Australian Government

MURRAY–DARLING BASIN AUTHORITY

Constraints Management Strategy 2013 to 2024

Murray–Darling Basin Authority

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Cover Image: Darter, Barmah Forest, Keith Ward 2011.

Acknowledgement of the Traditional Owners of the Murray–Darling Basin

The Murray–Darling Basin Authority acknowledges and pays its respect to the Traditional Owners and their Nations of the Murray–Darling Basin. The contributions of earlier generations, including the Elders, who have fought for their rights in natural resource management, are also valued and respected.

The MDBA recognises and acknowledges that the Traditional Owners and their Nations in the Murray–Darling Basin have a deep cultural, social, environmental, spiritual and economic connection to their lands and waters. The MDBA understands the need for recognition of Traditional Owner knowledge and cultural values in natural resource management associated with the Basin. Further research is required to assist in understanding and providing for cultural flows. The MDBA supports the belief of the Northern Murray–Darling Basin Aboriginal Nations and the Murray Lower Darling Rivers Indigenous Nations that cultural flows will provide beneficial outcomes for Traditional Owners.

The approach of Traditional Owners to caring for the natural landscape, including water, can be expressed in the words of Ngarrindjeri elder Tom Trevorrow: 'our traditional management plan was don't be greedy, don't take any more than you need and respect everything around you. That's the management plan—it's such a simple management plan, but so hard for people to carry out.*[1] This traditional philosophy is widely held by Traditional Owners and respected and supported by the Murray–Darling Basin Authority.

[1] Tom Trevorrow (2010) Murrundi Ruwe Pangari Ringbalin 'River Country Spirit Ceremony: Aboriginal Perspectives on River Country'.

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Preamble

At the request 12 months ago of Basin Ministers, MDBA was commissioned to produce a Constraints Management Strategy.

The Basin governments collectively recognise that governments — with people who live and work in the Basin — can manage the system better to get the best use of the available water. This recognition led to MDBA being asked, under the Basin Plan, to develop a strategy which 'identifies and describes the physical, operational and management constraints that are affecting environmental water delivery'.

The work we have undertaken to prepare this Strategy is a continuation of the joint efforts which have been made by Basin governments and communities over the past decades. Substantial investment of both knowledge and funding has been made by individuals, communities and governments to maintain and restore the health of the rivers. We have been entrusted to build on their considerable achievements.

Importantly, while managing water for environmental use may be a relatively new concept, the people who will be responsible for it are the same people who have been looking after the river and managing water for consumptive use for many decades. Australia has world class river operators, who have been delivering water for irrigation and consumptive use for a century; and in more recent times they have also been delivering environmental water. Based on their collective track records, we can all be confident that 'environmental water' will be managed with the same care and diligence that has always been demonstrated.

This Strategy canvasses the river areas and river management practices worthy of further examination. It has been prepared to provide the basis for conversations with governments, Basin communities and landholders. What this Strategy sets out to do is to provide Basin governments with ideas for how we can make better use of water. It puts forward a work plan for the next ten years — with a measured approach for looking at the ways that rivers are operated and ways they could be made more efficient for the benefit of productive uses and the environment.

It also spells out roles and responsibilities for this forward plan — we all, governments and communities, have a part to play.

The Strategy does not suggest towns are going to be flooded, rather it proposes modest changes. Neither does it say there will be across-the-board changes made immediately. It does not put forward anything that would mean individual entitlements would change. One of the Strategy's overarching principles is that there will be no new risks to entitlement holders.

Over the coming years, there will be many opportunities to participate in the scoping and development of specific projects which might be pursued. We encourage you to

register your interest in being involved. Please ring us on 1800 230 067 or email engagement@mdba.gov.au. We look forward to hearing from you.

We would not have got this far without many people giving generously of their time and advice. Once again we express our appreciation for the sharing of your knowledge and understanding of constraints in the Murray–Darling Basin.

Figure 1 Reedy Swamp Barmah–Millewa before environmental watering, 2010

Executive summary

For more than a hundred years, the infrastructure and management of the Murray–Darling Basin has been developed to support our agriculture industries. This has played a vital part in building our nation's wealth and has established our place in the world as a major food and fibre producer. We pay tribute to all those who have built the systems and to the generations of farmers who have worked and cared for their land.

Over the decades, many rivers have been modified and become highly managed to provide water supply to towns and cities and to develop irrigated agriculture, as well as deal with floods, droughts and for recreational pursuits such as boating and fishing.

Of course, there are consequences to every action. The dams and water storages which capture upstream flows and rain can also prevent flows from a number of catchments from intersecting, as would occur in nature. We typically draw water from our dams in summer and autumn to meet the needs of irrigators and the crop cycle and refill them with winter and spring rain. This means changes to natural flows and seasonal peaks, which can affect breeding and feeding opportunities for water-dependent animals and flood-dependent vegetation like our river red gums.

Over many years, Basin governments have developed many river management practices around how water is managed in the rivers and in our dams. These govern how water is delivered and how balance is maintained to support the needs of our farmers and our towns and cities. Others aim at protecting the health of the system and making it as resilient as possible to the effects of drought and the environmental consequences of things like salinity and acid-sulphate soils. As a result of this historic effort, Australia can boast a world class system of access to and management of water resources, including some of the most comprehensive hydrologic modelling.

But equally, based on that history and the knowledge that history brings, we know there is always more to be done to ensure the system is balanced and resilient for the future. The structures and practices which have been and remain of great benefit to our productive industries can and must be improved upon to maintain our competitiveness as an exporter of food and fibre, as well as ensuring the environmental resilience of our land and waterways.

Basin governments and the Murray–Darling Basin Authority (MDBA) have been looking at opportunities to get better environmental outcomes by changing the way we manage river structures and revisiting some of the management practices in place, while still retaining the benefits of river regulation. Recognising the potential to improve the effectiveness of environmental watering, Basin governments commissioned the MDBA with preparing a Strategy under the Basin Plan for addressing constraints to water delivery.

Constraints are river management practices and structures that govern the volume and timing of regulated water delivery through the river system.

The timeframe prescribed to develop the Strategy was within 12 months of the commencement of the Basin Plan.

The Constraints Management Strategy is looking at ways to ensure that the environmental benefits of returned water to the river system are maximised and the community has neutral or better outcomes — such as improved capacity to cope with flows up to minor flood levels. The Strategy will inform decisions by Basin governments, who may choose to relax or address priority constraints to water delivery, to achieve better outcomes from the use of environmental water. Developing the Strategy is the first step in a long-term commitment by governments to address key constraints.

Importantly, Basin governments and the MDBA are also investing significant effort and funds to ensure that rivers and irrigation systems are operated as efficiently as possible and to assist farmers to increase on-farm efficiency. These activities are being supported by related but separate programs and are not covered in this Strategy.

The Constraints Management Strategy

The Strategy proposes a timetable for phased assessment and decision making over the next 10 years. The Strategy sets out:

- the **overarching principles** that guide the implementation of the Strategy
- the **roles and responsibilities** of governments and communities
- a **framework and timetable** for the implementation of the Strategy encompassing three broad phases: 1) pre-feasibility (to the end of 2014); 2) feasibility (to June 2016); and 3) implementation (until 2024)
- the **key steps in phase 1** (pre-feasibility) outlining the issues to be considered and methods to be used in completing the pre-feasibility analysis
- the **action plan or next steps** for each of the seven key focus areas in the Basin identified as worthy of further consideration
- an **overview of the Basin's river management practices**, canvassing their impact on the ability to deliver environmental water.

The Strategy also reports briefly on the technical scoping work and consultation that has informed its development.

Figure 2 sets out the broad phases for the development of the Strategy, including the preliminary work already undertaken. It is expected that there will be overlap in these phases, where work on particular constraints may progress faster, or take more time.

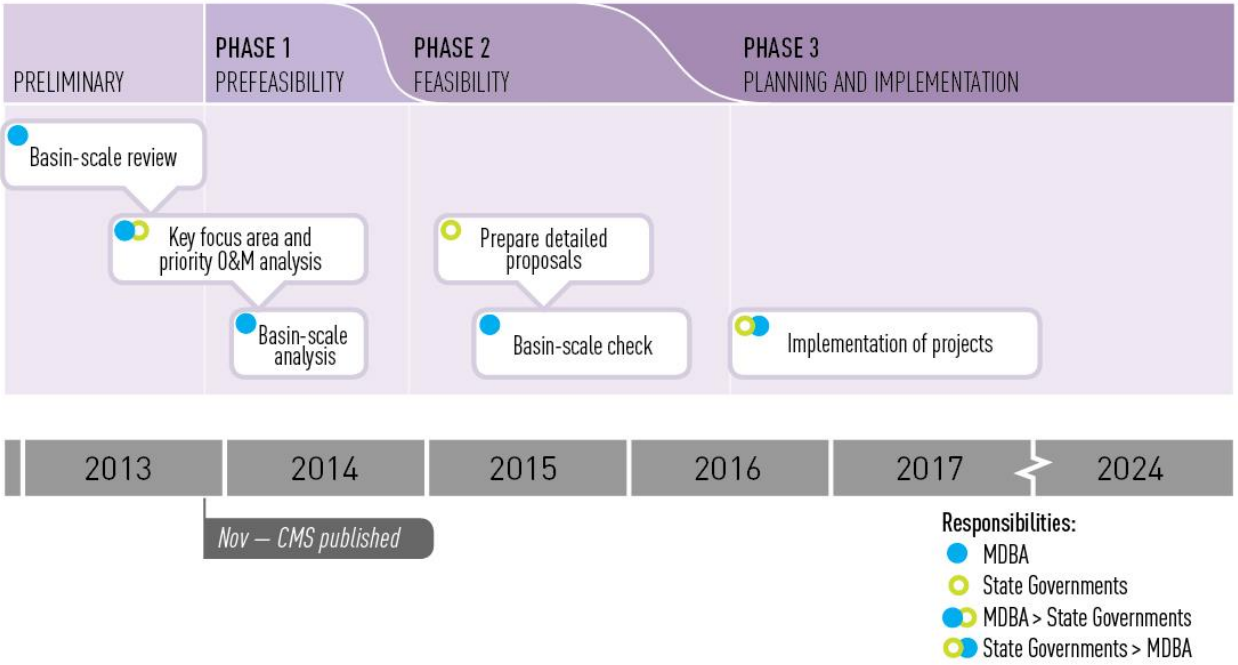

Figure 2 Three broad phases of Constraints Management Strategy implementation

The Strategy also includes overarching principles that have been central to its development and should also guide its roll-out. These are:

- The Strategy aims to maximise environmental outcomes that can be obtained from managing all water available for environmental use (and managing water for other purposes on route).
- Affected communities, including land holders and managers, water entitlement holders, traditional owners, management agencies and local government need to be involved from the beginning to identify potential impacts and solutions.
- In pursuing environmental outcomes through the relaxation or removal of constraints, solutions need to:
    - recognise and respect the property rights of landholders and water entitlements holders
    - not create any new risks on the reliability of entitlements
    - be identified in consultation with affected parties to determine if impacts can be appropriately addressed and mitigated to enable changes to proceed
    - identify and aim to achieve net positive impacts for the community
    - be worked through in a fair and transparent/equitable way
    - work within the boundaries defined by the Water Act, the Basin Plan and relevant state water access and planning systems.
- All water holders, whether existing consumptive users or environmental water holders, should be able to use their water efficiently to meet the needs of that use, while not adversely affecting other entitlements.

- Potential changes will be worked through with relevant Basin governments and relevant stakeholders to resolve issues before changes to river management practices or on-ground arrangements are made.
- Decisions to proceed with removing constraints will be made by Basin governments with investment being decided by the Commonwealth on the collective advice of governments. Investment should:
    - be prioritised on addressing the constraints that will provide the best Basin-wide environmental outcomes, taking into account economic and social considerations
    - focus on lasting solutions to provide certainty and protection to stakeholders over time.
    - be focussed on avoiding and addressing any impacts to third parties.

