



Australian Government  
Bureau of Meteorology

National Research  
**FLAGSHIPS**  
Water for a Healthy Country



# WIRADA IMPLEMENTATION STRATEGY (2010-2013)

CSIRO & Bureau of Meteorology

Water for a Healthy Country Flagship Report  
Revised May 2011

[www.csiro.au](http://www.csiro.au)

a water information R & D alliance between the Bureau of Meteorology and CSIRO's Water for a Healthy Country Flagship



**Water Information**  
DATA > INFORMATION > INSIGHT

The Water for a Healthy Country Flagship aims to provide Australia with solutions for water resource management, creating economic gains of \$3 billion per annum by 2030, while protecting or restoring our major water ecosystems.

The work contained in this report is collaboration between the Flagship and the Bureau of Meteorology.

In April 2008, the Australian Government announced *Water for the Future*, a \$12.9 billion national water investment program. This program includes \$450 million for the *'Improving Water Information Program'* to be administered by the Bureau and backed by the Commonwealth *Water Act 2007* and key stakeholders.

Under the *'Improving Water Information Program'*, the Bureau will enhance the quality and utility of Australia's water information by producing the National Water Account, supported by a truly national water monitoring and data collection network. The program includes the development and maintenance of an integrated, national water information system freely accessible to the public.

In April 2008, a joint initiative—\$50m over five years—between the Bureau's Water Division and CSIRO's Water for a Healthy Country Flagship was formed to provide the core underpinning research to support the Bureau's role as the national water information provider.

For more information about the partnership visit <http://www.csiro.au/partnerships/WIRADA.html>

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## EXECUTIVE SUMMARY

The Water Information Research and Development Alliance (WIRADA) was established in April 2008 to provide the core underpinning research to support the Bureau of Meteorology's role as the national water information provider. WIRADA is formalised under an Umbrella Research Collaboration Agreement between the Bureau and CSIRO.

WIRADA is a joint initiative—\$50m over five years—between the Bureau's Water Division and CSIRO's Water for a Healthy Country Flagship. The shared goal is to improve the management of Australia's water resources by delivering value-added water information products and tools based on a comprehensive and robust nationwide water information system.

To meet this goal, numerous longstanding and new challenges within the Australian water information domain require resolution including:

- specifying data standards for water information transfer, storage, access and update that allow relationships between geographic and time-dependent characteristics
- designing an enduring information system architecture that can evolve over time as technologies and system requirements change
- improving the geographic resolution, frequency and national coverage of critical data sets required for hydrological analysis including rainfall, runoff and evapotranspiration
- integrating multiple data sets, models and reporting systems without redeveloping them
- providing accurate assessments of the stocks, flows and interactions of water across the Australian continent at multiple spatial and temporal scales for catchment and urban areas, rivers and aquifers (groundwater)
- explicitly assessing and reporting confidence intervals for data and model outputs
- developing improved short, medium and long term water forecasting capability

The *WIRADA Implementation Strategy* sets out the strategies and mechanisms to make successful the partnership and relationship between the Bureau of Meteorology Water Division and CSIRO's Water for a Healthy Country Flagship.

To maximise the impact, streamline delivery and evolve the WIRADA portfolio three core strategies will be pursued:

1. **Targeted research** – design an integrated and coordinated research portfolio that targets medium to longer term end user needs;
2. **Quality relationships and collaboration** – develop quality relationships and harness added-value from related research investments; and
3. **Quality delivery and impact** – deliver high quality science with operational impact and peer recognition.

In summary, the WIRADA Implementation Strategy:

- builds an open and close working relationship between CSIRO and the Bureau that allows each to reflect and adjust work programs and manage key risks
- provides for a five year investment profile increasing from \$8m in 2008/09 to \$12m in 2012/13 supported by roadmaps for each WIRADA research stream, interlinked with Bureau strategic objectives and timelines
- defines a deliberate and resourced strategy for research collaboration to enhance delivery

- signals a trebling of effort in water forecasting research and capability
- sets out a process to transition research to operations with roles, responsibilities and decision points well defined
- clarifies the communication protocol with well defined roles for the WIRADA Management Committee, WIRADA Director and relevant Bureau and CSIRO officers.

The Strategy will be refreshed and adjusted periodically as the Flagship's research platform is delivered, and, the Bureau's water information policies, systems, products and services are implemented.

<h2>WIRADA Implementation Framework</h2>	
<h3>WIRADA Implementation Framework</h3>	
<p><b>Targeted research</b></p>	
<p><b>DEFINE RESEARCH AGENDA</b></p>	<ul style="list-style-type: none"> <li>1 – Define research needs based on the Bureau's information products and services</li> <li>2 – Identify the key end user decisions and applications for water information</li> <li>3 – Refresh the WIRADA Science Plan</li> </ul>
<p><b>ALIGN RESEARCH FOR IMPACT</b></p>	<ul style="list-style-type: none"> <li>1 – Develop pathways for research transition to operations and application</li> <li>2 – Develop communication and adoption strategies</li> </ul>
<p><b>Quality relationships &amp; collaboration</b></p>	
<p><b>DEVELOP RELATIONSHIPS</b></p>	<ul style="list-style-type: none"> <li>1 – Build trusted relationship between the Bureau and CSIRO</li> <li>2 – Specify outcomes, develop or maintain linkages with key research providers</li> <li>3 – Specify outcomes, develop or maintain linkages with key international initiatives</li> </ul>
<p><b>HARNESS COLLABORATION</b></p>	<ul style="list-style-type: none"> <li>1 – Develop coordinated approach to research with key collaborators</li> <li>2 – Develop participation by key end users</li> <li>3 – Develop industry links</li> </ul>
<p><b>Quality delivery &amp; impact</b></p>	
<p><b>MANAGE SCIENCE QUALITY</b></p>	<ul style="list-style-type: none"> <li>1 – Performance monitoring and managing risks</li> <li>2 – Robust portfolio review</li> <li>3 – Balancing research product and scientific outputs</li> </ul>
<p><b>CHAMPION EVALUATE &amp; FEEDBACK</b></p>	<ul style="list-style-type: none"> <li>1 – Communicate for impact</li> <li>2 – Evaluate research impact, uptake and report outcomes</li> <li>3 – Adjust portfolio focus and investment profile</li> </ul>
<p><i>Approved by authorised representatives of the WIRADA Management Committee</i></p>	<p><b>Dr Greg Ayers</b></p> <p><b>Dr Rob Vertessy</b></p> <p><b>Dr Andrew Johnson</b></p> <p><b>Dr Bill Young</b></p> 
<p><b>Dated: 28 April 2011</b></p>	



# 1. THE WIRADA PARTNERSHIP

The *WIRADA Implementation Strategy* sets out the strategies and mechanisms to make successful the partnership and relationship between the Bureau of Meteorology Water Division (the Bureau) and CSIRO's Water for a Healthy Country Flagship (CSIRO). The Strategy outlines the tools to develop a partnership ethos – encouraging an open and deep relationship between the Bureau and CSIRO where success and challenge are shared and solved collectively.

The Strategy provides a pointer to tactical investment priorities, maps out at a high level how the research may unfold over the next five years, and identifies processes to facilitate the transition of research into the Bureau's water information policies, systems, products and services.

The Strategy is organised into six key sections and three appendices:

Section 2 outlines the implementation strategies, tactics and key performance measures;

Section 3 sets out the five year investment profile and priorities for investment and how the research portfolio links and could be supported by key research collaborations;

Section 4 outlines WIRADA research delivery, capability requirements and opportunities for collaboration;

Section 5 outlines the key risks and mitigation strategies for the WIRADA program overall;

Section 6 outlines the WIRADA Communication Protocol (a requirement under the WIRADA Agreement);

Appendix A provides the WIRADA research stream roadmaps;

Appendix B sets out a framework for transitioning research to operational systems; and

Appendix C presents the WIRADA Communication Plan

The Strategy should be read in conjunction with the:

- *WIRADA Umbrella Research Collaboration Agreement* between the Bureau and CSIRO which formally outlines the obligations, commitments and governance arrangements for the Alliance.
- *WIRADA Science Plan* (CSIRO, 2008) which outlines the scope of research that could be undertaken to support the Bureau's water information function. The Science Plan does not present priorities within or between research outputs, nor does it explicitly link the research to operational requirements.

The Strategy will be refreshed and adjusted periodically as the Flagship's research platform is delivered, and, the Bureau's water information policies, systems, products and services are implemented.

## 2. IMPLEMENTATION FRAMEWORK

To maximise the impact, streamline delivery and evolve the WIRADA portfolio three core strategies will be pursued:

1. **Targeted research** – design an integrated and coordinated research portfolio that targets medium to longer term end user needs;
2. **Quality relationships and collaboration** – develop quality relationships and harness added-value from related research investments; and
3. **Quality delivery and impact** – deliver high quality science with operational impact and peer recognition. Impact will be achieved primarily through implementation of the science into the Bureau’s operational systems.

The strategies outlined below (summarised in Figure 1) are designed to:

- define and prioritise the strategic direction for research investment over the terms of the WIRADA Agreement;
- maximise capture of the vast body of relevant water research to underpin the Bureau’s water information function;
- foster collaboration;
- integrate research delivery with the design and implementation of water information policies, products, services and operational systems;
- evaluate outcomes;
- manage risk; and
- communicate research outcomes.

The following sections outline the tactics to achieve the core strategies.

### WIRADA Implementation Framework

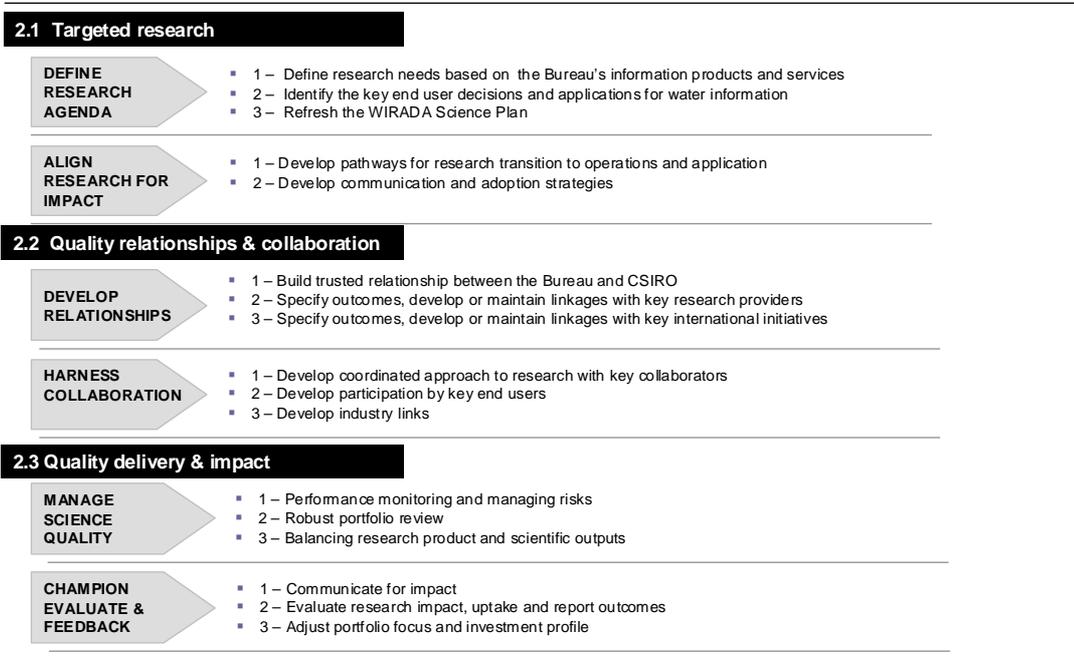


Figure 1 WIRADA Implementation Framework

## 2.1. Targeted research

**Goal** – design an integrated and coordinated research portfolio that targets medium to longer term end user needs.

### 2.1.1. Define research direction

**Objective** – Design a coordinated research portfolio that delivers knowledge, information and tools to vastly improve water data integration, water resource assessments, national water accounts, flood forecasts and water availability outlooks.

#### Strategies

1. *Identify the key end user decisions and applications for water information*  
Identify key decisions and applications of water information by government and industry where research can be most beneficial.
2. *Define research needs based on the Bureau's information products and services*  
Develop a targeted research portfolio that delivers information, knowledge and tools to support the objectives of the Australian Government's Improving Water Information Program.
3. *Refresh the WIRADA Science Plan*  
Review the direction and balance of the WIRADA research portfolio to ensure that it will meet the longer term needs of the water sector (including government, industry and researchers). Refresh the WIRADA Science Plan to reflect these needs.

#### Key Performance Measures

- Confirmation by the Bureau that WIRADA outputs meet their and their user needs.
- WIRADA Project Agreements refreshed and approved annually by the Management Committee.
- WIRADA Communication Plan aligned with Bureau's product adoption plans

### 2.1.2. Align research for impact

**Objective** – Determine the priority between research investments and develop path to impact.

#### Strategies

1. *Develop process to transition research to operations*  
Working closely with the Bureau develop a structured process or framework that will facilitate the transition of WIRADA research outputs to a point where they can be delivered into the Bureau's operational systems or development environment.
2. *Develop communication and adoption strategies*  
Working closely with the Bureau, develop adoption strategies to maximize the uptake and impact of the WIRADA research outputs.

#### Key Performance Measures

- WIRADA Research Transition Plans developed for all projects.
- WIRADA Communication Plan developed, review quarterly and progressively being implemented.

## 2.2. Quality relationships and collaboration

**Goal** – develop quality relationships and harness added-value from related research investments particularly across the Water for a Healthy Country Flagship portfolio, and build enduring partnerships with supporting initiatives.

### 2.2.1. Develop relationships

**Objective** – Define and develop relationships to enhance delivery of the WIRADA program and establish the necessary governance arrangements.

#### Strategies

1. *Build trusted relationships between the Bureau and CSIRO*  
Through agreement on roles, responsibilities, function and effective communication build trusted (open and close) relationships between the Bureau and CSIRO .
2. *Specify outcomes, develop and maintain linkages with key research collaborators*  
Ensure collaboration with aligned research initiatives, in particular those of eWater CRC, Centre for Australian Weather and Climate Research (CAWCR), Geoscience Australia (GA) and the Consortium of Universities for the Advancement of Hydrologic Science Inc (CUAHSI) to achieve specific outcomes in support of WIRADA activities.
3. *Specify outcomes, develop and maintain linkages with international initiatives*  
Ensure collaboration with lead international water information and standards setting initiatives including the Open Geospatial Consortium (OGC) Hydrology Domain Working Group and the World Meteorological Organization Commission for Hydrology (WMO CHy) to achieve specific outcomes in support of WIRADA activities.

#### Key Performance Measures

- Processes for Bureau engagement in Project design, development and delivery defined, agreed and implemented i.e. Project. Sponsor, Business Lead, Technical Lead, Bureau Research Team members.
- Bureau staff actively engaged in the research design and development. CSIRO researchers actively participating in R&D transition processes to operations.
- Outcomes specified and monitored for collaboration with CAWCR, eWater, and GA.
- Outcomes specified and monitored for collaboration with international initiatives including CUAHSI, OGC and WMO.
- No skills gaps or shortage of capabilities to meet demand.

