Submission No 89

INQUIRY INTO ADEQUACY OF WATER STORAGES IN NSW

Organisation: Water for Rivers

Date received: 31/08/2012

Water For Rivers

31st August 2012

The Director
Standing Committee on State Development
Parliament House
Macquarie Street
Sydney NSW 2000

Dear Sir / Madam

RE: Standing Committee Inquiry into Adequacy of Water Storages in NSW

"Water for Rivers has demonstrated that there is sufficient water for all sectors if it is managed properly "

On behalf of the Water for Rivers Board I would like to make the following submission to the Standing Committee on State Development, specifically addressing parts *a, b and c* of the Terms of Reference –

a) The capacity of existing water storages to meet agricultural, urban, industrial and environmental needs;
b) Models for determining water requirements for the agricultural, urban, industrial and environmental sectors; and
c) Storage management practices to optimise water supply to the agricultural, urban, industrial and environmental sectors.

It is not Water for Rivers position to pass judgement on whether or not new dams should or should not be built, but we are of the firm view that implementation of the Computer Aided River Management (CARM) project across all regulated river systems would ensure that NSW could meet its balanced water resource needs well into the future.

It goes without saying that water is a finite resource. Future climate predictions indicate that competition for water will be stronger. However, Australia does need to continue to produce food and fibre and manage the health of its rivers. Water for Rivers has demonstrated that efficiencies gained at all levels of the water usage and delivery system through 'real time' management will ensure there is more water available for future use

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What is Water for Rivers?

As a purpose built water recovery vehicle, owned by the NSW, Vic, and Commonwealth Governments, Water for Rivers has developed a wealth of experience and credibility in this sector. Incorporated in December 2003 to deliver a 212 GL of water to the Snowy and 70 GL to the Murray by 2012, Water for Rivers is the longest standing water recovery organisation operating in the Murray Darling Basin. Our 282 GL target has been exceeded by 11%, within the time and budget. Furthermore 80% of this water he been achieved through infrastructure projects.

Water for River realised early that cost effective water recovery requires a 'whole of valley' approach. Water saving initiatives can potentially 'compete' against each other. However if a **whole of valley approach** is taken, projects will compound the benefit of individual investments, providing an improved overall outcome.

CARM - Computer Aided River Management

Water for Rivers has worked in partnership with NSW State Water Corporation and Murrumbidgee valley communities to develop and implement a sophisticated river management system that has revolutionised regulated storage management and water delivery on the Murrumbidgee River.

The CARM system applies technology to measure water flow, demand and use and report in 'real time' all the inputs required to manage a regulated river system. These inputs include- tributary inflows, water extraction, crop types and crop area including future water demand, soil moisture, long range weather forecasting, and future water orders. All this information is fed, in 'real time', into a hydro-dynamic river model that provides the river operator with an extremely powerful tool to **deliver the right amount of water to the right place at the right time with minimal wastage.**

The environment is becoming the biggest 'customer' of water held in storage. We have been able to demonstrate how CARM can precisely deliver environmental water to where it is needed, as well as reducing the volumes of water required to be released to target particular wetlands.

The implementation of CARM has resulted in better matching water releases to meet demands while capturing water previously released and 'lost' in the system. This water is often referred to as 'operational surplus'. Modelling work undertaken by NSW Office of Water (August 2012) has indicated that an annual average of 200 GL of operational surplus is now being kept in storage. This stored operation surplus water is available to be redirected for a specific purpose, eg a credit towards meeting environmental watering targets. This benefit is significant as it has delivered approximately $400 million in value benefit to NSW for minimal cost (compared to the high cost of building new storages). Implementing of CARM in conjunction with other water saving initiatives such as the NSW Metering and on farm efficiencies projects will compound the benefits of these individual projects and provide increased overall water efficiency/saving outcome for NSW's river systems.

CARM across NSW for improved efficiency and water savings

A feasibility assessment undertaken by Water for Rivers has estimated that it will cost the NSW/Commonwealth Government $41mil to deliver CARM across the Namoi, Gwydir, Macquarie, Lachlan and Border Rivers. It conservatively estimated, based on our Murrumbidgee experience, that this initiative will yield around 80 GL of previously lost operational surplus. There is also an option to include the Barwon-Darling. CARM applied in these valleys will not only provide efficiency savings, it will also provide real service improvement to all customers - irrigators, urban, industrial and the environment.