Key focus areas

Seven key focus areas in the Basin are identified where the relaxation of constraints needs detailed consideration. These are:

- Hume to Yarrawonga (Upper Murray)
- Below Yarrawonga to Wakool Junction (Mid-Murray)
- Goulburn
- Murrumbidgee
- Lower Darling
- Gwydir
- South Australia (Lower Murray).

The areas were based on a preliminary technical report (developed in consultation with state water agencies) that identified in which areas the relaxation of physical constraints would give the greatest return for the environment from a Basin-scale perspective of environmental outcomes.

The views of many people in these key focus areas contributed to shaping the draft Strategy released by the MDBA in October 2013 — landholders, irrigators, peak groups, Landcare and environmental groups, Indigenous leaders, catchment management authorities, state water agencies and local councils. Around 500 people were involved through over 70 meetings before the draft Strategy was developed.

The Strategy proposes further examination of the physical constraints in the key focus areas and provides more detailed next steps for working in key focus areas with communities.

Operational and management constraints

Definitions

Planned environmental water is water that is committed by legislation to achieving environmental outcomes, and cannot be used for other purposes except under very specific circumstances.

Held environmental water is water available under a water right, for achieving environmental outcomes.

River management practices comprise the policies, procedures and protocols that are outlined in legislation, intergovernmental agreements, water resource plans, river operating manuals and procedures and guidelines, as well as unwritten practices. Some of these have management objectives that predated water being delivered for the environment**.**

The consideration of river management practices identified broad areas, as summarised below, that are constraints to environmental watering:

- limited capacity to deliver environmental water on top of other 'in-stream' flows
- lack of protection of environmental water in-stream restricting the ability to provide environmental benefits throughout the length of the river
- insufficient mechanisms to estimate environmental water use
- insufficient formal channel sharing arrangements at times of both high consumptive and environmental demand
- water accounting practices can result in insufficient 'held' environmental water being available to commence watering events
- some planned environmental water does not optimise environmental outcomes
- environmental water can sometimes substitute for other planned or operational water
- limited formal arrangements exist to coordinate all water and inter-valley watering events.

Table 1 (pp. 21 to 22) provides further exploration of these river management practices.

The Strategy suggests priority actions related to river management practices that would benefit from further consideration by Basin governments and/or the MDBA, in consultation with water users/entitlement holders.

Consultation on the draft Constraints Management Strategy

The MDBA held a formal three-week public comment period on the draft Strategy between 9 and 30 October 2013. There were also more than 20 briefing sessions on the draft Strategy held in regional areas of the Basin during this time.

All feedback on the draft Strategy, including feedback documented during the various meetings and workshops, and feedback received via the MDBA's 1800 number, engagement email and in postal submissions, was recorded and considered for inclusion in the final Strategy and the forward work program for implementation.

More than 80 separate items of feedback were received through a range of different avenues; including 68 written responses to the MDBA.

A separate report has been prepared which outlines and summarises this feedback and indicates what changes the MDBA has made to this Strategy to incorporate people's knowledge, ideas and views. Some information and suggestions have resulted in direct changes to the contents of this report and other suggestions are specific to a location, and will be taken up in the future work in the key focus areas. Some feedback is beyond the scope of the Strategy but relevant to other work of MDBA and will be addressed directly by those areas. This includes specific feedback on the need for more information about environmental watering objectives and activities; and more information about the sustainable diversion limits and the adjustment mechanism.

The MDBA appreciates the many individuals and groups who have taken the time to meet with us this year, and who have helped us to further understand river constraints in the Murray–Darling Basin while we were developing the Constraints Management Strategy.

Figure 3 Goulburn River near Alexandra looking upstream

Introduction to the Constraints Management Strategy

1. Introduction to the Constraints Management Strategy

In November 2012 the Commonwealth Water Minister adopted the Basin Plan, the first integrated framework for water planning in the Murray–Darling Basin. The Basin Plan endeavours to improve the health of the Murray–Darling Basin through setting limits on the amount of water (surface and groundwater) that can be taken from Basin water resources on a sustainable basis. The Plan:

- defines Basin-wide environmental, water quality and salinity objectives
- ensures that sufficient water is allocated to the environment
- provides an environmental watering plan to optimise the management of environmental water in the Basin
- defines a Basin-wide consistent framework for water trading
- provides for continuous improvement in the adaptive management of Basin water resources through monitoring and evaluation, and improving knowledge and information.

The Basin Plan provides an integrated and strategic framework to ensure the water resources of the Murray–Darling Basin can be managed in a sustainable way to achieve a healthy working Basin in the national interest. In the Basin Plan, the MDBA determined 10,873 gigalitres per year to be the overall volume of surface water in the Basin that reflects an environmentally sustainable level of take (sustainable diversion limit). MDBA estimated that, on a long–term average annual basis, surface water use in the Basin totalled 13,623 gigalitres (GL) per year; which meant that a reduction of 2,750 GL in diversions was required to achieve a sustainable level of water extraction. This water is in addition to other water available for the environment, such as 500 GL through the Living Murray Initiative.

Delivering environmental water

The Basin Plan Sustainable Diversion Limits (SDLs) were determined based on the existing physical characteristics and river operations in the Basin.

The SDLs return part of the water that was previously supplied (primarily for irrigation at regulated flow levels from spring to autumn) to the environment for use throughout the year. Environmental watering is delivered right across the year – not all at once, not all in one place. Water comes from all over the Basin, not just from one or two dams; and contributes to significant local and downstream outcomes.

Water available for environmental watering varies from one year to the next — the 2,750 GL to be recovered as a result of the Basin Plan is a long-term average as allocations will vary over the years. Some years there will be more water and some years less – as is the case for all entitlement holders.

River operators have an important role to play in the delivery of environmental water. Operators are required to deliver water to their customers within the established river management practices. The river operators' responsibility is to deliver water to all entitlement holders, be it for environmental or consumptive use.

Environmental watering actions have evolved significantly over the last 10 years, from the management of small allocations and limited watering at specific sites, to more recent system-wide watering that provides benefits to entire regions. River operators will manage environmental water with the same diligence and caution that they deliver irrigation and town water. This includes continually appraising any risks, forecasting rainfall events and tributary inflows against peak regulated operating levels and being careful to avoid any possible impacts while delivering water. This means that environmental water holders work with operators in real time to vary delivery to avoid issues while still getting the best environmental outcomes.

Delivery and use of Commonwealth environmental water is based on environmental need and varies from year to year with the prevailing seasonal, operational and management conditions. In the situation that the preferred pattern of delivery for the environment cannot be met, environmental water holders have been working with river operators to see if the pattern of delivery can be changed to avoid risks, but still get good environmental outcomes. The Commonwealth Environmental Water Holder takes a cautious approach to environmental flow management in order to eliminate, to the fullest extent practical, the risk of unintended impacts on landholders, irrigators and other third parties, while still delivering positive environmental outcomes. Every watering decision is based on a comprehensive assessment of all real and potential risks and where such a risk cannot be appropriately managed, the Water Holder will not proceed with that watering.

While the 2,750 GL of environmental water can be delivered within the current physical constraints, relaxing or removing key constraints would allow for more flexibility in water delivery, which means we can achieve even more with the water available. The Constraints Management Strategy is about investigating how this can be done in ways that avoid or address impacts on third parties, and therefore optimise environmental, social and economic benefits.

Adding value to the Plan

During the development of the Basin Plan, the Murray–Darling Basin Ministerial Council requested that the MDBA explore the potential additional environmental benefits that would result if some major existing river operating constraints to the delivery of water in the southern connected system were relaxed.

Previous worked showed that relaxing or removing particular constraints could improve the delivery of environmental water proposed to be recovered under the Basin Plan, and also increase the environmental benefits that could be achieved with any additional environmental water. This means we can do more with environmental water. This work also showed that additional environmental benefits could be achieved if more water was available for the environment and constraints were relaxed or removed.

At the request of Basin governments, the Plan includes a mechanism to adjust sustainable diversion limits, within a net effect of 5% of the SDL, and the requirement to develop a Constraints Management Strategy. The mechanism provides the capacity to:

- reduce the volume to be recovered for the environment (by up to 650 GL) provided that equivalent environmental outcomes can be maintained.
- increase the volume of water available for the environment (by 450GL) provided that social and economic outcomes are maintained or improved
- ease or remove constraints.

The provisions for adjusting the SDL are found in Chapter 7 of the Basin Plan. The requirements for the Constraints Management Strategy are captured in section 7.08 of the Basin Plan (reproduced in Appendix A). Basin governments have agreed on a process to progress SDL adjustment and constraint projects in the *Intergovernmental Agreement on Implementing Water Reform in the Murray Darling Basin (2013*).

The Strategy sits within this adjustment mechanism. Addressing constraints will contribute to getting better environmental outcomes possible within the SDLs set by the Basin Plan, and any subsequent changes to SDLs resulting from adjustment measures (Figure 2).

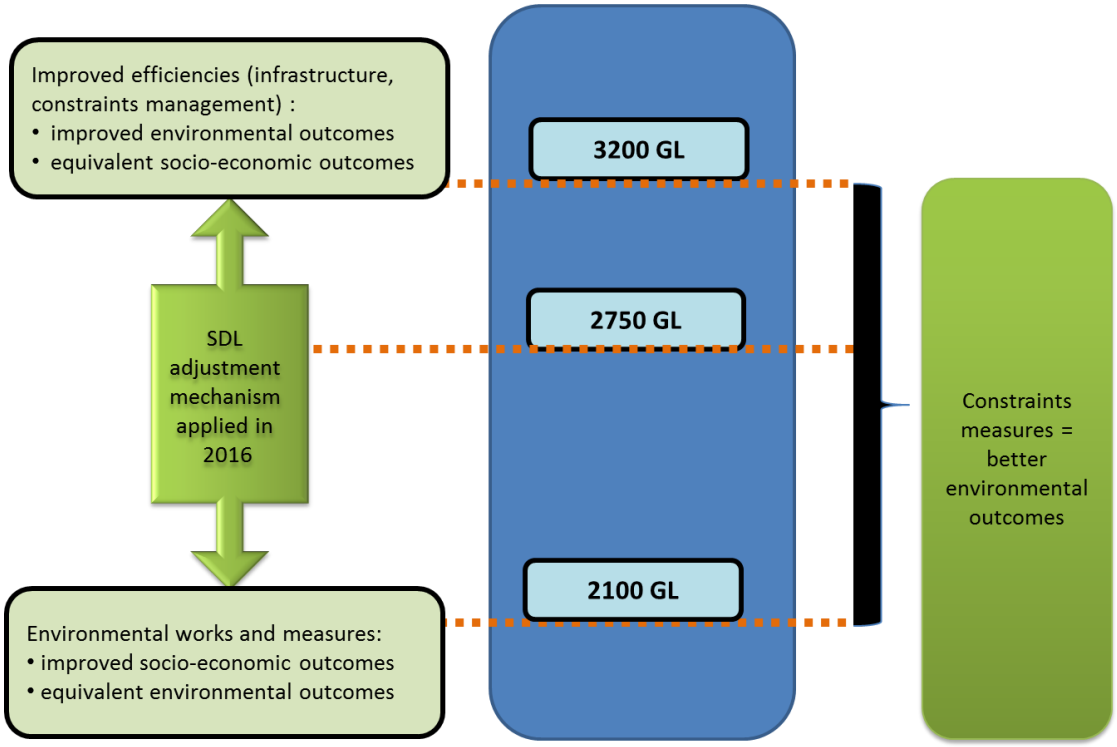

Figure 4 Schematic representation of the components of the SDL adjustment mechanism including the contribution of constraints to get better environmental outcomes

A significant amount of work has been started by Basin governments to identify projects — known as supply measures — that would enable the equivalent environmental outcomes to be achieved with less water. These projects are being pursued in a separate stream of work and are not covered by this Strategy.

