strategic oversight of the Bureau's water information role and position the Bureau as a 'world leader in water information'. The records of the meetings indicate that it provided a key consultation forum to assist the Bureau in the implementation of the program.[24] Over time, the Council provided high-level policy advice to guide the broad direction of the program. This enabled the Bureau to examine

23 In November 2013, the streamflow forecast skill scores were high for 15 out of 70 locations and moderate for 32 locations. A skill score is a statistical score used to objectively assess the performance (skill) of a model.

24 AWIAC membership included an independent Chair and representatives from relevant Australian Government agencies and the water industry.

key program implementation challenges and possible solutions within a forum that had a high level of expertise and interest in the program and its outputs.

2.20 The JRGWI was established to coordinate the Bureau's water information activities with those of the states and territories.[25] As the JRGWI comprises senior representatives from water data providers, it has been an important forum for the Bureau to test the impact of program requirements as well as the likely acceptance of new products and services. Generally, these consultation forums have assisted the Bureau in shaping its products and services to better meet user needs—especially given the challenges in introducing a standardised national water information system.

Program resourcing

Budget appropriations and expenditure

2.21 The Government initially provided $450 million over 10 years for the Improving Water Information Program. The funds were primarily allocated as agency[26] funding to cover items such as staffing, information technology and equipment, as well as research and development. Administered funding of $80 million over five years was available to support the M&E Program of financial assistance to water data providers to modernise and extend their water monitoring systems.

2.22 Since the program's inception, a series of government savings measures, including efficiency dividends of between 0.5 and 4 per cent per annum, and changes to funding for whole-of-government travel arrangements and IT have resulted in a reduction in available budget funds of around $30 million over the 10-year life of the program. Of the $340 million of budget funds available to develop and deliver water information products and services, the Bureau has expended $186 million (54.7 per cent) after six years.

25 The JRGWI comprises representatives from the lead water agencies in each state and territory. It provides a forum for members to articulate the water information priorities in their jurisdictions and provide feedback to the Bureau on its various water information products. It has also been used as a forum for input on emerging water data standards.

26 This category of funding is used to meet the annual operating costs of agencies.

Additional funding

2.23 In addition to budget funding, the Bureau has received funding of around $18 million from other Australian Government agencies for the development and delivery of water information program-related products and services. This additional funding was primarily provided by the National Water Commission and the Department of the Environment.

2.24 The Bureau has informed the ANAO that further projects are planned in the current financial year, including a project that is to be funded by a state agency. While the participation of other stakeholders in financing program delivery helps to achieve better value for money outcomes, care is needed to ensure that projects are consistent with the original objectives of the program and that all projects are prioritised on their merits so that resources are not unreasonably diverted from existing projects. The Bureau has managed these risks to date.

Stakeholder communication and engagement

2.25 Effective stakeholder communication and engagement was important for the implementation of the Improving Water Information Program because of the collaborative nature of the program and the reliance on third parties to provide essential water data. The Bureau's Corporate Communication Strategy (2010–2015) noted that:

> Communication is a fundamental part of the Bureau's core business. Our success relies not only on our ability to monitor and analyse the environment, but on our skill in communicating with users and each other to develop and deliver high-quality products and services.[27]

2.26 In 2008, the Bureau developed a Water Information Communication and Adoption Strategy. The strategy was designed to 'document the suite of goals, strategies and tactics that were expected to support the Bureau's broader water information goals'. It also aligned with the Water Division Strategic Plan (2008) and the Bureau's broader Corporate Communication Strategy that was being prepared at that time. The strategy provided a context for the water information business and its operations and outlined the range of challenges facing the Bureau including: maintaining and enhancing existing water related

27 Bureau of Meteorology, *Corporate Communication Strategy,* 2010–2015, p. 13.

services; managing expectations and relationships with hundreds of diverse stakeholder groups; and delivering a suite of sophisticated products and services that provide a new level of insight and utility.

2.27 The strategy highlighted new water information products to be developed, including: large data downloads (raw data and interpreted data); a national water account that standardised water resource information for the first time in Australia; water resources assessments across jurisdictional boundaries that were intended to provide interpreted data on the condition of water resources in Australia; and a range of water availability forecasts and a national flood warning service. These products were consistent with the range of products and services outlined in the Water Division Strategic Plan (2008). An annual review of the strategy was planned for May each year. However, the overall strategy has been updated and was largely superseded by individual product communication strategies. The conduct of the foreshadowed annual reviews would have better placed the Bureau to manage communication channels and important stakeholder relationships. The issue was also raised during an internal audit of the Bureau in 2013.

2.28 The Bureau informed the ANAO that it intends developing an overarching stakeholder framework for the program for 2013–17 that will incorporate an aggregated analysis of stakeholders, a risk assessment and reporting requirements and will be updated annually.[28]

Risk management

2.29 Delivering a new program on a national scale with the pressing water policy issues facing governments presented a range of risks. A comprehensive risk management strategy, developed early in the implementation phase and regularly monitored in conjunction with effective mitigation treatments, assists agencies to manage risks to program implementation.

2.30 In May 2008, the Bureau released an agency-wide risk management manual to assist staff to adopt appropriate risk management practice. In giving effect to corporate risk management requirements, the Bureau developed a risk

28 The Bureau indicated that, in addition to the existing advisory and consultation arrangements, it has been engaging stakeholders at different levels using a variety of channels since the inception of the Improving Water Information Program. This has included: national water information seminars for stakeholders across Australia in 2007, 2009 and 2011; technical bulletins; and newsletters.

management strategy in November 2008, as part of the Water Division Strategic Plan. The strategy was designed to provide 'the basis for monthly tracking of progress in implementing effective strategies for risk mitigation in relation to the water information initiative'. The strategy identified 10 risks that required management. These risks covered staffing, the status and adequacy of the science, potential inadequacies in or failure to produce water information products of value to external users, and potential failure to establish effective systems for web-based delivery and data management.

2.31 The Bureau's risk management strategy provided reasonable coverage of the higher level risks to the effective implementation of the program. These were appropriately identified early in the implementation phase. The risk register has also been updated each year to reflect changes in the program's risk profile. Corresponding treatment strategies to mitigate the risks were identified and included: active liaison with stakeholders and service users; staff recruitment, training and development; investment in research and development alliances; and engaging a private sector partner in the build of IT systems. The treatment options were practical and achievable. However, the risks of 'failure to produce water information products of value to external users' and 'not having an effective system for web-based delivery and data management,' were underestimated—especially given the importance of water information for government policy purposes and the significant challenges in building new information technology systems.

2.32 A systematic, risk-based program of compliance assessment activities is also an important risk management tool to enable an agency with regulatory responsibilities to target available resources to the highest priority risks and to respond proactively to changing and emerging risks.[29] An early focus on compliance assists agencies to put in place an effective, planned compliance process rather than simply reacting to non-compliance after the event.

2.33 The Bureau's Compliance Strategy was finalised in August 2009. It sets out the Bureau's broad approach to compliance and enforcement under the *Water Act 2007* and the associated Water Regulations 2008. The strategy was appropriately designed to meet the Bureau's regulatory responsibilities. Consultations with key stakeholders (including the Minister) in 2008 and 2009

29 ANAO Better Practice Guide – Administering Regulation, March 2007, Canberra, p. 51.

also assisted the Bureau to align its initial compliance and enforcement actions with government priorities and expectations.

Performance measurement and reporting

2.34 Performance measurement and reporting informs management decision making, apprises stakeholders of program performance and provides assurance that programs are being effectively implemented in the way intended. The ANAO examined the Bureau's key performance indicators (KPIs) to inform its reporting to external stakeholders, as well as internal reports to senior management. The three annual progress reports on the Improving Water Information Program that supplement the annual reporting requirements were also examined.

Key performance indicators and operational targets

2.35 KPIs and operational targets provide the means by which the performance and impact of the program is measured. While water information KPIs have been largely reflected in the Bureau's Portfolio Budget Statements for each year of the program, the number and nature of KPIs have changed over the life of the program. This was to reflect changes in the program's performance framework, as well as changes as the program has matured over time. This variability in the number of KPIs is illustrated in Table 2.1.

Table 2.1: Key performance indicators for the Improving Water Information Program

Year	Number of Key Performance Indicators
2007–08	7
2008–09	4
2009–10	7
2010–11	10
2011–12	9

Source: Bureau of Meteorology annual reports from 2007–08 to 2011–12.

2.36 In 2007–08 and 2008–09, the KPIs were broad and difficult to measure. For example:

- **2007–08**: Hydrological services contribute to: minimising loss of life and property and community disruption; minimising economic and other costs of disaster preparedness; the safety, comfort, convenience and

general welfare and economic benefit of the public and major community groups; government and community planning; the management of the environment, including natural resources; and the economy and efficiency of primary and secondary industry; and

- **2008–09**: community safety and wellbeing are served through preparation of water data products and information and the effective use of hydrological and flood forecasting services by the general public, industry, and major social and economic sectors.

2.37 A further consideration is that some KPIs may not have been able to be achieved within the timeframe of the program. There are also multiple factors that could influence the stated outcomes apart from hydrological services, and it would have been particularly difficult for the Bureau to separate these from its activities with any degree of precision.

2.38 In 2011–12, the KPIs were more specific and measureable. They included:

- the *2011 National Water Account* provides a satisfactory basis for reconciling water use with water access entitlement regime in high-priority managed water systems; and
- skilful streamflow forecasts of up to three months ahead for at least 21 key locations in the Murray–Darling Basin.

2.39 While these KPIs were more measurable, it is also important that KPIs sufficiently cover all key aspects of the program and readily inform an assessment of the extent to which the program is achieving its outcomes. It is recognised that KPIs change to some extent from year to year to reflect changes in government requirements or to better measure results. However, a core set of specific, measureable and achievable KPIs should form the basis of consistent measurement and reporting over time.[30]

30 The Bureau has a higher degree of consistency in the operational targets that are used for internal reporting purposes. This has helped the Bureau to measure progress on key deliverables, such as compliance, the program of financial assistance to data providers, new water products and IT systems.

Recommendation No.1

2.40 To strengthen the reporting of performance information on the Improving Water Information Program, the ANAO recommends that the Bureau of Meteorology:

- develop relevant, reliable and complete key performance indicators; and
- report against these indicators on the extent to which the program's outcomes are being achieved.

Bureau's response:

2.41 *Agreed. The Bureau has redesigned and consolidated its key performance indicators (KPIs) in 2012–13 to better demonstrate its performance in achieving its legislative and program responsibilities, and enterprise outcomes and objectives. Enterprise level KPIs are underpinned by program level KPIs that demonstrate progress against deliverables. Progress is monitored by the Bureau's Senior Managers' Meetings (SMM) two to three times a year. The Bureau retained the KPIs from the 2012–13 Portfolio Budget Statements in 2013–14 to enable consistency in reporting. Performance against KPIs is also included in the Bureau's Annual Report. The status of AWRIS and other major IT projects are now specifically identified as major deliverables in the Bureau's operational plan and progress is now reported to SMM.*

Reporting to Parliament and stakeholders

2.42 Annual reports are one of the principal accountability mechanisms between departments and the Parliament.[31] The reporting of performance through the annual reporting cycle provides an opportunity for agencies to demonstrate and promote their achievements and explain any variance from expectations or reference points, while meeting statutory accountability requirements.

2.43 The Bureau uses its KPIs to form the basis of performance reporting for its annual report to Parliament each year. However, as outlined earlier, the Bureau has changed the number and nature of KPIs for the Improving Water Information Program each year, which makes it difficult for stakeholders to determine program performance over time.

31 Department of the Prime Minister and Cabinet, *Requirements for Annual Reports,* 2010, Canberra, p. 3.

2.44 Nevertheless, each annual report to Parliament has included coverage of the program with explicit recognition of performance shortcomings as well as program achievements. For example, the 2011–12 report noted the positive delivery of water information from organisations listed in the Water Regulations 2008, product releases such as a new version of the Hydrological Geospatial Fabric[32] and 24-hours-a-day flood forecasting and warning services for 300 locations across 126 basins. It also noted delays in the release of products, such as the National Water Account, that streamflow information was not published online and the absence of a user satisfaction survey, which was anticipated to measure a KPI for the program.

2.45 In addition to the Bureau's annual reports, annual progress reports on the program were intended to describe the progress made each year in delivering on statutory obligations under the Act. The reports provided stakeholders with insights into the achievements of the program and progress against expectations. The reports prepared from 2010 to 2012 acknowledged the improvements being made to water information and the range of new products and services being produced. However, these reports would have benefitted from greater coverage of the constraints and challenges in implementation that were noted in both internal reports and the annual reports. Greater detail in this regard would have assisted stakeholders to better understand the issues facing the Bureau in the implementation of an important initiative that is intended to improve government policy development and water management in Australia. The 2013 report (tabled during the course of the audit) has, however, recognised the challenges faced by the Bureau in building the data warehousing component of the Australian Water Resources Information System. The report explicitly notes the redesign and rebuilding work undertaken.

Internal reporting

2.46 Quarterly reports to senior management have been the key means by which the performance of the Improving Water Information Program was communicated internally. The Bureau's internal performance reporting from January 2009 to April 2013 outlined the management of risks and progress

32 The Australian Hydrological Geospatial Fabric (Geofabric) is a specialised Geographic Information System (GIS). It registers the spatial relationships between important hydrological features such as rivers, water bodies, aquifers and monitoring points. Available from: <http://www.bom.gov.au/water/geofabric/> [accessed 23 September 2013].

against intended outputs and products or services. These reports have utilised 'traffic light' indicators to highlight the status of key initiatives and targets.

2.47 In 2009, the reports outlined the challenges relating to compliance and IT system development. From 2010, the focus of the reports changed as compliance rates improved and greater attention was given to delays or difficulties with particular products or services. Where problems or delays were reported, measures were outlined to address them. Continuing problems were noted with data and/or IT system capability from January 2009 through to April 2013. This issue is discussed further in Chapter 5.

2.48 There was, however, scope for the reports to have included information on whether the products and services were progressing within cost estimates, as budgets had not been established for each project/product being developed and released. Advising senior management of actual costs against estimates for major projects would better position the Bureau to manage financial risks under the program. This approach would assist in making judgements on the extent to which the program is delivering value for money to the Government.

Conclusion

2.49 Since the inception of the program in 2007–08, the Bureau has appropriately focused its planning processes to meet the requirements of the legislation and the policy outcomes expected by government. A range of new products are now in place, although generally later than planned. Management and advisory structures were appropriate and consistent with a collaborative model of service delivery necessary for the program. The technical and scientific challenges in building capability in data management and producing a suite of high-quality water information products and services were substantial, requiring investment in applied research with a range of partner agencies. Expenditure under the program has been $186 million to 30 June 2013, representing 54.7 per cent of the planned budget after savings have been taken into account.

2.50 An appropriate approach to stakeholder communication and engagement has also been established and will be enhanced through a planned overarching stakeholder framework for 2013–17. While the Bureau gave appropriate and early attention to risk management and compliance, some risks (such as a failure to establish effective systems for web-based delivery and data management) were underestimated.

2.51 The program's early KPIs were broad and difficult to measure, but have become more specific and measurable over time. Nevertheless, the program's current KPIs do not readily inform an assessment of the extent to which the program is achieving its outcomes. Having a set of specific, measurable and consistent KPIs from year to year will better position the Bureau to inform internal and external stakeholders of the program's progress—particularly in relation to implementation challenges and constraints.

3. Collaboration and Compliance Management

This chapter examines the Bureau of Meteorology's arrangements for collaborating with water organisations and managing compliance with water data provision requirements.

Introduction

3.1 The Water Regulations 2008 (the Regulations), which commenced on 30 June 2008, form the basis of the relationship between the Bureau and Australia's water organisations. According to the Regulations, named water organisations are required to provide the Bureau with specified water information that is in their possession, custody or control, in accordance with Part 7 (Water Information) of the *Water Act 2007* (the Act). The Regulations also specify the timeframe and form in which this information must be given. As the regulator, the Bureau has to balance its regulatory role with its goal of fostering collaboration among water organisations.

3.2 The ANAO examined the Bureau's:

- communication with water organisations;
- national water information standards development;
- data licensing arrangements; and
- compliance management arrangements.

Communication with water organisations

3.3 Since 2007, the Bureau has conducted a range of communication activities across the water sector. These activities initially focused on raising awareness of the Bureau's new role and responsibilities under the Act and consultation on the development of the drafting instructions that would underpin the Regulations.

3.4 The organisations that were to be named under the Regulations were sent emails in December 2007 and again in February 2008 that: outlined the Bureau's new water information role under the Act; explained the proposed obligations; and directed the organisations to a website where information

about the Act, the latest version of the drafting instructions for the Regulations and a suite of frequently asked questions could be accessed.

3.5 The Bureau also delivered national water information seminars targeting the water sector and related groups in all Australian capital cities in 2007, 2009 and 2011. This seminar series enabled the Bureau to reach a large number of stakeholders—with more than 1000 participants each year. In 2007, the seminars focused on informing stakeholders about the Bureau's new water information role and establishing relationships with key stakeholders. The later 2009 seminars updated stakeholders on the Bureau's progress and introduced some water information products. The 2011 seminars focused on demonstrating the practical value and use of water information in water resources policy, planning and management.

Guidance provided to named water organisations

3.6 In June 2008, the Bureau notified named water organisations in writing of their new responsibilities under the Water Regulations 2008 and provided information on the types of water data that would be required, how the data should be provided, when the data would need to be submitted and how the organisations could access the Regulations and RegsOnline.[33]

3.7 The Bureau also requested the organisations to complete a water information survey through the Bureau's website. The survey was designed to provide the Bureau with the information needed to determine the relevant data held by each organisation and to establish an appropriate data transfer process with each organisation.

3.8 After the Bureau had determined the data held by each organisation, a Letter of Understanding (LoU) was provided to each organisation that outlined data provision requirements. The letter included an attached schedule of: the specific subcategories of water information the organisation had in its possession, custody or control and would need to provide to the Bureau; and the subcategories the organisation did not have in its possession, custody or

33 RegsOnline is a web-based tool on the Bureau's website that enables organisations to view, download and generate reports on their obligations under the Regulations. RegsOnline continues to be available through the Bureau's website to aid organisations in understanding their regulatory responsibilities. Available from: <http://www.bom.gov.au/water/regulations/search.php> [accessed 30 July 2013].

control and, therefore, would not need to provide to the Bureau.[34] These documents were signed by the organisations and returned to the Bureau to indicate and record the organisations' understanding of their responsibilities.

3.9 The Bureau also provides information and guidance to water organisations via its website, water information bulletins, newsletters, ongoing contact with individual organisations and the Jurisdictional Reference Group on Water Information (JRGWI).[35]

ANAO consultation with named water organisations

3.10 In June 2013, the ANAO sought written comments from the water organisations named under the Regulations, on their experiences with the Improving Water Information Program.[36] Of the 41 organisations that responded in relation to the guidance provided by the Bureau, 88 per cent (36 of 41) indicated that the Bureau had provided them with sufficient information on their obligations and responsibilities, seven per cent (3 of 41) said the Bureau had not provided them with sufficient information and five per cent (2 of 41) were neutral in their response.