### 2.2.2. Harness collaboration

**Objective** – Harness and value-add from relevant research investment.

#### Strategies

1. *Develop coordinated approach to research with key collaborators*  
Facilitate a coordinated approach to research delivery to the Bureau with key research collaborators by identifying synergies and opportunities to synchronize delivery including Water for a Healthy Country Themes, eWater, CAWCR, GA and CUAHSI. Table 5 provides an overview of possible collaborations by WIRADA project.

2. *Facilitate participation by key end users*  
Working closely with the Bureau, create opportunities for involvement of key end users in the development, testing and delivery of the research program outputs.
3. *Develop industry links*  
Working closely with the Bureau, actively participate in relevant water information, spatial and information technology 'Communities of Practice'.

#### **Key Performance Measures**

- Action plans for research collaboration implemented with particular regard to eWater, CAWCR, GA, CUAHSI and relevant Water for a Healthy Country Flagship Themes.
- Jurisdictional and industry participation in WIRADA research projects and pathways for adoption specified (including training).
- WIRADA research project participation and leadership in communities of practice.

### **2.3. Quality delivery and impact**

**Goal** – deliver quality science with real world impact and positive peer recognition.

#### **2.3.1. Manage science quality**

**Objective** – Ensure sound science quality management practices maintained.

##### **Strategies**

1. *Performance monitoring and managing risks*  
Develop financial and output performance monitoring processes and risk register to be used by the WIRADA Management Committee.
2. *Robust portfolio review*  
Using international and independent peer review, monitor science outputs for quality.
3. *Balancing research product and scientific outputs*  
Create an ethos of quality research delivery and require the preparation of scientific outputs by project teams.

#### **Key Performance Measures**

- More than 80% of the WIRADA deliverables achieved and accepted to time and budget, with the delayed deliverables completed within the following quarter.
- The majority of WIRADA research outputs embedded in, or influential on the implementation of Bureau operational systems.
- WIRADA portfolio subject to periodic independent peer review and aligned with formal reviews of the Improving Water Information Program and Flagship Program.
- Scientific publication productivity and citation index at or above the CSIRO benchmark.

#### **2.3.2. Champion, evaluate and feedback**

**Objective** – Champion the research outcomes; assess impact and adapt the WIRADA research program.

##### **Strategies**

1. *Communicate for impact*

Build external profile of the outcomes of the WIRADA research partnership through media coverage, jurisdictional and industry forums and contribution to international initiatives.

2. *Evaluate research impact, uptake and report back*

Undertake assessment of research impact, research uptake and report back to investors and stakeholders.

3. *Adjust portfolio focus and investment profile*

Review investment portfolio, renegotiate investment terms by the investors, redesign research activities to achieve agreed focus and delivery.

**Key Performance Measures**

- WIRADA research outcomes reported in media coverage, participation in key jurisdictional and industry forums and contribution to international initiatives.
- Research impact assessment undertaken and reported in the WIRADA Annual Research Report.
- Five year, rolling implementation strategy and investment profile agreed by Bureau and CSIRO through the WIRADA Management Committee

The following Sections provide amplification on:

- Investment priorities (2.1.1 Define research agenda)
- Transitioning research to operational systems (2.1.2 Align research for impact)
- Research collaboration (2.2.1 Develop relationships)
- Risk management (2.3.1 Manage science quality)
- Communication protocols (2.3.2 Champion, evaluate & feedback)
- Evaluation (2.3.2 Champion, evaluate & feedback)

### **3. INVESTMENT**

WIRADA is a joint initiative—\$50m over five years—between the Bureau’s Water Division and CSIRO’s Water for a Healthy Country Flagship. The shared goal is to improve the management of Australia’s water resources by delivering value-added water information products and tools based on a comprehensive and robust nationwide water information system.

To meet this goal, numerous longstanding challenges within the Australian water information domain require resolution including:

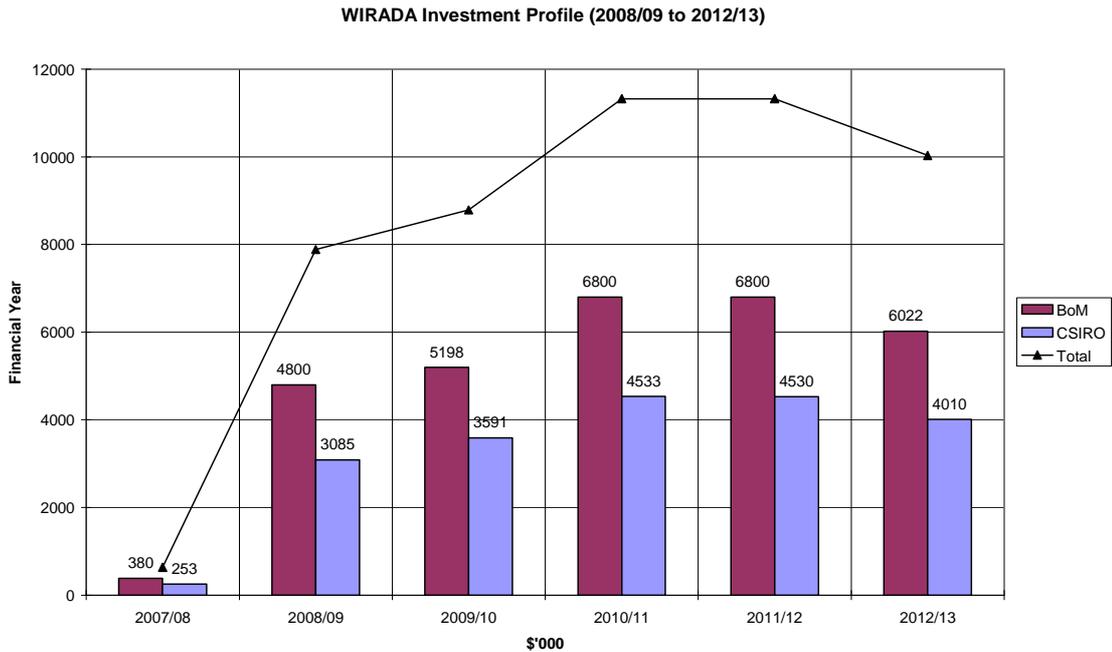
- specifying data standards for water information management, transfer, storage, access and update that support relationships between geographic and time-dependent characteristics;
- designing an enduring information system architecture and governance protocols that can evolve over time as technologies and system requirements change;
- improving the geographic resolution, frequency and national coverage of critical data sets required for hydrological analysis including rainfall, runoff and evapotranspiration;
- integrating multiple data sets, models and reporting systems without redeveloping them;
- providing accurate assessments of the stocks, flows and interactions of water across the Australian continent at multiple spatial and temporal scales for catchment and urban areas, rivers and aquifers (groundwater);
- explicitly assessing and reporting confidence intervals for data and model outputs; and
- developing improved short, medium and long term water forecasting capability.

#### **3.1. Five year investment profile**

The Bureau’s Improving Water Information Program will ramp up over the next two to three years. Resources made available to the Bureau by Australian Government will be guided by year-on-year resource requirements and the balance of priorities for Government at the time.

CSIRO investment is based on a four year funding agreement with Australian Government (2007/08 to 2010/11). CSIRO’s internal science investment processes take into account on-going contractual obligations such as WIRADA.

Investment has been planned over the term of the WIRADA Agreement (1 April 2008 to 30 June 2013). This non-indexed investment of \$50m over five years is equivalent to \$45m in 2008 dollar terms (assuming 5% CPI annually). This approximates to a 200 FTE effort over the five year term. A 2010/12 plateau five-year investment profile is provided in Figure 2.



**Figure 2 WIRADA Five year (ramping) investment profile**

Key considerations for CSIRO include:

- A 25% increase of investment (in \$ terms) over the next 5 years – based on a \$4m per year projected investment.
- Building research capacity from 32 in 2008 to 45 FTE in by 2010/11
- Managing research focus, investment and capacity beyond 2013.

Key considerations for the Bureau include:

- Sequencing the delivery of research outputs with system development cycles (operationalisation) in the medium term. For example, close alignment with AWRIS implementation schedule will be critically important.
- Capacity to adopt and/or adapt the research outputs being delivered by WIRADA
- Provision of sufficient lead time between initiating and completing research and scheduling implementation.
- Sourcing research support beyond 2013 – from CSIRO or other parties

### 3.2. Investment priorities

The WIRADA Science Plan provides a useful scan of the research challenges, outputs and capability that might be required to support the Improving Water Information Program. The WIRADA Science Plan was prepared at a time when there was a general idea of what and how the Bureau would implement the development of the Australian Water Resources Information System (AWRIS) and develop the various information products required under legislation (e.g. the set of National Water Accounts).

The WIRADA Science Plan sets out four core research areas of interest that align with the functions and responsibilities of the Bureau of Meteorology:

1. Water Information Systems;

2. Foundation Data Products;
3. Water Accounting and Assessment; and
4. Water Forecasting and Prediction.

These elements of the Science Plan have not been prioritised. The breakdown of 2010/11 \$11.33m investment by the WIRADA research streams is as follows: Water Information Systems – 27.4%; Foundation Data Products – 13.8%; Water Accounting and Assessment – 32%; Water Forecasting and Prediction – 22.6%; and Management – 4.1%

### **3.2.1. Drivers for research**

Australia has one of the most variable climates in the world and this tendency towards the extremes of drought and floods is increasing due to climate change. Eight ‘big’ water scarcity factors have been identified that demand a deep knowledge of climate, water cycle and mechanism to manage water – drying and warming climate; growing urban demand; over-allocation to irrigation; expanding plantations; bushfire recovering impacts; expanding farm dams; uncapped groundwater extraction (BoM 2008). The *National Water Initiative* and the \$12.9 billion *Water for the Future* Program set out the Council of Australian Governments response to these challenges. The NWI is a long term water reform process which is address water management challenges to which there are no ‘off-the-shelf’ solutions.

The role for research in water management to underpin the *National Water Initiative* and *Water for the Future* Program is relatively clear: provide solutions to the immediate challenges facing Australian communities while developing the understanding, knowledge and tools to manage Australia’s water resources under more extreme and uncertain future conditions.

Outlined below are the key drivers that may impact on the evolution and delivery of the WIRADA research program and Flagship’s broader research platform.

### **Policy and Programs**

*Government priorities* – the WIRADA research program has been shaped by the objectives and priorities of the *National Water Initiative* and *Water for the Future* Program (of which the *Improving Water Information Program* is a part). The Bureau will be required to respond to these priorities and in turn the WIRADA research program will be adjusted to remain aligned and relevant.

Broader resource management policy initiatives could benefit from some of the foundation research within WIRADA including emissions trading (model technology could be repurposed to carbon balance); the global need to maximise food production (model technology could be repurposed to crop biomass); the information economy (e.g. rural access the broadband could open up a new demand for agricultural information services); Caring for our Country (investment in environmental monitoring infrastructure).

*International collaboration* – the Bureau is the lead agency representing Australia’s interests at international forums e.g. WMO, GEO, GEOSS. As water scarcity increases focus on water management there is an opportunity and, most likely, expectation that Australia will take leadership on some of these matters. WIRADA research could play a significant supporting role

in these initiatives, however, that this may also impact on research scope and timing and not produce any tangible benefits for CSIRO or Bureau.

*Beyond water information* – Over the longer term AWRIS could be evolved to serve as a major contributor to an Australian National Environmental Information System (NEIS) providing information on the carbon balance and greenhouse gas emissions, soil and terrain information, agricultural productivity and environmental health. The supporting research required would be well beyond the defined scope of WIRADA, but the progression is made more likely by the way in which the energy, carbon and water cycles are intertwined with agriculture and ecosystems.

## **Implementing Improving Water Information Program**

*Improving Water Information Program rollout* – research timing and questions will emerge as the Bureau design, develop and implement water accounting, water resource assessment, hydrological forecasting and the Australian Water Resources Information System. During this process some research areas will transition from fundamental research to application development.

*Water resource assessments will evolve* – the Bureau's initial focus for water resource assessment and accounting will be on water quantity, availability and use at catchment scale. As the technology for spatial observation and estimation evolves, it will become possible to provide data of direct relevance to individual land holders, producers and households. Assessments will be extended to consider water quality (accounting for water resources quality from a use value perspective; early warning of groundwater degradation; near real time observation of river salinity), and environmental water management with associated reporting on water ecosystem response. Research will need to evolve to support a greater data granularity, range of parameters, systems understanding and transition from retrospective to prospective assessment (drawing on water forecasting).

*Forecasting water availability* – water markets will mature to use and depend on forecasting water availability. The majority of water sharing plans (or equivalent) will be reviewed over the next five years. The underpinning research and information will come under increasing scrutiny – emphasis on quantifying and qualifying uncertainty will be critical.

## **End user developments**

*Users will drive change* – with increased accessibility to water information, users will demand customised, higher resolution (in space and time) and accurate water information. This will require tools and techniques to manage higher numbers of transactions and rapidly retrieve, interpret and represent water information in near real time ultimately to seamless prediction services. Is the research capacity geared to respond in a timely way to rapidly increasing client side demand?

*Location-based services* – location-based services (my place, now, future) will demand customised solutions at high resolutions in time and space. Water information services will therefore need to support multi-scale products.

*Centralised to distributed services* – the Bureau's information products and services will be used to deliver independent information services. These services may be mission critical (e.g.

flood forecasting for emergency response). New technologies and solutions to support cost effective and computationally efficient distributed modelling, data access and real time update may be required and shape future water information systems research.

## Technical developments

*Leadership in standards setting* – water data transfer and sharing is founded on adopting standards and protocols. WIRADA researchers are active at an international level through OGC, CUAHSI and WMO to deliver WaterML2.0. Involvement at these levels can impact on the scope and delivery timelines. An initiative that may impact on AWRIS implementation and WIRADA research is the Commonwealth Spatial Data Integration (CSDI) project which aims to define the standards and protocols for spatial data sharing across all Australian Government agencies. If implemented, the infrastructure for sharing spatial data between all Commonwealth agencies will be in place by 2010. There is an opportunity for WIRADA researchers to help shape the CSDI project and to ensure alignment with approaches being taken to the Australian Hydrological Geospatial Fabric.

*Technology will drive change* – the volume, diversity, source/nature of sensors will dramatically increase. Higher resolution (in time and space), multi-spectral space-based sensors will expand dramatically over the next 5 to 10 years and will be collected by a greater number of organisations and nations. This will require tools and techniques to assimilate, validate, store, retrieve, interpret and present water information – in near real time. The Australian government is considering its space strategy and Senate enquiries have identified earth observation for water resources management as a key driver for this. Conversely, Australia's space strategy is likely to have a profound influence on technological development in WIRADA and beyond.