The Strategy will inform decisions by Basin governments on measures to ease priority constraints to achieve better environmental outcomes, while taking into account social and economic considerations including impacts on third parties.

The Basin Plan sets out the environmental outcomes to be pursued. These environmental outcomes include improvements to the health of forests, fish and bird habitat, and increased connectivity between the river and floodplains and recharged groundwater. Addressing constraints means that these benefits can be achieved both in local areas and also contribute to downstream outcomes.

The Commonwealth Government has allocated $200 million to ease or remove priority constraints in the context of the SDL adjustment mechanism.

Why look at constraints?

There are some good reasons to be looking at addressing constraints now....

During the debate about the Basin Plan there was an overwhelming view that we needed to look at many aspects of how water is managed; and not just by changing the balance between consumptive use and what's left for the environment. If better environmental outcomes can be achieved by looking at the river management practices around water use, then there is less chance that further changes will be needed in the future to get the Basin's rivers in healthy working condition.

All of the river management practices currently set up for water use have been focused around extracting water from the river at a defined location. Environmental water holders need to be able to use their entitlements in new ways, such as leaving water in the river to achieve multiple benefits as the water moves downstream. Just as in the past when new industries were developed that required more flexble ways to manage the system, we need to continue to think about how to meet these new needs. Consistent with the Stategy's guiding principles this needs to be done without changing the risks to other entitlement holders or impacting other third parties. MDBA's testing with computer models shows that for some small changes to things like peak river height, up to around minor flood level (Figure 5), we can get a relatively large increase in environmental outcomes. This is because wetland and floodplain forest complexes tend to form in the lower lying areas which were frequently flooded before development, and often are still flooded several times per decade. Because these low lying areas are flood prone, our towns, infrastructure and farms are generally not located in these areas. This means there is the opportunity to get water into these lower areas a little more frequently than is currently the case, providing better outcomes as long as any potential impacts along the way can be mitigated. Addressing constraints is not about creating big floods. It is about modest changes (Figure 5).

Addressing constraints through physical structures such as bridges would have benefits over and above more efficient use of water, providing access for communities during flooding.

The continued challenge of sustaining river health in the Basin has given us a strong signal that we need to be more efficient and flexible managers, and to start running the rivers as a connected system; whereas we have sometimes neglected to think about what happens downstream. Some of the current river management practices sometimes don't even allow the passage of water to downstream catchments or locations.

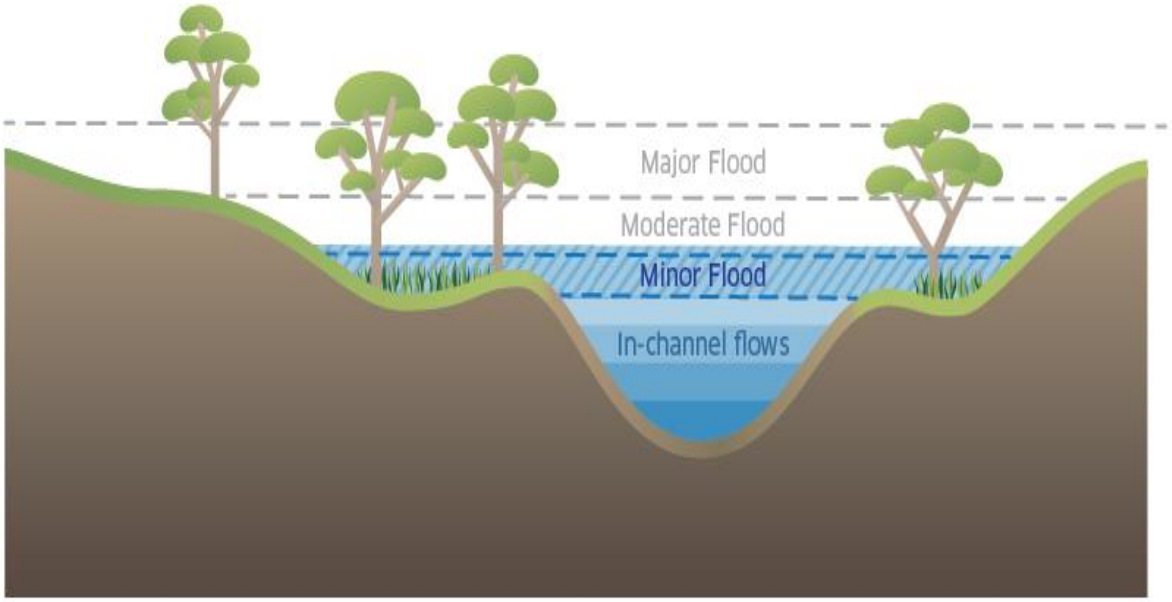

Figure 5 Schematic cross section of a river showing flood levels and the range of flows being explored through the Strategy.

(Flows up to minor flood level shown in the blue cross hatch).

Understanding constraints to water delivery across the Basin

2. Understanding constraints to water delivery across the Basin

Over the past 100 years the river systems of the Murray–Darling have been engineered through structures (dams, weirs, regulators) and operated to maximise the conservation of water for irrigation and domestic supply. This, in turn, has reduced high flow and protected properties from flooding. The construction of water storages and the regulation of flows for irrigation and urban uses have resulted in significant social and economic benefits at a regional and national scale. However, it has become increasingly apparent that river regulation and diversion can reduce important environmental values and ecological functions.

Over many decades, there has been a measurable decline in the number and health of native fish and waterbird populations; and an overall decline in the size and health of wetlands, floodplain forests and woodlands.

Many changes have been made over the decades by governments, industry and communities to improve the sustainability of the environment and irrigation enterprises. This has resulted in good dividends but it is recognised that more can still be done to restore some of the natural values. For instance, floodplain ecosystems continue to be under stress because river regulation generally keeps flows within the main channel. This has resulted in fewer overbank flow events, meaning that rivers connect with their associated wetlands and floodplains much less than they used to. The environmental degradation caused by these changes was exacerbated by the millennium drought and while the system has somewhat recovered with subsequent good flows, there is still a long-term pattern of decline.

River management practices restrict releases from dams to within the channel to avoid losses to nearby wetlands and floodplains; and also require extraction from water within the river whenever possible, rather than order from storage. For these reasons, river regulation has changed the size, duration, frequency, and seasonal distribution of flows downstream. Small and moderate floods are mostly captured and stored in public and private reservoirs for later use, removing much of the flow variability in the system. This is significant, given that a variable seasonal flow, and connection between the rivers, floodplains and wetlands is the context under which many river and floodplain species have evolved.

Differences in the system between the north and the south

The characteristics of constraints to environmental water delivery vary between regions. They are generally determined by the size, shape and configuration of the river channels, the operational and management practices for water delivery within the valley, which in turn is largely determined by the existing infrastructure and water-sharing arrangements specific to each region.

Parts of the Basin can be broadly classified as ‘regulated’ or ‘unregulated’ (as described on the following pages). The nature of constraints within these regions may share some characteristics; but they can still vary considerably from region to region. In broad terms, the southern parts of the Basin are generally regulated systems, together with some areas in the northern NSW. The northern Basin contains predominantly unregulated systems. This means that for the southern Basin, constraints to environmental water delivery include the allowed patterns of release from major physical structures and other operational and management issues. In the northern Basin, operational and management constraints to environmental water delivery are the most important, as there is less regulation.

Constraints to environmental water delivery may not be the same as constraints to delivery of irrigation water. The Barmah Choke is one such example, which is explained in Section 9.

Figure 6 A section of the Lower Darling river

Regulated systems

Regulated regions (mainly those in the southern part of the Basin, and some northern catchments in NSW) are characterised by their infrastructure, such as dams and weirs, which allow a relatively large proportion of the flow to be controlled. This allows water to be captured in the wetter parts of the year (late autumn to early spring) for use over the drier summer period. These regions have an associated water allocation system that allows entitlement holders to request water for consumptive use. Managed environmental watering in these systems will usually rely on combining storage releases, with in-stream flows to achieve a desirable peak or pattern of flows. Constraints in these regions are therefore largely determined by the characteristics of the storages, channel capacities, and water-sharing polices.

In practice, the achievement of an environmental watering event in a regulated system will often seek to combine storage releases with inflows (possibly unregulated) from a tributary river; so long as this does not result in third party flooding risks after the flows converge. For instance, if rainfall is predicted to produce large inflows from a tributary (such as the Ovens River) then environmental releases from an upstream storage (such as Hume Dam) can be coordinated to ensure that the combined flows deliver targeted environmental outcomes.

Releases from storage will need to be carefully timed to achieve the combined flows and mitigate any risks to third parties. Furthermore, in some cases releases may be made from multiple storages to build a single environmental flow.

In both the north and south parts of the Basin, flow travel times from tributary storages to the desired location on the main river are generally all greater than one month. Unregulated flow travel times are even longer and can be difficult to predict with an accuracy of better than a few days. The capacity to coordinate the timing of dam releases (in regulated areas) with tributary inflows has begun to be tested in the southern Basin over the last decade and this will require further work to get the best environmental outcomes.

The management of environmental flows to the Barwon–Darling River may be particularly difficult, as it would rely almost completely on the accurate timing of releases from multiple storages in both regulated and unregulated tributary catchments. Additionally, delivering combined flows in this region will be more difficult compared to the south due to larger flow travel distances and drier catchments.

If higher regulated releases are to be made to deliver environmental water, the risk of these flows coinciding with a rain event in the following weeks will need to be addressed. Water managers would need to consider this risk and obtain the best information possible to lessen the level of risk. Emerging improvements in weather and flood forecasting could improve the predictive capacity.

Unregulated systems

Unregulated rivers are characterised by a lower level of flow-controlling infrastructure, or by this infrastructure being smaller private off-stream reservoirs (rather than the entire river being regulated by a large public dam). A significant proportion of water diverted for consumptive use in these regions is associated with unregulated licences. These allow licence holders to access water during specific flow conditions, such as during times when river levels exceed given heights (pumping thresholds). These systems are therefore characterised by water-sharing polices and river management practices that govern access to flows as they pass downstream.

The largest unregulated catchments are located in the northern parts of the Murray–Darling Basin. The northern Basin comprises the catchment area of the Barwon–Darling River and its tributaries upstream of Menindee Lakes. It includes more than half of the Murray–Darling Basin and is more arid and flat than the southern Basin. Rainfall and resulting stream flows are more variable compared to the south, and are summer dominant in the northern sections (compared to winter dominant in the southern Basin).

These features of the northern Basin have meant that the surface water resources have been developed and managed differently to the southern Basin. The proportion of flows regulated by dams is much lower and a significant proportion of irrigation production relies on diverting unregulated flows directly into large, privately constructed, off-stream storages.

As such, many of the water licences in the northern Basin allow access during unregulated flow conditions, known as unsupplemented access in Queensland and supplementary access in NSW. Holders of these licences are able to access water during specific flow conditions, often associated with periods of mid-to-high flow.

Due to these differences, approaches for environmental watering in the northern Basin will be different from that in the south. The Commonwealth and other environmental water holders will generally seek to use the water against their entitlements by not taking their share as flows proceed downstream. However, current limitations on using water in this way include that the pumping thresholds of other licence holders may result in that environmental water being extracted for consumptive use.

Management arrangements (including ‘shepherding’) to protect environmental flows are intended to ensure that environmental water holders are able to use their water for environmental purposes ‘in-stream’, without increasing or diminishing the interests of consumptive users.