3.11 In relation to the Bureau's communication with stakeholders overall, of the 42 organisations that responded, 81 per cent (34 of 42) gave a positive opinion. No organisation gave a negative opinion and 19 per cent (8 of 42) gave a neutral or mixed opinion. Many of the stakeholders commented on their good working relationship with the Bureau.

National water information standards development

3.12 Under the *Water Act 2007*, the Bureau has the statutory responsibility to compile and deliver comprehensive water information across Australia. Under section 130 of the Act, the Director of Meteorology may issue national water information standards relating to water information. The standards within the Bureau's area of authority cover a range of water information activities from collecting, monitoring and transmitting water information through to

34 The Regulations exempt data providers from providing information that they do not have in their possession, custody or control. The Bureau has determined that information is in an organisation's possession, custody or control once it is in the organisation's data management system.

35 The purpose and composition of the JRGWI is discussed in Chapter 2.

36 In total, 56 organisations provided feedback to the ANAO, however, each respondent did not answer every question.

reporting and water accounting.[37] The following three key sets of standards have been developed and disseminated by the Bureau: the Water Data Transfer Format (WDTF); a standardised national set of terms and definitions; and the Australian Water Accounting Standard.

3.13 The WDTF was developed jointly by the Bureau and CSIRO as a national standard for translating water data into a common format.[38] Most large water agencies in Australia have adopted the standard, as have most vendors of water information system software used in Australia. In 2012–13, 78 per cent of all files received by the Bureau were in WDTF. The first version of WDTF (V0.1) was released in August 2008 and the sixth version (V1.0.2) was released in May 2012, with this version scheduled to become a legislated standard for lead water agencies in 2013–14. According to the Bureau, the use of the WDTF standard is enhancing the quality and increasing the sharing of water data in Australia.

3.14 The standardised national set of terms and definitions was developed for water entitlements, allocations and trades, which is an area that has had significant terminology variances between jurisdictions across Australia. The standardised terms and definitions have been adopted in the National Water Market[39] and for the National Water Account.[40] Further standardisation of water information terminology has been achieved through the Australian Water Information Dictionary, which was released online in 2011 and contains definitions for terminology used in the Bureau's water information products.

3.15 The first Australian Water Accounting Standard (AWAS 1) was developed and disseminated as a basis for preparing the National Water Account and for the application of water accounting by other Australian water

37 According to section 130(2) of the Act: the national water information standards may deal with all or any of the following: (a) collecting water information; (b) measuring water; (c) monitoring water; (d) analysing water; (e) transmitting water information; (f) accessing water information; (g) retaining and storing water information; (h) reporting water information; (i) water accounting; and (j) any other matter relating to water information that is specified in the Regulations.

38 WDTF provides a standardised file format based on an Extensible Markup Language (XML) schema. The importance of WDTF in data management is discussed further in Chapter 5.

39 Water markets relate to the buying and selling of water. The Australian national water market is made up of several water markets, differentiated by water system or administrative boundaries. The scale of Australia's water markets varies greatly, from small unconnected water markets to extensive connected systems such as the Murray–Darling Basin, the largest water trading area in Australia.

40 The National Water Account is published annually by the Bureau. It contains standardised information about the management of Australia's water resources. The National Water Account is discussed further in Chapter 6.

agencies and businesses. The AWAS 1 was developed by the Water Accounting Standards Board, an independent advisory body established by, and reporting to, the Bureau. The standard blends accrual-based financial accounting principles with water balance concepts used by hydrologists. It sets out procedures for quantifying water assets, water liabilities, net water assets, changes in water assets and changes in water liabilities. The Bureau informed the ANAO that, as at October 2013, three organisations—the Bureau, the New South Wales Office of Water and the Commonwealth Environmental Water Office—were using the AWAS 1 to guide the preparation and presentation of water accounting reports.

3.16 In late 2012, the Water Accounting Standards Board and the Auditing and Assurance Standards Board[41] also released a proposed second standard on assurance engagements, AWAS 2, for public comment.[42] The proposed standard establishes requirements relating to assurance engagements and provides explanatory material regarding an assurance practitioner's responsibilities when conducting an engagement to provide assurance on a general purpose water accounting report. Assurance with AWAS 2 is intended to enhance users' confidence in the quality of reported information and in making decisions about the allocation of water resources.

Consultation with industry

3.17 In 2010, the Bureau sought to consult experts in the water industry and engaged a consulting firm to undertake a needs analysis for Australian water information standards. The objective of the project was to gather views on the adequacy of current water information standards and seek suggestions for improvement. Through consultation with approximately 50 stakeholders, the project found there to be a general perception that water information standards were inadequate, particularly for metadata and describing data quality. Stakeholders indicated that a few simple measures—such as, improved definitions, common units and minimum standards for data transfer and metadata—would be particularly beneficial.

3.18 Overall, the mandate of the Bureau to lead the process was well recognised, however, there was a strong view that a highly collaborative

41 The Auditing and Assurance Standards Board is an independent, statutory agency of the Australian Government, responsible for developing, issuing and maintaining auditing and assurance standards.

42 AWAS 2 was available for public comment until 15 March 2013.

approach was required if new standards were to be widely adopted. The findings of this industry needs analysis assisted the Bureau in determining a strategy for water information standards development. One of the recommendations from the project was that the Bureau convene a forum to consult with industry on the development of standards. The Bureau subsequently established the Water Information Standards Business (WISB) Forum.[43]

Bureau's approach to water standards development

3.19 Through the WISB Forum, the Bureau has developed a three-tiered approach to developing water information standards: Tier 1—Legislated standards; Tier 2—Non-mandatory standards and guidelines; and Tier 3—Work practices and procedures.

Tier 1—Legislated standards

3.20 Compliance with legislated standards is mandatory. There is a legal requirement for certain organisations to comply via an act or regulation. Legislated water information standards are issued by the Bureau under Part 7 (Water Information) of the Act. An example of a Tier 1 legislated standard is the WDTF V1.0.2, once it is mandated. An amendment to the Regulations, which will bring this into effect, is planned for 2013–14.

Tier 2—Non-mandatory standards and guidelines

3.21 Conformance to non-mandatory standards and guidelines is voluntary, with published documents providing requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purposes. It is within this tier that the WISB Forum plays a key role in the development, endorsement and promotion of national industry guidelines. For example, at its meeting in May 2013, the Forum endorsed a series of 10 National Industry Guidelines for hydrometric monitoring, including seven guidelines for general hydrometrics and three guidelines dealing with the application of Acoustic Doppler

43 The WISB Forum was established in December 2010 as a committee with national representation to coordinate and foster the development, review, endorsement and promotion of water information guidelines and standards. The Forum is chaired by a Bureau representative, and its membership includes representatives from state and territory water agencies and water utilities, the Murray–Darling Basin Authority, the Australian Hydrographers Association and industry groups. As at October 2013, there had been four one-day meetings of the Forum: December 2010; November 2011; September 2012; and May 2013. The ANAO observed the fourth meeting in May 2013.

technology.[44] These guidelines have the support of the hydrometric industry and were recommended for Forum endorsement by the peak industry body for hydrometric monitoring—the Australian Hydrographers Association. These guidelines were published on the Bureau's website in September 2013.

Tier 3—Work practices and procedures

3.22 Work practices and procedures are typically developed by an organisation to assist with the implementation of the requirements of overarching standards or guidelines within each of the organisation's business activities. Work practices and procedures describe detailed work instructions and directions. The WISB Forum provides members with the opportunity to share work practices and procedures. Examples of Tier 3 work practices and procedures include site visit procedures and operating procedures for monitoring instruments.

Reporting on standards development

3.23 Within the Bureau, progress on national water information standards development is reported in the senior management meeting quarterly reports. Externally, progress on standards development is reported in the Bureau's annual reports under the Water Information Program's first objective:

> To improve the transparency, independence and rigour in managing water information across Australia through the development and issuing of national water information standards.[45]

3.24 Reporting against this objective includes narrative information on performance and results for a number of deliverables and key performance indicators (KPIs), as outlined in Table 3.1. Progress on standards development is also reported to key stakeholders at JRGWI and WISB Forum meetings.

44 Acoustic Doppler technology relates to the use of Acoustic Doppler Current Profilers (ADCPs), which are hydro-acoustic current meters similar to sonar. ACDPs measure water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column.

45 This objective was reported against in the Bureau's 2009–10, 2010–11 and 2011–12 annual reports.

Table 3.1: Annual reporting on standards development

Annual Report	Deliverable / Key Performance Indicator	Result
2008–09	Water information standards satisfy the requirements of water planners and managers.	In progress.
2009–10	Complete preliminary national water accounting standards.	Achieved.
2010–11	Publish the *Australian Water Accounting Standard.*	Achieved. Exposure draft published in October.
	Publish Version 1 of the *Australian Water Information Dictionary.*	Achieved.
2011–12	Release the first Australian Water Accounting Standard.	Achieved.
	Publish Version 2 of the *Australian Water Information Dictionary.*	Achieved.

Source: ANAO analysis of Bureau of Meteorology annual report information.

Data licensing arrangements

3.25 While the Act empowers the Bureau to acquire and publish water information, data owners retain full ownership rights to their data. This has implications for the utilisation of acquired data by others. Although the Bureau is freely able to use the data it acquires, this is not necessarily the case for third parties who may wish to repurpose the data that is published by the Bureau. The Bureau has negotiated with data providers to establish common licensing arrangements that maximise the utilisation of the data by third parties.

Creative Commons Attribution licence arrangements

3.26 The Bureau sought the agreement of the named organisations to make their data available under a Creative Commons Attribution licence. Under this type of licence, users can freely copy, distribute, transmit and adapt the data and make commercial use of it, as long as they attribute ownership of the data to the provider.

3.27 As at October 2013, 40 of the 232 named organisations had full exemptions from providing data to the Bureau. Of the 192 organisations that did not have full exemptions:

- 90 per cent (172 of 192) had agreed to supply water data under a Creative Commons Attribution licence;

- three per cent (6 of 192) had responded that they do *not* agree to supply water data under a Creative Commons Attribution licence; and
- seven per cent (14 of 192) had not yet nominated a preference.

3.28 Those that did not agree to provide data under a Creative Commons Attribution licence provide data under general copyright. The Bureau is permitted (under the *Water Act 2007*) to use this data, but other users must contact the data provider to secure permission before using the data.

Compliance management arrangements

3.29 The timelines by which organisations were required to submit data ranged from three to 12 months from the commencement of the Regulations. The earliest required transmission of data applied to 44 organisations[46] that were required to supply specified new and ongoing hydrometric water information in three water information categories[47] by October 2008.

3.30 There are eight categories of water organisations named under the Water Regulations, as outlined in Appendix 2. Any one organisation can fall under a number of these categories and most fall under more than one. For example, a major water utility is likely to fall under three organisation categories: D—Owners and operators of major storages; F—Urban water utilities; and H—providers of flood data.

3.31 Each category of organisation is associated with particular categories and subcategories of water information that need to be provided to the Bureau—if the information is in the organisation's possession, custody or control. According to the Bureau's website, there are 10 categories of water information and 105 subcategories.[48]

Exemptions

3.32 The Regulations contain a number of exemptions from organisations' obligations to provide water information. These exemptions include situations where the organisation does not have water information in their possession,

46 In three water organisation categories—A, B and C.

47 Surface water resource information, ground water resource information and water storage information.

48 A list of the 10 water information categories and the associated number of subcategories is provided at Appendix 2.

custody or control. Where organisations hold water data, they can obtain exemptions for the provision of water information that is:

- not in an electronic format;
- collected from a single site for no more than 12 continuous weeks;
- in the possession, custody or control of an organisation that reasonably believes that the water information is already in the Bureau's possession and has notified the Bureau, in writing, of the decision not to provide the information because of that belief; and
- collected solely for a project that the organisation expects to be of no more than 12 months duration.

3.33 As mentioned at paragraph 3.27, 40 named organisations have full exemptions (see Table 3.2).

Table 3.2: Exemptions

	Number of exemptions
Data not in possession, custody or control	21
Organisations reasonably believe information is already in the Bureau's possession and have given written notification	16
Information not in electronic format	2
Data collected solely for a project of no more than 12 months duration	1
Total	**40**

Source: ANAO analysis of Bureau of Meteorology information (as at October 2013).

3.34 The ANAO's examination of the Bureau's arrangements to manage the compliance of named water organisations focused on: the Compliance Strategy; compliance monitoring; non-compliance; and reporting on compliance.

Compliance Strategy

3.35 Following the introduction of the Regulations, the Bureau developed a Compliance Strategy that outlined its arrangements for communicating regulatory responsibilities to named water organisations, monitoring compliance, escalating responses to non-compliance and taking enforcement action when necessary. According to this strategy, examples of non-compliance include: incomplete or no data sent; late data; information that is not in the form or manner specified in the Regulations; contravention of an obligation

imposed under section 126 of the *Water Act 2007*; and provision of false or misleading information.

3.36 The Bureau's preferred approach has been to work with named water organisations by educating them about their obligations and encouraging them to meet these obligations. The Bureau has met with organisations to discuss regulatory requirements, conducted workshops and informed organisations about technical issues and changes to the Regulations through mail-outs and emails. The Bureau has also responded to individual inquiries and provided ongoing assistance to water data providers.[49]

3.37 In those cases where established activities do not elicit the desired response from an organisation, the Bureau has an escalating response policy, which involves three levels of communication, as outlined in Table 3.3.

Table 3.3: Non-compliance letters by level

Level	Description	Signed by
Level 1	Letter alerting the recipient to the fact that they may be in breach of the Regulations and advises how the situation can be addressed.	Assistant Director
Level 2	Letter providing a fixed date by which action must be taken to address the breach.	Assistant Director
Level 3	Letter advising that unless the breach is addressed within a fixed period, the Bureau will recommend to the Minister that enforcement action be taken.	Deputy Director

Source: ANAO analysis of Bureau of Meteorology information.

3.38 The Compliance Strategy outlines that the Bureau's Customer Relationship Management (CRM) system is to be used to record: the communication with water organisations; the Bureau's efforts to assist each organisation to achieve compliance; and the compliance status of each organisation.

49 While all water data providers are named water organisations under the Regulations, not all named organisations are water data providers, as some named organisations have exemptions from providing data or do not have water data in their possession, custody or control.

Compliance monitoring

Early compliance monitoring

3.39 After the October 2008 deadline had passed for the first 44 named organisations to submit data, the Bureau assessed the level of compliance in November 2008 and found that six of the 44 organisations had indicated that they did not have data to supply and were, therefore, exempt from supplying data under the Act. Of the remaining 38 organisations:

- 45 per cent (17 of the 38) had provided the specified data; and
- 55 per cent (21 of the 38) had indicated that their delivery of data in the Bureau's preferred format would be delayed.

3.40 The organisations that were unable to meet the required timeframes sought reassurance from the Bureau that they would not be the subject of an enforcement action[50] if, in applying the Bureau's preferred transfer formats, they did not meet the timeframes prescribed in the Regulations. In November 2008, the Bureau obtained the Minister's agreement to defer enforcement action, for a period of six months, against organisations that had not met their obligations to give water information to the Bureau—where an agreed process and timetable for supplying the information had been provided and was being followed.[51] The six-month deferment was expected to help maintain the high level of cooperation the Bureau had received since the commencement of the Regulations.

3.41 In August 2009, the Bureau assessed the level of compliance and found that 55 organisations had not submitted data by the due dates. Only three of these cases were deemed to be non-compliant requiring follow-up.[52] In each of these cases, the due date and the six-month deferment period had passed. The

50 There are a range of enforcement actions outlined in Part 8 of the *Water Act 2007* that the Minister may take in response to a contravention of the Water Act or Water Regulations. These actions include injunctions, declarations, civil penalties, infringement notices and enforceable undertakings.

51 According to section 137 of the *Water Act 2007*, the Minister is the appropriate enforcement agent for a contravention under Part 7 of the Act. As the Minister is the deemed enforcement agent, the Bureau could not give organisations assurance without agreement from the Minister.

52 The reasons the other 52 organisations had not submitted data were: 22 were catchment management authorities that had approximately five months remaining until the deferred due date; 20 organisations had acceptable reasons why they had not yet submitted data; four organisations had technical issues that the Bureau was working with them to resolve (and had resolved by October 2009); and six Tasmanian organisations had undergone institutional changes (only two were included in the subsequent revised list of named organisations).

Bureau sent Level 1 letters of non-compliance to these three non-compliant organisations, and all three cases were resolved without escalation.

Ongoing compliance monitoring

3.42 As outlined at paragraph 3.27, 192 organisations were required to submit data to the Bureau (and had no exemptions), and all had established an ongoing data-provision relationship with the Bureau. The Bureau continues to monitor these organisations' data delivery and compliance to ensure that water data specified in the Regulations is being delivered. The Bureau's data compliance activities have focused on the receipt of data that is used to deliver the Bureau's services, reports and products.

3.43 The Bureau informed the ANAO that there has been a high level of cooperation and compliance from organisations supplying data and a high level of support for the Bureau's Improving Water Information Program. In the period from June 2008, when the Regulations came into effect, to October 2013, named organisations supplied the Bureau with more than 21 million water data files containing over 4 billion time-series observations.

Routine compliance investigations

3.44 The Bureau conducts a number of routine investigations into the compliance of water data providers each year as part of its compliance monitoring activities. The Bureau informed the ANAO that it has conducted 123 routine compliance investigations between 2008–09 and 2012–13, with the nature of investigations evolving over time. Initially, they focused on whether required data had been delivered. Later, they involved more extensive investigations into the data categories that had been delivered, the periods for which data had been delivered and the sites for which data had been delivered. For each of the 123 investigations, the Bureau's Data Provider Liaison Officer conducted a manual in-depth analysis of raw data files, which involved up to two weeks for the larger water data providers. As part of the 2012–13 investigations, the Bureau also assessed the impact that mandating the use of WDTF would have on lead water agencies.

3.45 The Bureau's selection of organisations to investigate has been risk-based, with the Bureau's Data Provider Liaison Officer selecting organisations with data supporting upcoming Bureau product releases or who had been identified as being potentially non-compliant through the Bureau's regular and ongoing checks of incoming water data.

Non-compliance

3.46 Although data provision relationships exist with all relevant named organisations, an organisation can become non-compliant if one of its data streams fails in transmission to the Bureau. Many organisations submit multiple streams of data to the Bureau every day. For example, one urban water utility is required to submit data for 26 subcategories of water information. For 13 of these subcategories, data is to be submitted at least daily and, for each of these categories, the organisation could report on dozens of sites. If one of the organisation's potentially hundreds of daily data deliveries were to fail, the organisation would be considered 'non-compliant' until all of the daily data transmissions were restored. The Bureau informed the ANAO that most cases of 'non-compliance' are accidental, minor in nature and resolved relatively quickly through informal communication with the organisation.

3.47 The Bureau's Data Provider Liaison Officer regularly reviews incoming data, identifies potential non-compliance and communicates with potentially non-compliant organisations. The details of communications between the Bureau and perceived non-compliant organisations (by telephone, email and letter) are recorded in the Bureau's CRM system.