Regardless of the argument of whether or not new storages should be commissioned, it is imperative that we improve the management of our existing water storages and regulated water delivery systems across the state. CARM is a proven tool, owned by State Water and the NSW Govt, and should be applied across all river valleys, to maximise system efficiencies.

Water for Rivers would welcome the opportunity to provide an oral presentation to your committee to explain further the benefits of CARM in managing and delivering NSW regulated water resources.

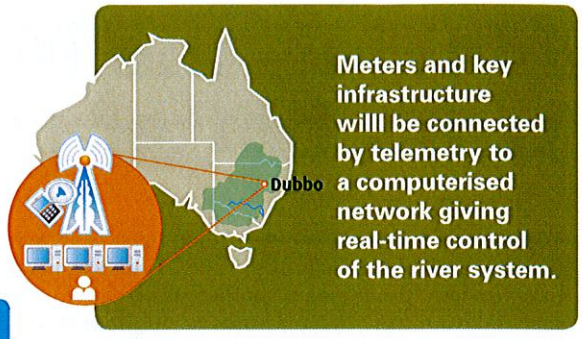
Yours faithfully

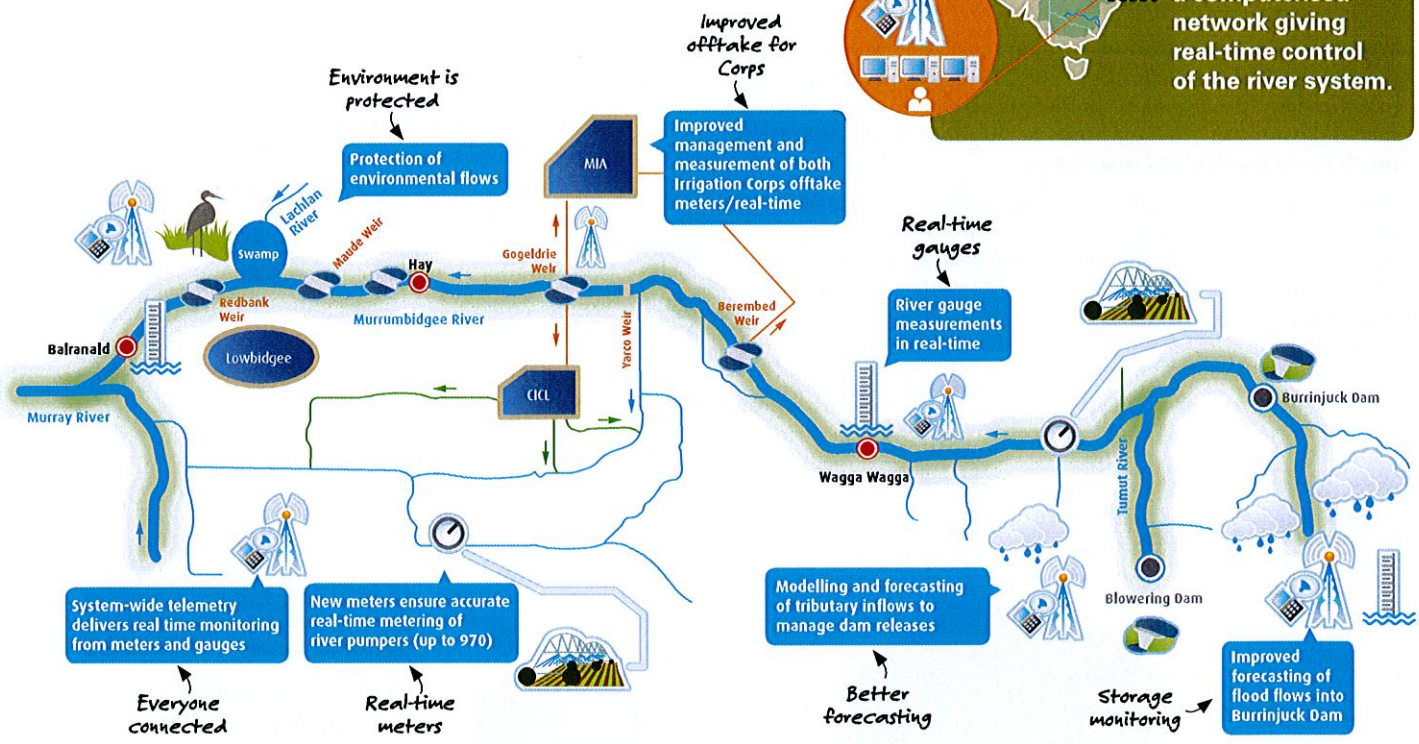
Richard Bull
Chairman ,
Water for Rivers