Development of the Constraints Management Strategy

3. Development of the Constraints Management Strategy

Several pieces of work have been completed to inform the Strategy:

- modelling undertaken for Basin Plan development in 2012
- Basin-wide review of physical constraints
- discussions with communities and agencies in key focus areas and consultation on a draft Strategy
- identifying operational and management constraints.

In addition, there have been a number of other bodies of work which the Strategy has drawn upon. These include outcomes from the Experienced River Operators' Workshop, environmental watering trials and river management reviews.

Modelling of relaxing constraints during Basin Plan development

At the request of Basin governments, MDBA completed a set of modelling scenarios in 2012 that looked at the effect of relaxing eight key physical constraints in the southern Basin (see Appendix B). Overall, the study showed that if constraints were addressed, it could result in significant increases in the area that can be watered through active management of environmental water – to around 75% of the wetland and dominant vegetation communities of the floodplain in the southern connected system. This could be of critical importance to the long-term sustainability of these communities.

In one scenario (based on 2,800 GL/y water recovered for the environment), while there was no change in the overall number of environmental flow indicators achieved, relaxing constraints resulted in a change to the achievement of specific environmental flow indicators and an overall increase in the peak and duration of desirable environmental flows. This would contribute to:

- improvements in the health and resilience of flood-dependent vegetation
- recharged floodplain groundwater systems
- flushing of salt from the landscape
- improvements in the lateral connectivity and nutrient and carbon exchange between the floodplain and river; supporting fundamental ecosystem functions.

A second scenario (based on recovering 3200 GL/y of water for the environment) indicated that a much larger number of the environmental flow indicators could be

achieved; which would mean that (in addition to the benefits seen in the 2800 scenario), larger areas of native vegetation and floodplain ecosystems would benefit (such as river red gum, black box woodland and lignum shrublands) especially in the Lower Murray.

Basin-wide review of physical constraints

This comparative modelling led to governments requesting that the MDBA complete a Constraints Management Strategy as part of the requirements of the Basin Plan. In early 2013, the MDBA began work on an inventory or Basin-scale review of priority constraints (in consultation with Basin state water agencies) to capture a base understanding of the valley-specific constraints. In July 2013 the *Preliminary Overview of Constraints to Environmental Water Delivery in the Murray–Darling Basin* (Technical Report) was published.

The technical report was not an exhaustive list of all constraints to environmental water delivery in the Basin, but captured the main known physical constraints valley by valley that directly impact on achieving additional environmental targets. It was a starting point to identify the most important constraints from a spatial perspective, and in particular, constraints that were important to achieving both Basin-scale and local outcomes.

Building on the information identified in the technical report, together with additional information provided through discussions with stakeholders, seven key focus areas were identified for further analysis (Figure 7). They are:

- Hume to Yarrawonga (Upper Murray)
- Yarrawonga to Wakool Junction (Mid-Murray)
- Goulburn
- Murrumbidgee
- Lower Darling
- Gwydir
- South Australia (Lower Murray).

The areas we have identified can be characterised as first order constraints – not at the exclusion of other areas or structures, but those most worthy of further investigation in the first instance.

From a Basin system perspective, the first six of these areas are considered to have primary physical impediments that prevent the achievement of additional environmental outcomes. The River Murray in South Australia has been included as a key focus area because changes to flow regime through the delivery of

environmental water may have implications that require further investigation to understand issues and determine if mitigation options are needed.

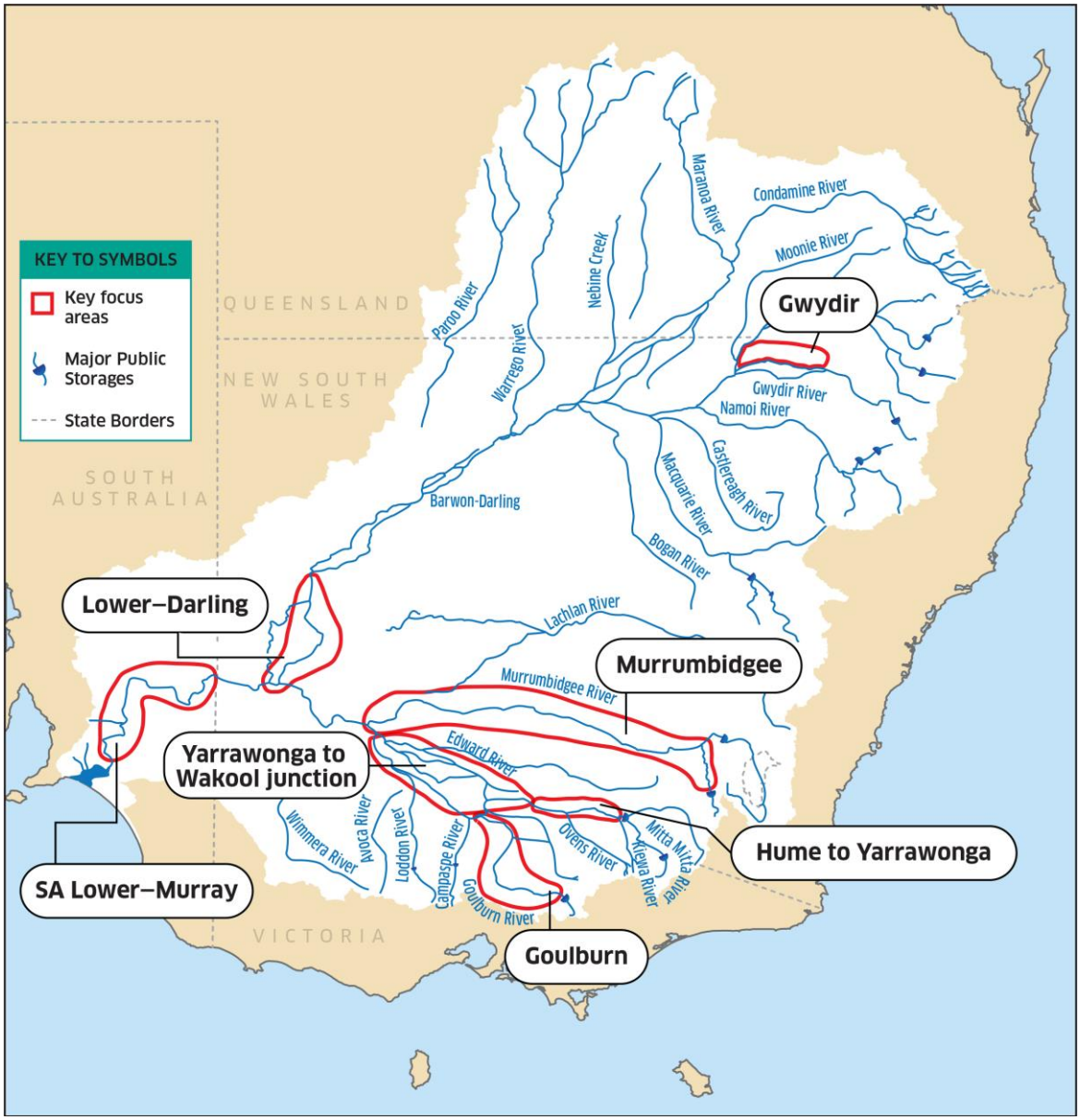

Figure 7 Key focus areas

Consultation in key focus areas leading to the final Strategy

In developing the Strategy, the MDBA has placed significant effort and resources into consultation with communities in the areas that were the most important in terms of addressing constraints. MDBA also worked closely with state government agencies with an interest and knowledge in water management, environmental water delivery and land management in areas with key constraints.

Early consultation activities to develop the Constraints Management Strategy focused on:

- landholders whose property is adjacent to key constraints and who possess significant knowledge of the impacts of flows, at a property and regional scale
- Catchment Management Authorities that hold expertise in river management and who possess knowledge of local and community interests and contacts
- local government and State Emergencies Services that possess information and knowledge of the impacts of flows on public infrastructure
- water delivery authorities that manage the delivery of water from storages to customers, whether that be for consumptive or environmental use
- industry and representative bodies that share views, knowledge and information between the MDBA and their constituents.

The consultation approach considered related activities and programs being undertaken by state and/or Commonwealth agencies. MDBA sought to build on any consultation activities being undertaken (e.g. Customer Service Committees, Environmental Watering Advisory Groups) and invited state participation.

In some locations, consultation was delayed, or limited, in recognition of other processes or programs that were already underway. That is, MDBA ensured its consultation was coordinated with state and Commonwealth agencies so as to avoid burdening communities already involved in similar discussions with others. This happened primarily in the Gwydir, Murrumbidgee and Lower Darling, where other substantial processes were underway.

Consultation was also undertaken in these key focus areas on the Draft Strategy. A separate report has been prepared that outlines and summarises the feedback resulting from this process. The report outlines the changes the MDBA has made to this Strategy to incorporate people's knowledge, ideas and views. Some information and suggestions have resulted in direct changes to the contents of this Strategy, and other suggestions are specific to a location, and will be taken up in the future work in the key focus areas. A brief description of the issues raised for each key focus area and the resulting actions to address these are included in Section 9.

The feedback received on the draft Strategy covered a range issues. The role of communities and importance of ongoing commitment to consultation was recognised in a large proportion of the feedback. Feedback suggested that the MDBA could refine the language used in the Strategy to make it clearer. The overarching principles were commented on by a large proportion of respondents,

with general support that these were an important part of the Strategy and suggestions for additions and refinements to the principles.

There was a significant amount of feedback on the phasing proposed by the Strategy covering a range of issues with divergent views on whether the timeframes were sufficient. There was significant interest and wide ranging feedback relating to the operational and management constraints.

Questions about the relationship between the Strategy and SDLs were raised by a number of respondents and there were several requests to make this clearer in the document. The issue of prioritisation and investment in constraint measures was also a focus, with feedback emphasising the need for a transparent prioritisation process that reflected the interconnected nature of constraints.

Finally, there was a significant amount of feedback about the effects of making changes. These included the possible impacts such as restricted access, damage to agricultural land, bank erosion, damage to levees and irrigation pump damage. Benefits were also recognised such as improved biodiversity. Some respondents explicitly identified mitigation options such as erosion control works and negotiation of easements. The local issues will be followed up on by the MDBA to feed into the first phase of the Strategy.

Identifying operational and management constraints

In addition to the physical constraints in specific locations in the Basin, there are a range of operational and management constraints that are relevant across a range of geographic areas across the Basin. During 2013, MDBA worked to identify these and group them into categories; as otherwise there might have been thousands of separate rules across the Basin (further detail in section 10).

Environmental watering has been undertaken throughout the Basin over many years. As well as uncovering challenges, this experience has resulted in valuable learnings and forms the basis of some outcomes we have identified which are required to deliver environmental water effectively.

To maximise the benefits from environmental watering, managers need to be able to work with the natural variability of river systems. At times, overbank flows are required to allow for connection between rivers and floodplains and to support in-stream functions. To achieve this, managers need to be able to:

- coincide environmental watering and natural seasonal patterns and flow events
- use environmental water to target a range of sites and ecosystem functions in, and between, rivers

- consider opportunities within the broader management of water across the system to better contribute to environmental outcomes.

The major environmental watering events in recent years have been designed to provide water to multiple sites in the lower Basin in sequence.

Within this context, broad operational and management constraints were identified (Table 1).

There could be different ways to achieve these environmental outcomes, so the MDBA has not prescribed specific changes to operational and management practices. The responsibility for any changes to these practices clearly rests with state governments. Consistent with the Strategy principles, any detailed consideration of these particular constraints will require related third party impacts to be addressed or avoided.