Reporting on compliance

3.48 Information on compliance activities and rates are reported both internally and externally. Internal reporting is on an ad-hoc basis, with compliance updates included in some senior management meeting quarterly reports and Australian Water Information Advisory Council (AWIAC) reports. Reports of non-compliance that require escalation have been provided to the relevant Bureau executive through internal briefs, but rates of ongoing compliance are not regularly reported for any specified periods. There would be merit in the Bureau recording the daily compliance rate at set intervals to enable analysis of compliance trends over time.

3.49 As outlined in Table 3.4, compliance rates against relevant KPIs were reported externally in the Bureau's 2009–10, 2010–11 and 2011–12 annual reports.

Table 3.4: Annual report compliance reporting

Annual Report	Key Performance Indicator	Result
2009–10	80 per cent of Australia's historical water data, collected through the Water Regulations 2008, has been consolidated into a standardised, quality-assured, national repository.	Achieved: 95%.
2010–11	Ensure 95 per cent compliance with water data supply to the Bureau per the Water Regulations 2008.	Achieved.
2011–12	Consolidate over 80 per cent of Australia's historical water data collected through the Water Regulations 2008 into a national repository.	Achieved.
	Ensure 95 per cent compliance with water data supply to the Bureau per the Water Regulations 2008.	Achieved: 98%.

Source: ANAO analysis of Bureau of Meteorology annual report information.

Conclusion

3.50 The Bureau has provided appropriate guidance to named water organisations on their responsibilities under the *Water Act 2007* and the Water Regulations 2008, and water organisations were generally satisfied with the level of communication and guidance they have received from the Bureau.

3.51 The development of national water information standards is continuing, with the Bureau engaging with stakeholders through the Water Information Standards Business Forum. The Bureau has taken a three-tiered approach to standards development, with a small number of standards to be mandated and others to be adopted on a voluntary basis. The development of standards and guidelines assists with harmonising water data collection, analysis and reporting across Australia and ultimately improves the quality of the data provided to the Bureau.

3.52 The Bureau has effectively promoted the licensing of water data under Creative Commons Attribution licences, which allow users to freely copy, distribute, transmit and adapt the data as long as they attribute ownership to the data provider. The Bureau has negotiated with water data providers and, as at October 2013, had achieved a 90 per cent participation rate in the Creative Commons Attribution licensing arrangements. The Bureau's achievement of high participation rates for these licensing arrangements has helped maximise

the utilisation of the Bureau's water data by third parties and has increased the availability of water data to the Australian community.

3.53 Monitoring the compliance of organisations named under the Water Regulations 2008 is a key Bureau responsibility. The Bureau has developed and implemented a compliance strategy and an escalated response policy. Initially, the compliance focus was on establishing a data-provision relationship with each named organisation. Since the commencement of the Regulations, there have been only three non-compliance cases identified by the Bureau where a formal response has been required. In each case, the compliance issues were resolved after the first formal response and no further escalation was required. As at October 2013, all of the non-exempt named organisations had provided data to the Bureau.

4. Financial Assistance to Water Data Providers

This chapter examines the Bureau of Meteorology's arrangements for providing financial assistance to water data providers through the Modernisation and Extension of Hydrologic Monitoring Systems Program.

Introduction

4.1 When the Australian Government assigned the Bureau responsibility for reporting on Australia's water resources in 2007, it was evident that major improvements in water data availability, quality and coverage were needed across Australia. The Bureau determined that its efforts to undertake its new national water information role would need to be supported by new technologies to monitor, communicate, process and store water data.

4.2 To address these issues, and to promote collaboration and cooperation among water data providers, the Bureau established the Modernisation and Extension of Hydrologic Monitoring Systems Program (M&E Program) in 2007–08. This program was designed to financially assist water data providers named under the Water Regulations 2008 to modernise and extend their water monitoring systems and to enhance the accuracy and transfer of real-time data to the Bureau.

4.3 As previously noted, the M&E Program awarded $78.1 million across 463 projects over five rounds from 2007–08 to 2011–12. The value of individual grants ranged from $5000 to $2.1 million. Projects received funding to modernise streamflow, groundwater and water storage monitoring networks and to modify their water information systems to export data using the Bureau's Water Data Transfer Format (WDTF). These investments were intended to help address declines in the quality and coverage of hydrologic monitoring networks and to enhance the ease and stability of data sharing.

4.4 The ANAO examined the Bureau's administration of the M&E Program, including the:

- guidance to key stakeholders;
- assessment and selection of grant recipients;
- negotiation and ongoing management of funding deeds;

- acquittal of grants; and
- evaluation and reporting of the program.

4.5 The Bureau engaged consultancy firms to conduct an internal audit of the first two rounds in 2009 and a program review of the first three rounds in 2010. Both made suggestions for improvement, and the Bureau subsequently changed some practices.[53] The ANAO examined the Bureau's assessment practices for Rounds 3, 4 and 5, including documentation for a sample of 75 grants (27 per cent of the 276 grants awarded in the relevant rounds).[54]

Guidance to key stakeholders

4.6 To facilitate access to grant programs, it is important that clear, consistent and well documented grant program guidelines are developed. The Bureau prepared program funding guidelines for each year of the M&E Program and published these on the Bureau's website.

4.7 The 2009 Commonwealth Grant Guidelines (CGGs) outlined that, in addition to the Expenditure Review Committee of Cabinet (ERC) considering guidelines for new grant programs, agencies should consult with the then Department of Finance and Deregulation on whether proposed changes to guidelines for existing grant programs would require ERC consideration.[55] Although the Bureau did not consult with Finance, the Bureau did seek, and receive, Ministerial approval for the M&E guidelines prior to their release in each round.

4.8 The M&E Program funding guidelines included information on the: program objective; key contacts; themes for the round; eligibility and merit criteria; application and assessment process; funding deed; privacy, confidentiality; and conflict of interest and freedom of information arrangements.

4.9 While the M&E Program funding guidelines for Rounds 3 to 5 provided potential applicants with a broad range of information, there was

53 For example, for Rounds 3–5, the Bureau ensured that at least three panel members assessed applications for merit. In earlier rounds, the number of assessors varied. Further detail on the findings of the internal audit and review is provided at paragraph 4.45.

54 Grants were selected on a stratified random sample basis to include grants from each of the three rounds and each of the states and territories.

55 Commonwealth Grant Guidelines, July 2009, p. 11. The 2009 Commonwealth Grant Guidelines applied for the Rounds 4 and 5 program guidelines.

scope for the Bureau to have provided further information relating to the merit assessment process and the decision-maker. The funding guidelines outlined the merit criteria, but did not outline how the criteria would be weighted during the assessment process.[56] This information would have provided applicants with an indication of the relative importance of each assessment criterion. In addition to the merit criteria, the Bureau considered three additional factors when assessing applications: the organisation's track record under the M&E Program; the amount of water information the applicant was required to report to the Bureau under the Regulations; and the alignment of the application with the relevant state or territory Strategic Water Information Management Plan (SWIMP). Only one of these additional factors was explicitly outlined in the funding guidelines.

4.10 While the funding guidelines outlined the selection process, they did not clearly outline who was to make the final approval decisions. According to internal Bureau documentation, the Project Evaluation Committee (PEC) evaluated the applications and made recommendations to the Deputy Director (Water) for decision. Once the Deputy Director (Water) had agreed to the list of recommended projects, it was submitted to the Minister for endorsement. Although the Minister endorsed the list of approved projects, the Minister was not the final decision–maker, with the funding approval decisions made by the Deputy Director (Water).[57] For any future grant programs, there would be merit in the Bureau clearly identifying in the published funding guidelines: the relative importance of the assessment criteria; any additional factors to be considered during the assessment process; and the final decision–maker.

Assessment and selection of grant recipients

4.11 The Bureau established the PEC to assess applications and provide an evaluation report to the Deputy Director (Water) recommending projects for funding. The PEC was composed of: 41 Bureau officers in Round 3; 50 Bureau officers in Round 4; and 57 Bureau officers in Round 5.

56 The internal application evaluation plan prepared for each round indicated that the seven merit criteria were weighted between five and 15 points each in Rounds 3 and 4 and between five and 20 points in Round 5.

57 In the first two rounds of the program, the Minister had been the decision-maker. This is discussed at paragraph 4.20.

4.12 The Bureau created an Application Evaluation Plan for each round, which outlined the assessment process and the roles and responsibilities for the PEC, evaluators, approver and Minister in assessing, recommending, approving and endorsing applications. The plan outlined that applications were to be assessed, given a score out of 100 and subsequently ranked based on these scores.

Receipt of applications

4.13 Applications were to be submitted by email to the M&E Program mailbox, with rounds being open for between four and 10 weeks[58] (as shown in Table 4.1).

Table 4.1: M&E Program application round dates

	Round 1	Round 2	Round 3	Round 4	Round 5
Application round opened	26 Feb 2008	15 Sep 2008	20 Apr 2009	26 Feb 2010	22 Feb 2011
Application round closed	28 Mar 2008	10 Oct 2008	18 May 2009	30 Apr 2010	6 May 2011
Length of round	4 weeks	4 weeks	4 weeks	9 weeks	10 weeks

Source: ANAO analysis of Bureau of Meteorology information.

4.14 The Bureau received a total of 789 applications across the five rounds of the program. Of these, four were withdrawn by the applicants, 10 were deemed ineligible and 775 were assessed for merit by the Bureau. Of the assessed applications, 60 per cent were awarded funding, as shown in Table 4.2.

58 The Bureau considered a minimum of four weeks to be a reasonable timeframe for an application round. In the early rounds, timeframes for the whole program were compressed, and the Bureau was unable to offer applicants more than the minimum time. By Rounds 4 and 5, the Bureau was able to offer applicants an extended application timeframe.

Table 4.2: Applications assessed and funded per round

	Round 1	Round 2	Round 3	Round 4	Round 5	Total
Applications received and assessed for eligibility	70	230	207	171	111	**789**
Applications deemed to be ineligible	2	5	1	2	0	**10**
Applications deemed to be eligible	68 (97%)	225 (98%)	206 (99.5%)	169 (99%)	111 (100%)	**779 (98.7%)**
Applications withdrawn	0	0	2	2	0	**4**
Applications assessed for merit	68	225	204	167	111	**775**
Applications funded (percentage of applications assessed for merit)	55 (81%)	132 (59%)	118 (58%)	92 (55%)	66 (59%)	**463 (60%)**

Source: ANAO analysis of Bureau of Meteorology information.

Eligibility assessment

4.15 The number of potential applicants was contained—as only the organisations named under the Water Regulations 2008 were eligible to apply for funding under the M&E Program. Before an organisation could submit an application, it was required to contact the Strategic Water Information Co-ordinator (SWIC) for their state or territory to obtain a Project Identification Number (PIN) and an application form—these could not be directly sourced from the Bureau.[59] After applications were submitted (and the application deadline had passed), Bureau staff assessed the applications against the six eligibility criteria. The outcomes of the eligibility assessment were recorded in a master spreadsheet.

59 The Bureau funded a SWIC in each state and territory to: promote the M&E Program; register and provide PINS and application forms to applicants; assist applicants to prepare applications and coordinate projects with other organisations; prepare Strategic Water Information Management Plans (SWIMPs); and assist the Bureau with general coordination with water data providers.

Merit assessment of applications

4.16 PEC Members were assigned applications to evaluate that reflected their expertise in the six to 10 theme areas for each round.[60] Arrangements to identify potential conflicts of interest were established, with all evaluators signing a conflict of interest declaration. The merit assessment of applications was undertaken by the PEC, with three PEC members independently evaluating each application and scoring them against the seven merit criteria, which were weighted, as outlined in Table 4.3.

Table 4.3: M&E Program merit criteria (with weightings)

Criterion	Rounds 3 and 4 Weighting	Round 5 Weighting
Project alignment with the Bureau's water information objectives	15	20
Project feasibility	10	10
Methodology	10	10
Value for Money	10	10
Project budget information	5	5
Risk analysis	5	5
Organisational and management capability	5	5
Subtotal	**60**	**65**
Additional three factors considered by the PEC following initial merit assessment	40	35
Total	**100**	**100**

Source: ANAO analysis of Bureau of Meteorology information.

4.17 For the 75 grants reviewed by the ANAO, all applications had been reviewed by three separate evaluators and had the evaluators' rankings recorded in the evaluation master spreadsheet.

4.18 Within the PEC, the PEC sub-committee comprised the PEC Chair, the PEC Facilitator and up to six PEC members. The role of the PEC sub-committee was to: conduct the final evaluation—which was based on the initial evaluations and additional information, such as the organisation's track record under the M&E Program; rank projects by order of merit; and make

60 There were between three and 38 Bureau officers with the expertise necessary to assess applications for each theme area in each round. The theme areas for Rounds 3, 4 and 5 are provided at Appendix 3.

recommendations to the decision-maker. This process was documented in the Bureau's application evaluation plans, and the sub-committee's assessment decisions and reasons for these decisions were documented in the evaluation master spreadsheets.

4.19 Of the 75 grants reviewed by the ANAO, all were recommended for funding in the PEC Evaluation Report. Of these, 60 per cent were recommended for full funding, and 40 per cent were recommended for partial funding. The methodology for determining the amount of partial funding was not clearly documented in the program funding guidelines or the application evaluation plans, but the reasons for partially funding individual applications were recorded in the evaluation master spreadsheet by the PEC sub-committee.[61]

Funding decisions

4.20 In the first two years of the M&E Program, projects recommended by the PEC were submitted to the then Minister for Climate Change and Water (the Minister) for approval. The length of time between receipt of applications and approval of recommended projects was three weeks for Round 1 and approximately two months for Round 2, as shown in Table 4.4.

Table 4.4: M&E Rounds 1 and 2 application round and approval dates

Round	Application round closed	Date of Minister's approval
Round 1 (2007–08)	28 March 2008	18 April 2008
Round 2 (2008–09)	10 October 2008	4 December 2008

Source: ANAO analysis of Bureau of Meteorology information.

4.21 In December 2009, the Bureau sought the Minister's agreement to delegate authority to vary funding deeds and transfer funding between projects to the Bureau's Deputy Director (Water). In response, the Minister requested further advice as to whether there was a limit on the Deputy Director's delegation and for any relevant direction from the then Department of Finance and Deregulation (Finance).

61 Reasons for offering partial funding were also provided in briefings to the decision-maker.

4.22 In March 2010, the Bureau provided the Minister with the following advice from Finance:

> The guidelines for the Program constitute a policy document and carry no ability to delegate the power to approve projects. The authority to approve projects comes from the *Financial Management and Accountability Regulations 1997*. Under the *Financial Management and Accountability (Finance Minister to Chief Executives) Delegation 2007 (No. 2)* this authority is delegated to the Director of the Bureau, who has in turn delegated this authority to the Deputy Director (Water).

4.23 The Bureau informed the Minister that the Deputy Director (Water), therefore, already had the ability to administer, approve and vary funding deeds as necessary to ensure efficient and effective use of Commonwealth resources. The Bureau sought, and received, the Minister's agreement to change M&E Program guidance from stating that recommended projects required approval by the Minister to stating:

> All projects selected for funding and any variations thereto require approval by Bureau of Meteorology officials who do not sit on the Project Evaluation Committee. Approved projects are recommended to [the Minister] for endorsement. Subject to the Minister's endorsement, the Bureau will make applicants aware of any funding offers. The Minister may vary the processes or timing set out in these guidelines and will not be obliged to endorse any application.

4.24 For Rounds 3, 4 and 5, recommended projects were approved by the Bureau's Deputy Director (Water) and endorsed by the Minister. The length of time between the date applications were received by the Bureau and the date recommended projects were approved by the Deputy Director (Water) was one to two months, with the Minister's endorsement being given one to 19 days after approval, as shown in Table 4.5.

Table 4.5: M&E Rounds 3, 4 and 5 application round, approval and endorsement dates

Round	Application round closed	Date of Deputy Director's approval	Date of Minister's endorsement
Round 3 (2009–10)	18 May 2009	3 July 2009	22 July 2009
Round 4 (2010–11)	30 April 2010	[unclear date] June 2010	28 June 2010
Round 5 (2011–12)	6 May 2011	16 June 2011	17 June 2011

Source: ANAO analysis of Bureau of Meteorology information.

Basis of funding decisions

4.25 The PEC provided the decision-maker with the basis for its recommendations in the PEC Decision Brief and Report, which included:

- the full list of recommended projects and a list of reserve projects;
- a description of the evaluation process;
- the evaluation criteria;
- the project themes;
- the dispersion of funds across the states and territories; and
- links to the full applications, the evaluation master spreadsheet, the funding guidelines, a standard funding deed and the application evaluation plan.

4.26 The CGGs and FMA Regulation 9 state that an 'an approver must not approve a spending proposal unless the approver is satisfied, after making reasonable inquiries, that giving effect to the spending proposal would be a proper use of Commonwealth resources'. In all three rounds reviewed by the ANAO, the decision-maker made inquiries and sought additional information prior to the list of recommended projects being finalised. The PEC Chair provided the decision-maker—the Deputy Director (Water)—with additional information where requested.

4.27 In a number of cases in each round, the proposed projects and amounts of funding were adjusted at the Deputy Director's suggestion. During Rounds 3, 4 and 5, the Deputy Director made a total of 28 documented inquiries, which resulted in 13 changes—each of which had a documented reason for the change. For example, the following four changes were made in Round 5: the amount of funding was reduced for one project; the amount of

funding was increased for one project; and partial funding was recommended for two projects that had not initially been recommended.

4.28 In all three rounds reviewed by the ANAO, the Minister endorsed all recommended projects without making any changes to the finalised list of recommended projects. The value of individual grants ranged from $5000 to $2.1 million.

Notification of application round outcome

4.29 After the list of projects had been approved and endorsed, the Bureau provided formal offers of funding to successful applicants and provided written notification to unsuccessful applicants on the outcome of the round. Following these notifications, the Bureau published the list of all awarded grants on its website—as required by the CGGs.

ANAO consultation with water organisations

4.30 As previously noted, the ANAO sought written comments from the organisations named under the Regulations, on their experiences with the Improving Water Information Program.[62] Of the 25 organisations that responded in relation to the allocation of M&E Program funding, 88 per cent (22 of 25) indicated that they considered funding had been allocated in an open, accountable and transparent manner. The remaining three respondents gave the following responses:

> For individual years of the program, funding allocation was transparent. However, in the final year, it was not entirely clear why some bids were accepted over others.
>
> ***
>
> Although we were successful in obtaining a grant, it was not clear how prioritisation was made.
>
> ***
>
> The approval process for projects was managed by the State agency which may have skewed the priorities to State level needs rather than regional priorities.[63]

62 There were 56 organisations that provided feedback to the ANAO.

63 SWICs reviewed applications for funding in their jurisdiction and provided the PEC with a ranked list of the projects in the order of what they considered to be their jurisdiction's priorities. Although the PEC considered the SWICs' rankings as part of their evaluation process, the PEC was not obligated to follow these suggestions.