### 3.2.2. Research directions

The research priorities for WIRADA will be shaped by the drivers outlined in Section 3.2.1. From our current understanding of the research challenges and their achievability, this section sets out research investment directions for WIRADA over the next five years. These research directions will be reviewed annually and refined according to new research and knowledge (including those generated from the Flagship's broader research platform), and progress in the implementation of the Bureau's water information policies, products, services and operational systems.

Table 1 provides an investment profile (allocation of full time equivalents) for each of the WIRADA Research Streams. The rationale for this investment profile is as follows:

**Water information systems** has a significant contribution to make in the early and mid phases of WIRADA as the Bureau designs and implements Phase 1 and 2 of AWRIS. Over the next 3-5 years the functionality and technical sophistication of AWRIS will need to expand through greater levels of automation (business knowledge), increased standardisation, semantics integration, systems integration, and [de]centralisation. There will therefore be an on-going requirement for research into, and development of, best practice information management, and integration solutions. Solutions to data ingestion were identified as a new area for R&D during 2009/10. This area remains a high priority and will require increased focus in 2011/12. . Effort in water information systems therefore incur a sustained increase during 2010-2012 and then reduce in the final year 2012/13.

The initial projects developing **Foundation Data Products** and services will provide the fundamental data and methods to operationally populate rainfall, evapotranspiration and digital elevation model components of the Australian Hydrological Geospatial Fabric. As AWRIS evolves and the user base grows there will be increasing demand for higher resolution (in time and space) data and derived information (e.g. flood magnitude and floodplain mapping, aquifer mapping, near real time provision of continental rainfall and actual evapotranspiration data services, spatial information on land cover and water use). Effort in Foundation Data Products will therefore be progressively decreased to 50% of 2008-09 levels by 2012/13.

The requirements for precise and timely (regular) **Water Resource Assessment and Accounting** will increase over the next 2-5 years as the water information user base grows. Water resource assessments are likely to evolve to be prospective in nature to support real-time decision making. Water availability outlooks will draw on the water forecasting service to provide information properly functioning water markets. Prospective water resource assessment will require quantification of the impact of climate change on the changing state and/or threshold conditions for Australia's critical water resource systems – with focus on managing risk and thereby improved understanding of extreme events. Research will also need to be extended to support water quality management and environmental water assessments which will need to draw on expertise outside the existing complement of WIRADA researchers. It is anticipated in the medium to longer term that resource assessments will integrate the water, carbon, greenhouse gas and energy balances, as coupled through the land surface, ecosystems, crops and forests. Increased emphasis on transitioning AWRA-L into operations will require additional resources in 2010/11. Effort in water resource assessment and accounting will therefore be marginally increased above 2009/10 levels over then reduce for the final year of the program.

Of all the research areas **Water Forecasting** has the greatest potential to add economic and social value. Water forecasting is an immature science and will be shaped over the first two years with a focus on enhanced flood forecasting and continuous flow forecasting. Increased skill in short-term and seasonal water forecasting is fundamentally reliant on improved precision in weather and climate forecasting. Highly prospective areas of research include probabilistic forecasting and verification; inundation monitoring, hydrodynamics and forecasting to support emergency response and relief; and integration of a wider range of remote sensing observations and distributed sensor networks (e.g. cosmic ray soil moisture sensor technology) to provide real time information on catchment status to support forecasting. Long term (years to decadal) water forecasting will be developed to capitalise on, and link with the significant body of climate change research. Renewed interest in flash flood forecasting following major flood events in 2010 and 2011 may direct some of the increased research activity. Effort in water forecasting will more than treble from 2008-09 levels by 2012.

Investment in **Management** will be contained within a cost of less than 5%.

**Table 1 Indicative profile of Full-Time Equivalents for WIRADA Streams**

	<b>2008/09</b>	<b>2009/10</b>	<b>2010/11</b>	<b>2011/12</b>	<b>2012/13</b>	<b>Total</b>
Water Information Systems	9.1	9.1	11.8	11.0	8.8	<b>49.7</b>
Foundation Data Products	6.8	7.8	8.0	3.8	3.0	<b>29.4</b>
Water Accounting and Assessment	10.0	10.7	14.5	14.0	11.0	<b>60.2</b>
Water Forecasting and Prediction.	5.1	6.6	10.0	15.5	16.0	<b>53.2</b>
Management	1.0	1.2	1.2	1.2	1.2	<b>5.8</b>
<b>Total (approx)</b>	<b>32.0</b>	<b>35.2</b>	<b>45.5</b>	<b>45.5</b>	<b>40.0</b>	<b>198.3</b>

## **4. RESEARCH DELIVERY AND COLLABORATION**

This section outlines WIRADA research delivery, capability requirements and opportunities for collaboration.

### **4.1. Research delivery**

In the context of WIRADA, the primary path for delivery for the majority of the research outputs will be to and/or through the Bureau. To effectively and efficiently deliver research the following actions need to be addressed:

- clarity in roles, functions and responsibilities for Bureau and CSIRO teams (refer Section 4.1.1, Table 2 and Table 3);
- alignment of the research to support the priorities and phasing of AWRIS<sup>1</sup> Systems, Products and Services (refer Section 4.1.2);
- design specifications, quality measures, and/or formats for research outputs (refer Section 4.1.3); and
- support (e.g. documentation or training) to enable the use and/or implement the research.

#### **4.1.1. Roles and functions**

The WIRADA partnership arrangements are well supported by the Bureau through Project Sponsors for each project and being linked to Business Lead (domain specialists) and Technical Lead (delivery specialists). In the context of WIRADA, a range of roles and responsibilities to facilitate the design, development, implementation and transition of research into operations are recognised. To ensure efficient and effective uptake of research outputs there must be a close and regular working relationship between the Research Project Leader, Business Lead and Technical Lead. A summary of these roles is provided in Table 2.

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<sup>1</sup> AWRIS is assumed to be the Bureau's delivery mechanism for all products and services

**Table 2 Roles at the ‘research interface’**

<b>Role</b>	<b>Responsibilities</b>
Project Sponsor (Bureau)	<ul style="list-style-type: none"><li>• Champion the WIRADA activities within the Bureau of Meteorology;</li><li>• Promote the WIRADA activities outside the Bureau of Meteorology;</li><li>• Manage the identification of Water Division needs/requirements;</li><li>• Identify the research gaps/needs to address these requirements;</li><li>• Prioritise the research gaps/needs;</li><li>• Manage the Bureau resource inputs to all elements of product identification through R&amp;D to product implementation;</li><li>• Review and endorse Project Agreements; and</li><li>• Manage the review progress against milestones and approve payment of invoices.</li></ul>
Business Lead (Bureau)	<ul style="list-style-type: none"><li>• Identify and manage the user/Bureau interface;</li><li>• Lead the identification and development of Water Division products and services;</li><li>• Identify the research and development required to support the production of these products and services;</li><li>• Identify the R&amp;D gaps that need to be filled;</li><li>• Contribute to the development of Project Agreements;</li><li>• Works on research transition to the implementation process with the Technical Lead and Research Project Leader; and</li><li>• Review progress against milestones and requirements.</li></ul>
Technical Lead (Bureau)	<ul style="list-style-type: none"><li>• Contribute to the identification of Water Division products/services;</li><li>• Contribute to the user interface discussions;</li><li>• Lead and manage the implementation R&amp;D outputs as Water Division products and services;</li><li>• Identify development and implementation requirements/specifications;</li><li>• Define methods of delivering products from research to trial/testing stages;</li><li>• Develop Quality Control procedures for product delivery using the water Division agreed processes;</li><li>• Contribute to the development of Project Agreements;</li><li>• Works on research transition to the implementation process with the Business Lead and Research Project Leader; and</li><li>• Assist in the review of progress against milestones from an implementation perspective.</li></ul>
Research Project Leader	<ul style="list-style-type: none"><li>• Manage the research–Bureau interface;</li><li>• Lead the identification and development of research to meet Water Division water information products, services or system requirements;</li><li>• Identify the research and development required to support new or next</li></ul>

<b>Role</b>	<b>Responsibilities</b>
	<p>generation water information products, services or systems;</p> <ul style="list-style-type: none"> <li>• Develop Project Agreements;</li> <li>• Manage research project teams for on-time and budget delivery;</li> <li>• Work on research transition to the implementation process with the Technical Lead and Business Lead; and</li> <li>• Report progress against milestones and requirements.</li> </ul>
Research Stream Leader	<ul style="list-style-type: none"> <li>• Support Research Project Leaders in project design and facilitate resourcing the appropriately skilled researchers</li> <li>• Provide leadership in portfolio design with particular attention to integration across projects within the WIRADA Portfolio</li> <li>• Work on research transition to the implementation process with Research Project Leaders, Technical Leads and Business Leads;</li> <li>• Monitor and facilitate the research–Bureau interface; and</li> <li>• Review progress against milestones and requirements.</li> </ul>
Team Members (Bureau)	<ul style="list-style-type: none"> <li>• Provide input/contribute to the Project Activities as outlined in the Project Agreements;</li> <li>• Represent the Bureau’s needs/interests in the Project Activities;</li> <li>• Assist in the review of progress against milestones; and</li> <li>• Assist in the development of Project Agreements.</li> </ul>

The overarching management arrangements for WIRADA are outlined in Table 3 – noting the role of *Communication and Adoption* in the R&D to operations process.

**Table 3 Roles, functions and lead responsibilities for WIRADA implementation**

<b>WIRADA Function</b>	<b>Responsibility</b>	<b>Lead</b>
<b>Governance</b>	Fiduciary, accountability	WIRADA Management Committee
<b>Leadership</b>	Research strategy	WIRADA Director, Flagship Science Director, CSIRO Program Leaders, WIRADA Stream and Project Leaders
	Products & Services	Bureau Assistant Directors, WR&T Manager, Section Heads and Technical Leads
<b>Management</b>	Research development	WIRADA Director, Stream and Project Leaders, Deputy Director Water, Assistant Directors, R&D Manager, Section Heads
	Coordination	WIRADA Director, Bureau WR&T Manager
	Performance Management	WIRADA Director, Bureau WR&T Manager
	Reporting	WIRADA Director, Project Leaders
	Communication & Adoption	Flagship Communication Manager, WIRADA Communicator, Bureau Communication and Adoption Strategist

<b>WIRADA Function</b>	<b>Responsibility</b>	<b>Lead</b>
		and Water Division Communication Manager
<b>Project development</b>	Design	Project Leaders, Bureau Business Lead, Technical Lead
	Approval	WIRADA Management Committee through WIRADA Director, Bureau Assistant Directors (Sponsors), WR&T Manager
<b>Project implementation</b>	Research	Project Leader and Activity Leaders
	Integration	Business Lead, Technical Lead
<b>Project finalisation</b>	Research	Project Leader
	Operationalisation	Technical Lead

#### **4.1.2. Research alignment**

The success of WIRADA will be judged on the ability to deliver solutions that can be used and/or implemented by the Bureau to prepare and evolve AWRIS Systems, Products and Services. To be successful WIRADA research will:

- support implementation choices and decisions on AWRIS Systems, Products and Services
- align with the priorities and delivery schedules for AWRIS Systems, Products and Services
- help position the Bureau to evolve and generate new AWRIS Systems, Products and Services.

The foundation for success is regular, quality dialogue between CSIRO and the Bureau.

Timelines (or roadmaps) for WIRADA and Bureau's Water Division are provided in **Appendix A** including:

- A high-level five year timeline (or roadmap) for the WIRADA
- A summary of the Bureau Water Division work plan (as at May 2009).
- Research Stream-level breakdown showing the key research challenges and research outputs for the WIRADA Research Streams.

Refinement to, and scheduling of, research outputs into operational development processes will be assessed during the preparation of the *Research Transition Plan* for each project.

#### **4.1.3. Transitioning research to operations – Action Plan**

WIRADA projects will provide information and/or tools that will inform or be incorporated into the development of the Bureau's water information policies, systems, products or services. Research is an integral part of operationalising any information product or service. The transition from research to operational systems should therefore be managed as a staged process with evaluation, feedback, decision points and agreed responsibilities for the research and operational teams.

WIRADA research has not been designed (or required) to develop a fully functional operational systems but rather provide knowledge and components to systems that are still in the process of being defined and designed.

**Appendix B** outlines a framework to facilitate the transition of WIRADA research outputs to a point where they can contribute to the development and/or operationalisation of the Bureau's water information policies, systems, products or services. In summary, the high level framework consists of the following steps:

1. **Project Phases:** Identify project phases or categories which characterise where an output of a project would be delivered. The lifecycle for a project would typically involve moving through some (not all) the phases with appropriate decision points (staging gates) identified along the way. Knowing what phase a project is at will provide valuable information of the effort and time required before it can become operational.
2. **Staging Gates:** Identify the process required at each staging gate (decision point) of the transition process. That is, the questions and criteria that needs to be met to allow further investment to take place and work to continue (resulting in the Go/NoGo outcome). This process may include the change in responsibility between CSIRO and the Bureau in moving to the next phase.
3. **Feedback:** Appropriate feedback loops that will help to control, regulate and inform the transition process. Feedback will occur at the completion of a project (to assist planning the next phase) and also occur during regular quarterly progress reporting.
4. **Governance:** Apply a governance model for the transition process. This could be through an individual or a joint committee (e.g. Operational Systems Implementation Committee) with responsibility to apply the framework to WIRADA projects as an ongoing process.

The actions identified (13 November 2009 TROPS workshop) to maximise the outcomes from research and facilitate effective uptake and implementation of WIRADA research outputs are:

1. **Assign roles:** Agree the role description for Business Leads and Technical Leads and identify appropriately skilled staff for each research project – Alliance Director and Water Division Leadership Team by 18 December 2009.
2. **Form team:** Establish regular (minimum monthly) communications within research projects between Research Project Leaders, Business Leads and Technical Leads – Research Project Leader initiated by end of February 2010.
3. **Performance criteria:** Document performance criteria and staged verification process as part of the research project plans for 2010/11 – Research Project Leader, Business Lead and Technical Lead by June 2010.
4. **Informal briefings:** Short verbal briefings (<30 min) on progress are provided to the Project Sponsor (or Project Sponsors Agent), Research Stream Leader, Water Research & Training Manager and Alliance Director on a regular monthly basis – research Project leader initiated by end of February 2010.
5. **Collaboration tools:** Investigate the options and guidelines for using collaboration tools (SharePoint, Jira, Wikis, Google Wave) to improve communication and transparency between CSIRO and the Bureau – IWIS Theme Leader and AD IT Planning and Development (or delegate) to advise by March 2010.
6. **Supported IT platforms:** IT Infrastructure and Planning to prepare and/or distribute documentation on supported platform(s) and software to Technical Leads (Sponsor: Peter Gigliotti) by end of March 2010.

7. **Data Management standards:** Data Management to prepare and/or distribute documentation on supported data formats and standards including metadata requirements to Technical Leads (Sponsor: Tony Boston) by end of April 2010.
8. **Data access:** Technical Leads to coordinate access to Bureau-held data sets or data streams. Amend WIRADA research project data request process with the technical lead and the first point of contact.
9. **Third party data streams:** Data Management to prepare policy for sourcing and managing third party data streams required for modelling e.g. remotely sensed data (Sponsor: Tony Boston) by end of April 2010.