Attachments: -

1. "CARM across NSW" description document
2. Summary of Murrumbidgee CARM
3. "Integrated river valley approach to water recovery" (diagram)

Computer Aided River Management





The Computerised Network

The networked operation to be developed is based on established river and catchment computer simulation tools. These simulations can accurately predict water flow travel times (with separate modelling for dry and wet periods).

Using real time and forecast information to its maximum potential, the network will automatically determine optimal water releases. It will monitor and take into account such variables as the effects of rainfall on tributary inflows and more accurately predict the beginning, extent and end of supplementary flows, all-the-while 'self adjusting' to optimise management of the river.

Computer Aided River Management will mean:

- Improved modelling
- Better forecasting of inflows
- Redistribution of water to better meet demand
- Less operational surpluses
- Optimal en-route storages
- Greater control over diversions and flow paths
- Improved shepherding and measurement of environmental water
- Minimising losses

A better Murrumbidgee will mean we make the best use of every drop of water that we have

- **More security and certainty for every water user**
- **Vastly improved river management**
- **More precise control of flows through system-wide connectivity**
- **Less wastage of water**
- **A higher percentage of total flow available for allocation**
- **Fairer distribution of available water**
- **Improved environmental outcomes**
- **Historic opportunity for irrigators to leverage technology into on-farm systems**
- **Improved on-farm water management delivering greater profitability and convenience**

CARM | The Murrumbidgee Computer Aided River Management Project
Creating the world's most efficient natural river system

State water

Making the Murrumbidgee work better for everyone

The Murrumbidgee Computer Aided River Management (CARM) project is a major upgrade of infrastructure and management processes throughout the river system that will make control of water flows throughout the river system much more precise and responsive.

This higher level of control will achieve positive outcomes for all water users – including the environment – along the river: significantly improved levels of service delivery on some parts of the system, more reliable delivery to all water users, greater technology options for irrigators, equity between water users and more confidence in the management and measurement of the Murrumbidgee system.

As (diagram A) below shows, there are currently about 320 GL of water being lost from the system each year.

The CARM project is expected to recover up to 80 GL of those losses annually.

The total cost of the project is over $80 million. In return for investing this money, Water for Rivers will use 40 GL of the water saved through improved conveyance through the system (not water saved at meters) to supplement environmental flows in the Snowy River. The balance of the savings will stay in the system to improve water security for all water users.

The project will encompass the entire Murrumbidgee River and its key tributaries and anabranches.