Negotiation and ongoing management of funding deeds

4.31 Funding deeds were developed and finalised for all of the 75 grants reviewed by the ANAO. The funding deeds outlined between four and eight milestones for each one-year project, with an average of 6.7 milestones. For example, one funding deed reviewed by the ANAO outlined seven milestones for a $22 760 grant. The grant recipient was required to submit a milestone report and invoice (with supporting documentation, such as photographs and/or receipts) at around two-month intervals for payments of between $2000 and $10 000. The Bureau was then required to assess submitted documentation and prepare a milestone evaluation report.

4.32 Requiring grant recipients to submit regular milestone reports helps agencies obtain assurance that projects are proceeding as planned and grant funding is being appropriately applied. However, the extent and timing of monitoring requirements needs to be carefully considered for low-value grants or smaller organisations with limited resources. The CGGs and the ANAO Better Practice Guide on grants administration promote the proportionality principle—where a balance is struck between the complexity and frequency of reporting requirements and the level of risks that need to be managed.[64] The establishment of a large number of milestones under the funding deeds increased the administrative burden on the Bureau and grant recipients.

4.33 The Bureau's August 2010 internal review suggested that the Bureau 'explore administrative streamlining with potential savings to the Bureau and grant recipients'. However, for the grants reviewed by the ANAO, the average number of milestones increased slightly from Round 3 to Round 5.

4.34 A number of grant recipients commented on the administrative burden imposed by M&E Program reporting requirements:

> The required reporting was excessive, difficult and/or overly time consuming, for the amount of funding received.
>
> ***
>
> Staff provided feedback regarding the significant overhead of administering projects. The required commitment and auditing cost made bidding for smaller projects less attractive.
>
> ***

64 ANAO Better Practice Guide – Implementing Better Practice Grants Administration, June 2010, Canberra, p. 94; Commonwealth Grant Guidelines, June 2013, sections 9.1 and 9.4.

> The overheads for ensuring an auditable trail of spending and project progress were significant. There was no benefit for a project under $100 000.

4.35 There would be merit, for any future grant programs, in the Bureau taking a risk-based approach to defining the extent and frequency of monitoring—particularly for low-value grants.

Ongoing management

4.36 M&E Program projects were actively monitored in terms of their milestone achievement. As outlined earlier, before a milestone payment was released, the grant recipient was required to submit a milestone report evidencing that the milestone had been completed along with an invoice, if the milestone was associated with a payment. Bureau staff were required to review the milestone report and prepare a milestone evaluation report and a spending proposal. For the grants reviewed by the ANAO, 93 per cent (320 of 344) of required milestone reports and 97 per cent (333 of 344) of required milestone evaluation reports were retained. The remaining documentation was not retained by the Bureau.

4.37 One of the suggestions for improvement in the 2009 Internal Audit of the M&E Program was to ensure that a signed copy of each approved spending proposal was retained in accordance with the Bureau's records management policy.[65] For the milestone payments reviewed by the ANAO, 295 of 305 had a signed spending proposal on file.[66] The 10 spending proposals that were not retained related to Round 3 grants.

4.38 Of the 295 signed spending proposals reviewed by the ANAO, all were signed by a delegate with an appropriate delegation limit except for two. These two proposals were signed in 2010 by a Bureau Finance Manager, who, at the time, had delegation up to $50 000. The spending proposals exceeded this limit by $5000 in one instance and $60 000 in the other. The delegation for the Finance Manager was increased from $50 000 to $175 000 in April 2011. In those instances where the payment was more than $175 000, the spending proposal was signed by a Deputy Director.

65 For the 10 grants reviewed as part of the internal audit for Rounds 1 and 2, there were three cases where a signed spending proposal was not retained on file.

66 Some milestones were not associated with a payment.

4.39 The majority of signed and dated spending proposals associated with a milestone report were signed after the milestone report had been evaluated and approval given to release the funds. However, eight per cent—a total of 20 proposals—were signed before the evaluation report had been completed and approval given.[67] In all cases, the milestone had been achieved and approval was ultimately given, however, the early payments did not follow the Bureau's processes to ensure that performance against milestones had been achieved before payments were issued. For future grant programs, there would be merit in the Bureau reviewing its procedures to ensure that milestone performance has been evaluated before payments are issued.

Acquittal of grants

Final reports and audited financial statements

4.40 As part of the funding deed, the grant recipient agreed to provide the Bureau with a final report and audited financial statements within 90 business days of the completion of each project, or the termination of the deed, whichever is the earlier. The final reports were to include performance information, such as, the extent to which the project achieved its objectives. For the 75 grants examined by the ANAO: 71 final reports were completed and retained; three were incomplete; and one had not been submitted to the Bureau.

4.41 The audited statements were to be prepared in accordance with Australian Accounting Standards by a qualified accountant who was acceptable to the Bureau. For the 75 grants examined by the ANAO, 70 audited financial statements had been provided. For the remaining five grants:

- one grant recipient had yet to submit audited financial statements;
- one grant recipient did not have financial statements reviewed by an independent auditor, but the Bureau advised that as the project was under $50 000, it was considered sufficient to have a qualified accountant within the Bureau review and endorse the financial statements and invoices; and

67 The number of days early ranged from one to 10 days.

- three grant recipients submitted financial statements that had not been audited. All three grants were under $50 000, and the Bureau had allowed for the relevant financial statements and invoices to be reviewed by a qualified accountant within the Bureau. However, the Bureau accountant who had reviewed previous financial statements was unavailable, and a Bureau staff member—who was not a qualified accountant—reviewed and endorsed the financial statements and invoices.

4.42 As previously mentioned, the CGGs promote proportionality in grants administration, with the aim of striking a balance between the stringency of acquittal requirements and the level of risk. The CGGs advise that agency staff 'should consider that independently audited financial statements may be expensive and difficult to source in rural and remote areas or may comprise a large proportion of a low value grant'. The Bureau's decision to exempt some grants under $50 000 from providing audited financial statements aligns with the proportionality principle outlined in the CGGs. However, as the funding deeds signed between the Bureau and these grant recipients specifically stated that audited financial statements were required, there would have been merit in the Bureau varying the funding deeds for these grants to align the financial statement requirements with the level of risk.

Acquittal reports

4.43 Bureau officers were required to complete a financial acquittal report for each project, indicating whether: the final report and financial statements had been received, reviewed and approved by the Bureau; the project was complete; and the project had expended all allocated funds. For the 75 grants reviewed by the ANAO, 74 (99 per cent) had a financial acquittal report. In the remaining case, the grant recipient had yet to submit audited financial statements. The 74 financial acquittal reports indicated that the project was completed and financial information had been submitted, and all were signed by a grant officer.

Recovery of unexpended funds

4.44 The Bureau had arrangements in place to recover grant funds if the recipient did not comply with the funding deed, did not complete the project or had underspent on the project. Of the grants reviewed by the ANAO, 32 involved unexpended funds that required recovery by the Bureau. As at October 2013, the Bureau had raised invoices for all 32 grants and recovered

the unexpended funds for 31 grants. For the remaining grant, the Bureau had followed up on the outstanding invoice and, as at November 2013, had secured agreement from the grant recipient to return the unexpended funds.

Evaluation and reporting

Evaluation

4.45 As noted earlier, the Bureau engaged consultancy firms to conduct an internal audit of the M&E Program in 2009 and a program review in 2010. The audit report presented findings and suggestions for improvement related to applicant selection, funding deeds, milestone reports and spending proposals. The 2010 review had two objectives: to assess the success of the program in meeting its stated objective; and to identify any weaknesses in the program and where improvements could be made. The review found strong evidence that the program was an effective means of modernising networks—a key aspect of the stated objective—but less direct evidence that the program had been effective in extending networks. The review also provided an overview of the M&E Program, a program logic framework and high-level suggestions for improvement, such as streamlining administrative processes and improving the descriptive aspects of project reporting.

Reporting

4.46 Internally, the Bureau reported on the progress of the M&E Program in senior management reports. Reports included targets for the year, the status and achievements of current activities and risk levels for each target activity. Updates were also provided to the Australian Water Information Advisory Council (AWIAC) on an ad-hoc basis.

4.47 The Bureau published a progress report on the M&E Program in 2010, which was released in hard copy and made available on the Bureau's website. It included case studies and an overall description of the program's progress. The Bureau also outlined, in its 2011–12 Annual Report, that it would publish a final progress report once all of the M&E projects had been acquitted. Further progress on the M&E Program was reported to key stakeholders at the Jurisdictional Reference Group on Water Information (JRGWI) meetings[68] and

68 There had been 15 JRGWI meetings between February 2008 and May 2013.

in the Improving Water Information Program annual progress reports, which were published in 2010, 2011 and 2012.

4.48 The Bureau's 2010–11 and 2011–12 PBS and annual reports included two KPIs for the M&E Program, and the 2009–10 PBS and annual report included one, as outlined in Table 4.6.

Table 4.6: M&E Program key performance indicators for 2009–10 to 2011–12

Key Performance Indicators	2009–10 Annual Report	2010–11 Annual Report	2011–12 Annual Report
Program funding results in a measurable improvement in the currency, completeness and accuracy of water information relayed to the Bureau from the organisations listed in the Water Regulations 2008.	Achieved.	Achieved.	Achieved.
Over 75% of funding recipients express satisfaction with the Bureau's administration of the program.		Achieved.	Achieved.

Source: ANAO analysis of Bureau of Meteorology PBSs and annual reports.

Key program achievements and outcomes

4.49 A range of activities and improvements were funded under the M&E Program. The majority of funding was allocated to projects that focused on modernising and extending monitoring equipment and networks (51 per cent) and improving water data management systems and the quality and accuracy of water data (41 per cent), which aligns with the M&E Program's objective.[69] As result of the significant rollout of telemetry systems supported by the M&E Program, more 'near real-time' information has been received by the Bureau.[70] Over 600 monitoring sites have been equipped with new telemetry systems. These investments have enhanced the value of hydrologic data to water managers and the general public, lowered the cost of data acquisition and reduced the duration of monitoring system outages.

69 The remaining eight per cent of funding was allocated to: coordinating projects through state and territory SWICs; developing water information standards; and providing hydrographic training.

70 Telemetry systems enable monitoring station data to be downloaded remotely via radio or mobile phone connection.

4.50 The accuracy of Australian streamflow measurements has also been enhanced through the purchase of 145 Acoustic Doppler Current Profilers (ADCPs)[71] across 25 projects supported by the M&E Program. This technology enables hydrographers to take more measurements, with greater accuracy, under a wider range of flow conditions.

4.51 As part of the audit, the ANAO interviewed M&E Program grant recipients and visited nine sites where equipment was upgraded or installed under the program. One example of an M&E project that the ANAO observed related to the purchase of a Q-boat[72] by Melbourne Water.[73] The Q-boat has increased the accuracy and quality of Melbourne Water's high-flow measurements. For example, the Q-boat out–performed all other flood gauging methods during the record events recorded in Victoria in early February 2011. Over two days, 56 flow measurements were taken with the Q-Boat at 15 sites. The majority of measurements taken during this event were well beyond those on existing rating tables and under circumstances where there was no other way to measure the flow.

ANAO consultation with water organisations

4.52 The ANAO asked organisations to provide comments on their overall experience with the M&E Program. Of the organisations that responded to this question, 86 per cent (25 of 29) indicated a generally positive experience, and 14 per cent (4 of 29) indicated a mixed experience. The M&E Program benefits most cited by respondents were: improved data management and delivery; the modernisation of monitoring equipment and IT systems; assistance in achieving compliance with the Water Regulations; and improved data quality.

71 As outlined earlier, an ADCP is a hydro-acoustic current meter similar to a sonar, for measuring water current velocities over a depth range using the Doppler effect of sound waves scattered back from particles within the water column.

72 A Q-boat is a remote controlled ADCP gauging platform.

73 Melbourne Water is owned by the Victorian State Government. It manages Melbourne's water supply catchments, sewage, rivers and major drainage systems throughout the Port Phillip and Westernport region.

Conclusion

4.53 Overall, the Bureau's financial assistance to water data providers was supported by effective administrative arrangements. The Bureau published funding guidelines for each round of the M&E Program. These guidelines provided detailed information for stakeholders and generally aligned with the requirements of the Commonwealth Grant Guidelines. The assessment and recommendation of applications was conducted in an open and accountable manner, in accordance with the financial management framework. Assessment documentation was generally retained and the decision-maker made reasonable inquiries before approving funding. The majority of stakeholders consulted by the ANAO indicated that they considered funding had been allocated in an open, accountable and transparent manner.

4.54 While a robust monitoring regime was established to help ensure that grant recipients met agreed milestones, in some cases the monitoring arrangements were not proportionate to the value of the grant. The adoption of a risk-based approach to defining the extent and frequency of monitoring would help streamline the administration of future grant programs and potentially achieve savings to the Bureau and grant recipients. Notwithstanding the scope to streamline the extent of monitoring activity, the Bureau's arrangements for managing grant funding, such as payments and acquittals, were generally appropriate. The majority of grants examined had been acquitted, and the Bureau managed the recovery of unexpended funds effectively, with invoices raised and funding recovered in a timely manner.

4.55 The provision of funding under the M&E Program has assisted grant recipients to modernise and extend their water monitoring systems. This has addressed the objectives of the program and improved the accuracy, quality and frequency of the data available to the Bureau to provide national water information.

5. Data Systems, Collection and Management

This chapter examines the Bureau's planning, collection and management of water data. The information systems used to receive, store and report the data under the Improving Water Information Program are also examined.

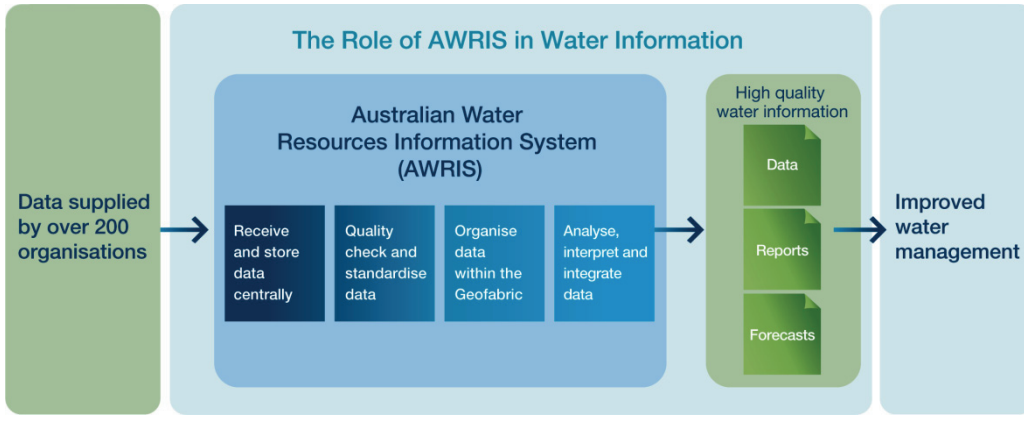
Introduction

5.1 Data systems and the collection and management of data underpin the *Water Act 2007* and whether the anticipated products and services are produced efficiently and effectively. In 2007, the Bureau commenced work on the development of an IT system—the Australian Water Resources Information System (AWRIS)—to receive, store and manage national water data and to underpin the delivery of high-quality water information to all Australians. The development of AWRIS was a key objective of the program with the Bureau describing the system as:

> The technology centrepiece of our water information mission. It is the means by which the public will access water information online and download data, and the tool that the Bureau will use to generate water accounts and water resources assessments.

5.2 Figure 5.1 provides a simplified representation of the role of AWRIS in managing the water information collected by the Bureau.

Figure 5.1: The role of AWRIS in water information



Source: Bureau of Meteorology, Information Sheet 3, AWRIS.

5.3 The ANAO examined whether the Bureau has established effective arrangements: for collecting and managing water data, including whether AWRIS is an efficient and reliable repository for water data and provides consistent high-quality water information.

Early planning for AWRIS (pre-2007)

5.4 The requirement for the Bureau to implement an 'Australian Water Resources Information System' was contained in the then Prime Minister's 2007 National Plan for Water Security.[74] The idea and articulation of the need for AWRIS, however, was well developed before this announcement, originating from the 2005 assessment of Australian Water Resources (AWR 2005)[75], which was undertaken by the Water Resources Observation Network (WRON) Alliance.

5.5 The AWR 2005 led to the development of detailed specifications for AWRIS. Rather than a centrally-held database, AWRIS at this stage was envisaged as a set of tools that would enable access to data that was made available by lead water agencies and others through a distributed data infrastructure. This distributed or decentralised approach was estimated to cost between $3.6 million and $10.8 million. It was originally envisaged by AWR 2005 as a web portal to provide the tools to allow users to access water data held throughout the water sector.[76] In January 2007, the National Water Commission (NWC) approved a $10 million project to develop AWRIS in accordance with the AWR 2005 recommendations.[77] In that same month, the 2007 National Plan for Water Security was announced and referred specifically to AWRIS:

> The Bureau will maintain a national database and web-based reporting system for all water information (Australian Water Resources Information System—AWRIS). This will include maintaining a national water account and managing

74 The Hon John Howard MP, Prime Minister, *A National Plan for Water Security*, 25 January 2007, p. 16.

75 The purpose of AWR 2005 was to provide a baseline understanding for the National Water Commission at the commencement of the National Water Initiative on a range of water management and resource issues from which future comparisons and the success of NWI reform processes could be measured.

76 However, the distributed model had substantial shortcomings in terms of data quality and control considerations when compared with the central database model that was implemented by the Bureau.

77 Under the $250 million Raising National Water Standards Program, which was administered by the NWC between 2005 and 2012, grants were provided for projects—such as the $10 million AWRIS project—that would improve the capacity to measure, monitor and manage Australia's water resources.

all of the information yielded from Australia's enhanced water use metering programme.[78]

5.6 The articulation of AWRIS as a 'national database' for water information in the National Plan for Water Security meant that the scope and architecture for AWRIS would be different from that originally envisaged by AWR 2005.

5.7 Following the announcement of the National Plan for Water Security, the National Water Commission agreed to proceed with providing $10 million in financial support to the Bureau for the development of AWRIS. Although designing and developing AWRIS was a Bureau responsibility, an AWRIS Steering Committee, co-chaired by the Bureau and the National Water Commission[79], was established to provide advice on priority national water resource reporting needs and to endorse the AWRIS work plan and proposed expenditures.

Planning and delivery of AWRIS 1

AWRIS Phase 1 Planning

5.8 AWRIS was planned to be delivered in an initial phase (Phase 1) followed by future development and expansion of functionality that would support delivery of the Bureau's full suite of water information products and services.

5.9 The IT project planning, development and implementation for the new water information functions was undertaken by the Bureau's Water Division separately from 'core Bureau' IT functions.[80] The Bureau informed the ANAO that it made a decision to take advantage of the opportunity for a 'step change' in its approach to IT, where, over time, new approaches trialled in the water area could be taken up by other areas in the Bureau. The limited number of core Bureau IT staff was also a consideration in this decision. It was identified

78 The Hon John Howard MP, Prime Minister, *A National Plan for Water Security*, 25 January 2007, p. 16.

79 The AWRIS Steering Committee first met in August 2007, with a further 10 meetings held between September 2007 and February 2010. Committee membership comprised senior Bureau, NWC and Murray–Darling Basin Authority officers and consultant hydrology experts, with Bureau and NWC staff also attending as required. Over time, membership changed to also include officers from jurisdictional agencies and water utilities. At its first meeting, the AWRIS Steering Committee considered that it was not necessary to expand the Steering Committee's composition to include high-level IT expertise.