## 4.2. Research capability

The following strategies will be adopted to ensure high calibre and focused research effort is maintained over the term of WIRADA:

- *Dedicated team* – majority of lead scientists with >70% allocated to WIRADA projects by 2010/11
- *Grow team* – working proactively with CSIRO Program Leaders and CAWCR to access the required balance of skills and experience from 32 Full Time Equivalents (FTE) in 2008/09 to 39 FTEs in 2012/13. WIRADA can also take advantage of PhD and Postdoc schemes available to Flagships and Divisions through CSIRO.
- *Bureau participation* – targeted involvement of researchers from the Bureau’s Water Division in WIRADA projects, in particular to research transition and uptake.
- *Strategic input* – strategic involvement of senior research leaders (e.g. Chiew, Podger) for critical project phases e.g. scientific review panels for both planning and scientific progress reviews
- *Collaboration* – grow ‘value-add’ research support to the program through targeted research collaborations (not on critical path).

As the research type and maturity changes over the term of WIRADA, so too will the capability requirements. A high level summary of the range of research capability required to support WIRADA research (Table 4) will be used to focus negotiations within CSIRO, CAWCR and partners as well as coordination and collaboration across related research initiatives such as the South Eastern Australian Climate Initiative and eWater CRC.

Table 4 Evolution of capability to support WIRADA research

<b>Discipline</b>	<b>Required by 2012/13<sup>2</sup></b>
<b>Climate</b>	
Seasonal climate modelling	+
Impacts of climate change modelling	++
Quantitative precipitation forecasting	++
Rainfall observation, spatial and temporal structure	+
Downscaling of climate model outputs	+
<b>Water resource assessment &amp; accounting</b>	
Natural resources accounting	o
Conceptual modellers	o
Foresighting and scenario planning	o
Spatio-temporal data analysis and reporting	++
Water rights and trading	+
<b>Hydrology and water resources</b>	
Spatial and statistical hydrology	+
Groundwater hydrology	+
River and floodplain hydraulics	o
River regulation and river modelling	+
Groundwater and surface water interactions	+
Catchment hydrology including irrigation	o
Model updating and uncertainty quantification	+
Soil-water-vegetation-carbon relations	+
Water resource quality assessment	+
<b>Informatics</b>	
Semantics and web services	+
Data standards and data delivery	–
Database and System Architecture	+
Information modellers/modelling	o
Human factors and user interface design	+
Software engineering and developers	+
GIS Operators	+
Spatial and temporal data management	o
<b>Observational sciences</b>	
Satellite imagery classification	+
Real time event detection and early warning	+
Spatial modelling	+
Statistical design and analyses, modelling & reporting	+
Terrain analysis (geomorphology)	+
Model-data fusion, including data assimilation	++
Statistical classification and data mining techniques	+

<sup>2</sup> (++) ramping; (+) growing; (o) maintaining; (–) reducing

### 4.3. Research collaboration

The success of WIRADA is critically dependent on the quality of the relationship between CSIRO and the Bureau's Water Division. Approaches to research delivery including definition of roles, responsibilities and the transition process are outlined in Section 4.1.

The success of WIRADA will be augmented by developing strong:

- internal (to CSIRO) research linkages, in particular with Water for a Healthy Country Themes developing eWater products; and
- external research collaborations that can add value and imprimatur to WIRADA outputs and Bureau outcomes.

Table 5 sets out the key research linkages and strength of relationship relevant to the WIRADA research portfolio. Project-level collaborations (in particular the university sector) will be identified and approved through Project Agreements.

The *must have* Program-level collaborations outcomes include:

- **Centre for Australian Weather and Climate Research** – CAWCR is a partnership between CSIRO and the Bureau that provides significant capability at the *climate and water* interface. Strengths in earth observation, data assimilation and modelling. CACWR will design, develop and make operational the Australian Climate Community Earth Simulation System (ACCESS). Outcomes sought from collaboration include:
  - access to CAWCR capability in the areas of short term, seasonal and long term climate forecasting, evapotranspiration processes and data-model fusion.
  - linking hydrological predictions with climate predictions.
  - bridging the gap between climatological and hydrological models.
- **eWater Cooperative Research Centre** – eWater is developing the next generation of river management and river operations tools. Outcomes sought from collaboration include:
  - leverage from the Toolkit, River Manager and other tools.
  - product functionality that use and comply with interoperability and water information standards (e.g. WaterML2.0).
  - capacity to link and/or interchange eWater and WIRADA tool modules.
- **Consortium of Universities for the Advancement of Hydrologic Science Inc** – building on previous interactions and visits by Dr David Maidment (University of Texas at Austin) and Prof. Larry Band (University of North Carolina) there are existing and future research collaboration opportunities through CUAHSI. Outcomes sought from collaboration include:
  - co-development of water information standards WaterML2.0.
  - sharing of advancements in water information assimilation and hydrological modelling.
- **Open Geospatial Consortium** – building water information standards based on OGC standards through the Hydrology Domain Working Group. Outcomes sought from collaboration include:

- access to OGC network of expertise in standards development, testing and publishing.
- internationally recognised standards framework on which to build and develop domain specific standards for hydrology, specifically WaterML2.0.
- **World Meteorological Organisation Commission for Hydrology – WMO CHy** provides the authority for adoption of methods and tools in hydrology. Through active participation in WMO CHy activities standards such as WaterML2.0 will become internationally recognised and adopted standards. Outcomes sought from collaboration include:
  - Influence over the scope and direction of water information standards being developed and mandated by the WMO.
  - WaterML2.0 adopted and mandated by WMO CHy.

Other *highly desirable* collaborations that will be maintained or developed include:

- **Deltares:** CSIRO has a Memorandum of Understanding with Delft while the Bureau has close links with Deltares for access to FEWS and for collaborative research into operational observation and forecasting systems. Outcomes sought from collaboration include:
  - Access to modelling knowledge, experience and expertise.
  - Improved flood forecasting and warning services in particular, and hydrological modelling in general.
- **Australian Government and Information Sector** – opportunities to more formally collaborate with Australian Government and industry research and development agencies such as Geoscience Australia<sup>3</sup>, the Office of Spatial Data Management, Public Sector Mapping Agency will be pursued. Outcomes sought from collaboration include:
  - Access to geospatial information, knowledge and expertise.
  - Improvements to the Geospatial Fabric and thus to service quality and usability.
- **Space agencies** of Europe, US, Japan and increasingly China and India and associated research centres (e.g. Goddard, JPL, ESA-associated unis, Chinese Academy of Sciences) are critical for our research as well as data access. Collaborative connections with these exist but should be priority for strengthening, particularly with the relatively small number of researchers involved with water cycle observation in these centres. The Bureau as well as others (e.g. Geoscience Australia) have a role in data access and management and this should be continued but should be supported or at least informed through WIRADA where necessary, reasonable, and feasible. Outcomes sought from collaboration include:
  - New data sources enabling improved spatial coverage of parameters.
  - Ability to influence future data collection platforms and ensure the interoperability of data.

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<sup>3</sup> The Bureau has contractual arrangements with GA through an overarching MoU. CSIRO has many points of contact and shared interest with GA.

**Table 5 WIRADA linkages and key relationships**

WIRADA Portfolio	Bureau of Meteorology					Research and Product Providers				
	IT Planning/AWRIS	Water Data	Water Assessment & Reporting	Water Forecasting & Prediction	Observations Program	WfHC Regional Water	eWater CRC	CAWCR/ACCESS	Geoscience Australia	CUAHSI
<b>1 Water Information Systems</b>										
1.2 Hydrologists WorkBench	•		••	••						•
1.5 SWIM/Australian Hydrological GeoFabric	••	•••								•
1.4 Water Data Transfer Standards	••	•••								•••
<b>2 Foundation Data Products</b>										
2.1 One-second DEM	•	••	••						••	
2.2 Precipitation and Actual ET	•	••	••	•••	••			••		
<b>3 Water Resources Assessment and Accounting</b>										
3.1 Water Resources Assessment & Accounting	•		••		••	•••	••	••	••	
<b>4 Water Forecasting</b>										
4.1 Water forecasting - short term	•	•		•••	••	••	•	•••		
4.2 Water forecasting - Seasonal to long term	•	•	•	•••		••		•••		

••• Core – frequent research interactions (RI); •• Contributing: regular RI; • Supporting – occasional RI

## 5. RISK

### 5.1. Risk framework

The WIRADA Risk Management Framework is designed to focus on strategic-level or 'programme level' risks. Project level risks are identified and controlled via the individual project plans.

This framework provides a comprehensive yet succinct approach for the WIRADA Management Committee to adopt in identifying and managing programme-level risks, which if not managed, could hinder the programme and/or damage the reputations of the WIRADA partners.

The implementation and management of a robust and transparent risk management strategy is vital in order to ensure that the programme meets the objectives set by the Australian Government and the mandate given to the Bureau and CSIRO to deliver an effective water information system.

This framework has been developed to:

- allow the partners to proactively manage risk in a systematic and structured way and to continually refine its processes to reduce the programme's overall risk profile;
- ensure appropriate strategies are in place to mitigate risks;
- embed sound risk identification, control and mitigation processes in the programme's management systems;
- provide the WIRADA Management Committee with all necessary information, in a timely and succinct fashion, upon which sound risk management decisions can be based;
- give credibility to the process and engage the WIRADA Management Committee in the treatment, monitoring, reporting and review of identified risks as well as considering new and emerging risks on a continuous basis;
- ensure that no gap exists between the risk management strategies adopted via the 'top down' programme risk assessment and the 'bottom up' project (operational) risk assessment; and
- provide the WIRADA Management Committee with an accurate quantification of risk in terms of scope, potential impact(s) and mitigation actions.

### 5.2. Risk profile

The key risks identified for WIRADA are summarised in Table 6. A risk assessment including mitigation measures and metrics are provided in **Appendix C**.

**Table 6 WIRADA strategic risk profile**

<b>CAT/ID</b>	<b>RISK DESCRIPTION</b>
<b>Strategic</b>	
1	Failure of science to be able to produce the required outputs
2	Bureau and CSIRO loss of resources due to Government decision/policy or other pressures
3	Communications disconnect where outputs/capabilities are released prematurely
4	Duplication of research effort
5	Research results are called into dispute due to inadequate peer review
<b>Operational</b>	
6	WIRADA failure to deliver to agreed milestones and timing
7	Bureau does not provide adequate feedback, advice and guidance to WIRADA
8	WIRADA output cannot be operationally implemented efficiently
9	Bureau cannot/doesn't deliver key data requirements.
10	Bureau makes operational decisions which makes research implementation difficult or requiring more resources
<b>Resources</b>	
11	Failure of WIRADA to access the required expertise
<b>External</b>	
12	Failure of external providers to deliver to time and specification

### **5.2.1. Risk Thresholds**

To focus on risk with significant probability or impact, while maintaining confidence that all significant risks are brought to the Committee's attention, thresholds have been applied to a risk analysis. Quantitative metrics have been developed for each of the key of the key risks.

The following risks thresholds (Table 7) will be applied as triggers for alerting the WIRADA Management Committee and enacting risk mitigation measures.

**Table 7 Risk metrics and threshold levels**

RISK		ALERT LEVEL		
		GREEN	AMBER	RED
ID	METRIC			
<b>STRATEGIC</b>				
1	Percentage of staging gates failed	<5%	5-20%	>20%
2	Percentage of planned resources available	>98%	90-98%	<90%
3	Percentage of publications of research outcomes that do not follow the Communication Protocol	0%	0-2%	>2%
4	Number of formal responses to challenges on originality of WIRADA science (directly or indirectly)	0	1	>1
5	Number of formal responses to challenges on validity of WIRADA science (directly or indirectly)	0	1	>1
<b>OPERATIONAL</b>				
6	Percentage of deliverables provided according to milestones	>85%	70-85%	<70%
7	Percentage of material provided for review, feedback provided within 1 month	>90%	75-90%	<75%
8	Percentage of unplanned rebuild and/or re-engineering required by Bureau	<10%	10-20%	>20%
9	Percentage of data requests met within 1 month of request	>90%	80-90%	<80%
10	Percentage of WIRADA research stranded by Bureau decisions	<5%	5-10%	>10%
<b>RESOURCES</b>				
11	Ratio of proportion effort expended to proportion deliverables completed per quarter	<=1	1-1.2	>1.2
<b>EXTERNAL</b>				
12	Percentage of scheduled deliverables impacted by non-delivery of external parties	<5%	5-10%	>10%

### 5.3. Monitoring and managing risk

At each quarterly meeting of the Management Committee, a Risk Report will be presented for discussion. This report will be based on the Risk Register (Appendix C) and alert criteria set out in Table 7.

The plan will seek to inform the Committee of any significant change in the Program's risk profile, based on regular analysis of the risks contained in the risk register. Should any of the risks change (likelihood, consequences or mitigation requirements), details of these change(s) will be highlighted and a commentary provided by the WIRADA Director. The previous status will be included for comparison.

## 6. COMMUNICATION PROTOCOL

The Communication Protocol sets out the principles and roles for any communication or publication of matters relevant to the Water Information Research and Development Alliance (hereafter ‘the Alliance’).

### 6.1. Purpose

The Alliance Communication Protocol aims to:

- enable effective communication and adoption of the scientific and technical results and capability encompassed by the Alliance
- build a strong sense of partnership and trust between the Bureau and CSIRO and further enhance the relationship between the two Participants
- provide a framework that is consistent with the communication procedures of the Participants and with which the staff of those organisations are familiar
- strike a balance between providing a structure and framework to enable appropriate Alliance communication while NOT creating a brand independent of CSIRO or the Bureau, and
- protect Intellectual Property and Confidential Information.

### 6.2. Defining principles

The Alliance will:

- not establish a separate entity or new brand identity
- utilise existing communication mechanisms to the maximum extent possible
- abide by publication and communication policies in both organisations
- define the authority and roles of the Management Committee and WIRADA Director.
- adopt a communication and adoption framework as outlined in the Bureau’s *Water Information Communication and Adoption Strategy* and consistent with CSIRO’s Flagship Communication Plan.
- use both logos and program identifiers for the Bureau of Meteorology and CSIRO Water for a Healthy Country Flagship in all communication.

To avoid any doubt all publicity, announcements, events and media releases must be approved by each partner with appropriate notice<sup>4</sup> before release to the media. It is not the intention of either partner to censor or restrict the flow of information or to provide editorial comment unless there are factual errors, the partner is misrepresented or there are legal or policy implications.

### 6.3. Scope

This Protocol applies to the following communication forms:

---

<sup>4</sup> Under normal planned circumstances the material will be provided to the partner **six working days** in advance with a two day turn around. For non-planned and quick response situations the notice needs to be given as soon as possible with a turn around time of 24 hours.