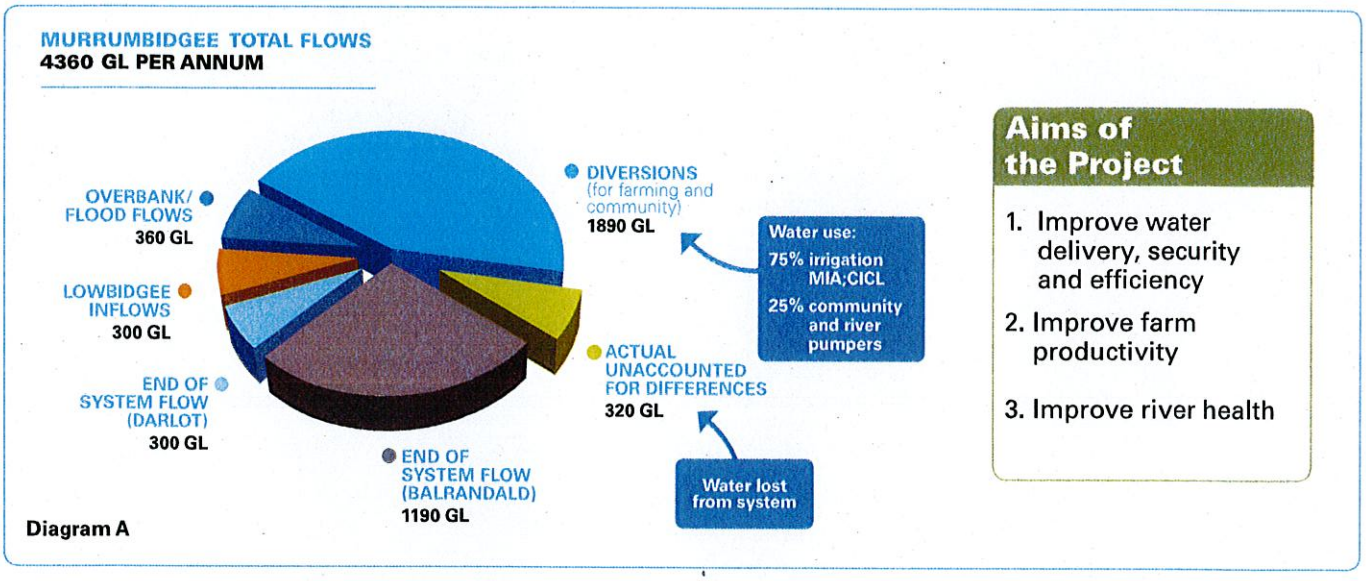


Diagram A

The Project Encompasses Six Contributing Schemes

There are six areas of work which make up the overall project. Two are major and involve the entirety of the river and the majority of water users; the others are specific works to improve management of waterways and storages. All are designed to improve the management and delivery of water in the Murrumbidgee system and, for the first time on a natural system, monitoring and metering of water will be aided by an extensive computerised management network. Following this work, Australia will have the world's most efficient natural river system, where water – our most valuable environmental and farming input – will be well managed to the benefit all water users.

Two Major system-wide, enabling technological components:

1. Total river flow monitoring and management software
2. Fully-funded meter upgrade

Plus

Four Localised modernisation and management projects in key waterways and storages:

3. **Yanco Creek**
   - Reducing transmission losses
   - Improving flow management
4. **Bundidgerry Creek**
   - Improving flow management
   - Reducing surface area to minimise evaporation
5. **Old Man Creek**
   - Controlling and retaining flows within the stream
   - Reducing surface area to minimise evaporation
6. **Tombullen**
   - Reducing surface area to minimise evaporation

CARM The Murrumbidgee Computer Aided River Management Project
Creating the world's most efficient natural river system