80 Nevertheless, there was evidence of guidance from the Bureau's Chief Information Officer, who was transferred into the lead IT role in the new division from October 2008.

early in the program's establishment that the additional IT resources required for the new water function would be recruited to the Bureau or contracted from external service providers to meet the planned delivery timeframes.

5.10 The development of AWRIS had high-risk features—particularly in the initial phase. The system was a new and innovative IT system that was intended to receive and manage a large volume of data in various formats from over 200 sources. It was designed as a national repository for water information with web access for interaction with potentially thousands of stakeholders, including internal Bureau teams who would rely on the system to deliver products and services under the program. The water function was new to the Bureau and consequently the operating environment (including the relationship with data providers) was not yet fully understood at the time of AWRIS planning. These factors meant that there were many unknown risks and complex aspects of the project. As a result, sound business and project planning and execution by an experienced team, coupled with strong oversight and governance arrangements, was essential.

Specification of Phase 1 outputs

5.11 The high-level work plan developed by the Bureau for the $10 million NWC-funded Phase 1 project was endorsed by the AWRIS Steering Committee in December 2007. This project was to establish the infrastructure and methodology for accessing, collating and organising water data and information within AWRIS. The work plan, however, did not include costings, timeframes or specifications for the future AWRIS development and expansion. The outputs of Phase 1, were scheduled to be completed over 27 months from September 2007 to December 2009.

AWRIS Phase 1 delivery

5.12 The delivery of AWRIS Phase 1 outputs did not proceed as planned, with implementation continuing as at September 2013—almost four years after its planned completion date.

5.13 In December 2008, the Bureau engaged an IT management consultancy firm to undertake a review of the AWRIS project management, governance and delivery approach. This review was commissioned in response to concerns about the Bureau's ability to meet established project timeframes. The review found that the project was in danger of failing to deliver the overall solution and unlikely to succeed in its current form at the time. It noted the short time remaining to the project deadline—that 12 months had passed and 12 months

remained—yet the project was still in the early phase of development and that activities were progressing without effective coordination. The review identified shortcomings in:

- internal project governance;
- project management and planning practices;
- software development lifecycle expertise, including architecture design management; and
- uncoordinated sub-projects, that lacked a clear integration path.

5.14 Following the review, an initial 30-day improvement plan, assisted by the consultancy firms, focused on addressing the following key recommendations:

- **governance and project management:** new governance bodies were established to provide oversight at various levels of detail within the AWRIS Project;
- **user requirements:** high-level business requirements were grouped by business needs and draft specifications were identified to allow software planning to proceed;
- **scope definition:** a roadmap was developed for AWRIS, including work streams for the re-scoped AWRIS Phase 1 that included focusing on delivering the water storage product; and
- **resource transition plan:** roles and responsibilities for progressing AWRIS Phase 1 development were documented and a capability assessment of current resources was undertaken. This was used to inform an approach to industry for specialist support to assist with the development of AWRIS.

5.15 In reporting these findings and actions to the Bureau's Executive and external senior advisory committee (the AWIAC) in June 2009, the Bureau identified that:

> AWRIS is a technically-challenging project that is stretching our project management abilities. We are managing risk as diligently as possible but need to acknowledge that this project is a potential major failure point.

5.16 However, despite the early recognition of the problems and actions to address them, the functionality and timing anticipated in the project plan were not achieved or only achieved to a limited extent.[81] This negatively impacted on the efficient delivery of products and services under the program. Delivery against planned project outputs at the scheduled conclusion of Phase 1, December 2009, is shown in Table 5.1.

Table 5.1: Delivery of AWRIS Phase 1 Outputs

Work Plan Outputs	Delivery at December 2009[1]
Enabling Framework to ingest, store and manage data	
EF 1: Set of standards and agreements for contributing to and accessing AWRIS	Yes
EF 2: A common (model) language for Australia's water data and information	Yes
EF 3: A central repository for storing national water data	To a limited extent
Public Web Access for data downloads and dashboards	
PWA 1: Data dashboards	To a limited extent
PWA 2: Data explorer	To a limited extent
PWA 3: Data download	No
Business Systems for Bureau analysis, modelling and reporting	
BSY 1: A credible water balance model	To a limited extent
BSY 2: Statistical and analysis tools, models and procedures	To a limited extent
BSY 3: Report generator	To a limited extent
Expenditure directly attributed to AWRIS at this time.	$13.3 million

Source: ANAO analysis of delivery against AWRIS Phase 1 Work Plan outputs.

Note 1: December 2009 was the date specified for delivery of these components in the Bureau's AWRIS Phase 1 work plan and the 2008 ICT Strategic Plan.

Challenges with the technical solution

5.17 A significant factor affecting the project related to the system architecture. In an attempt to handle the large volume and broad scope of data under the water program, and to make the system adaptable to future water

81 To a limited extent' means that while the delivery date had not been met, the Bureau had made some progress towards the objective. For example, the specifications for a data explorer may have been completed and data collection commenced, but the data explorer was not operational by the due date.

information program requirements, a multi-layered, abstract schema[82] was developed within the database.

5.18 To implement the schema around the Water Data Transfer Format (WDTF), and to allow for the range of other formats in which data was received, the Bureau and its industry partner designed complex data file transformations and mapping with purpose-built tools and code for data ingestion and storage. User requirements were established, but were not well managed or prioritised. Delivery was adversely impacted by the number and complexity of activities undertaken. The adoption of a non-industry-standard design and approach[83] has also meant that it has been difficult to query the AWRIS database. For example, an ad-hoc query to determine the amount of water in a particular reservoir requires a complex structured query language code. This query may then take considerable time to access the data or not run at all. As such, time-consuming work-arounds and processes, such as examining raw (uningested) data files, are required to answer relatively straightforward questions.

5.19 In addition, any changes to WDTF or the water regulation categories would require changes to be carried through many layers of the system. The Bureau has advised that because of the complex design of the system, if any significant changes were required, it would not always be possible to modify the system to ingest or store data without the original consultant. Another problem with AWRIS 1 is that data is not able to be readily deleted from the database when it is found to be incorrect or subsequently updated—such as for rolling block time-series data[84] and when provisional data has subsequently been validated[85] by a data provider. This has led to significant duplication of data, with the Bureau estimating that some line items had 98 per cent redundancy prior to a recent time-consuming de-duplication activity. AWRIS

82 A database schema describes how the database is structured and refers to the data that can enter the database, how it is organised within the database, and how it is presented to users, including data relationships, views and functions. To use any database, a clear understanding of the design logic is required in order to write reports and extract the data.

83 Four architecture properties are considered essential for the design of a data warehouse: scalability; extensibility; security; and administerability. The AWRIS technical architecture did not incorporate these properties. Kelly, S, *Data Warehousing in Action,* John Wiley & Sons, New York, 1997.

84 Where, for example, today's observation is appended to the previous 29 days.

85 'Provisional' and 'validated' data are discussed later in this chapter and refer to the level of assurance of accuracy.

data duplication has required additional space for data storage, caused system performance issues and increased the complexity of queries.[86]

Weaknesses in contract management

5.20 In June 2009, through a prequalified tender process[87], the Bureau engaged an IT industry partner to assist with the AWRIS build and to address identified project skill and delivery shortcomings in the Bureau. This contract was initially valued at approximately $2.5 million over the first 12 months, with provision for similar levels of service for up to three further years, based on need. Within 18 months, however, four change orders had been processed to increase the value of the IT industry partner contract to over $15.4 million (GST-exclusive) in the first two years, representing a three-fold increase on the initial contract value.[88] Reasons cited by the Bureau for the contract extensions were related to the need to complete specified work, expansion of AWRIS-related sub-projects and the inclusion of new tools and methods for system configuration from the Water Information Research and Development Alliance (WIRADA) with CSIRO.

5.21 The milestones for the IT industry partner contract were not tightly specified, nor was the extent to which the industry partner staff would be integrated with or separated from internal Bureau IT staff roles and deliverables. A number of broad task headings, such as 'project management', and estimated consultant resources were identified for each month, without clear progress or delivery being required on those tasks before payment was due. As a result, this contract resembled a time and materials contract rather than a fixed-fee contract contingent on achieving milestones and deliverables, as would be better practice in these circumstances where time and resources are limited. Fixed-fee contracts, with stretching milestones and deliverables, even where a margin for uncertainty surrounding the extent of development activity exists, necessitate clear project specification and robust contract management by both parties. Importantly, they also promote accountability

86 Data duplication as a result of rolling time-series observations, means that the same values are stored many times in the system. For example, on 'Day 30', the 'Day 1' record will be received 30 times, requiring the system to store all values and to sort values to find the most recent value when queried.

87 The Bureau approached 10 providers from the Bureau's Hydrology Multi-use List, of which nine submitted tenders.

88 With an initial contract value of $2.5 million per year, the original estimated expenditure over a two-year period was $5 million, rather than the $15.4 million that was actually expended.

and support achievement of value for money. A fixed-fee contract with the IT industry partner, combined with whole-of-life-cycle system costing for AWRIS (Phase 1 and future scope) would have improved detailed specification at the early stages and necessitated discipline around changes in system design, scope and resourcing.

Further review and redesign

5.22 Ongoing concern about poor system performance and complexity and continued slow project delivery led to a further external review in March 2010 focused on the AWRIS design and architecture. This review found considerable inconsistency in AWRIS project concepts, approach and terminology, making it difficult to understand the overall architecture and noted that a general systematic approach to information modelling and architecture seemed to be missing, or was not well documented. In addition, the review highlighted the importance of standardisation of data to improve the sustainability of data ingestion. The review made strong recommendations in relation to architectural leadership and skills, adopting a standards-based approach and basing future AWRIS work on better IT engineering principles.

5.23 Following the review, the Bureau established an IT Architecture Section within the Climate and Water Division, in March 2011. The new team gave further consideration to the IT architectural requirements. In September 2011, the team concluded that the architectural framework adopted by the Bureau's previous industry partner had proven to be too complex to easily manage. While acknowledging the importance of innovation to the Bureau's water information and related functions, it was noted that the pressures of delivering immediate business priorities prohibited explicit innovation activity. In addition, it highlighted to the Bureau's Water Division leadership team a number of significant issues in relation to AWRIS:

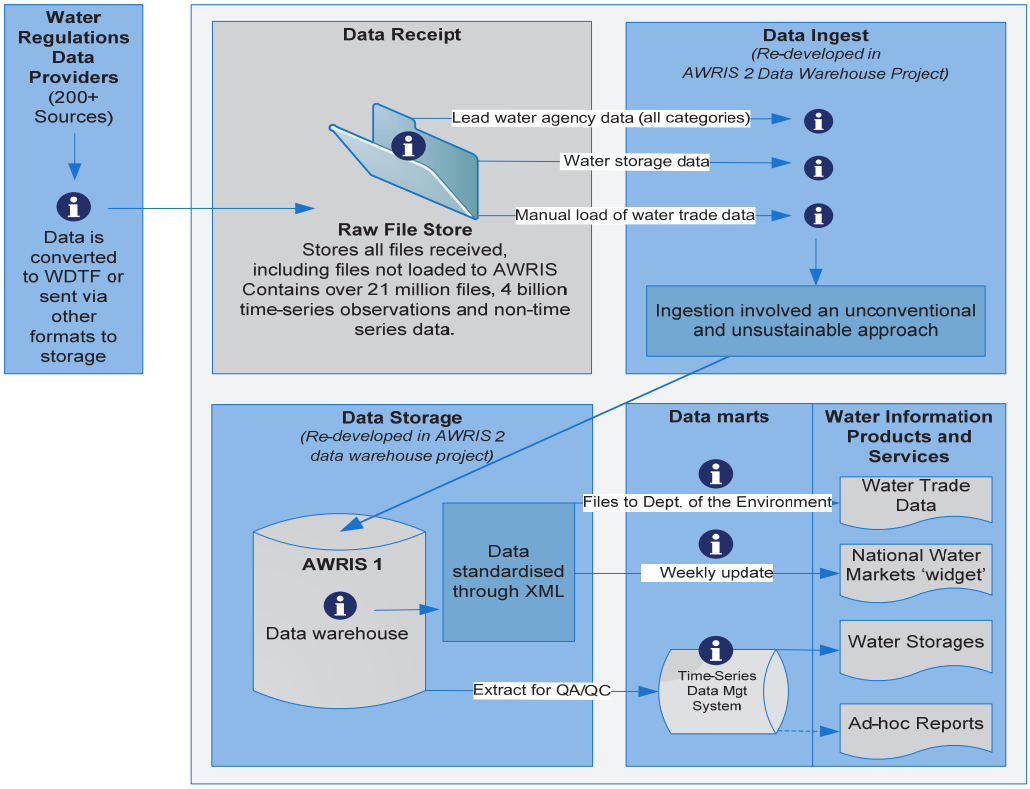
- **AWRIS unsustainability[89]:** This remained the major concern and a redevelopment project would be preferable to incremental repair.

89 In this context, 'unsustainability' refers to the cost and effort involved in maintaining the database, and problems with extending and scaling the system to cope with future volumes of data and enhanced functionality.

- **Over-engineering:** The current AWRIS solution was over-engineered, with a considerable investment to date. A leaner, more sustainable solution may well have been produced with a lower investment.
- **Data warehouse:** Ostensibly, AWRIS was a data warehouse, however, it failed to conform to the standard data warehouse architectural pattern—an unconventional and unsustainable data ingestion solution had been implemented, the database was poorly designed leading to lack of scalability and inability to efficiently query, access to data was highly constrained and not extensible. Significant effort would need to be devoted to redressing these architectural issues if the existing solution was ever to fulfil its goals.
- **Overall architectural ownership and vision:** It was unclear where responsibility lies for overall AWRIS architectural roadmap and vision. There appeared to be tension between short-term business drivers for new development without any coherent strategy.

5.24 This frank assessment of AWRIS, combined with known issues relating to performance and maintenance, prompted the development of a business case in May 2012 recommending the major redevelopment of the AWRIS database, ingest processes and data transformations processes. Effectively, this meant decommissioning the AWRIS 1 database and using a standard industry-approach to build a replacement data warehouse. A high-level depiction of key aspects of AWRIS 1, and its limited product output, is shown in Figure 5.2.

Figure 5.2: High-level depiction of key aspects of AWRIS 1



Source: ANAO analysis of Bureau of Meteorology information.

System work-arounds

5.25 The products that are currently delivered from AWRIS include a water markets 'widget' (a website add-on providing a water markets data dashboard) and a weekly file containing trade data that is provided to the Department of the Environment, both of which rely on a manual loading of data. The website tool and smartphone application for water storage take time-series observational data from AWRIS and converts it to a 'stream' of data to determine water storage levels for over 300 publicly-owned water storages.

5.26 As AWRIS is difficult to query, ad-hoc reporting generally only occurs from the time-series data management system, or data files are obtained from the pre-ingest raw file store. Analysis and cleansing of raw data files is time-consuming and is used only for limited products, such as streamflow forecasting. Much of the complexity of AWRIS 1 resides in the non-industry standard design of the 'data ingest' and 'data storage' elements, which are being redeveloped as part of the AWRIS 2 data warehouse project.

5.27 The majority of key water information products that have been delivered under the program to date currently rely on other systems, processes and data sources rather than AWRIS. These 'work-arounds' have been essential to enable the Bureau to produce planned products. However, the requirement to set up further systems has taken additional time and resources and increases the risk of data integrity issues not being systematically addressed.

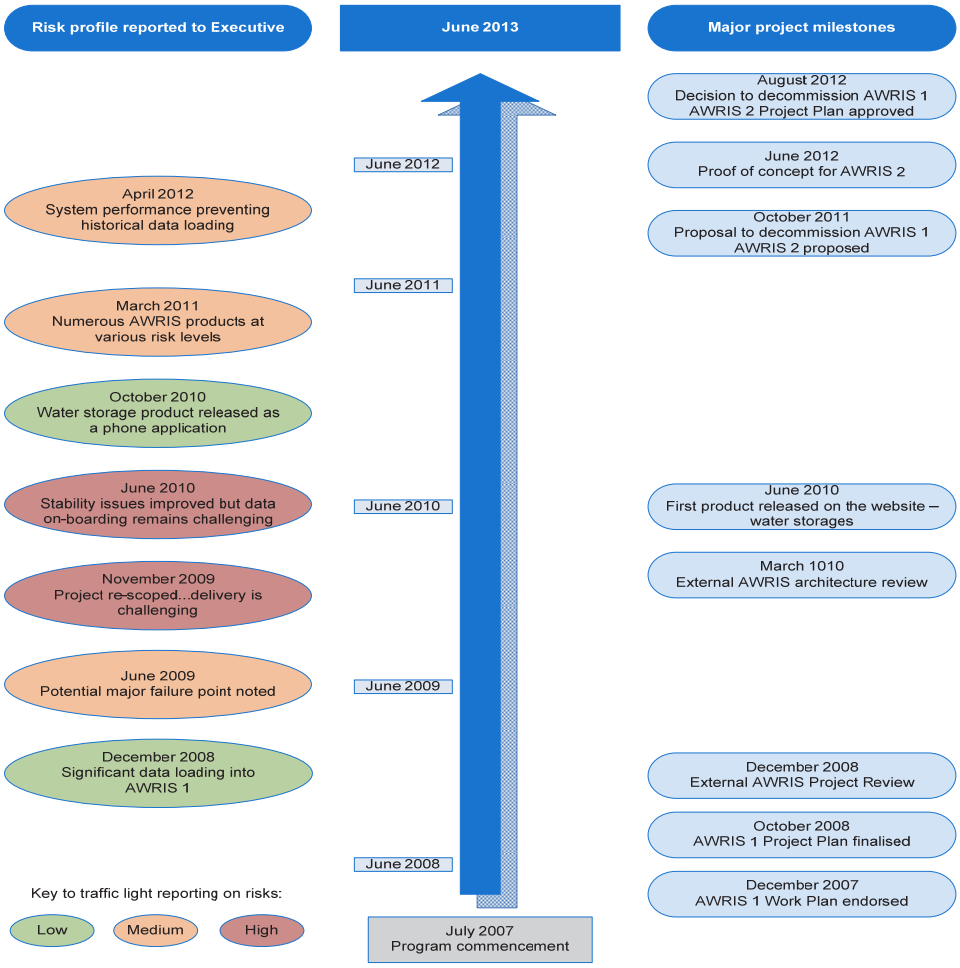
5.28 The links between AWRIS and the majority of the Bureau's flagship water information program products are provided through the catalogue services, processed streamflow time series, and the provision of raw (uningested) data files, which must then have Quality Assurance/Quality Control (QA/QC) processes applied by the teams responsible for those products. This is time consuming and inefficient and has been a contributing factor in the delay to the production of new water information products and services (discussed further in Chapter 6).