- **Project publication:** A communication or publication product produced as a result of a WIRADA project outcome.
- **Media release:** A formal written statement issued to announce milestones or make announcements arising out of the Alliance.
- **Public comment on behalf of the Alliance:** Any verbal or written statement provided to the media by an authorised Alliance spokesperson.
- **Public comment by each organisation about the Alliance:** Any verbal or written statement provided to the media on behalf of one of the Participants and by an authorised Alliance spokesperson.
- **Government communications:** Any verbal or written statement provided to Ministers, Members of Parliament and government officials on matters arising out of the Alliance.

## 6.4. Authority and responsibilities

The WIRADA Communication Plan will include a research delivery sign-off process that is agreed by both parties.

The governing arrangements for the Alliance include the establishment of a Management Committee and appointment of the WIRADA Director – communication authorities and responsibilities for these functions are set out below.

### **WIRADA Management Committee**

The WIRADA Management Committee will contribute to risk assessment and management. The Deputy Director (Water) of the Bureau and the Flagship Director are authorised by the Management Committee to make public comment.<sup>5</sup> The Flagship Director (or delegate) will speak on behalf of CSIRO and the Deputy Director Water (or delegate) on behalf of the Bureau, and either on behalf of the partnership using agreed messages.

### **WIRADA Director**

The WIRADA Director is responsible for assessing communication impact and managing risk. The WIRADA Director (or delegate) will be the first point of referral for communication enquiries and responsible for ensuring that communication is managed according to the agreed principles and protocols.

## 6.5. Branding, logos and design

Communication of WIRADA research outcomes will not establish a new brand identity (see Defining Principles). The appearance of any information or material arising from Projects is to convey the collaborative nature of the Alliance Agreement. Material is to include both Participants' logo and program identifier with affiliation given as:

*A water information R&D alliance between the Bureau of Meteorology and CSIRO's Water for a Healthy Country Flagship.*

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<sup>5</sup> In accordance with Management Committee powers under s 5.8 (n) of the *Umbrella Agreement*, 'any other matters prescribed under this agreement as requiring a decision of, or direction or other action by, the Management Committee.'

The Participants will adopt partnership branding for publishing research outputs and products that contain Alliance research material.

**Through the acceptance of the *WIRADA Implementation Strategy* and the *WIRADA Communication Protocol*, the Participants provide a once-off endorsement<sup>6</sup> for the use of their names and logos on publications for the life of the Agreement in accordance with the Defining Principles.**

## **6.6. Copyright and disclaimer notices**

The following joint copyright and disclaimer notice should be used in WIRADA publications:

### **Copyright and Disclaimer**

© 2011 Bureau of Meteorology and CSIRO. To the extent permitted by law, all rights are reserved and no part of this publication covered by copyright may be reproduced or copied in any form or by any means except with the written permission of Bureau of Meteorology and CSIRO.

### **Important Disclaimer:**

Bureau of Meteorology and CSIRO advise that the information contained in this publication comprises general statements based on scientific research. The reader is advised and needs to be aware that such information may be incomplete or unable to be used in any specific situation. No reliance or actions must therefore be made on that information without seeking prior expert professional, scientific and technical advice. To the extent permitted by law, Bureau of Meteorology and CSIRO, including each of its employees and consultants, excludes all liability to any person for any consequences, including but not limited to all losses, damages, costs, expenses and any other compensation, arising directly or indirectly from using this publication (in part or in whole) and any information or material contained in it.

## **7. ADVANCED MINISTERIAL NOTIFICATION PROTOCOL**

The Ministerial Notification Protocol sets out the principles and roles for any communication, publication or event relating to the Water Information Research and Development Alliance (hereafter ‘the Alliance’) that require Ministerial (or parliamentary) notification.

### **7.1. Purpose**

To ensure that CSIRO and the Bureau meet their responsibilities and statutory obligations to notify in advance their Ministers of significant events and activities.

Advance notification enables the Ministers to keep informed of CSIRO’s and the Bureau’s activities in relation to the Alliance and to respond to questions in Parliament and from the media and general public.

### **7.2. Defining principles**

The Alliance will:

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<sup>6</sup> Internal approval processes have been undertaken within CSIRO and the Bureau.

- utilise existing notification mechanisms in each organisation to the maximum extent possible
- abide by policies in both organisations
- each organisation with acknowledge the other has been part of the approval process at the appropriate place in the process (or on the brief if provided)

To avoid any doubt all ministerial notifications re WIRADA will be circulated to both parties early in the process of developing a brief. It is not the intention of either partner to censor or restrict the flow of information or to provide editorial comment unless there are factual errors, the partner is misrepresented or there are legal or policy implications. Early notification will ensure that the timing and messages of the briefings are consistent for the two organisations and the ministers concerned (as appropriate).

### 7.3. Scope

This Protocol applies to the following communications:

- **Ministerial communications:** Any verbal or written statement provided to Ministers, Members of Parliament and government officials on matters arising out of the Alliance.

### 7.4. Timing

Under normal planned circumstances the material will be provided to the partner six working days in advance with a two day turn around. For non-planned and quick response situations the notice needs to be given as soon as possible with a turn around time of 24 hours.

The Alliance Advanced Ministerial Notification Protocol will include a sign-off process that is agreed by both parties.

### 7.5. Authority and responsibilities

**Point of contact in the Bureau of Meteorology** will be Assistant Director, Executive and International Affairs (or delegate). The Assistant Director will be responsible for seeking input and ‘signoff’ within the Bureau for any Ministerial briefs that CSIRO generates and for producing ‘mirror’ briefs for their minister (as required).

**Point of contact in CSIRO** will be the Communications Manager for Water for a Healthy Country Flagship (or delegate). The Communications Manager will be responsible for seeking input and ‘signoff’ within CSIRO for any Ministerial briefs that the Bureau generates and for producing ‘mirror’ briefs for their minister (as required).

#### **Alliance Director**

The Alliance Director is responsible for assessing impact and managing risk. The Alliance Director (or delegate) will alert both CSIRO and Bureau points of contact if

there is a need to produce a ministerial brief. The Alliance Director will be included in the development of the briefs from each organisation at the formative stage. The WIRADA Director is responsible for ensuring that ministerial notification is managed according to the agreed Alliance principles and protocols for Advanced Ministerial Notification.

## **8. WIRADA IP EXPLOITATION PRINCIPLES**

Four principles (lettered) and criteria (numbered) have been adopted for assessing proposals for WIRADA IP exploitation. The term “Participant” refers to CSIRO or the Bureau of Meteorology as defined under the WIRADA Umbrella Research Collaboration Agreement:

### ***A. Enhances WIRADA partnership delivery (preferred)***

1. IP exploitation enhances the opportunities for the WIRADA partnership to deliver:
  - a. supplementary outputs [meeting user requirement], or
  - b. on time [on schedule or earlier], or
  - c. to quality [meeting specification or exceeding], or
  - d. with innovation [better approaches, better products], or
  - e. the opportunity to a shared development of WIRADA IP, or
2. IP exploitation enhances the impact and/or reputation of CSIRO and/or the Bureau

### ***B. Demonstrable benefit, cost effectiveness and/or efficiency (mandatory)***

1. IP exploitation contributes directly to the proposing Participant’s legislative obligations or published business objectives, and
2. IP exploitation benefits (not only financial) exceed the costs, and/or
3. IP exploitation substantially improves research and/or operational efficiency of a Participant, and/or
4. The proposing Participant is demonstrably the best placed and resourced to exploit the IP

### ***C. No adverse business impacts (mandatory)***

1. IP exploitation does not duplicate or replicate the core functions or services of the other Participant
2. IP exploitation leads to benefit for both Participants (preferred), or does not reduce the benefits accruing to the other Participant
3. IP exploitation activity does not diminish the capacity of either Participant to deliver on the WIRADA Agreement

### ***D. Risks are manageable and acceptable (mandatory)***

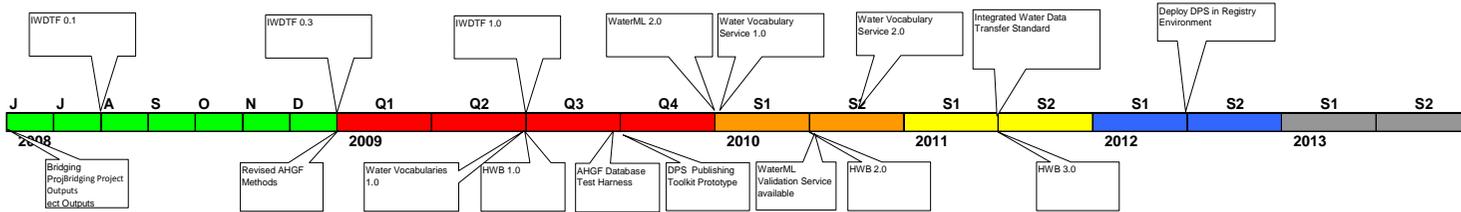
4. IP exploitation does not present unacceptable risk to either Participant, in particular reputational, political, financial or exposure to third party liabilities



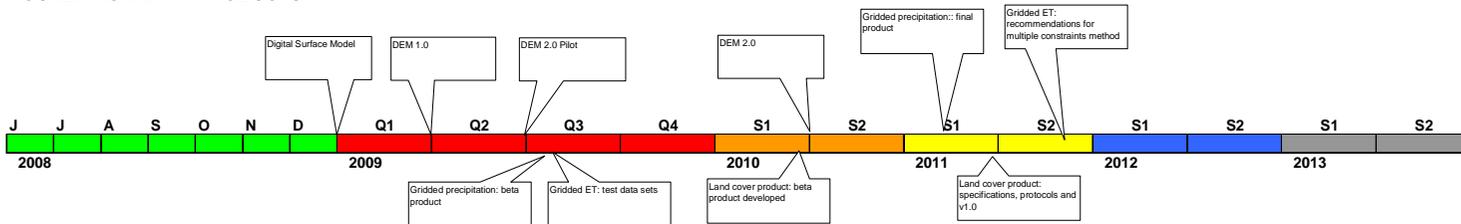
# WIRADA PORTFOLIO OUTPUTS

## APPENDIX A – WIRADA ROADMAPS

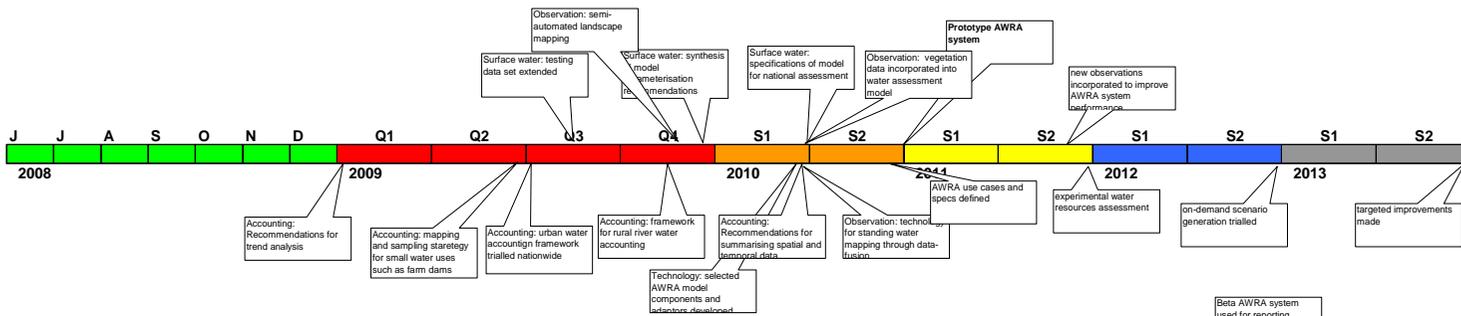
### WATER INFORMATION SYSTEMS



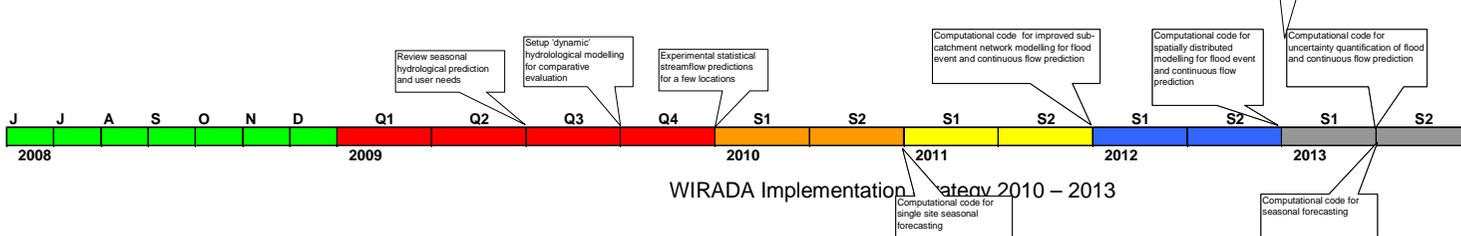
### FOUNDATION DATA PRODUCTS



### WATER ACCOUNTING & ASSESSMENT



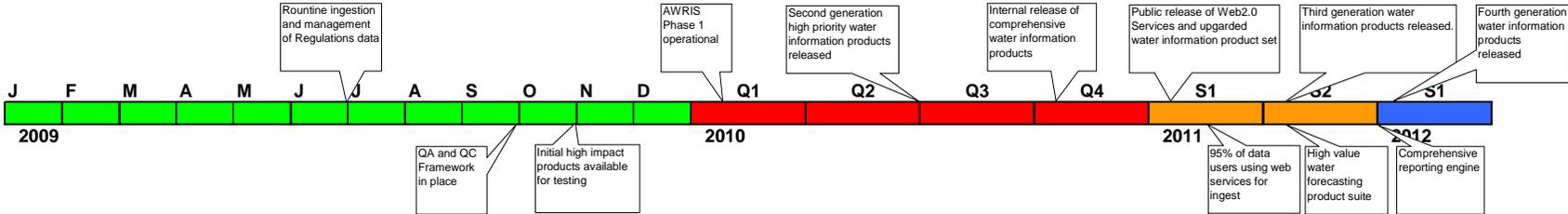
### WATER FORECAST & PREDICTION



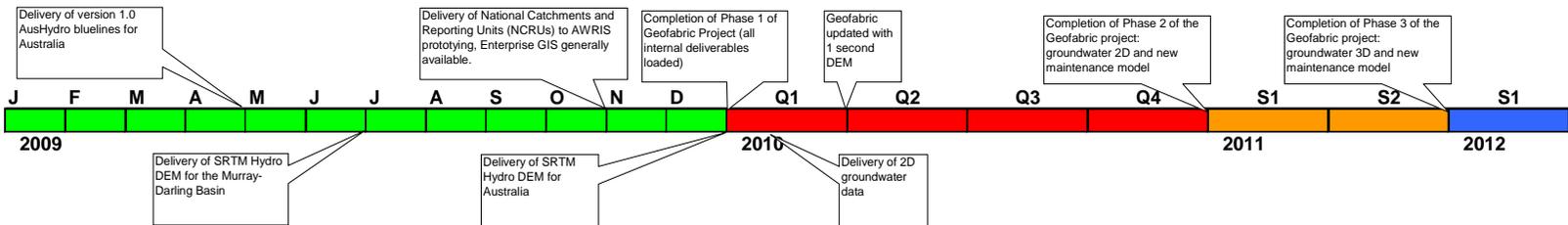
WIRADA Implementation Strategy 2010 – 2013