Table 1 Summary of operational and management constraints

Operational Outcome sought	Broad description of constraint	Priority actions
Delivery of environmental water on top of other in-stream flows.	Currently a water order is for a volume. Orders are met by the most efficient source to conserve water for extractive use. This includes using water from unregulated flows to meet the order. This limits managers' ability to 'top up' events.	Develop formal (standing) operational and management practices to allow held environmental water to build on natural flow cues including in-stream, or where safe, unregulated flows.
Environmental water is protected on an event basis from consumptive extraction or re-regulation.	There is no recognition of an entitlement en route or beyond its order point and environmental water use is difficult to measure, particularly during an event.	Develop and implement policies to protect environmental water from consumptive extraction or re-regulation. Develop a methodology to estimate environmental use which is transparent and equitable.
Environmental water can be used throughout the length of a river.	Water orders associated with entitlements are met by placing a water order for volumetric extraction at one location on the river. Water cannot be ordered in a way that can ensure it benefits multiple sites.	Develop operational and management practices to enable held environmental water to flow throughout the river (via a release from headwater storage to the end of the system).
Transparent and equitable channel capacity sharing.	The capacity of a river channel to carry water can limit the volumes able to be delivered. Channel capacity competition	Develop formal supply sharing arrangements to provide a mechanism for managing the delivery of water when demands exceed channel sharing capacity.

Operational Outcome sought	Broad description of constraint	Priority actions
	arises at times of both high consumptive and environmental demand.	
Held environmental water is available in time to respond to natural cues	The timing of the water year and reaching peak allocations do not align with natural seasonality. At times there may be insufficient environmental water to commence a water event.	Investigate options to improve the availability of environmental water to enable it to respond to natural cues.
Planned environmental water aligns to natural cues.	Some planned environmental water provisions do not reflect natural cues and seasonal variability.	Review the efficacy of planned environmental water provisions across the Basin to optimise environmental outcomes.
Ensure environmental water is not substituted for other water.	Releasing of held environmental water from storage and flow throughout the river can result in substitution of held water for planned water, pre-releases or spills.	Undertake analysis to identify the extent to which substitution is an issue. Develop transparent policies to ensure treatment of held environmental water with planned environmental water or other releases from storage
Environmental water is coordinated with all water and between valleys for maximum environmental benefit.	Existing governance arrangements are generally developed around individual environmental water holder objectives. There are limited formal arrangements for the coordinated planning of all environmental water and inter-valley watering events.	Development of governance and policy arrangements for the coordinated planning of environmental water, both annually and longer-term, for the southern connected system. Assess the feasibility of coordinating environmental flows in the northern Basin.
Environmental planning is included in river operations.	Current river management practices were developed primarily for security of water supply and not environmental outcomes.	Support the integration of environmental water planning into river operations.

Overview of the Constraints Management Strategy

4. Overview of the Constraints Management Strategy

The Strategy proposes a timetable for phased assessment and decision making over the next 10 years. It identifies seven key focus areas for further analysis and nine broad areas of operational and management practice for further consideration.

It contains the following components:

- overarching principles that guide the implementation of the Strategy
- the roles and responsibilities of the relevant stakeholders
- a framework and timetable for the implementation of the Strategy encompassing three broad phases: 1) pre-feasibility (to the end of 2014); 2) feasibility (to June 2016); and 3) implementation (until 2024)
- key steps in phase 1 (pre-feasibility) outlining the issues to be considered and methods to be used in completing the pre-feasibility analysis
- the action plan or next steps for each of the seven identified key focus areas and for each operational and management area.

Figure 8 Mundarlo Bridge on the Murrumbidgee

Overarching principles

5. Overarching principles

A number of key principles have been central to thinking through how constraints should be managed in the Basin. They have been important in the discussions that have already occurred between the MDBA, governments and communities and should also guide the roll out of the Strategy. They have been revised in light of the feedback we received through the consultation process. The principles are:

- The Strategy aims to maximise environmental outcomes that can be obtained from managing all water available for environmental use (and managing water for other purposes on route).
- Affected communities, including land holders and managers, water entitlement holders, Traditional Owners, management agencies and local government need to be involved from the beginning to identify potential impacts and solutions.
- In pursuing environmental outcomes through the relaxation or removal of constraints, solutions will:
    - recognise and respect the property rights of landholders and water entitlements holders
    - not create any new risks to the reliability of entitlements
    - be identified in consultation with affected parties to determine if impacts can be appropriately addressed and mitigated to enable changes to proceed
    - identify and aim to achieve net positive impacts wherever possible
    - be worked through in a fair and transparent/equitable way
    - work within the boundaries defined by the Water Act, the Basin Plan and relevant state water access and planning systems.
- All water holders, whether existing consumptive users or environmental water holders, should be able to use their water efficiently to meet the needs of that use, while not adversely affecting other entitlements.
- Potential changes would be worked through with relevant Basin governments and relevant stakeholders to resolve issues before changes to on-ground arrangements are made.
- Decisions to proceed with removing constraints will be made by Basin governments with investment being decided by the Commonwealth on the collective advice of governments. Investment should:
    - be prioritised on addressing the constraints that will provide the best Basin-wide environmental outcomes, taking into account economic and social considerations
    - focus on lasting solutions to provide certainty and protection to stakeholders over time.
    - be focussed on avoiding and addressing any impacts to third parties.

Roles and responsibilities

6. Roles and responsibilities

This Strategy proposes a collaborative approach to the development and prioritisation of constraints projects, and includes a strong focus on community involvement throughout the process.

Basin governments: will make decisions to proceed with removing constraints under this Strategy. The Commonwealth Government has allocated $200 million to relax or remove priority constraints in the context of the SDL adjustment mechanism. The *Intergovernmental Agreement on Implementing Water Reform in the Murray-Darling Basin* (2013) includes a protocol for the consideration of adjustment measures, including constraints, in 2016.

Basin state governments will, for the most part, develop specific constraints projects and be involved in the consideration of projects proposed by other jurisdictions.

A package of projects will be considered by Basin governments via the Murray–Darling Basin Ministerial Council, advised by the Basin Officials Committee, with the final investment decision made by the Commonwealth.

States will be responsible for implementation of projects within their respective jurisdictions, including consultation and engagement consistent with the overarching principles of the Strategy. Unrelated to the Strategy, Basin states may also address constraints, or review their river management practices at any time including when water sharing plans are negotiated.

MDBA: is responsible for the development of the Strategy and must report annually to the Murray–Darling Basin Ministerial Council on progress on the matters covered by the Strategy.

Over the next several years, the MDBA will provide technical advice and analysis, and will provide a Basin-scale perspective when assessing the mix of constraints projects that will best deliver environmental outcomes. The MDBA will work with Basin states to undertake the pre-feasibility assessment, to enable Basin-scale analysis across key focus areas and operational and management constraints.

The MDBA may have a role in the design and implementation of particular projects, especially where they involve more than one jurisdiction or a change to River Murray operations.

Communities: will be involved throughout the development and implementation of the Strategy. In the key focus areas local landholders, Traditional Owners, Catchment Management Authorities, local governments and industries will participate in the detailed scoping of the potential impacts from changes to flow patterns and flow heights. Water users will also be involved in considering changes to river management practices captured in their local water resource plans.

A phased approach to addressing constraints

7. A phased approach to addressing constraints

Addressing constraints requires time to do the necessary assessment and consultation at the local level. The Strategy outlines a 10-year process to identify and address constraints to environmental water delivery across the Basin. This section outlines the key elements and timetable for implementation, including reference to key dates for other related activities such as the SDL adjustment mechanism.

Building on the preliminary work that has already been completed, the Strategy has three phases (Figure 9). These are:

- *Pre-feasibility phase 1*: 2013–2014
- *Feasibility phase 2*: 2015–2016
- *Planning and implementation phase 3*: 2016–2024.

A summary of each of these phases is provided below.

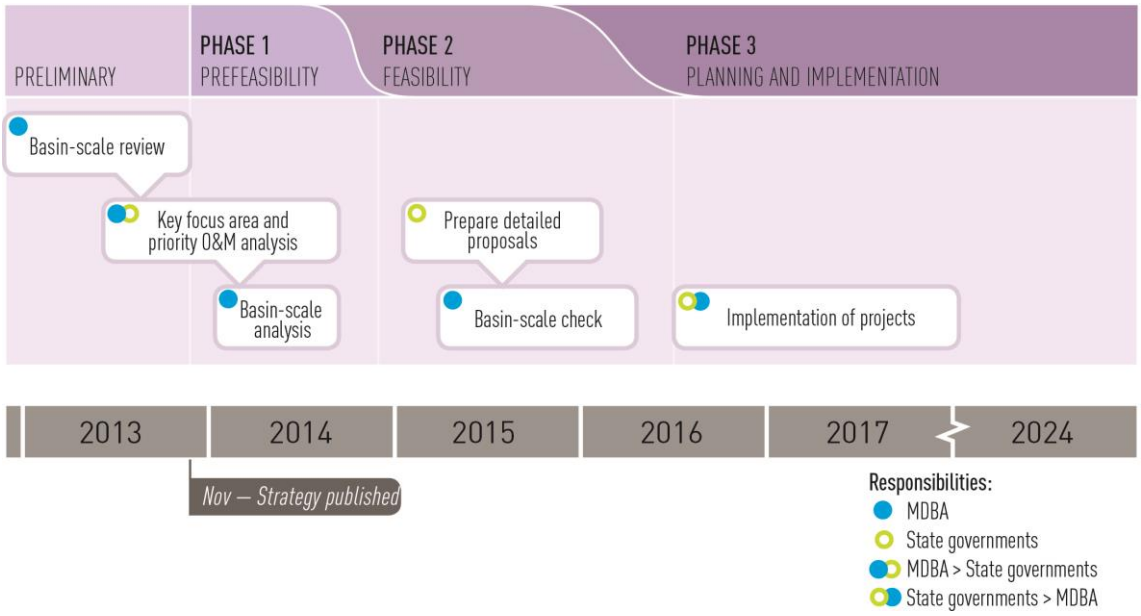

Figure 9 Three broad phases of the Constraints Management Strategy implementation showing potential overlap between phases

Pre-feasibility phase I: 2013 to 2014

The purpose of the pre-feasibility phase is to compile an information base to allow a first pass Basin-scale assessment of constraints that are worthy of further investigation. During the pre-feasibility phase, the MDBA, in consultation or partnership with states, will continue to investigate opportunities to address constraints; any risks to water users and landholders; and the environmental outcomes. This work includes preliminary assessment of the impacts of changes to constraints on environmental water delivery and third parties; as well as downstream impacts and the initial assessment of options to address those impacts. Reflecting the Strategy's overarching principles, work will continue to be undertaken in close consultation with the community.

This information will be used as the basis for Basin-scale analysis. This work will take into account trade-offs, interdependencies and flow-on effects across constraints to identify potential investment options and support recommendations to governments. This is part of phase 1, which will consider how the Basin functions as a river system, and which things may need to be done first or concurrently to get the best outcomes.

Phase 1 will also include further work to identify and prioritise important operational and management constraints, including their relationship to physical constraints. An objective of the pre-feasibility work is to define and agree between the MDBA and each of the Basin governments the respective roles and responsibilities to progress priority operational and management constraints. Consultation with entitlement holders and industry will also be a core component of the work program consistent with the Strategy's overarching principles.

The phase 1 outcomes will include the results of the work in key focus areas, the progress with prioritising the operational and management constraints and the Basin-scale analysis and prioritisation. The outcomes will be captured in the first Constraints Management Strategy Annual Report, which will be presented to Basin Ministers in November 2014 and then be publicly available. This report represents the end of the pre-feasibility phase of constraints assessment, and will provide recommendations to governments about potential investment options. A more detailed description of the work to be undertaken in phase 1 is provided in sections 8 and 10.