5.29 Further planned development under the AWRIS 2 Production Implementation Project will develop additional data marts[90] and tools that will allow increased, but not complete, reliance[91] on Regulations data from AWRIS for these products. Figure 5.3 outlines major project milestones, reviews and decision, as well as traffic light risk reporting to the Bureau's Executive Group during the implementation of AWRIS. In general, corrective actions taken to address the weaknesses in AWRIS were not adequate. As outlined earlier, major reconfiguration and a replacement system—AWRIS 2—were considered necessary to address the problems with the system.

90 A data mart is a subset of the data warehouse and is usually oriented to a specific business product or team.

91 Complete reliance on Water Regulations (AWRIS) data for all products is not feasible, as other data sources, such as meteorological data, are required for the water information products.

Figure 5.3: AWRIS project timeline



Source: ANAO analysis of Bureau information.

Planning and delivery of AWRIS 2

Planning for AWRIS 2

5.30 The planning framework for AWRIS 2 recognised the considerable challenges and experiences faced when developing AWRIS 1. The framework also built on the Bureau's significantly improved understanding of, and experience with, water information data and business processes. The business case for AWRIS 2 stated that:

> AWRIS was developed around a database with a complex schema causing many technical and operational problems including the possible failure of the system due to overloading. The [AWRIS 2] project seeks to address these

deficiencies by transforming the existing database into a flexible data warehouse and a series of data marts to supply the needs of specialist reporting dashboards while the data ingest processes will be migrated from their existing proprietary format into a commercial off-the-shelf technology.

5.31 Consequently, the Bureau's planning and IT design has focused on an industry-standard data warehouse. The architecture has been designed to provide the following operational benefits:

- simplified access to data for future dashboard applications and analysis;
- reduced cost of development for ingesting new data categories and new versions of WDTF;
- improved system stability and reduced risk of service outage; and
- reduced maintenance effort.

5.32 Following approval of the AWRIS 2 business case, a 'proof-of-concept' exercise was conducted in June 2012 in which: AWRIS 2 data warehouse base schema and data mart schemas were designed and confirmed; a commercial-off-the-shelf/open source based ETL[92] suite was utilised for data ingest and manipulation; and it was verified that AWRIS 1 data could be migrated and ingested into AWRIS 2.

5.33 As a result of the successful proof-of-concept exercise, AWRIS 2 is being built using the resources of the newly created in-house architectural team, supplemented by several IT contractors. This approach utilises the experience of recently recruited staff in building large-scale operational databases for the Australian Government and other jurisdictions.

5.34 The AWRIS 2 project is being delivered in two distinct phases:

- AWRIS 2 Data Warehouse Project; and
- AWRIS 2 Production Implementation Project.

92 ETL is an IT tool used to migrate data from one database to another, to form data marts and data warehouses and also to convert databases from one format to another.

5.35 Following user acceptance testing[93], the AWRIS 2 data warehouse project was nearing completion as at January 2014. Delays of over one year have been encountered in this project's delivery, largely because of the architecture team's involvement in other significant Climate and Water Division IT system projects. However, recent functional testing of the data warehouse has reported no unacceptable ('severity 1') results. Data ingestion times were found to be significantly reduced, by a factor of at least 10, with one test for one of the largest data files showing an ingestion time of 30 minutes for the AWRIS 2 data warehouse compared with 19 hours for AWRIS 1. The Bureau has advised that because of the faster ingestion times, and the problems with AWRIS 1 database complexity and data duplication, all Water Regulations data files will be reloaded into AWRIS 2 rather than migrated from AWRIS 1.

AWRIS 2 delivery

5.36 Because of the problems encountered with AWRIS to date, the Bureau commissioned a further external review in August 2013 of the AWRIS 2 data warehouse design, approach and delivery. This review found that technically and architecturally, the AWRIS 2 data warehouse solution has largely followed better practice approaches and has set a sound foundation for the solution to avoid the problems that AWRIS 1 encountered. The review noted: dramatically improved data ingest performance; that data storage design no longer captured redundant data; and that fit-for-purpose, scalable technologies have been used. This is a positive result for the Bureau. However, the review also noted several substantial challenges for the Bureau in its continuing development of AWRIS 2. There has been a lack of joint responsibility by senior IT and business representatives for the database and water information products and services. Further improvements could be made to project management and governance structures to avoid project overruns. As at 30 June 2013, the Bureau had expended $38.5 million on AWRIS and associated IT systems and applications. This included $23.2 million that had been capitalised and $15.3 million in operational expenses. The Bureau has advised that, in the preparation of its financial statements, the accounting treatment for

93 User acceptance testing is undertaken to confirm that a new system meets business-user requirements. It is one of the final stages of an IT project and is undertaken by users (or subject matter experts) after other functional and non-functional testing of the system confirms that, among other things, technical, performance and security requirements have been met.

the $12.5 million in expenditure capitalised during the development of the AWRIS 1 data warehouse will be reviewed to take into account its limited functionality and early decommissioning.

5.37 The aim of achieving operational requirements for a national information technology system with maximum interoperability[94] and flexibility has not been achieved. As a consequence, there have been significant delays in the rollout of products and services and 'work-arounds' required to enable products and services to be produced. This result, particularly when contrasted with planned expenditure and functionality, raises questions regarding the value for money achieved.

5.38 The AWRIS 2 Production Implementation (A2PI) project is currently in its early stages. The A2PI project will result in the replacement of the AWRIS 1 data warehouse system as the operational system for water data (and other environmental data) ingestion and online product support. The A2PI project will also provide the design and implementation framework for the AWRIS data archive process and provide the platform to expand the range of externally available products and services. The project will be delivered in discrete work packages using a combination of in-house and contract-in assistance, with an expected completion date of June 2015.

5.39 The Bureau has identified a number of significant project risks, including the many interactions between this project and other Bureau business and technology areas[95] resulting in complexity and conflicting stakeholder priorities.

5.40 In May 2013, the internal Bureau project board papers noted that there may be insufficient resources to take all approved projects through to production. Clear prioritisation and specification of the tasks required and products that will be delivered from AWRIS 2, and their delivery timeframes, cost, resource allocation, risks, interdependencies and benefits, will be necessary to ensure smooth and efficient delivery of the required functionality

94 The capacity of software and hardware on different computers from different manufacturers to share data.

95 The Bureau has identified that the A2PI project scope includes components that will be used throughout the Bureau, and links with these areas including the water and climate data functions, water forecasting products and services, meteorological observations and core Bureau IT services, and that there is interaction with many areas of the business as usual aspects of these operations and projects (new capability) currently underway.

and to avoid the project delivery problems experienced with AWRIS 1. It is expected that significant work-arounds will be necessary for some time for the Bureau to continue to produce its current and expanded suite of water information products and services. Balancing the costs and benefits of consolidating foundational data management and system capability with the demands from new product and service delivery will require careful consideration by the Bureau.

Recommendation No.2

5.41 To improve the management of, and value for money from, information technology (IT) delivery, the ANAO recommends that the Bureau of Meteorology:

- strengthen strategic IT planning and project management to guide the delivery of IT projects and inform monitoring activities; and
- implement governance arrangements for all IT projects that are commensurate with the documented risk profile of each project.

Bureau's response:

5.42 *Agreed. From July 2013, the Bureau has established an Information Systems and Services Division to place greater emphasis on the information technology and information management. This is intended to enhance capability and increase flexibility and responsiveness. The Bureau is also implementing an enterprise-level Portfolio Management Board. The Board will enhance the prioritisation, selection and governance of projects by providing regular review of the status, cost and overall progress to the Executive. Governance structures and the level of project administration will be commensurate to risk factors such as the size of the project team, duration of the project, tolerance to variation, strategic, cost, interdependence on other activities, and overall complexity.*

Data management and quality control

5.43 Government data needs to be managed in a way that ensures it has integrity. That is, it is complete, accurate, accessible and useable for the purpose sought by government. The Water Regulations 2008 classify water information into 10 categories and require organisations to provide metadata and contextual information. The range of data required by the Bureau under the Regulations includes the level and flow of surface water, water storages,

level and pressure of groundwater, water access rights and water quality information.[96]

5.44 As outlined earlier, more than 200 organisations named under the Water Regulations 2008 are responsible for providing water data to the Bureau. Once the data formally becomes a Commonwealth record, the Bureau is responsible for providing an assurance over the completeness and accuracy of the data, particularly when it is used to produce Bureau products and services. The ANAO examined the Bureau's approach to water data management and the level of quality assurance over the data used for products and services.

Bureau's approach to water data management

5.45 The Bureau is receiving approximately 10 000 new data files containing time-series observations each day, and was managing more than 21 million water data files containing more than four billion time-series observations that had been received by the Bureau since the Water Regulations came into effect on 30 June 2008. This data relates to 105 parameters across 10 categories, and covers many thousands of hydrologic monitoring sites. Given the range of information and the number of different entities involved, obtaining a reasonable level of assurance over the integrity of the data represents a considerable challenge.

5.46 Early in the program, the Bureau reviewed national and international data Quality Assurance/Quality Control (QA/QC) approaches, including those used in the USA and Europe. The Bureau considered that these approaches were limited and did not cover all of the quality service needs for the program. In 2008, and again in 2009, the Bureau drafted strategy papers on its approach to quality assurance and quality control. In 2009, the proposal was to:

- consider the end-to-end water information chain, from data contribution and harvesting, through data organisation, analysis and modelling to delivery;
- provide appropriate governance, to ensure that QA/QC activities are coordinated and structured across AWRIS and the Water Division; and

96 Appendix 2 outlines the 10 categories of water information.

- deliver quality services on the basis of business requirements and other information to inform design and development of quality services as part of AWRIS.

5.47 In 2009, the Bureau did not intend to have a complete quality system or a comprehensive set of QA/QC services. The initial plan was to implement critical QA/QC processes and subsequently to put in place a more comprehensive framework for longer term governance, design and implementation of QA/QC services. To date, a number of critical QA/QC processes have been introduced. However, problems with the development of AWRIS, as outlined earlier in this chapter, have meant that the 2009 QA/QC strategy has not been implemented as intended.

Current processes in place for water data management

5.48 The Bureau informed the ANAO that, given the volume of data and the many variables affecting its quality, it is not possible to manually validate and assess all data for quality. As at September 2013, Bureau processes involved broad checks involving:

- the data providers adding a quality code to the data (ranging from 'best available' to 'not of release quality'); and
- where further data quality issues are identified by the Bureau (through the processes outlined below), they are returned to the provider for a response. The data provider is considered by the Bureau to be the 'point of truth' for the data and is responsible for making changes.

5.49 Some automatic data validation checks were in place, for example, the 'rate of change' and 'limit checks,' and work is underway to assess the extent to which further automation can be applied. In some cases, there are more extensive data checks that have been applied at the product level, including the use of modelling tools to perform data quality analysis.

5.50 An important quality control mechanism introduced by the Bureau has been the WDTF. At the commencement of the program, the Water Regulations did not specify the format in which the data was to be forwarded to the Bureau. As a consequence, the Bureau received millions of data files in formats that were often inconsistent and sometimes incompatible with its systems. This was a significant constraint in making progress under the program.

5.51 However, the WDTF is based on an Extensible Mark-up Language (XML) and has been progressively introduced from July 2008.[97] The WDTF has improved the Bureau's ability to obtain higher quality data and metadata in terms of completeness and comparability of content. WDTF has given the Bureau the capacity to capture the necessary data and metadata required using a standardised format and to ingest it into their IT system. The Bureau is then able to perform a range of checks on the data file content that results in further improvements to information quality.

5.52 While only 66 organisations currently provide data in WDTF for a range of data categories, these include the largest water data providers. As a result, 78 per cent of files are now in WDTF, which the Bureau can interpret and load into AWRIS. The most frequent challenge cited by stakeholders surveyed by the ANAO during the audit related to difficulties in applying the WDTF. A proposed amendment to the Regulations requiring the WDTF from data providers is planned to come into effect in 2013–14. Should this be adopted, it is likely to improve data quality by broadening the adoption of WDTF across data providers. However, Bureau assistance to smaller agencies is likely to be required in the immediate future.

Improving data quality in provider agencies

5.53 Detailed quality control for an individual hydrological site requires an understanding of the local conditions. For practical purposes this is the role of state and territory agencies or other data providers that operate these sites. As such, the Bureau relies on data providers for this level of quality control.

5.54 In 2009, the Bureau conducted a survey of the major data providers listed in the Water Regulations in order to better understand their QA/QC processes. Of the 23 organisations interviewed, 20 reported that they operated with some measure of quality control. Eight organisations advised that all or part of their operations are accredited ISO 9001 quality management systems, noting that the data provided to the Bureau is also used for operational purposes within their organisations. These eight organisations also had external auditors assess their systems.

97 Extensible relates to a programming language or system that can be modified by changing or adding features. XML is an IT industry-standard format for encoding documents and representing data structures.

5.55 Collected water data is assessed and graded by the Bureau according to defined quality codes provided by the data provider. Nineteen out of 23 audit survey respondents assigned their own quality codes to individual data points. However, each organisation has a unique set of quality codes and code definitions, and in most organisations the definition of quality code meaning has changed over time. This has been a further challenge for the Bureau in standardising water data for aggregation and analysis purposes. However, the WDTF has assisted in harmonising data from disparate sources by using a single definition of data quality codes. The WDTF defines a list of data quality codes that data providers map to from their quality coding system. This illustrates the value of a standard data format to enable quality control.

5.56 The Bureau has indicated that a particular challenge in obtaining accurate and consistent water data is that some key data sets are not directly measured by water agencies because it is not technically or practically feasible. Rather, rating tables are used to transform, for example, river level measurements to a flow value. The rating tables, however, are not always accurate as they are based on observations at particular sample locations at particular points in time, and river level and flow relationships change over time in response to river bed change (such as from floods). While continuous measurement and maintenance of the relationships are required, budget pressures within state and local agencies have led to a reduction in the number of monitoring sites and restrictions on the data collected. While seven closures have been reported to date (including one not replaced following flood damage), progressive deterioration in the monitoring network has the potential to affect the capacity of the Bureau to improve data quality over time.

5.57 For some datasets, in particular groundwater, where there has been limited investment by other parties in water data, the Bureau has recognised that data quality requires an adequate allocation of time and resources if it is to reach a satisfactory level of accuracy and completeness. For other datasets, especially surface water, the data is generally of a higher quality although there remain special challenges—particularly in terms of reconciling any anomalies from time-series data.

5.58 In order to address the variations in data quality, the Bureau contributed $4.1 million to data providers through the M&E Program to improve QA/QC. Six projects had QA/QC as the primary objective, while 18 had QA/QC as a secondary objective. In addition, the Bureau's WISB Forum recently approved 10 hydrometric monitoring National Industry Guidelines

(discussed in Chapter 3). The Bureau leads a Technical Reference Group on data quality, which is developing national industry guidelines on data quality. Bureau leadership in this area will continue to be important to support improvements in the accuracy and quality of water data collected over time.

Quality control in Bureau water information products and services

5.59 The systematic and increasingly comprehensive approach to QA/QC, as envisaged in the 2009 strategy, has not been achieved primarily because of difficulties in obtaining and ingesting data in compatible formats and the challenges with the limited functionality of AWRIS.

5.60 As a consequence, and even with the Bureau's broad data quality checks and the improvements in data provision as a result of WDTF and measures under the M&E Program, remedial action has been required to produce the Bureau's water information products and services. Product-specific QA/QC measures have been essential in providing assurance to the Bureau and stakeholders on the quality of the water data, products and services. For example, the Bureau currently relies on the provisional data stream for its daily updates to its water storage product. Provisional data has no inspection or validation and, as a result, often contains both random and systematic errors. As a consequence, the Bureau is required to inspect, detect and correct errors for data used by the water storage application—a time-consuming and labour-intensive process. The Bureau is currently implementing a 'Time Series Data Management System' that will produce a data product that uses validated data and augments this data with provisional data for the most complete and current record set. The system will also allow more automated QA/QC processes to be implemented and is expected to be finalised in 2013–14.

5.61 In the case of the National Water Account, a Data Management Plan has been developed for each reporting region to enable data to be collected in a consistent manner. It is expected be fully implemented for the next NWA to be released in 2014. The Bureau has advised that data management guidelines are currently being finalised, which will be used in conjunction with the Data Management Plan by providing further advice to Bureau and reporting partner staff on workflow processes and practices.

5.62 Seasonal streamflow forecasting relies on a range of data sets including Water Regulations data from the raw file store of AWRIS, monthly inflow estimates from water utility operators and temperature and rainfall data and

indices from the Bureau's meteorological operations. The quality of each data set is analysed for the quality and completeness of its data, and data cleansing is undertaken where necessary. The Bureau estimates that 40 per cent of the streamflow forecasting team's time is dedicated to data collection and data QA/QC. This QA/QC effort will be significantly reduced when validated Regulations data is available from the time-series data management system.

Conclusion

5.63 There have been major challenges and constraints on AWRIS achieving its objective. There were unclear business and system requirements, inadequate technical solutions, changes in design and approach and unanticipated costs and delays. The original project planning, governance and management did not follow established IT system design, development or implementation practices. Decisions were also taken that increased the complexity of the system to such an extent that it is difficult to maintain and severely constrained in its functionality. This level of expenditure on AWRIS, when contrasted with planned expenditure and functionality, also raises questions regarding the value for money achieved.

5.64 The decision to decommission AWRIS 1 and build a new AWRIS 2 has enabled a significant enhancement of the Bureau's IT architecture. While the system is progressing towards its performance targets, the expected enhancement to functionality will depend upon a clear understanding of user requirements, executive oversight and strong project management.

5.65 The comprehensive data quality approach originally envisaged by the Bureau has not yet been achieved. Extensive and time-consuming manual checking on the quality of data is still required after six years of program implementation. While the Bureau has been making improvements to data quality, this task has been made more challenging as data providers have reduced the number of monitoring stations that they maintained. Deterioration in the monitoring network has the potential to affect the capacity of the Bureau to maintain or enhance data quality over time.

6. Water Information Products and Services

This chapter examines the water information products and services produced by the Bureau in terms of their purpose, timing, coverage and relevance to the objectives of the Improving Water Information Program.

Introduction

6.1 The Bureau has developed a range of water information products and services designed to meet the needs of users engaged in areas such as water policy development, planning, operations, public enquiry, emergency services, education and research.[98] For example, improved data sets on the intensity, frequency and duration of rainfall assists engineers to update the design standards required for public infrastructure, such as dams and culverts. The National Water Accounts address the mandatory reporting requirements of the *Water Act 2007* and provide annually reconciled water accounts that explain key aspects of water use. Seasonal streamflow forecasts are generated each month for the upcoming three-month period. They provide predictions of future water availability in particular catchments to improve decision making on water releases for flood mitigation, environmental watering or the applicability of water restrictions.

6.2 The range of products and services (outlined in Table 6.1) primarily fall into three categories:

- improving the quality of water data;
- measuring the availability or allocation of water; and
- water forecasting.

98 Special services for registered users and particular clients (such as data rich streamflow forecasts or information on water markets) have been provided by the Bureau in addition to a smart phone application for water storages. Regular seminars and briefings have also been provided on the range of new water forecasting and assessment products and services.