State Water

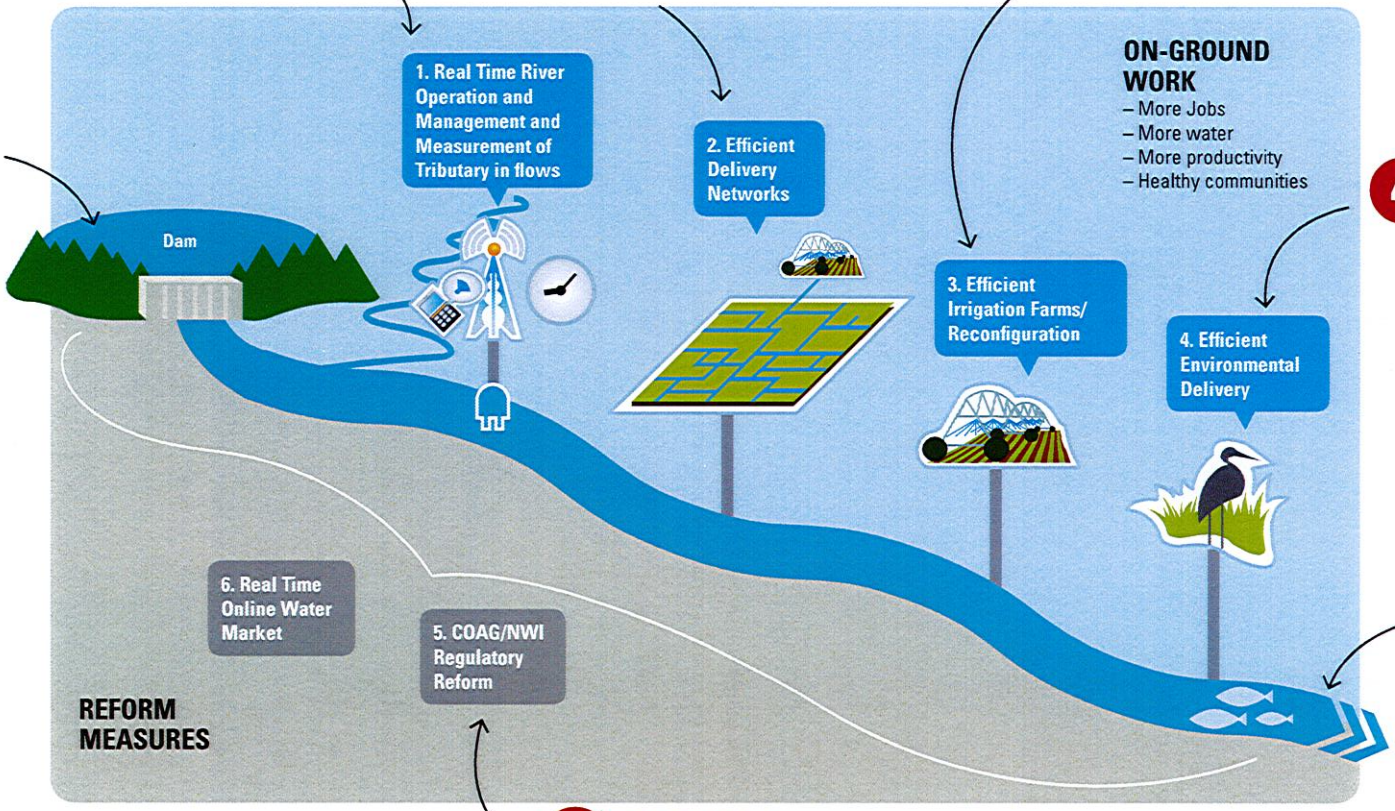
Smart recovery of water in river valleys

There are 5 key elements to integrated water recovery...

1. **Improved river operations** to manage our rivers better and optimise existing water to meet outcomes

2. **Irrigation district efficiency savings** to promote best practice water delivery in a setting which provides certainty for rationalising current systems

3. **On-farm improvements** to facilitate investment in best practice irrigation to minimise water use and maximise productivity



4. **Efficient environmental delivery** to manage and account for delivery of additional environmental flows to meet specific targets at least cost

5. **CoAG/NWI reform** to ensure that elements 1–4 deliver against the wider reform agenda and promotes real-time online water markets

IMPROVING RIVER EFFICIENCY

A COMPUTER AIDED RIVER MANAGEMENT SYSTEM (CARMS) FOR THE MURRUMBIDGEE RIVER, AUSTRALIA

By Terry van Kalken and Stefan Szylkarski; DHI, Nachi Nachiappan; NSW State Water and John Skinner; Water for Rivers

Background

As South-Eastern Australia recovers from its worst drought on record, the experience has driven new innovations for achieving water efficiencies, including better river management. The Murrumbidgee River was first highlighted in the Pratt Water report of 2004 as an example of where major water savings could be realised through infrastructure upgrades and smarter river operations. Murrumbidgee means "big water" in the local Wiradjuri aboriginal language. The river is one of Australia's longest at 1600km, and it is a major source of irrigation water to the Riverina region in NSW as well as an important source of water to the river wetlands. However, its management is a complicated task. The complex nature of the river system, coupled with the critical need to meet irrigation, environmental, and town water demands, often results in excess water being released from the headwater storages which are surplus to the actual requirements.

Now, NSW State Water, the river operator, supported by Water for Rivers (www.waterforrivers.org.au), have embarked on a $65m upgrade of the river management and operational system that will set a benchmark for efficient river operations in Australia and internationally. The Murrumbidgee Computer Aided River Management (CARM) project will make control of water flows and dam releases more precise and efficient through a combination of upgrades to river infrastructure, metering, operational modelling and information systems. Operational improvements will be realised through the integration of river monitoring, extraction metering, hydrodynamic river models and optimisation software systems. The system will support efficient and frequent decision making by river operators to ensure that the most efficient operational settings are achieved and that irrigators, environmental and other customers receive the right amount of water at the right location at the right time. The decision support system represents world's best practise in river operations.