Throughout the 10 year life of the Strategy, the MDBA will be working collaboratively with Basin governments. States may wish to work together with the MDBA in the pre-feasibility work in key focus areas or to start development of the full feasibility assessment or 'business cases' for key constraints. This may occur where we have a better understanding of particular constraints including their relative contribution to Basin-wide outcomes.

Phase 2: Feasibility assessment – business case development and Basin-scale prioritisation 2015 to mid-2016

Based on decisions by Basin Ministers regarding investment priorities identified through phase 1, development and feasibility assessment of projects would be led by the relevant government agencies in consultation with MDBA. This will require ongoing engagement with the local community, entitlement holders and industry, more thorough development of options and mitigation costings, and detailed design and costs in the case of infrastructure projects.

It is expected that most of the feasibility assessment would be carried out through 2015, although some of this work may start earlier and parts of the information needed may already be available as described above. It would also be desirable to progress work, where appropriate, to align with the SDL adjustment mechanism, which includes an expected business case completion date of June 2015.

This is the phase which would get down to a property-by-property assessment with regard to landholder impacts and mitigation options. If there are complex mitigation activities to be put in place, then the planning to be 'implementation ready' may extend past 2015. If this is the case, it will still be important to have firmed up the costs and outcomes to allow governments to consider the constraints in the 2016 SDL adjustment exercise. The SDL adjustment timetable anticipates the feasibility of projects to start testing in 2014, but for many constraints there is insufficient information to do this. At the end of this phase, it will also be necessary for the MDBA to complete a second pass analysis of the Basin-scale environmental outcomes and trade-offs in light of the more detailed information on projects. This assessment of Basin-scale outcomes and trade-offs will give governments a perspective on how important the constraints are to achieving system-level outcomes, and will inform decisions regarding the final suite of constraints measures to be implemented. This work will inform the confirmation of the package of work to be agreed by Basin governments as adjustment measures by December 2015.

Phase 3: Planning and implementation 2016 to 2024

It is expected that the majority of investment in constraints measures will commence following the completion of the feasibility assessment and operation of the SDL adjustment in mid-2016. However, there may be particular actions that are either:

- identified through the completion of the key focus area work, and the case for immediate investment is compelling, or
- may be developed enough to assess investment, but require a little more work to be 'implementation-ready'.

Key steps in phase 1

8. Key steps in phase 1

It is important to assess the project costs and the benefits of addressing constraints to inform government decisions. The objective of the key focus area analysis of physical constraints and operational and management analysis is to undertake the first assessment of the potential local scale impacts, likely benefits, mitigation options and costs.

Critically this work will involve understanding impacts and developing options in close consultation with the local community or broader water community, as relevant to the constraint.

There are several steps required in this analysis:

1. Understanding the changes arising from the different flow events such as: area inundated, when, how often and for how long?
2. Assessing impacts and identifying benefits.
3. Identifying options to mitigate negative impacts, including preliminary assessment of project costs and any benefits of mitigation options.
4. Undertaking a Basin-scale analysis and prioritisation.

Importantly, many of the steps need to be scoped in determining pre-feasibility, but will need to be done in greater detail at the feasibility stage; so the work in phases 1 and 2 will overlap to a certain extent.

1. Understanding changes from different flow levels

The main constraint in the key focus areas is the limit on channel capacity and regulated flow delivery, which restricts the amount of water that can travel down the river and into adjacent wetlands at any one time.

In the key focus areas, a range of different flow levels will be explored, along with different timing and duration of flows. The river heights being explored are generally below minor flood level, but are likely to increase the inundation of low-lying paddocks and floodways.

The first step is to identify what may be inundated, when, how often and for how long under any proposed changes. This information is critical to any analysis of the social and economic impacts. This requires local level understanding of the different uses for particular land areas. Flood inundation mapping is currently under development in some areas. As this work becomes available, it will form a basis for the next steps.

If the proposed change is to an operational or management practice, or introduces a new procedure, then this would normally be explored through hydrologic modelling of long-term flow patterns and water use.

2. Assess impacts

The impacts of increasing peak regulated flow heights on individuals and local resources need to be identified. Potential negative impacts include reduced use and/or access to part of the property with consequent effects on agricultural production due to increased inundation. Also, public and private infrastructure (including roads and causeways) could be subject to more frequent inundation. The impacts may vary depending on the timing and frequency of flows. Potential positive impacts include improved native pasture productivity and possibly increased tourism, fishing and recreational fishing activities.

It is important in assessing impacts to distinguish between what occurs naturally and any additional problems caused through deliberate environmental flows. For example, some areas are currently inundated regularly under natural flows, which may result in some level of the impacts described above. Therefore, in undertaking this step of the key focus area analysis it will be important to distinguish between impacts currently felt and the additional impacts that arise from changing flow patterns.

Water managers are cautious in their approach. Taking the opportunity to deliver environmental water in conjunction with over-flow events does not mean inevitable flooding. Water managers use local knowledge and their understanding of system behaviour and weather forecasting to manage risks around environmental water delivery in real time to avoid third party impacts.

If the proposed changes are to river management practices, then the changes need to be assessed to see if they could have any impacts on reliability. This would normally be done by modelling any changes to see what the effects are; and it will be important that any modelling is shared and understood. It is commonly acknowledged that water entitlements are already subject to a variety of risks — such as climate variability, impacts of increases in utilisation of existing entitlements and impacts from changes to the way water is used (eg. timing, ordering patterns). These risks are inherent in the entitlement. However, governments have agreed that changes to practices should not place any new risks on entitlement reliability that are not already present in the existing entitlement frameworks.

3. Options to mitigate negative impacts and preliminary assessment of costs

For changes to peak flows, the impacts identified above may be avoided or removed by undertaking certain mitigation activities.

Examples of these mitigation activities could include (but are not limited to):

- flow advice so landholders know in advance of a flow
- building or improving levees to protect land from inundation
- building new bridges or raising existing bridges to allow continued access during higher flow peaks.

Other options include acquiring an interest in land through covenants or easements to compensate landholders for the impacts.

While these options may address the impacts or compensate landholders, they themselves come with a cost. Therefore it will be important to undertake preliminary costings of the relevant options for each constraint.

These options may provide additional benefits to the community during times of existing high flows. For example, building or improving existing bridges or roads will not only reduce access issues caused by changing flows, it may also result in additional benefits to the community, who can use the improved infrastructure throughout the year, including at times of natural high flows.

Finding the most appropriate mechanisms to address a constraint will depend on a range of factors including: the suitability to achieve its intended purpose; acceptability to the parties; and the cost and durability (i.e. long-term applicability, maintenance costs, resilience to change).

A combination of mitigation options may be appropriate in some cases. For example, a landholder may be able to better mitigate the effects of an overbank flow if forewarned *and* erosion management activities had been undertaken on their property.

In some instances, landholders could gain additional benefit from mitigation strategies that also provide protection under natural flood conditions. This consideration is relevant to future discussions with stakeholders about mitigating the effects of environmental flows that inundate the floodplain.

Mitigation strategies will vary across key constraints depending on matters such as land-use and the geographic profile of the floodplain. General information about the mitigation options, consistent with the overarching principles of the Strategy, is presented below.

Notification of flows—mid-term and short-term

Forewarning about the timing and duration of regulated environmental releases could allow some floodplain landholders to manage business decisions to reduce any impact. During the development of the Strategy, landholders indicated that knowing intended environmental flows in advance would minimise the risk profile of their businesses associated with relaxing constraints. Basin-wide or annual environmental watering plans could provide guidance towards the likelihood of floodplain inundation over the water year and allow landholders to appropriately plan crop and grazing regimes.

Short-term flow warnings may be able to provide some level of protection in some cases. For example, floodplain graziers may be able to relocate livestock if provided with 3–4 days notice. Irrigators with low-lying pumps may benefit from forewarning so that vulnerable equipment could be moved to avoid inundation.

Some environmental flows could also be planned for a particular window that avoids the cropping season or limits access issues at peak planting or harvesting times.

Infrastructure improvements

Improving or constructing new infrastructure such as bridges and roads could mitigate the impacts of overbank flows in some regions. Considerable work is required to understand the effects of particular flow rates and the opportunities and effects of infrastructure. Co-contribution from landholders and or governments may be appropriate, whereby the improved infrastructure provides additional benefits under a broader range of conditions (i.e. natural flow events). Maintenance assistance for current infrastructure could also mitigate the impacts of an increase in overbank flow frequency.

If on-farm and large-scale irrigation networks in low-lying areas are affected by changed flows, MDBA will need to work with irrigation companies and individual landholders to understand impacts and develop suitable mitigation strategies.

Easements or similar interests in land:

Negotiating with landholders to obtain an easement to deliver flows that inundate private property is a compensation approach that has significant merit. It could allow relevant governments to be recognised on the title of floodplain properties in exchange for a payment to landholders. Acquiring an interest in land would provide long-term security to landholders and governments and their agencies

Designed correctly, payment for an interest in land would compensate the landholder for any reduction in the total property value resulting from the change to the title.

There are various ways in which governments could obtain an interest in property, including:

Easements:

A properly negotiated easement acquisition process could be a good way to establish an agreement to inundate private land, as it has the advantage of surviving a transfer of property ownership and allows the landholder continuing full use of his/her land for the remaining time.

Easements require an accurate definition of affected land on each property. This would require the acquisition of verified image data to confirm the footprint of target flows in key constraint areas. Acquiring easements on a case-by-case basis throughout key constraint areas is a significant body of work.

Covenants:

Land covenants are agreements with landholders that concern the use of the land. Generally, they are less complicated to acquire than easements, as a precise definition of affected land is not required. Additionally, covenants can be more flexible owing to the fact that they can specify periodic review and positive obligations on landowners to undertake activities such as weed management. Covenants can be recognised on the title of floodplain properties, but do not necessarily survive a transfer in ownership, which reduces their long-term security.

4. Basin-scale analysis and prioritisation

The purpose of this step is to draw together all the information gathered under the key focus area analysis, including information on environmental benefits, to examine the trade-offs and interdependences across constraints. This step will allow consideration of how the benefits, costs and risks associated with addressing one constraint are influenced by the removal or otherwise of other constraints.

While this step may primarily focus on constraints for investment, it may also be appropriate to identify particular river management practices that need addressing to achieve the desired outcomes. This information will then be used to develop recommendations to governments on which constraints (or packages of constraints) should be further assessed under phase two.

Consideration of the benefits, project costs and risks will importantly include a strong consideration of how the system functions, and how each activity can contribute to the driving objectives of the Strategy — which are improving environmental outcomes of the Basin Plan — while also identifying mechanisms by which impacts on third parties can be addressed.

There are several factors that will be considered in undertaking this analysis. These are described below.

Benefits from addressing constraints

This includes the environmental benefits associated with addressing constraints. These are likely to be described in physical terms or a proxy (e.g. flow targets) rather than dollar values. Where possible, it will include other benefits such as increased tourism, fishing and recreational fishing activities, and improved native pasture growth. Other benefits could accrue from mitigation activities which may help the community during times of existing natural inundation (e.g. bridges that can be used throughout the year). Benefits of addressing constraints will be considered at multiple levels from local to Basin-scale. It is expected that the highest priority constraints for investment will be those which have local, regional and Basin-scale benefits.

Interdependence of constraints

The environmental benefits achieved from relaxing a constraint and the associated third party impacts may change depending on whether or not other constraints are relaxed. For example, there may be little environmental benefit achieved from relaxing a constraint downstream unless a constraint upstream is addressed. Therefore it is likely that constraint investment priorities will fall out into two groups: a set of essential activities which could almost be considered as precursors to pursuing some other opportunities; versus other activities which could be pursued in isolation, or as alternatives to each other. The essential activities or precursors will tend to be activities which are so intrinsic to delivering the environmental outcome that the outcome will not be achieved without that activity.