Table 6.1: Bureau water information products and services

Improving the quality of water data	Measuring the availability or allocation of water	Water forecasting
Intensity-Frequency-Duration estimates	National Water Accounts (legislative requirement)	Seasonal Streamflow Forecasts
Australian Hydrological Geospatial Fabric	Australian Water Resources Assessments	Short-term Streamflow Forecasting
National Groundwater Information System	Water Storages	Flood Forecasting Service
National Groundwater Dependent Ecosystems Atlas	National Water Trading Data	
National Groundwater Aquifer Framework	Information on Water Restrictions	
Environmental Monitoring Sites		
Water Information Standards		
Australian Water Accounting Standards		
Australian Water Information Dictionary		
Hydrologic Reference Stations		

Source: ANAO analysis of Bureau of Meteorology information.

Note: Products and services in the white cells were examined by the ANAO; those highlighted blue were not examined.

6.3 The ANAO examined a sample of key products and services across the three categories to ascertain their timeliness, coverage and relevance to the objectives of the program.

Improving the quality of water data

6.4 The Bureau has identified significant gaps in the quality of water data, in particular, water sectors that are important to the management of water resources. For example, current standards for water infrastructure are based on outdated rainfall data while the accuracy of topographical maps is problematic in some jurisdictions or regions. The products or services designed by the Bureau to improve the quality of water data have included:

- intensity-frequency-duration (IFD) rainfall estimates used to design water and stormwater infrastructure;
- the Hydrological Geospatial Fabric (a geographic information system that maps the spatial dimensions of water features); and

- national groundwater data that includes a Groundwater Dependent Ecosystems Atlas that was released in September 2012 and the development of a national groundwater information system—which is not expected to be released until late 2014.

Intensity-frequency-duration rainfall estimates and the Australian Hydrological Geospatial Fabric

6.5 Intensity-frequency-duration (IFD) rainfall estimates and the Australian Hydrological Geospatial Fabric were foreshadowed in the 2008 divisional strategic plan. They were intended to address the outdated design of water infrastructure in Australia[99] and gaps in the spatial relationships between important hydrologic features such as rivers, water bodies, aquifers and monitoring points. While both products require further development, they are expected to address important gaps in water information once fully operational.

Intensity-frequency-duration estimates

6.6 IFD rainfall estimates are part of a larger suite of design flood estimation inputs currently being revised by Engineers Australia, to be released progressively over the next two years to replace outdated information used to design Australia's infrastructure. These are based on a more extensive database, with nearly 30 years of additional rainfall information and data from 2300 extra rainfall stations. The Bureau has indicated that the new IFDs provide more accurate design rainfall estimates for Australia. IFD products were scheduled to be published online in mid-2011. However, while the initial IFDs were released in 2013, the full range of products is expected to be delivered progressively over the next two years.

Australian Hydrological Geospatial Fabric

6.7 The Hydrological Geospatial Fabric was planned to be developed over 10 years with progressive releases detailing the spatial dimensions of water features and how they are connected, to better measure how water is stored, transported and used through the landscape. This project was important because of gaps in the basic parameters used for hydrological measurement in

99 The current design specifications have not been updated since 1987. The Bureau has stated that hundreds of millions of dollars are spent annually on water infrastructure in Australia, including drains and dams for town water supplies.

some jurisdictions, such as poor quality topographic maps that limited the accurate measurement and forecasting of streamflows. The Hydrological Geospatial Fabric is an ongoing project that is the result of consultation across agencies within Australia and internationally. The project is led by the Bureau in partnership with Geoscience Australia, the Australian National University and CSIRO. The partnership provides a means for obtaining foundation hydrological data, maintaining and upgrading the data and improving the product suite.

6.8 These projects highlight two particular challenges facing water management practice in Australia: the design of urban infrastructure; and the constraints in forming an accurate picture of water flows through the Australian landscape. If severe weather events become more intense in the future, as predicted in climate forecasts[100], these projects will have increased relevance for state and local government infrastructure planning and development control.[101] As a consequence, the production of timely outcomes will be important so that there is sufficient lead time for adjustments to be made to vital flood warning systems, urban water management and infrastructure.

National groundwater data

6.9 Groundwater makes up some 17 per cent of Australia's currently accessible water resources and up to 30 per cent of Australia's water consumption in particular regions. Some state jurisdictions, such as Western Australia, are highly dependent on groundwater supply for urban communities and regional centres. Groundwater is also important for many natural ecosystems.

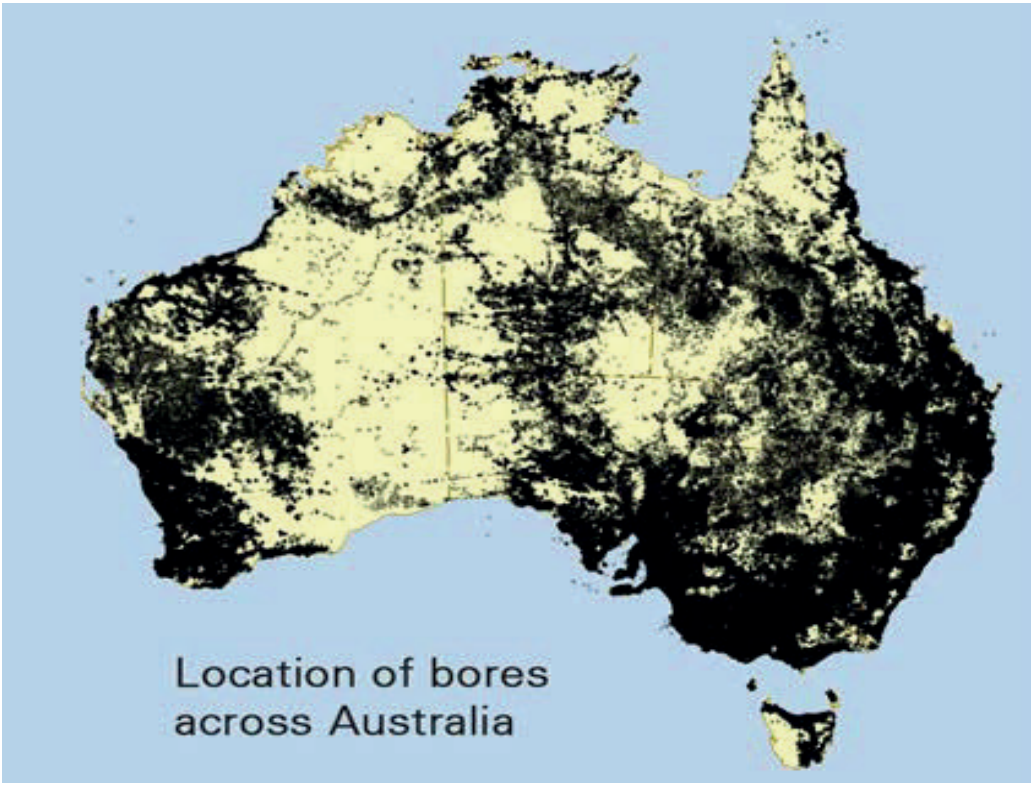
6.10 The Bureau has noted that in many parts of Australia there is increasing pressure on groundwater resources from activities, including agriculture, mining, urban and commercial developments. The Bureau aims to produce nationally consistent data so that better informed decisions can be made around how groundwater resources are managed. Figure 6.1 illustrates the distribution of approximately 800 000 groundwater bores across Australia

100 CSIRO and the Bureau of Meteorology, 2012, *Climate Change in Australia*.

101 Development control refers to the legal mechanism used by authorities to regulate development proposals.

and highlights the intensity of groundwater use and the potential vulnerability from excessive consumption.

Figure 6.1: Location of bores for groundwater extraction



Source: Bureau of Meteorology.

National Groundwater Dependent Ecosystems Atlas

6.11 In 2010, the Bureau signed a Memorandum of Understanding for financial assistance of up to $2.5 million (including GST) from the National Water Commission to develop a National Groundwater Dependent Ecosystems Atlas (GDE Atlas) as well as to address a gap in the understanding and management of groundwater across Australia. The primary aim of the GDE Atlas was to create a consistent, nation-wide inventory of GDEs in the form of a web-based tool. The GDE Atlas was launched in September 2012. The Bureau also finalised the National Groundwater Aquifer Framework in 2012. This provides the first nationally agreed system to describe sediments and rocks with similar hydraulic characteristics to address difficulties for cross-jurisdictional basins, such as the Great Artesian Basin and the Murray Basin.

6.12 While progress has been made since 2007, substantial gaps in knowledge are still apparent (particularly in terms of the sustainable level of extraction) that have the potential to be a significant issue in any future drought. While groundwater was not identified as a priority in the Bureau's 2008 divisional strategic plan, the links between groundwater and surface water for urban supply, agriculture and mining indicate that it has become a priority issue for attention by the Bureau. However, while agencies need to be adaptable, care is needed in balancing the staffing requirements of new projects (particularly when they come with financial assistance) to ensure that the delivery of existing priorities is not unreasonably delayed.

Measuring the availability or allocation of water

6.13 The limitations on information on the availability or allocation of water in storage or used by parties for irrigation or urban water supply was a major constraint for governments in 2007. The products and services developed by the Bureau have been designed to measure the availability or allocation of water supply in Australia at a point in time, including: the National Water Account; Australian Water Resources Assessments; and Water Storages.

National Water Account

6.14 Under the *Water Act 2007*, the Bureau has a statutory responsibility for compiling and delivering comprehensive water information across Australia. The National Water Account (NWA) is the only mandatory product required to be produced under the legislation. The NWA is a set of annually reconciled water accounts for the majority of managed water resource systems in Australia.

6.15 A Pilot NWA was released by the Bureau in February 2010. The experience gained from the pilot provided the Bureau with improved insights into the technical requirements and constraints in producing Australia's first NWA. As at October 2013, three national accounts had been produced for 2010, 2011 and 2012. These accounts cover water resources, the volume of water available for extraction, the rights to extract water and the actual extraction of water for economic, social, cultural and environmental benefit. As such, the NWA assists in answering some of the key questions on water availability that were required during the 'Millennium Drought,' such as changes in water inflows, outflows and storages, water access entitlements and trading in water entitlements.

6.16 The Bureau has estimated that the NWA covers around 70 per cent of Australia's population, about 75 per cent of the nation's water use and about 90 per cent of its water trade. In 2012, the NWA did not include any Tasmanian Basins. However, the Daly River region in the Northern Territory was included for the first time. North Queensland and much of central and southern Australia are also not included in the account at present. Figure 6.2 illustrates the regions included in the 2012 NWA.

Figure 6.2: Coverage of 2012 National Water Account

Source: Bureau of Meteorology, 2012 National Water Account.

6.17 The Bureau expects to increase its coverage incrementally over the next four years taking into consideration its capacity and the advice of the NWA Committee.[102] The focus at the regional scale enables regional comparisons—an important information output given the streamflow variability across Australia. The NWA has increased from eight regions in 2010 to nine regions in 2012. However, the Bureau does not envisage full national coverage. The Bureau has advised that the capacity of reporting partners, the availability of data and the priorities of stakeholders have determined the order in which regions have been included in the NWA.

Australian Water Resources Assessments

6.18 Australian Water Resources Assessments were intended to focus on regional variability and trends in water resources and patterns of water use over time using currently accessible data. In the Bureau's early planning documentation (such as in the divisional strategic plan) it was anticipated that the first assessment would be released in December 2010. However, the first Australian Water Resources Assessment was released in November 2011 and was based on available water information for the period July 2009 to June 2010. This was considerably later than original expectations largely because of data quality issues and operational problems with the Bureau's information technology system at that time (as discussed in Chapter 5).

6.19 The assessment provides a national overview of climate and water flows and stores in Australian landscapes in 2009–10, including water balance model outputs for the year. The regional assessments consider trends in water availability and use in 13 regions that cover the Australian continent. In October 2013, the Bureau released a second assessment based on data from 2012. This assessment provided additional information on further water resources components, including water storage, supply and use. An extended set of reference sites contributed to the analyses of trends and variability in water availability, supply and urban and agricultural use over the 2011–12 year and the past decades.

102 The National Water Account Committee was established in 2008. It is chaired by the Bureau of Meteorology and provides a forum for consultation with key stakeholders. The Committee's terms of reference include providing advice about the development and refinement of the National Water Account and its alignment with user needs.

Water storages

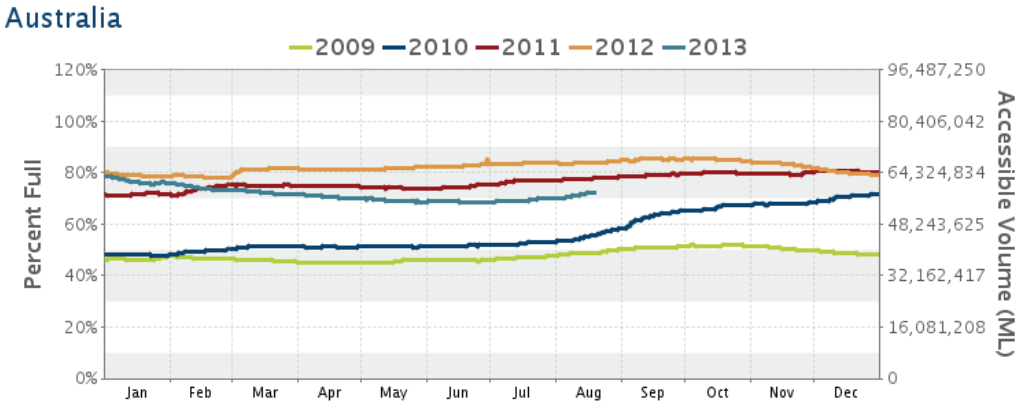
6.20 During the 'Millennium Drought', comparable data on the available level of water across Australia proved challenging for the Australian Government as different state and territory jurisdictions used different terminology and standards. Discussions with state agencies during the course of the audit also highlighted inaccuracies in the volume of water in some storages because of outdated or inaccurate bathometric measurements.[103] Updating the measures through the Improving Water Information Program means that Australia now has more accurate measures of storage capacity than was the case in 2007 and comparable information across state and territory jurisdictions. While the service was planned for trial delivery in December 2008 (with further development in 2009 and 2010), it was not released until June 2010.

6.21 The Bureau has estimated that Australia has around 500 publicly-owned water storages.[104] The Bureau's water storage website contains comparable information for 303 storages of one gigalitre or greater. The Bureau has indicated that over time, further water storages will be added, though the aggregate volume of water reported will increase only slightly as current reporting accounts for 97 per cent of Australian major storage capacity. Figure 6.3 illustrates the levels of water availability in Australia's major public storages over time from 2009 to August 2013.

103 The measurement of the depth of bodies of water, such as dams or water storages.

104 The aggregate water storage capacity of these storages is about 94 000 GL, representing more than 97 per cent of the total storage capacity of public and semi-public water storages in Australia.

Figure 6.3: Water availability in Australia's major public storages



Source: Bureau of Meteorology.

6.22 Current public water storage levels for all capital cities, except Perth, compare favourably with the levels in 2009 during the 'Millennium Drought'. There are still surface water supply limitations for Perth (21.6 per cent of capacity). This highlights the reliance that Western Australia places on supplementation from groundwater and desalination plants to meet current and projected water demand for Perth.[105]

6.23 While the Bureau has actively developed and improved its water information on public water storages, there is no information currently collected on private water storages. The level of water diversions from private agribusinesses in the northern catchments of the Murray–Darling Basin was of particular concern to the Government in 2007 during the 'Millennium Drought' as inland towns were rapidly running out of water.

6.24 The Bureau has found data on private water storages to be of poor quality. It has estimated that the aggregate storage capacity of the 216 private water storages that have been identified is 1351 gigalitres (1.4 per cent of the total capacity of public and semi-public storages). However, this is likely to be a significant underestimate of the actual total figure, primarily because of the absence of information for agricultural private water storages in New South Wales.

105 The WA State Water Corporation has indicated that almost half of Perth's current water needs—about 150 billion litres a year—is supplied by water desalinated at two desalination plants. By 2022, around half of Perth's drinking water is expected to be sourced from deep groundwater sources. Recharging the aquifer with recycled waste water is also being considered to enhance the sustainability of groundwater extraction over time.

6.25 Nevertheless, the Bureau is able to estimate private water storage in the northern catchments of the Murray–Darling Basin using a water balance model and a map of man-made water bodies. These calculations are made once a year and are published as estimates in the National Water Account. As at 30 June 2011, the volume of water estimated to be in private water storage in the northern Murray–Darling Basin was 534 gigalitres. Estimates are also made for other catchments using a variety of data inputs and techniques. However, there is no actual data on private storages available.

Water forecasts

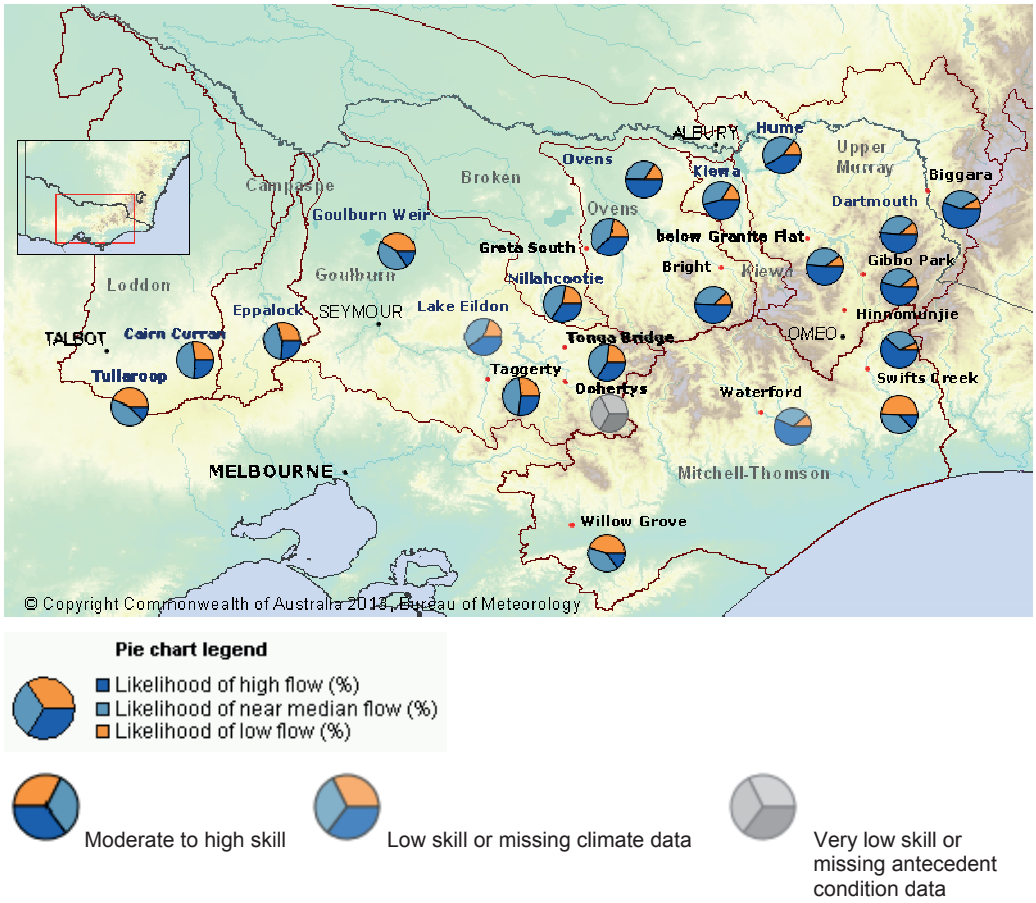
6.26 Water forecasting is intended to cover river flow forecasts, seasonal water availability forecasts and extended water availability projections. It is one of the most complex and challenging areas for improving water information. The long-term goal of the Bureau was to provide a service that would meet all water prediction needs from hours to days to years in advance and at all sites of interest. Water forecasting was scheduled for public release in 2010. The challenge for the Bureau was that these types of forecasts are complex and rely on frequent, high-quality data over time. The Bureau has indicated that in 2008 there were no generalised forecasting techniques in place that the Bureau could readily apply at an appropriate scale across Australia.