Current River Management Practice

State Water currently operates the Murrumbidgee River system, which includes the Yanco-Billabong Creek offtakes, through dam releases from the headwater storages at Burrinjuck and Blowering Dams and through an additional 10 re-regulation weirs and two off-line storages along the river. Irrigation is by far the largest user of river water in the basin, with two of the largest irrigation supply companies, Murrumbidgee Irrigation and Coleambally Irrigation accounting for approximately 70% of water use. These are supplied by dedicated offtake canals located between 5-7 days travel time downstream of the dams. In addition to hundreds of private irrigators extract water directly from the river by pumping. Releases from the headwaters can take up to 28 days to reach some irrigators at the tail end of the system. Environmental customers are also increasingly important, and the catchment includes significant wetlands including Lowbidgee, one of the most important waterbird breeding sites in the region. Large towns that also depend on the river for their water supplies include Gundagai, Wagga Wagga, Hay and Balranald.

Current river operations rely heavily on the experience and judgement of the river operator and are based on simple water balance modelling concepts. These models do not take into account the complexities of the catchment flow processes or river flow dynamics. Providing reliable water deliveries to customers located, in some cases, many weeks of travel time downstream of the dams is particularly challenging. Consequently dam releases often exceed actual demands, which lead to significant water loss. This is because, once released, water is removed from the basin due to much higher evaporation and evapotranspiration rates in the lower part of the river system compared to the headwaters. The main drivers leading to this operational surplus have been identified (SKM 2010b) as being due to unaccounted changes in channel storage, unaccounted tributary inflows and late changes in irrigation water orders. As a result, almost 12% of the annual 4200GL of regulated flows is currently unaccounted for, (SKM 2010a).

Improving the process for the identification of unaccounted losses, and reducing operational surpluses requires modelling tools capable of reproducing the key physical behaviour of the catchment and the river system, which can then form the basis for optimal dam release and weir operation strategies.

Computer Aided River Management System

The river operations decision support system being implemented by DHI is being built around DHI's Solution Software technology. The CARM 'engine' comprises a suite of MIKE by DHI computer simulation models that accurately reproduce the key catchment runoff and river flow processes: tributary inflows; continuously variable river flow travel times; in-channel storage dynamics; evaporation; evapotranspiration from riparian vegetation and near-river groundwater exchange.

The system will integrate the models with real time measurements from State Water's on-line data and control systems, and will provide a range of fully customised decision support user interfaces for the river operators.

The CARM will make full use of existing and new monitoring data, including rainfall measurements and forecasts from the Bureau of Meteorology, river flows and levels, as well as pumped extractions from real time metering that is being implemented as part of the project. Tributary inflows will be forecast using hydrological models, utilising both rainfall observations and Bureau forecasts. These will feed into a MIKE 11 hydrodynamic river simulation model that is being developed for the entire Murrumbidgee-Yanco Creek system, incorporating over 2000km of river channels and floodplains. Real time water level and flow measurements will be used to automatically update the model state so that it continuously emulates the real river behaviour exactly. Near-river bank and groundwater exchanges, which were previously unaccounted, as well as evapotranspiration along the riparian margin, will be simulated using a MIKE SHE integrated surface groundwater interaction model, fully coupled to the MIKE 11 river model. This will ensure continuous dynamic coupling between groundwater behaviour in the alluvium of the river and the dynamic water levels in the river. With these integrated models it will possible to understand the relationship between dam release operations and groundwater changes within the riparian zone.

The hydrologic and hydrodynamic models will form the basis for the optimisation of the river system's day to day operations. By utilising forecasts of river inflows and real time water orders, coupled with the ability to reproduce the river behaviour, it is possible to optimise the operation of the dam releases and the downstream re-regulation weirs, with the objective to meet all water demands while at the same time minimising releases from the headwater storages.

Environmental Flows and Flood Control

The hydrodynamic model will allow for a high level of control of the river, and allow State Water to accurately target both irrigation requirements and the watering of key habitats including the Lowbidgee Wetlands. When combined with the optimisation tool, the hydrodynamic model can synchronise releases to "piggyback" on tributary inflows to inundate environmental assets and wetlands.