# WATER DIVISION WORK PLAN... 1 [May 2009]

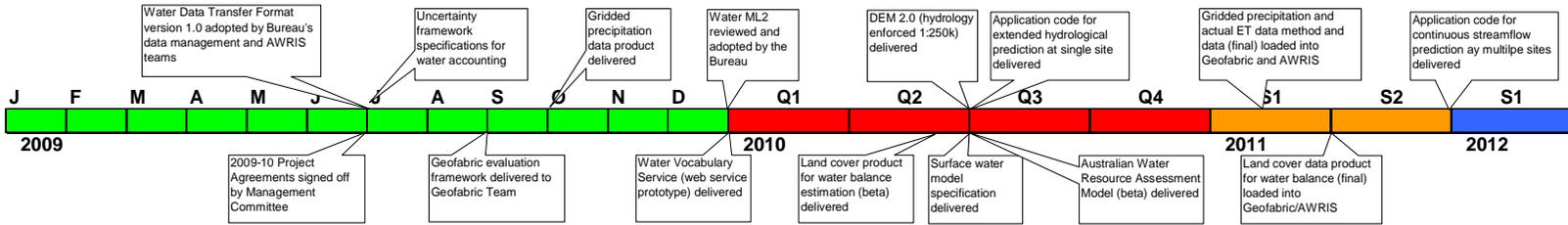
## Australian Water Resources Information System



## Geofabric and Enterprise GIS

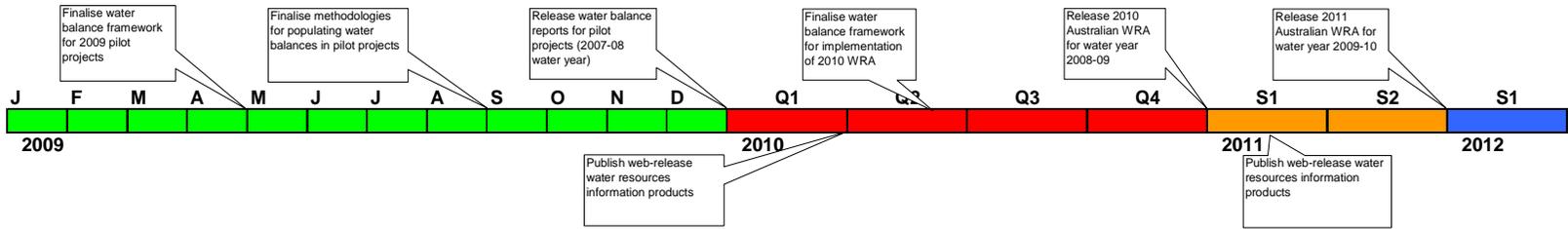


## WIRADA

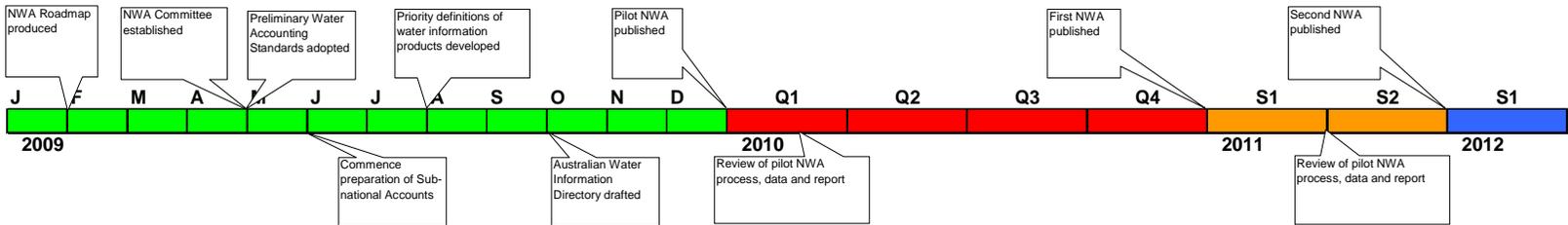


## WATER DIVISION WORK PLAN... 2 [May 2009]

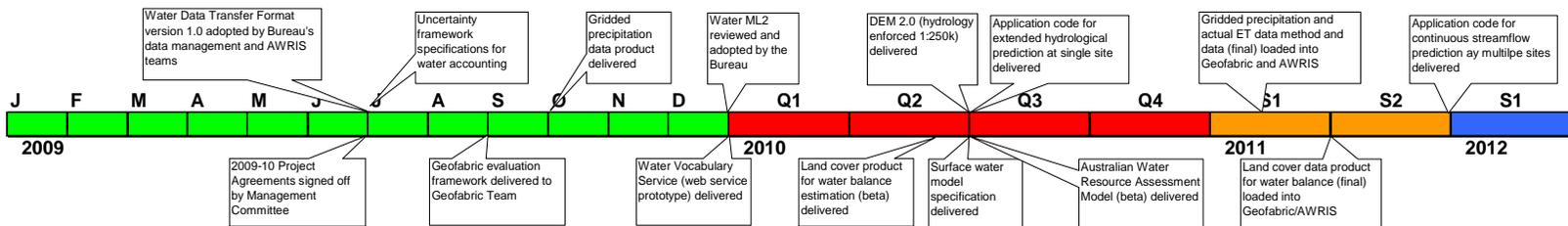
### Water Resources Assessment



### National Water Account

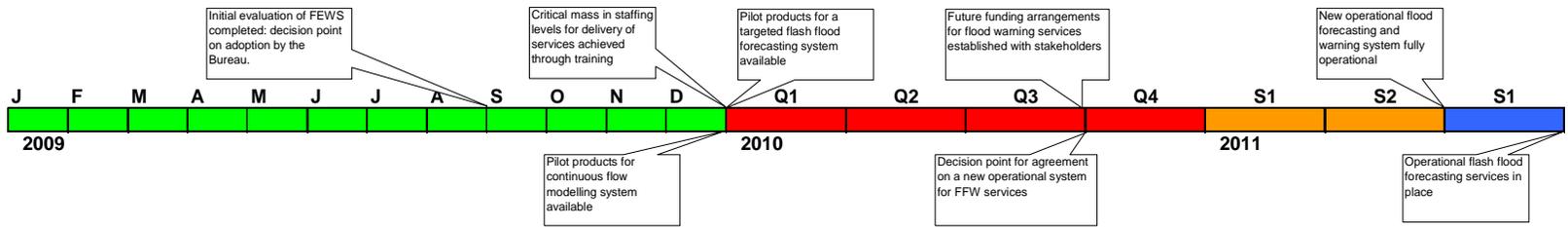


### WIRADA

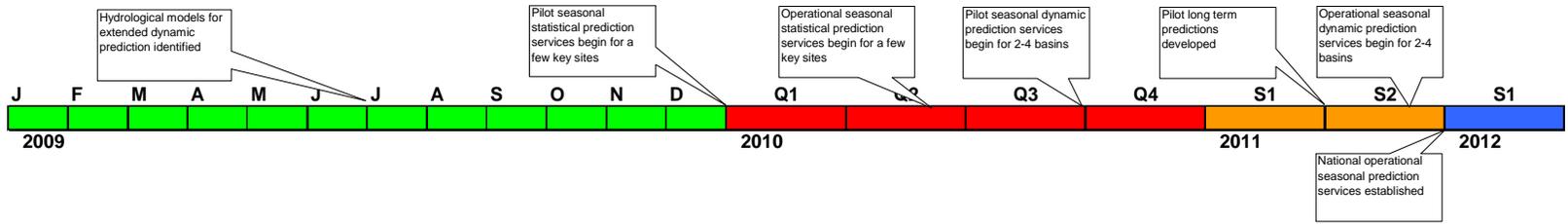


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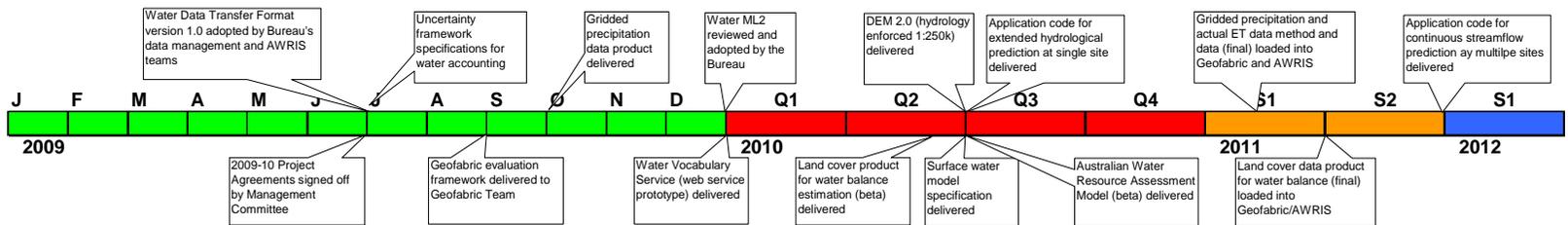
## Flood Frequency and Warning Services