6.27 The Bureau examined forecasting approaches overseas and engaged with CSIRO in January 2009 to plan the Statistical Seasonal Forecasting Project. The project was part of the Water Information Research and Development Alliance. It was designed to transform the research efforts of CSIRO into a Bureau operational seasonal forecasting service. Seasonal streamflow forecasts commenced for a limited number of catchments in December 2010 and were based on probabilities—that is the likelihood or chance—of water flowing into a stream or catchment based on relationships with recent climate and catchment conditions. At 30 September 2013, forecasts are provided for 70 locations in eastern Australia (plus an additional nine for registered users). No forecasts are currently provided for Western Australia, South Australia or Tasmania, as the Bureau's current forecast skill scores[106] are not sufficiently high enough to produce reliable forecasts in these states. The Bureau has been working with Western Australia to improve forecast skill scores and to identify

106 The forecast skill scores are used by the Bureau to objectively assess the performance (skill) of a model.

locations for forecasting. An example of one forecast region is illustrated in Figure 6.4.

Figure 6.4: Victoria seasonal streamflow forecast (August 2013)



Source: Bureau of Meteorology.

6.28 The forecast skill scores are used by the Bureau to objectively assess the performance (skill) of a model. The Bureau has indicated that it expects to increase the skill scores and plans to increase the coverage of catchments over time with forecasts of up to 250 locations planned for 2014–15.[107] Publicly disclosing the limitations of coverage and level of accuracy of forecasts enables users to make judgements on the value of the forecasts. It also provides a

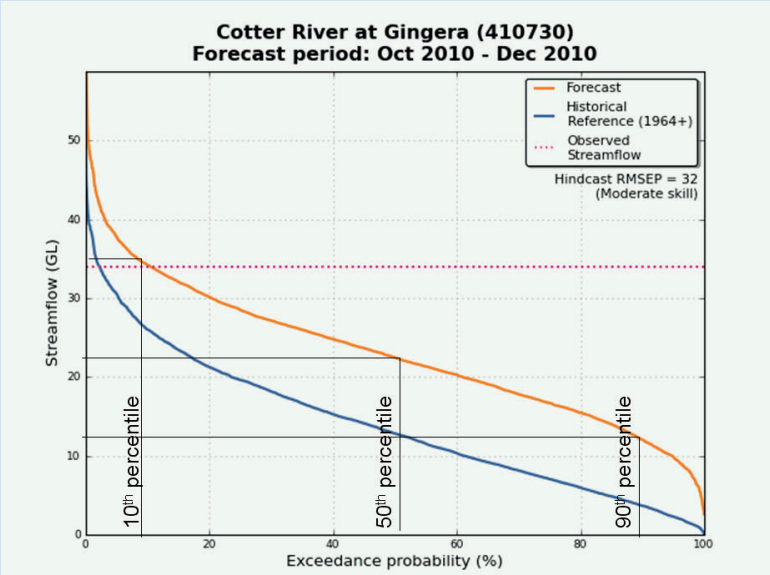
107 For example, the Bureau has improved the forecasts in 2013 by including the output of a dynamic monthly water partition and balance model. This was advised to stakeholders at the 15th Jurisdictional Reference Group on Water Information meeting in May 2013.

benchmark for future improvements in the service. Expanding the streamflow forecasts in terms of their coverage and accuracy is a priority for the Bureau over the next four years. An illustration of how streamflow forecasting has been used for decision making in a territory agency is illustrated in Figure 6.5.

Figure 6.5: Seasonal streamflow forecasts and decision making

Seasonal streamflow forecasts have been provided for two Australian Capital Territory Water locations in experimental form since mid-2009 and via public release from late 2010. During the 1997–2009 drought, the ACT had temporary water restrictions to limit water use. In spring 2010, consideration was being given as to whether to remove the water restrictions before the following summer.

The storage forecasts using the Bureau's seasonal streamflow forecasts are less variable than the historic reference period, and showed a high chance of increasing storage levels. The Bureau's forecasts reduced the uncertainty with only using historical data, and the ACT authority decided to remove the water restrictions in October 2010. In this instance, reduced uncertainty from the Bureau's streamflow forecasts helped critical decision making at a time when storage levels were low.



Source: Bureau of Meteorology, October to December 2010 seasonal streamflow forecast for Gingera (orange line). The 10th, 50th and 90th percentile forecasts (exceedance probability) are converted to monthly inflows.

6.29 The Bureau is also testing a Short-Term Flow Forecasting System that aims to provide seven-day streamflow forecasts. The website for this service was released through registered users' access in late 2011, with around 40 registered users covering 11 catchments and 16 forecast locations as at November 2013. Further work is underway to release an additional 50 catchments in 2014.

User access and feedback

6.30 Product testing, documenting user requirements and analysing user feedback are all important business processes that can assist an agency to understand how products and services should be designed and how much they should be adjusted or redesigned after initial release.

Monitoring user access

6.31 The Bureau monitors 'traffic' on its website and the level of interest in its products. Statistics on website access indicates that the site has received about 929 000 unique visitors[108] resulting in about 1.1 million page views. In the May–July quarter of 2013, the water information website received 227 000 page views (a 1.4 per cent increase on the same quarter for 2012) and 192 000 unique page views (a 2.2 per cent increase for the same period in 2012).

6.32 While much of the interest was in flood information and warnings (particularly in the period January–April 2013) there was also public access to Bureau water products, such as streamflow forecasts, the National Water Accounts, groundwater information, the Australian Water Resources Assessments and the Hydrological Geospatial Fabric. For water storage information, web page views have steadily increased and the total downloads of the water storage smart phone application was over 50 000 by August 2013.

Product testing and user surveys

6.33 Product testing and user surveys have been undertaken by the Bureau and provide useful input into product development (particularly in relation to product design and attributes) as well as for accountability and performance reporting. As water information products and services have been developed, stakeholders have provided input through targeted user feedback processes to inform product design and improvements.

6.34 User surveys or expert user groups have provided the Bureau with feedback on the level of client satisfaction with the product or service. For example, in the case of the National Water Account, a review of user expectations was undertaken in 2009. A 2010 survey tested the user decisions most likely to be made based on the information in the National Water

108 The Bureau classifies someone as a 'unique' visitor each month. This means that 'unique' only applies within a period of one month.

Account, as well as specific stakeholder information requirements. An independent peer review was also conducted in 2010 to provide expert advice on progress.

6.35 This feedback enabled the Bureau to design the National Water Account to better meet the needs of stakeholders. However, some expectations were not easily met. For example, achieving national coverage across all major water resources and regions was a challenging task given the variability in capacity of partner agencies to provide data, variations in data quality and the resources available within the Bureau. Priority was given to those regions that were of greatest stakeholder interest. Coverage was to be extended over time, within the constraints of data availability and resource capacity.

6.36 For the seasonal streamflow forecasting service, experimental and pilot projects were introduced prior to operational services commencing. A user workshop was held by the Bureau in 2009 and a follow-up forum in 2010 discussed existing and future product ideas with representatives from eight water agencies. A survey was conducted in 2012 to report on performance indicators relating to user satisfaction and the adoption of the service. While the survey size was small (12 respondents) and not designed to produce statistically valid results, it was indicative of positive views from stakeholders, with 11 positive responses. The Bureau advised that a web-based survey of the seasonal streamflow forecasting service is expected to be completed by the end of 2013.

ANAO consultation with stakeholders

6.37 As previously noted, the ANAO sought written comments from the organisations named under the Water Regulations 2008, on their experiences with the Improving Water Information Program. In total, fifty-six responses were received. Overall, stakeholders were generally positive in their views of the program with 54 per cent (22 out of 41 responses) indicating a positive view. Of the remaining responses, 39 per cent (16 of 41) indicated a mixed or neutral view and seven per cent (3 of 41) indicated a negative view.

6.38 In terms of challenges or issues during the program's implementation, 32.5 per cent (13 of 40 responses) mentioned issues relating to data transfer.[109] There was a high level of awareness of Bureau products with 47 stakeholders

109 Eight respondents specifically mentioned WDTF.

(91 per cent) indicating an awareness of the Bureau's products and services, and 51 per cent (24 responses) indicating that they found the Bureau's products and services useful, particularly in relation to rainfall forecasting, streamflow forecasting and historical streamflow data.

Australian Government agencies

6.39 Consistent with the general response from stakeholders, Australian Government agencies were generally positive about the program and the role played by the Bureau, with one agency commenting:

> The ongoing collection of water data and information by the Bureau into the future is essential [...] and has the potential to provide valuable outcomes to assist water management and planning activities.

6.40 Agencies were particularly positive about the Bureau's water products and services, such as the national surface water data sets (including water storage information), the Hydrological Geospatial Fabric project and improved data on groundwater in Australia. However, a number of areas for improvement were also noted. These included: an enhanced focus on demand-driven products and data access, including a data download facility, in a form useful to decision-makers[110]; expansion to national coverage in the National Water Account; better alignment between the Bureau and the Australian Bureau of Statistics on water accounting; continuing improvements to information on groundwater; more information on water stress in catchments and aquifers; and amendments to the Water Regulations 2008 to align with the Murray–Darling Basin Plan's reporting requirements.

Conclusion

6.41 Since the inception of the Improving Water Information Program in July 2007, the Bureau has introduced a suite of new products and services with nationally consistent data, such as standardised, annual National Water Accounts, Australian Water Resources Assessments, Water Storage information and Seasonal Streamflow Forecasts. As a consequence,

[110] Providing data downloads was a priority in the Water Division Strategic Plan in 2008. The Bureau has provided some water data download services to agencies such as the Department of the Environment and the National Water Commission for their water markets reporting since 2010. However, the current limited availability has resulted in some duplication in effort and inefficiencies, with the same data request directed to state agencies from another Commonwealth body. The Bureau has indicated that it plans to provide more comprehensive data download services by early 2014. A proposed agreement to provide data to the Murray–Darling Basin Authority is expected to further support the Basin Plan.

governments in Australia and the public have access to better water information than was available prior to the introduction of the program.

6.42 However, most products have been introduced later than originally planned by the Bureau. There have also been considerable challenges in managing data from over 200 providers, and the Bureau was required to research and develop its own products and services because of the absence of acceptable models that could be readily applied. National coverage has been limited because of the capacity constraints on data providers to meet information requirements in particular catchments, as well as gaps and shortcomings in the quality and consistency of water information available to the Bureau. The wider adoption of national water data standards may assist in improving this situation over time.

6.43 The nature of the comments to the ANAO from stakeholders and Australian Government agencies in particular, suggest that while sound relationships have been established, there is a gap between the expectations of users and the current capacity of the Bureau to deliver. There remains a substantial forward work program to improve the quality of data and the coverage of Australian regions and to provide the range of products and services originally planned for by the Bureau. There is also scope to improve the value of products and services for users and introduce services, such as data downloads, that were a priority in the Bureau's 2008 strategic plan, but have yet to be fully delivered. For state and local data providers, strengthening the visibility of the proposed product/service line, and the engagement of these agencies in development or delivery, would assist in improving awareness and, potentially, user satisfaction.

Ian McPhee
Auditor-General

Canberra ACT
5 February 2014

Appendices

Appendix 1: Bureau's response

Australian Government
Bureau of Meteorology

Ms Barbara Cass
Group Executive Officer
Performance Audit Services Group
GPO 707
Canberra ACT 2601

Dear Ms Cass

The Bureau of Meteorology welcomes the Australian National Audit Office (ANAO) Audit Report on the Administration of the Improving Water Information Program. The Bureau has valued the thorough, evidence based process conducted in a transparent manner by the audit team.

The report provides important context on the circumstances leading to the Prime Minister's announcement of the Water Information Program in January 2007. In the midst of a prolonged 'Millennium Drought', water scarcity arose from factors including a drying and warming climate, growing urban demands, over-allocation of water to irrigation, bushfire recovery impacts and the environmental flow imperative. Changing weather patterns from autumn 2010 saw extensive rainfall over large areas of Queensland and Victoria, and floods of historic proportions. The report highlights Australia's climatic variability and the importance of the $450 million investment to secure comprehensive and accurate water information.

The Bureau also welcomes the ANAO's assessment that the Bureau has developed effective arrangements for collaboration with water data suppliers and has effectively administered the $80 million Modernisation and Extension of Hydrologic Monitoring Systems Program.

The report recognises that the Bureau has introduced a suite of new products and services providing better access to water information for governments in Australia and the public. It also noted the further expectations of users of the Bureau's current products and services. The Bureau will continue engagement with stakeholders to deliver product and services – including water download capability in 2014 – and manage expectations having regard to available resources.

The report recognises the complex challenge faced by the Bureau in collecting, standardising and processing water data from thousands of monitoring sites, from over 200 data providers in a variety of formats. The Bureau now holds more than 21 million water data files containing more than four billion time-series observations. The audit findings on how the Bureau delivered the associated IT system – the Australian Water Resources Information System (AWRIS) – are accepted. The Bureau also welcomes acknowledgement that the upgraded replacement system is progressing towards its performance targets, highlighting risks, and the need for executive oversight and strong project management.

Australia's National Meteorological Service
700 Collins Street Docklands Tel: +61 3 9669 4000 Fax: +61 3 9669 4699 www.bom.gov.au ABN 92 637 533 532

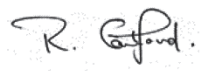
We provide the following comments on the two recommendations in the report.

Recommendation No. 1: Agreed.
The Bureau has redesigned and consolidated its key performance indicators (KPIs) in 2012-13 to better demonstrate its performance in achieving its legislative and program responsibilities, and enterprise outcomes and objectives. Enterprise level KPIs are underpinned by program level KPIs that demonstrate progress against deliverables. Progress is monitored by the Bureau's Senior Managers' Meetings (SMM) two to three times a year. The Bureau retained the KPIs from the 2012-13 Portfolio Budget Statements in 2013-14 to enable consistency in reporting. Performance against KPIs is also included in the Bureau's Annual Report. The status of AWRIS and other major IT projects are now specifically identified as major deliverables in the Bureau's operational plan and progress is now reported to SMM.

Recommendation No. 2: Agreed.
From July 2013, the Bureau has established an Information Systems and Services Division to place greater emphasis on the information technology and information management. This is intended to enhance capability and increase flexibility and responsiveness. The Bureau is also implementing an enterprise-level Portfolio Management Board. The Board will enhance the prioritisation, selection and governance of projects by providing regular review of the status, cost and overall progress to the Executive. Governance structures and the level of project administration will be commensurate to risk factors such as the size of the project team, duration of the project, tolerance to variation, strategic, cost, interdependence on other activities, and overall complexity.

The Bureau appreciated the constructive advice and direction provided throughout the audit process by the ANAO team.

Yours sincerely



Dr Ray Canterford
Acting Director
Bureau of Meteorology

9 January 2014

Australia's National Meteorological Service
700 Collins Street Docklands Tel: +61 3 9669 4000 Fax: +61 3 9669 4699 www.bom.gov.au ABN 92 637 533 532

Summary of Agency Response

The Bureau welcomes the Audit Report and is implementing the two recommendations:

- Key performance indicators have been redesigned, at enterprise and program levels; reported to management and in the Annual Report. Major IT projects (including AWRIS) are now identified as major deliverables in the Bureau's operational plan and progress reported to senior management.
- From July 2013, the Bureau established an Information Systems and Services Division to enhance capability and increase flexibility and responsiveness. An enterprise-level Portfolio Management Board is being implemented to enhance project governance and provide regular reviews of the status, cost and overall progress.

The Bureau was pleased with the ANAO assessment that the Bureau has developed effective arrangements for collaboration with water data suppliers, and will continue engagement with stakeholders to deliver product and services and manage expectations having regard to available resources.

Australia's National Meteorological Service
700 Collins Street Docklands Tel: +61 3 9669 4000 Fax: +61 3 9669 4699 www.bom.gov.au ABN 92 637 533 532

Appendix 2: Categories of water information and named water organisations

Categories of water information

1. There are 10 categories of water information and 105 subcategories.

	Water information category	No. of subcategories
1	Surface water resource information	2
2	Ground water resource information	3
3	Water storage information	7
4	Meteorological information	10
5	Water use information	12
6	Information about water rights, allocations and trades	7
7	Information about urban water management	51
8	Information about water restrictions	1
9	Water quality information	9
10	Water information for flood warning purposes	3
Total		**105**

Source: ANAO analysis of Bureau of Meteorology information.

Categories of named water organisations

2. There are eight categories of water organisations named under the Water Regulations 2008, as outlined in the table below.

Category	Category description	Water information category associations
A	Lead water agencies	1,2,3,4,5,6,8,9
B	Other agencies of the Commonwealth or a State	1,2,3,4,5,6,8,9
C	Hydroelectricity generators	1,3,4
D	Owners or operators of major storages	3
E	Rural water utilities	1,2,3,4,5,6,9
F	Urban water utilities	1,2,3,4,7,8,9
G	Catchment Management Authorities and others	1,2,4,9
H	Providers of flood forecasting and warning information	10

Source: Water Regulations 2008, sections 1.03 and 7.02, and schedule, *Persons and Classes of Persons.*

Appendix 3: Modernisation & Extension Program funding themes for Rounds 3, 4 and 5

Themes for Round 3	
1	Improving accuracy of measurement networks
2	Improving currency of measurement networks
3	Improving coverage of monitoring networks
4	Improving data management and transfer
5	Improving the Australian Hydrological Geospatial Fabric
6	Improving the National Water Account
7	Strategic water information co-ordination
8	Rescue of strategic data
Themes for Round 4	
1	Improving accuracy of water monitoring
2	Installation of telemetry
3	Extending the coverage of monitoring networks
4	Improving data management and transfer
5	Rescue of strategic data
6	Improving the Australian Hydrological Geospatial Fabric – surface water
7	Improving the Australian Hydrological Geospatial Fabric – groundwater
8	Improving the National Water Account
9	Strategic water information co-ordination
10	Water information standards
Themes for Round 5	
1	Data collection and telemetry
2	Coordination activities
3	Participating in cooperative planning and production of the National Water Account
4	Improving the Australian Hydrological Geospatial Fabric national surface water foundation set
5	Developing the National Groundwater information System (NGIS) as an input to the Australian Hydrological Geospatial Fabric national foundation groundwater data set
6	Data provision and water data transfer

Source: ANAO analysis of Bureau of Meteorology information.

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