Flood operations can be similarly optimised to mitigate the impacts of dam releases during flood events by avoiding synchronization of dam releases with downstream tributary peak inflows.

Proven Concept

In a proof of concept for the upper parts of the system (dams to Narrandera) based on historical measurements, the CARM optimised solution has been shown to significantly reduce dam releases without compromising irrigation water security. Two periods selected, October-November 2006 (dry) and December 2007-January 2008 (wet), were previously identified as periods where significant operational surpluses had occurred. The optimized solution reduced the dry period releases from 441GL to 351GL, a saving of 90GL or 20%, and in the wet period reduced releases from 181GL to 94GL, a saving of 87GL, or 48%. These savings were achieved whilst still meeting all virtually all 6 day and 1 day demands for Murrumbidgee Irrigation and water orders further downstream of Narrandera. Real water savings are realised through a reduction in river operating levels, which means less water is lost through evaporation and evapotranspiration.

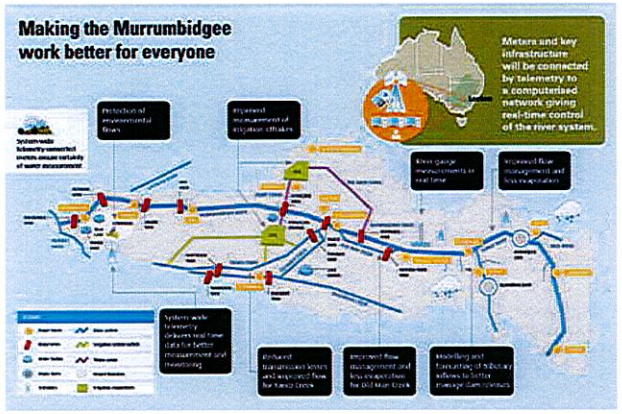
Decision Support System

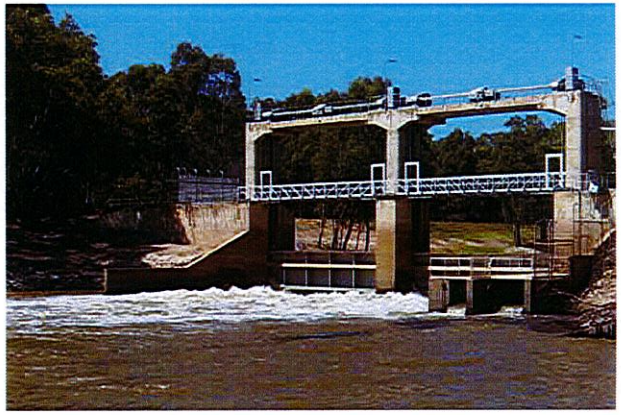
The new modelling and optimisation tools will be embedded into a state of the art decision support system being developed for State Water. The CARM decision support system will support all of State Water's business processes related to the river, including real time river operations, supplementary flow planning, environmental releases, flood operations and operations planning. The CARM system will provide river operators with real time access to State Water's monitoring and control systems, including metered water usage, customer orders and SCADA systems. Operators will also be able to view river levels and flows in real time via NSW Office of Water's river monitoring network and the latest weather forecasts from the Bureau of Meteorology. The system is based around an open and modular architecture, allowing State Water to expand and customise the system, and to take advantage of future advances in modelling and monitoring technology. The CARM system will allow full automatic control of the river operations, but with manual intervention possible at any time. The system is currently on track to be fully operational by the end of 2012.

Benefits

The higher level of water control possible with the new system will mean positive outcomes for all water users – including the environment – along the river: improved levels of service delivery on some parts of the system; more reliable delivery to all water users; greater technology options for irrigators; improve the equity for water delivery between water users and more confidence in the operation and measurement of the Murrumbidgee system. River operators will have access to all the information required to make informed and optimal decisions on river operations.

Despite an end to the drought and a return to wetter conditions, it is inevitable that drier periods will return in the future. By that time the Murrumbidgee River will be well established as one of the most efficient regulated river systems in the world, meeting the needs of irrigators whilst also improving environmental outcomes for all river users.





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