## Extended hydrological Prediction

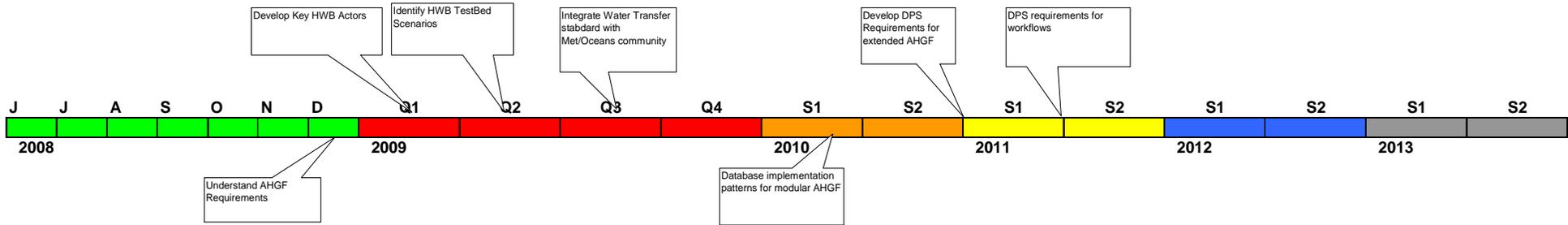


## WIRADA

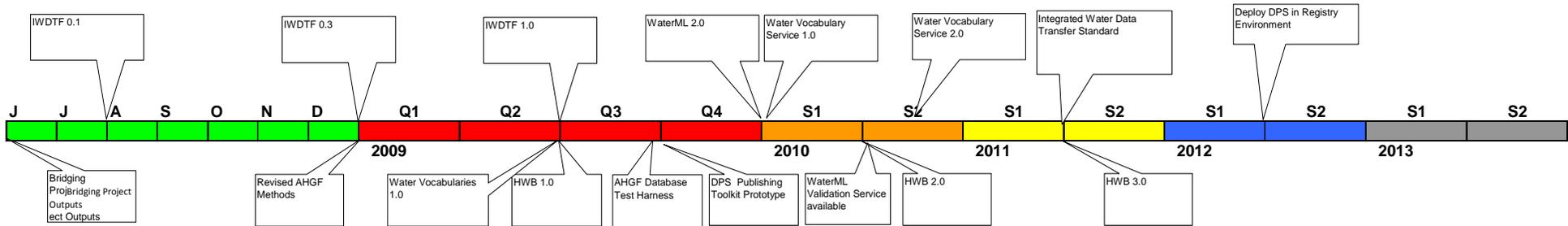


# WIRADA RESEARCH STREAMS

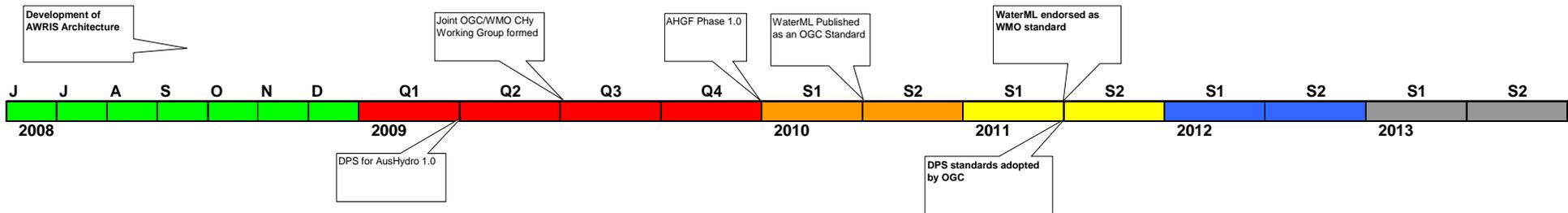
## WATER INFORMATION SYSTEMS RESEARCH CHALLENGES



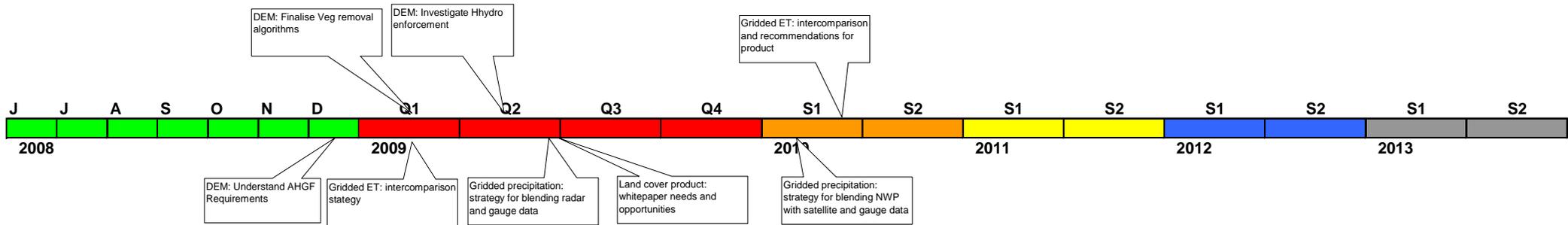
## RESEARCH OUTPUTS



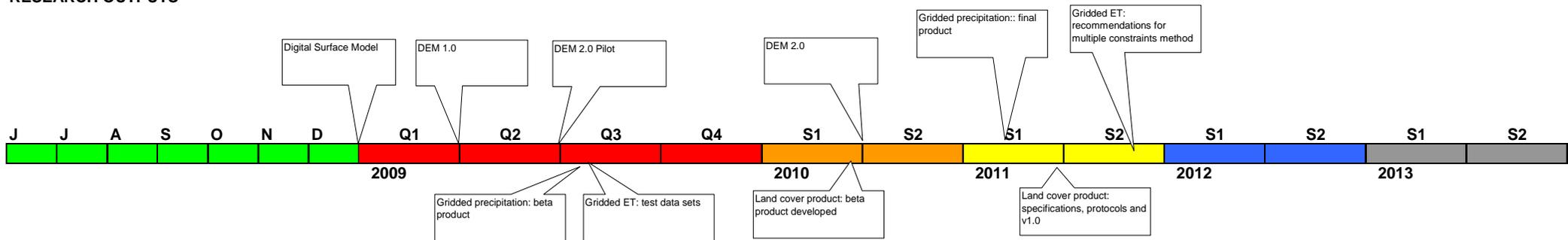
## OPERATIONS



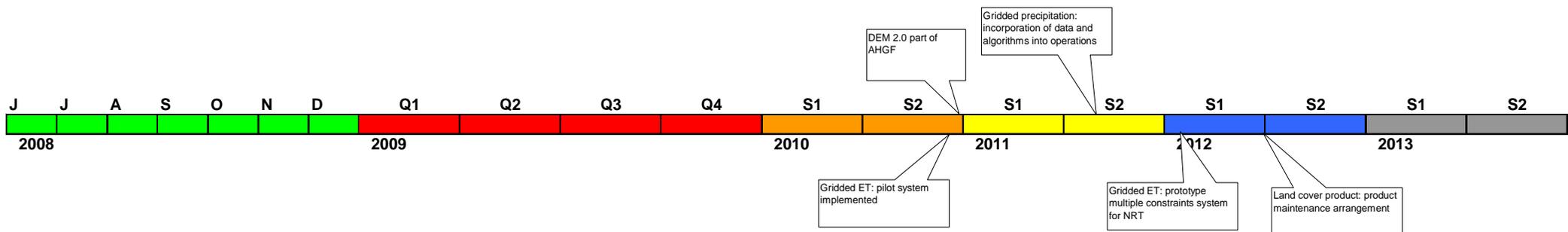
## FOUNDATION DATA PRODUCTS RESEARCH CHALLENGES



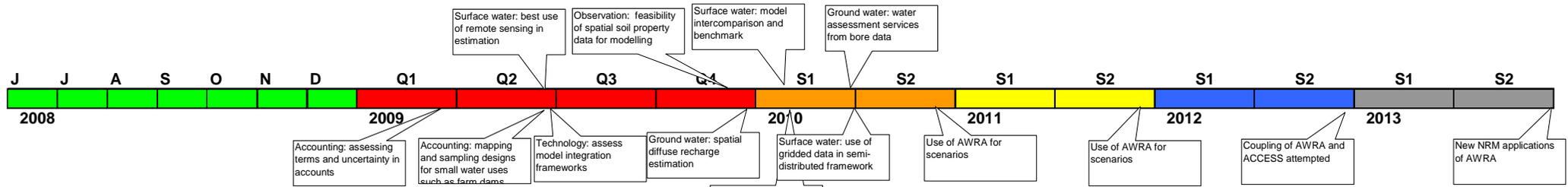
## RESEARCH OUTPUTS



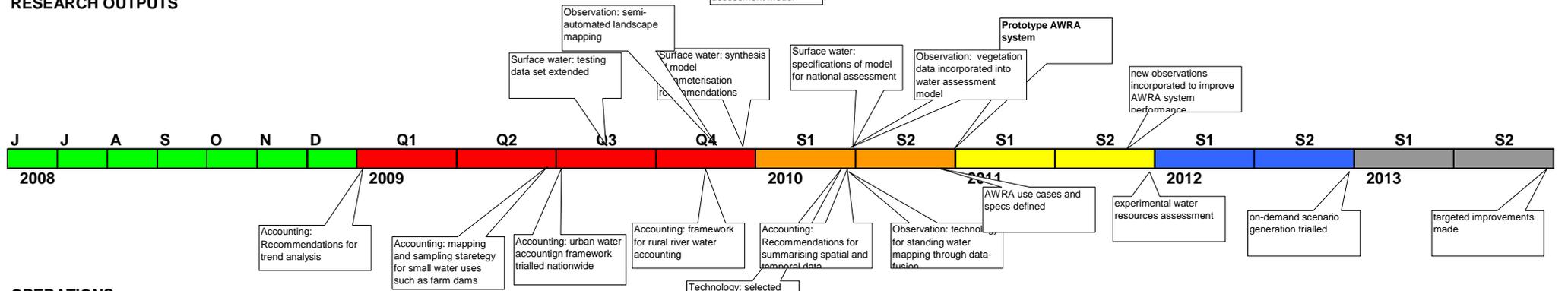
## OPERATIONS



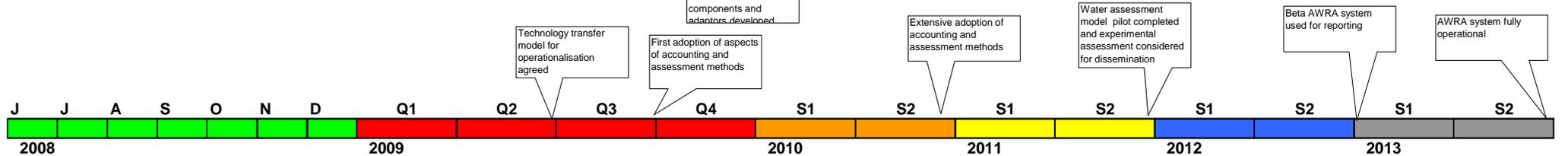
## WATER ACCOUNTING & ASSESSMENT RESEARCH CHALLENGES



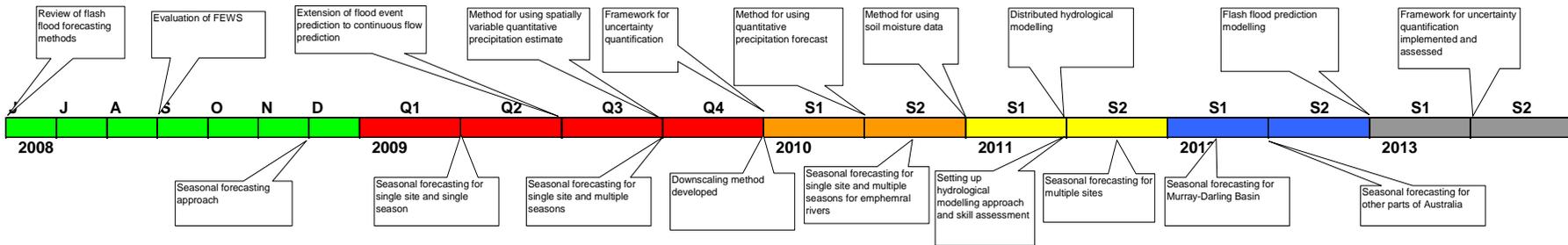
## RESEARCH OUTPUTS



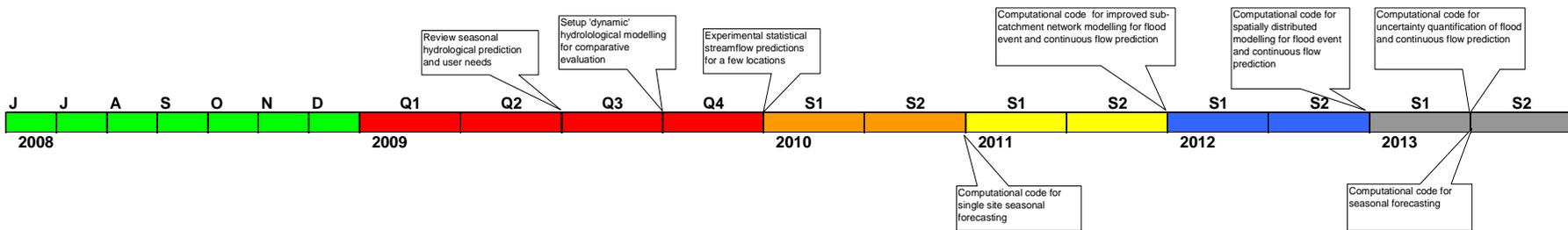
## OPERATIONS



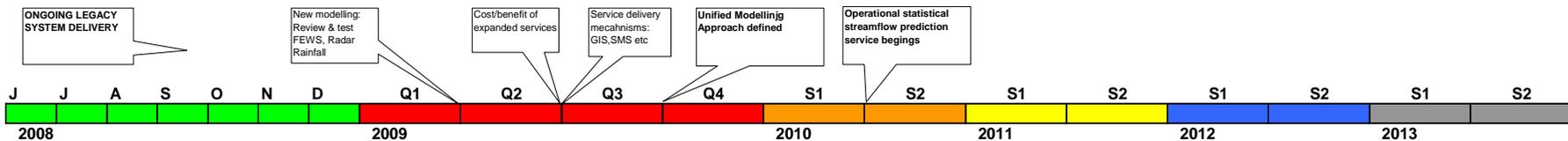
## WATER FORECAST & PREDICTION RESEARCH CHALLENGES



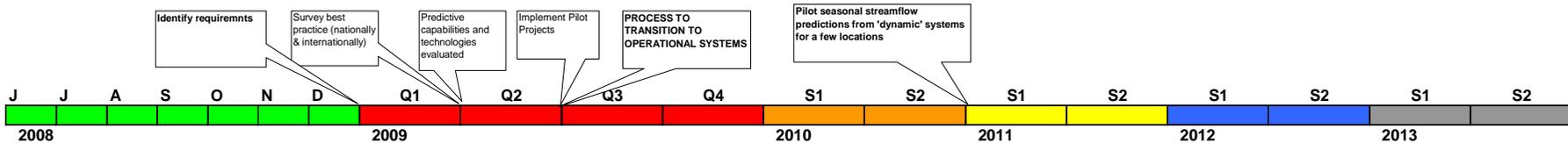
## RESEARCH OUTPUTS



## OPERATIONS: Short-term Flow Forecasting



## OPERATIONS: Extended Water Availability Prediction



## APPENDIX B – RESEARCH TRANSITION TO OPERATIONS

WIRADA projects will provide information and/or tools that will inform or be incorporated into the development of the Bureau's water information policies, systems, products or services. Research is an integral part of operationalising any information product or service. The transition from research to operational systems should therefore be managed as a staged process with evaluation, feedback, decision points and agreed responsibilities for the research and operational teams.

WIRADA research has not been designed (or required) to develop a fully functional operational system but rather provide knowledge and components to systems that are still in the process of being defined and designed.

The following sections outline a framework to facilitate the transition of WIRADA research outputs to a point where they can be contribute to the development and/or operationalisation of the Bureau's water information policies, systems, products or services.

The high level framework consists of the following steps:

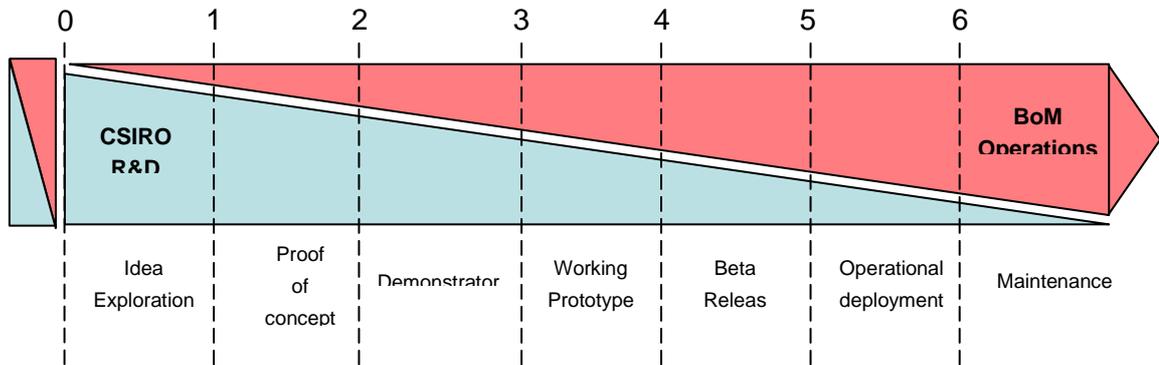
1. **Project Phases:** Identify project phases or categories which characterise where an output of a project would be delivered. The lifecycle for a project would typically involve moving through some (not all) the phases with appropriate decision points (staging gates) identified along the way. Knowing what phase a project is at will provide valuable information of the effort and time required before it can become operational.
2. **Staging Gates:** Identify the process required at each staging gate (decision point) of the transition process. That is, the questions and criteria that needs to be met to allow further investment to take place and work to continue (resulting in the Go/NoGo outcome). This process may include the change in responsibility between CSIRO and the Bureau in moving to the next phase.
3. **Feedback:** Appropriate feedback loops that will help to control, regulate and inform the transition process. Feedback will occur at the completion of a project (to assist planning the next phase) and also occur during regular quarterly progress reporting.
4. **Governance:** Apply a governance model for the transition process. This could be through an individual or a joint committee (e.g. Operational Systems Implementation Committee) with responsibility to apply the framework to WIRADA projects as an ongoing process.

A *Research Transition Plan* will be developed for each WIRADA project by CSIRO in collaboration with the designated Bureau Business and Technical Leads and linked with the appropriate Product Development Plan(s).

### Project phases

In terms of readiness for adoption by the Bureau (deployed into an operational environment) the outputs of WIRADA projects are likely to evolve through a number of phases before they can be classified as production ready. Quite often, CSIRO research is based on idea exploration to validate a hypothesis, or developing a proof of concept prototype. The output of this kind of work is a very long way (in terms of cost and time) to eventual operational systems. Between these two extremes there needs to be a progressive handover of responsibility and ownership of

the “product” from CSIRO research and development to ownership by the Bureau. At some point in the product lifecycle software development needs to switch from the software developers in CSIRO to the developers in the Bureau. Bureau software developers need to be concerned with things like software robustness and migrating the product into their enterprise architecture. Likewise, the hydrological input needs to switch from CSIRO (research) to the Bureau (day to day use) at some point.



**Figure 3 Research to product life cycle**

Understanding what phase or stage a project is at will help determine the time and effort required to reach production status, or to take it to the next phase.

### Idea exploration

Projects in areas of research can have small beginnings that are typically based on an idea or hypothesis. It may be a new area of work, novel application of an emerging technology or may be outside existing project activities. These projects are sometimes referred to as seedling projects and are often used to test and validate a new idea. The output of this work may be a white paper (or a publication with supporting data) that provides evidence of opportunity given further investment or feeds into the Bureau’s water information policies or decision making on method selection, that is, the research does not become part of an operational system directly.

This phase of a project would cater for investigative work that requires a known outcome to inform a decision. For example, the Bureau need to make a significant investment in an enterprise database engine available from a number of vendors to support spatial information. (Oracle Spatial, SQLServer Spatial, Postgres PostGIS) Which product will meet the needs of the Water Division? In this case, once the investigation is complete, there will be no need to continue the project and it can successfully terminate at this point.