Costs of addressing constraints

This involves preliminary estimation of costs associated with addressing constraints. It also includes costing any mitigation and/or compensation activities to ensure that third party impacts have been addressed appropriately. Examples of things that need to be costed include bridges, low level crossings, levees or other works or structures and potential purchase of easements.

It will be important that costing methodologies are consistent across locations where possible to ensure that comparisons and Basin-scale assessment is meaningful.

The costings that will be undertaken in phase 1 will be indicative only. The purpose of the costing in phase 1 is to provide insights into the scale of costs to guide which projects should have more detailed costings undertaken in phase 2.

Trade-offs between constraints

There may be alternative constraints that, if addressed, will achieve similar environmental outcomes. In this case it will be important to consider the costs of these alternatives, and their potential to mitigate impacts, in order to recommend constraints for further assessment under phase two.

Funding available to address constraints

Identification of projects that should proceed to phase 2 feasibility analysis should also take into account the potential funding available to address constraints.

The Commonwealth Government has allocated $200 million to address physical, institutional and operational constraints.

Basin states individually may pursue addressing constraints for other reasons and for other projects. For instance the Menindee Water Savings Project, may address the Lower Darling constraints.

Key focus areas: pre-feasibility findings to date and priority actions for 2014

9. Key focus areas: pre-feasibility findings to date and priority actions for 2014

The following section presents a summary of the results of work in key focus areas to date. This work will be ongoing through 2014.

MDBA recognises the value of local information and feedback provided throughout the public consultation period and its relevance for progressing priority actions in 2014 for each of the key focus areas. MDBA will establish or continue project officers for each of the key focus areas. Project officers will contact people who provided local feedback to further discuss issues raised and to make sure that they are appropriately considered in MDBA's work plan for 2014.

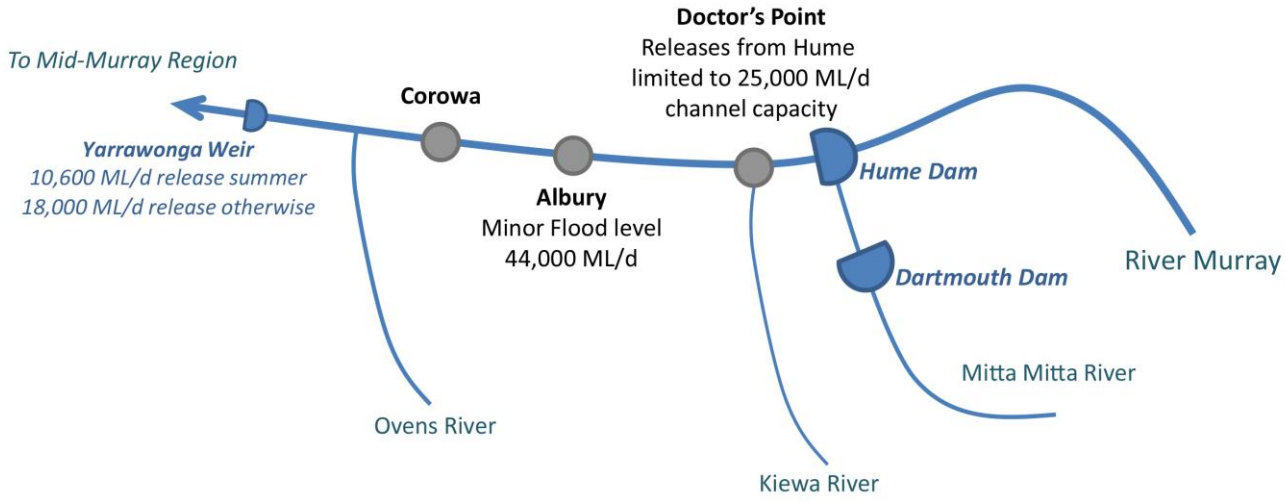

Figure 10 Schematic drawing of the section between Hume Dam and Yarrawonga Weir

Hume Dam to Yarrawonga Weir

Located about 16km east of the regional centre of Albury–Wodonga, the Hume Dam is the largest regulated storage on the River Murray. The reach of the River Murray between Hume Dam and Yarrawonga Weir is characterised by a complex network of anabranches in addition to the mainstem; and contains over 700 wetlands.

Regulated flows from Hume Dam are currently limited so that the River Murray's flow rate does not generally exceed 25,000 ML/day at Doctor's Point (situated downstream of the Kiewa River confluence) to limit impacts on riparian properties downstream from the dam.

MDBA modelling has demonstrated that increasing the flow duration and frequency of flows up to 40,000ML/day would, in varying degrees, benefit the local wetlands and environmental assets such as the Barmah–Millewa Forest, Werai Forest, Gunbower–Koondrook–Perricoota forests, Hattah Lakes, the Riverland–Chowilla Floodplain and

the Coorong, Lower Lakes and Murray Mouth. Changes to flows in the Hume to Yarrawonga reach would need to be considered alongside addressing constraints further downstream to achieve outcomes at these sites.

Consultation

Through the development of the Strategy, the MDBA continued consultation with the Murray River Action Group (MRAG), exploring the impacts of increasing the regulated flows at Doctor's Point for relatively short periods and possible mitigation strategies.

MDBA will be continuing to work with community representatives, local government and other relevant agencies to investigate the impacts of increasing the flow rate and to identify mitigation options. The MRAG would like to participate in the development of a fair and equitable compensation procedure to account for potential changes in farm production and land value if changes proceed.

Previous work in the reach (prepared in 2011) identified potential third party impacts including to agricultural production, infrastructure and access, as well as changes to farm management practices. Consultation during the public comment period captured a broad range of overbank flow issues likely to be experienced in the Hume to Yarrawonga reach.

Specific feedback on impacts or other issues that will be considered in future work on implementing the CMS include:

- the need for specific modelling on the extent, frequency, timing and duration of proposed flows
- the need to better understand potential impacts on council infrastructure and associated funding arrangements to address these impacts
- business and economic impacts arising from reduced tourism, leisure and commercial activities that may result from limiting river access
- reduced access to private properties or isolation of sections of farm land
- how emergency response capability, communication and water safety will be assessed
- process for timely, transparent and complete compensation for damage
- how groups will financially represent themselves and whether there will be compensation for this
- how to determine the potential costs and benefits to the Barmah–Millewa Forest and Koondrook–Perricoota forests, particularly in relation to reducing low flows and increasing medium to large flows.

Priority actions for 2014

Further work is required to understand the range of third party impacts as a result of potential changes in the frequency, timing, duration and predictability of proposed environmental flows.

This work includes:

Field validation of proposed flows

- Develop capacity to conduct opportunistic field monitoring of events which occur at the range of flows proposed:
    - examine the use of ortho-rectified aerial photography
    - examine the potential for a landholder-based field monitoring strategy
- Undertake a survey to measure the impact of flows at an individual property level, including the impact on access routes.

Community input

- Investigate opportunities for stakeholders, including MRAG, to be equitably represented in future negotiations with governments, in a way that minimises the burden on them.
- Form a steering committee through the existing Advisory Group for Hume to Yarrawonga Waterway Management representing concerned parties who would provide recommendations about the most appropriate way to assess and mitigate impacts.

Costing mitigation strategies

- Commence a feasibility study into access works and erosion mitigation.

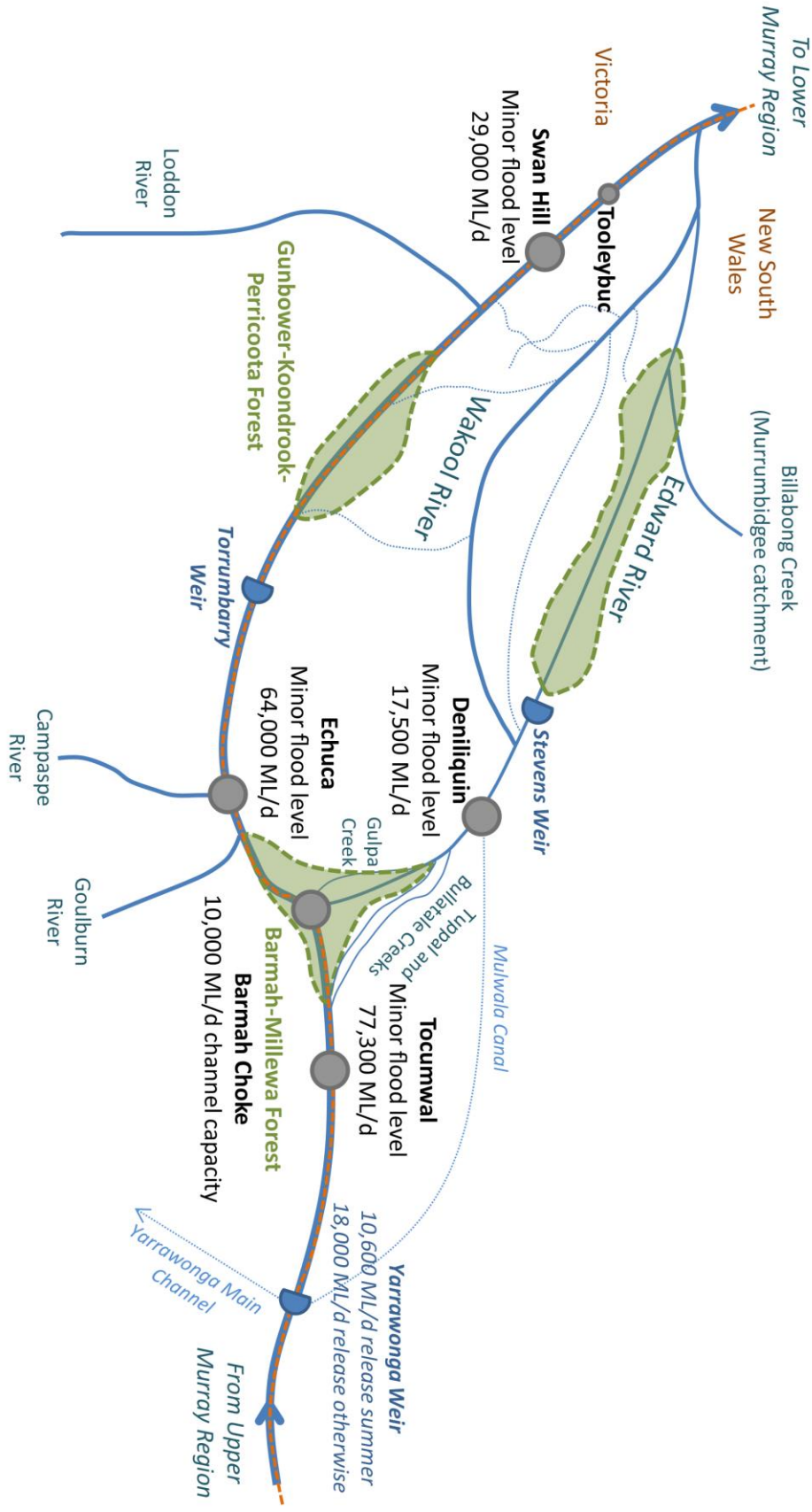

Figure 11 Schematic drawing of the section between Yarrawonga and Wakool Junction

Yarrawonga to Wakool Junction

The Yarrawonga to Wakool Junction reach includes the mid-Murray downstream of Yarrawonga to the Wakool Junction including the Edward–Wakool anabranch system. This key focus area also includes the associated network of rivers and creeks including, but not limited to: Tuppal, Bullatale, Native Dog, Gulpa, Colligen, Yallakool and Merran creeks and the Niemur River. This system is characterised by the complex interactions of a number of alluvial floodplains which are interconnected via low-lying creeks and flood runners.