### Proof of concept

Developing **proof of concept systems** is common among CSIRO research projects. This constitutes basic technology research to take a hypothesis and prove it. For example, “*can we remove SRTM striping artefacts by using 2-D Fourier transform and applying a narrow band frequency filter*”? The output of this work is typically in the form of a research publication describing the techniques used and the effectiveness of the results. Essentially a paper study that may (or may not) involve implementing a working system. Practical results (to validate the theory) may be generated with test data sets and GIS tool(s) put together by a specialist who

develops/implements the algorithm using proprietary language/tool with no concern for robustness, performance, elegance of design implementation etc.

This phase may involve a working system of sorts but it is brittle and only works in the hands of its creator. The end result of this work should be identifiable (valuable) IP and any software that was developed would need to be redeveloped or ported to a robust operational platform.

## **Demonstrator**

After the proof of concept phase a project will move to a **demonstrator** in order to show that the IP created earlier can be used for something useful. This allows the IP to be exposed to a wider audience (potential stakeholders). Almost always, any working software developed previously is used as a basis for the demonstrator. Having a working demo is the most powerful way to get the message across to potential users or adopters of the technology but there is a risk that a potential user or adopter may consider the demonstrator fit for purpose, which is almost always not the case.

If there is any expectation that the project will move beyond this phase, planning should be in place to ensure basic software engineering principles (design and development) are put in place at this point.

In addition to meeting basic functional requirements, additional requirements now need to be considered, such as robustness, scalability, platform dependencies, and expanded user requirements.

## **Working prototype**

At this phase the demonstrator has progressed to meet agreed requirements and is moving out of the hands of its developers into the hands of a select group of end users. It may be installed at other sites (the client's site). It is now being used by users (only a few) that are not the creators. This class of users are often called the alpha testers and should be a small controlled group that provide valuable feedback on the utility of the prototype.

A formal software development environment needs to be established and maintained. Minimal user documentation may be developed and the prototype may still be using fabricated data sets rather than live data.

## **Beta release**

A natural progression from the previous phase. This is where the software (known as beta release) is made available to "real" end users, although they are another controlled group, they agree to provide feedback on bugs and usability. This is the best environment to test the software and whole new class of unforeseen issues arise.

An issues tracking system needs to be in place to cope with the information coming from beta testers. A formal product release procedure needs to be in place as there will likely be many versions before the beta testers are satisfied with the software meeting the final requirements.

Supporting documentation or training needs to be available. The system is working in a "live" but controlled environment (in parallel with the production environment).

## **Operational**

The most difficult transition is to operational deployment. The system now needs to be bullet proof, and meets agreed specifications in terms of robustness, usability, documentation, and training.

It should be governed by an automated product release procedure (acceptance testing) where each subsequent version addresses issues from the bug tracking system through documented change requests, resulting in code modifications which then progress through unit test, regression testing, integration and release to production.

Requires development of operator/training and support manuals, help desk support.

For complex systems, especially ones with real-time outputs, an efficient sanity check is to run the two systems (test and operational systems) in parallel and compare outputs. This approach can be particularly valuable if the research system provides a basis for further improvements to the operational system - partly for trying things out, and partly because it makes researchers/developers think in terms of operational requirements.

## **Maintenance Phase**

The system needs to be maintained over the life of the product which may require new features to be added and bugs to be fixed, adequate documentation to allow expert knowledge of the design and implementation to be captured (for when staff move on) and possible re-implementation of components as technology changes.

## **Staging-gates**

Staging-gates (decision points) need to be applied to all projects. They are a mechanism to control the investment required to get to final product and are also an opportunity to redirect resources or modify the specification of a product. These points provided a useful basis for choosing the appropriate criteria (questions) to apply and the process is not necessarily sequential. For example, after a successful proof of concept the staging gate process may determine that a demonstration phase is not required and the project should precede implementation.

The staging gate should resolve the issues detailed in Table 8.

**Table 8 WIRADA Research to Operations staging gates**

Staging Gates	Idea Exploration	Proof of concept	Demonstrator	Working prototype	Beta Releases	Operational	Maintenance
<b>Research &amp; Development</b>							
1. Decision to initiate or continue research: a. initial hypothesis proved b. further investigation (investment) necessary c. additional research to expose new issues	✓	✓	✓				
2. Decision to initiate requirements definition and analysis and high level architecture design in preparation for production system that will meet specific need		✓	✓				
3. Decision to develop product based on:				✓			
a. technical feasibility to implement operationally			✓	✓			
b. valid system architecture developed/available			✓	✓	✓	✓	✓
c. systems integration plan available			✓	✓	✓		
d. test procedure and validation process					✓	✓	✓
e. end user documentation and training support					✓	✓	✓
4. Decision to proceed to the next phase, based on: a. current objectives been met b. appropriateness to next phase c. acceptable cost of next phase d. technical risk assessed and acceptable	✓	✓	✓	✓	✓	✓	
<b>Operations</b>							
1. Project charter and business case accepted			✓	✓	✓		
2. Decision to release product					✓		
3. Decision to remove product							✓
4. Costs and benefits identified and acceptable		✓	✓	✓			
5. Business risk assessed and acceptable					✓	✓	✓

## Governance

The WIRADA governance structure outlined in Clause 4 of the Umbrella Research Collaboration Agreement comprises a:

1. Management Committee with representatives from both the Bureau and CSIRO to perform functions under Clause 5 of the agreement
2. WIRADA Director to perform functions under Clause 6 of the Agreement
3. Project Leader for each project (Clause 7)
4. Principal Contact for each project (Clause 7)

At a more detailed level, governance of WIRADA occurs at three levels:

1. *Project level*. Project Leaders are responsible for the delivery of project outputs according to the schedule and budget. The procedure for acceptance of deliverables is

defined in the document: **WIRADA Output Review and Clearance Process**. At the completion of a project, Project Leaders will be required to conduct the staging gate process detailed in the **Research Transition Plan**

2. *Quarterly Reporting*. Quarterly reports are submitted to the WIRADA Director, Theme Leader and BoM Project Sponsors for review and feedback. They are based on the template document **WIRADA\_Quarterly\_Progress\_report\_guidelines** and provide a snapshot of:
  - a. *Overall progress* across the project as well as progress against scheduled deliverables
  - b. *Key issues* impacting on project delivery and suggested mitigation plans if required
  - c. *Science highlights*: any scientific breakthroughs, novel solutions or insights
  - d. *Research outcomes*: what adoption or impact has occurred as a result of progress to date.
  - e. *Activity outputs*: Publications, presentations, data sets, web site demonstrators, models.

Internal monthly financial reports submitted to the WIRADA Director provides an opportunity flag issues arising and take immediate corrective action prior to the quarterly review.

3. *Management Committee*. The Management Committee is required to meet on a quarterly basis to review progress in terms of science delivery, budget and schedule. This is described in detail in Clause 5 of the WIRADA Agreement.

We are aware of the importance in aligning WIRADA projects with the AWRIS project. Given the recent review of AWRIS and the recommendations to establish two steering groups, (1) Information Technology, and (2) Business Steering Group we may need to consider linkage of these processes with WIRADA governance processes.

WIRADA projects will also be required to conform to the Bureau's transition procedures, outlined in the document **Procedures for Transfer of Systems to Operations** (or equivalent).

## APPENDIX C – WIRADA RISK REGISTER

ID	CATEGORY	RISK >> CAUSE >> IMPACT	MITIGATION MEASURE	MONITORING	METRIC	SOURCE	ALERT LEVEL		
							GREEN	AMBER	RED
1	Strategic	Failure of science to be able to produce the required outputs >> unresolvable challenges e.g. seasonal forecast with sufficient 'skill' to be trusted, over-expectation >> Bureau inability to deliver products/services, reduced confidence in products by users	Critical components identified, staging gates set. Wide input to Project Agreement development	Watch points (staging gates) on research projects reported through Quarterly Reporting - Possible external peer review provisions	Percentage of staging gates failed	Research Transition Plan decision points	<5%	5-20%	>20%
2	Strategic	Bureau and CSIRO loss of resources due to Government decision/policy or other pressures >> Global, political and management factors override priorities >> reduced scope, slower to deliver, reduced product/service options, terminate research partnership	High impact and progressive delivery; effective communication internally and externally within government; contingency planning - evaluate priorities and rescope	Monitoring external environment; early warning signs shared by Management Committee; active investment and portfolio management; contingency planning	Percentage of planned resources available	Quarterly Financial Report	>90%	80-90%	<80%
3	Strategic	Communications disconnect where outputs/capabilities are released prematurely >> Communications Protocol not implemented, lack of collaboration and information sharing between Bureau and	Regular communication of progress and planned communication activities; adherence to the WIRADA Communication	Quarterly communication status reporting to the WMC	Percentage of publications of research outcomes that do not follow the Communication Protocol	Quarterly Communication Report	<5%	5-10%	>10%

ID	CATEGORY	RISK >> CAUSE >> IMPACT	MITIGATION MEASURE	MONITORING	METRIC	SOURCE	ALERT LEVEL		
							GREEN	AMBER	RED
4	Strategic	CSIRO >> Reputation risk to both parties Duplication of research effort >> not keeping abreast of national and international developments >> competing solutions, research rendered irrelevant, resource wastage	Protocol  Collaboration as integral part of all projects; early peer review of ideas and approach through presentation at lead conferences (national and international); research networks actively developed; joint workshops held	Independent peer review of the project methods and contribution to research body of knowledge	Number of formal responses to challenges on originality of WIRADA science (directly or indirectly)	CSIRO-BoM communication	0	1	>1
5	Strategic	Research results are called into dispute due to inadequate peer review >> inadequate peer review and quality assurance >> reputational risk to both CSIRO and the BOM	Independent peer review process; Industry workshops/involvement	Research outputs adhering to peer review, as reported in WIRADA Research Outputs to the WMC	Number of formal responses to challenges on validity of WIRADA science (directly or indirectly)	Public or professional comment	0	1	>1
6	Operational	WIRADA failure to deliver to agreed milestones and timing >> Research scope and challenge more significant than originally planned, poor project management/oversight >> Bureau inability to deliver products/services to schedule or standard	Project Planning and regular (monthly/weekly) reviews of project progress. Regular contact with Project Sponsors and Bureau staff, quarterly performance reporting to the WIRADA Management Committee.	Quarterly Reporting Performance Reporting	Percentage of deliverables provided according to milestones	Quarterly Performance Report	>85%	70-85%	<70%

ID	CATEGORY	RISK >> CAUSE >> IMPACT	MITIGATION MEASURE	MONITORING	METRIC	SOURCE	ALERT LEVEL		
							GREEN	AMBER	RED
7	Operational	Bureau does not provide adequate feedback, advice and guidance to WIRADA >> Bureau workload or lack of engagement, poor communication >> misalignment of research and operational needs, low morale among researchers	Bureau R&D Manager has coordination/ reporting role/ responsibility for Bureau input and will maintain a log of reviews	Bureau R&D Manager to monitor responses from Project Sponsors and report to WIRADA Director and Bureau Leadership Team	Percentage of material provided for review, feedback provided within 1 month	R&D Review Register (to be established)	>90%	75-90%	<75%
8	Operational	WIRADA output cannot be operationally implemented >> lack of understanding or willingness to adjust research development environment, research activity poorly defined >> Bureau inability to deliver the quality/sophistication of products/services	Technical review specification of research outputs by Technical Leads at Project Agreement stage	Research Transition Plan triggers technical review of implementation feasibility	Percentage of unplanned rebuild and/or re-engineering required by Bureau	Research Transition Plan resource evaluation	<10%	10-20%	>20%
9	Operational	Bureau cannot/does not deliver key data requirements >> resource required to service requests significant, lack of coordination >> research may not be able to be conducted or quality and scope compromised.	Internal policy for supply and resourcing of Bureau data to CSIRO agreed. Process for coordinating data supply, tracking and registration implemented.	Data supply registry	Percentage of data requests met within 1 month of request	Data Supply Register (established)	>98%	90-98%	<90%
10	Operational	Bureau makes operational decisions which makes research implementation difficult or requiring more resources >> lack of collaboration with research teams at design phase	Bureau involving CSIRO in decisions that have impact on the scope, direction and delivery of research outputs.	Quarterly reports on progress - issues management. WERL monthly teleconference	Percentage of WIRADA research stranded by Bureau decisions	Quarterly Performance Report	0%	0-2%	>2%

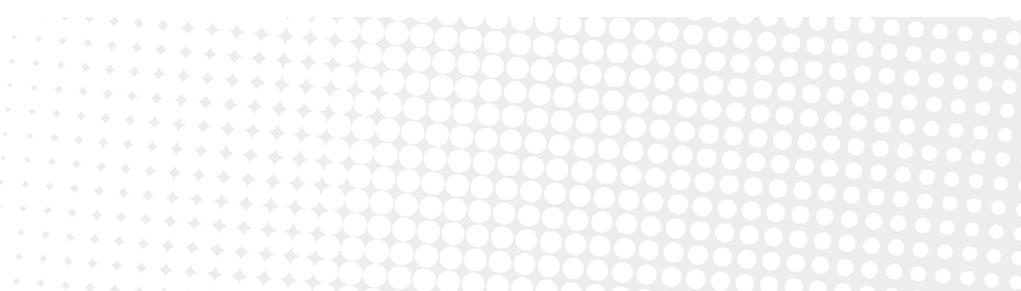
ID	CATEGORY	RISK >> CAUSE >> IMPACT	MITIGATION MEASURE	MONITORING	METRIC	SOURCE	ALERT LEVEL		
							GREEN	AMBER	RED
		>> research products that cannot be easily transitioned to development/operational systems.	WIRADA Director to convene executive-level monthly meetings to discuss key developments.						
11	Resources	Failure of WIRADA to access the required expertise >> loss of existing expertise, overriding priorities within CSIRO, recruitment failure in tight labour market >> research cannot be undertaken or slow to deliver	Detailed project planning; recruitment; Bureau staff participation; Maintaining staff motivation through high quality R&D activity	Financial and performance reporting	Ratio of proportion effort expended to proportion deliverables completed per quarter	Quarterly Financial and Performance Reports	<=1	1-1.2	>1.2
12	External	Failure of external providers (e.g.. eWater) to deliver to time and specification >> Delivery out of WIRADA and Bureau control >> Research outputs changed in scope, reduced product/service options	Alternative implementation strategies identified; maintain regular communication with external providers on progress. Agreements should cover liabilities/requirements.	Quarterly Reporting - issues identification - linked to Risk 1	Percentage of scheduled deliverables impacted by non-delivery of external parties	Quarterly Performance Report - Project Sponsor comments	<2%	2-5%	>5%

## REFERENCES

Bureau of Meteorology (2008) *Water Division Strategic Plan*. Commonwealth of Australia.

Commonwealth Scientific and Industrial Research Organisation (CSIRO) and Bureau of Meteorology (BoM) (2008) *WIRADA Umbrella Research Collaboration Agreement*. Water for a Healthy Country Flagship, CSIRO

Commonwealth Scientific and Industrial Research Organisation (2008) *WIRADA Science Plan*. Water for a Healthy Country Flagship, CSIRO.



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## CSIRO and the Flagships program

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