The long-term regulated flow downstream of Yarrawonga for the delivery of normal entitlements during late spring and summer is about 10,000 ML/day. Historically, flows of up to 24,000 ML/day have been targeted downstream of Yarrawonga to deliver environmental water. Flows of 18,000 ML/day at Yarrawonga provide some environmental benefits downstream; however, this flow rate is not enough to effectively water many wetlands and water-dependent ecosystems. Higher flow rates may result in third party impacts for some floodplain landholders and the MDBA will need to continue working with the community to understand these impacts and possible mitigation actions.

Consultation

The MDBA commenced consultation by working with state agencies to identify key local leaders and relevant land managers. Many of the local leaders and land managers represented various community water management or natural resource management interests, as well as state government agencies. This initial work helped to design a broader approach which targeted potentially affected landholders at the local scale. In all, MDBA met with over 150 landholders from across the broad geographic area. The MDBA also met with the five local councils of the region, the Murray CMA, Murray Irrigation Limited, NSW Office of Environment and Heritage and State Water Corporation.

Consultation during the public comment period captured a broad range of overbank flow issues likely to be experienced in the reach.

Specific feedback on impacts or other issues that will be considered in future work on implementing the Strategy includes:

- reduced access to land preventing livestock management, harvesting and other associated land management activities
- impacts on low-lying causeways and roads (particularly dirt) preventing the movement of heavy vehicles (including grain and livestock transportation)
- impacts on the extensive network of timber bridges in the Wakool Shire
- damage to fencing and the need to raise pumps
- examining flows of up to 80,000 ML/day through Tocumwal
- 'remote effects' such as isolation of properties which do not directly front rivers
- unknown effects of flows on the existing private and public levee infrastructure network
- potential environmental risks including river red gum infestation and carp breeding etc.
- environmental flows should be trialled incrementally to see what effects flows have on the ground
- increased impacts to recreational infrastructure: foreshore parks, boating facilities, low-lying campgrounds and associated access tracks
- additional higher flows may affect saline groundwater systems in the Wakool/Yallakool
- risk of uncontrolled flood events and knowledge of the interactions of flood-runners and creeks with regard to overland flows
- recognition that a 'wet' catchment will result in considerably different flow patterns to a 'dry' catchment
- competing demand for channel share.

Priority actions for 2014

Further work is required to understand the range of third party impacts as a result of changes in the frequency, timing, duration and predictability of proposed environmental flows. This work includes:

- modelling of flows and associated inundation mapping of proposed flows
- desk top assessment, field validation and liaison with potentially affected landholders and local government agencies to identify third party impacts at a range of flow rates
- identification and description of potential mitigation strategies
- investigating opportunities for stakeholders to be equitably represented in future negotiations with governments in a way that minimises the burden on them.

The Barmah Choke

The Barmah Choke is a relatively narrow stretch of the River Murray that starts downstream of Cobram and ends upstream of Echuca, running through the Barmah–Millewa Forest. The choke was formed around 25,000 years ago by a geological fault known as the Cadell Tilt; an uplift in the earth's surface that created a fork in the river, resulting in the Edward River to the north, and a narrow section of the River Murray to the south. The channel capacity of the Barmah Choke is about 8,500 megalitres per day (measured downstream of the Gulpa Creek junction near Picnic Point), which is the lowest capacity of any stretch of the River Murray.

Figure 12 The Barmah Choke

The channel capacity of the Barmah Choke presents a challenge to the delivery of irrigation entitlements, at times when it is not desirable to flood the forest (historically from 15th December through to 30th April).

During those periods of the year, when flooding the forest results in negative environmental outcomes and high water losses, water allocations can be affected. At these times, the forest regulators are kept closed and the MDBA aims to keep the flow downstream of Yarrawonga Weir to below about 10,600 ML/day. Of this, about 2,000 ML/day flows into the Edward River and Gulpa Creek, and the remainder passes along the Murray via 'the choke'.

However, there are times when it is desirable to water the forest and this often aligns with the winter–spring delivery of environmental water further downstream. At these times, the forest regulators are opened to allow water to flow through the forest. This allows larger volumes of water to be released downstream of Yarrawonga Weir and the choke is no longer limiting the delivery of water downstream. However, at these times other constraints come into play, such as higher flows down other nearby creeks which can affect access on some properties in areas near the forest and further downstream in the Edward–Wakool System.

There are no plans to modify or enlarge the Barmah Choke. This would have severe negative impacts on the forest as it would also interfere with the natural flooding of the forest and its surrounding environment. As such, it is not consistent with the aims of the Constraints Management Strategy which is about improving environmental outcomes in the Basin.

The Constraints Management Strategy will look at the landholder access issues within the nearby creeks, which flow out of the Millewa Forest and further downstream into the Edward–Wakool System — which ultimately receives additional water when larger flows are being passed downstream of Yarrawonga Weir through the forest. The unique characteristics of this part of the system on the patterns of flow in the Murray and Edward–Wakool systems are also considered in all environmental water planning and delivery.

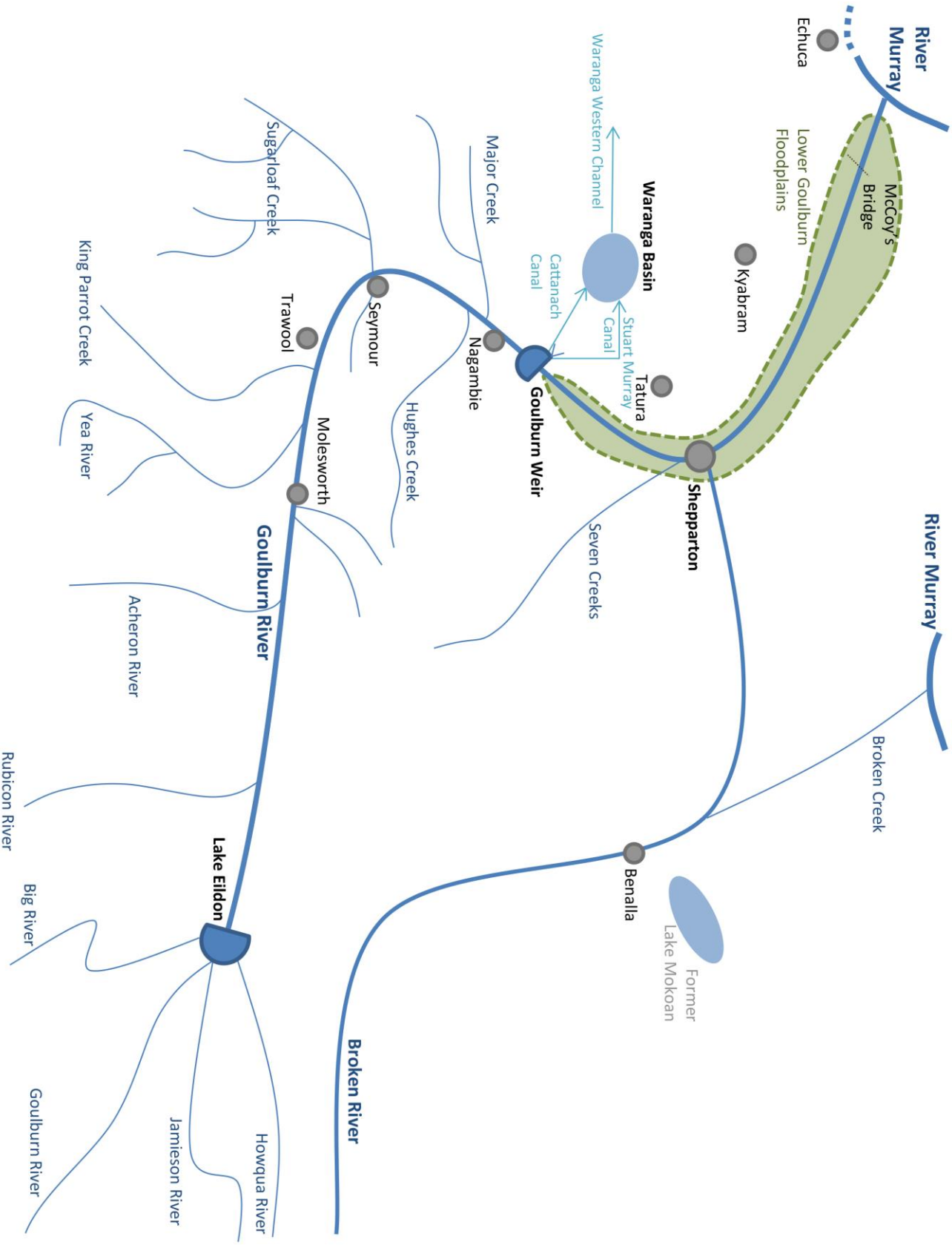

Figure 13 Schematic drawing of the section between McCoy's Bridge and Lake Eildon (Goulburn)

Goulburn

In central Victoria, the Goulburn River and its associated floodplain and wetland habitats support intact river red gum forest; and numerous threatened fish, mammal and bird species. The Lower Goulburn floodplain covers some 13,000 ha alongside the river channel from Goulburn Weir to the River Murray junction and contains many important cultural heritage sites.

Potential constraints to environmental flow delivery in the Goulburn valley consist mainly of third party inundation impacts below Lake Eildon and around Shepparton; and timing issues to be able to supplement unregulated tributary inflows with storage releases.

To achieve higher managed flows downstream of Goulburn Weir, unregulated tributary flows downstream of Lake Eildon would need to be supplemented with either Lake Eildon releases and/or adjustments to Waranga Basin harvesting operations. Importantly, large releases relying solely on Lake Eildon are unlikely to be feasible. The reach between Lake Eildon and Goulburn Weir has a much lower channel capacity, and landholders and businesses near Alexandra and Molesworth start to get affected when any flows get above 10,000 ML/day. The role of unregulated tributaries is critical for the future of higher managed flows in the lower Goulburn system.

Consultation

Consultation with landholders and communities in the Goulburn valley has commenced. Three regional advisory groups have been formed to assist MDBA with capturing the key issues and impacts likely to arise from increased flows. MDBA's regional consultation and analysis of the available technical work indicates that more frequent overbank environmental flows downstream of Goulburn Weir are feasible.

In addition to information gathered through the regional advisory groups, consultation during the public comment period captured a broad range of overbank flow issues likely to be experienced along the Goulburn River. Several people commented that the MDBA consultation process in the Goulburn region has been good and is beginning to capture local knowledge well. The priority actions listed for the Goulburn River were strongly supported. It was also recognised by a number of people that environmental flows will add to the biodiversity and value of the natural environment and may have positive economic outcomes, while having the additional potential to add to the amenity and quality of life for residents and visitors.

People also provided specific feedback on impacts or other issues that will be considered in future work on implementing the Strategy, including:

- they don't want to see the Goulburn environment (e.g. bank erosion) or communities impacted solely to provide larger flows further downstream
- 40,000 ML/day at McCoys Bridge may be too risky as if a local rainfall event occurs as well, it could become a damaging flood (there may be a risk of unintended adverse consequences)
- 40,000 ML/day at McCoys Bridge is too close to triggering the statutory release formula for the Loch Garry flood protection scheme
- increases in water levels don't have to be large to start affecting landholders in the mid-Goulburn, downstream of Lake Eildon. It should be acknowledged that Goulburn-Murray Water specifically constrains releases from Lake Eildon because of the risks of inundating private land in this reach
- higher flows create access issues including road closures, these would occur in the Lower Goulburn floodplain at the range of flows being considered (25,000–40,000 ML/day)
- the load on storm water drainage infrastructure during high river flows is a significant concern
- risks to irrigation pumps
- assessing the adequacy of the rainfall and river height gauging network to be able to trigger and manage environmental releases at a time of high river flows
- how levee bank ownership and management will be considered
- the backing up effects of high flows on tributaries means that it’s not just mainstem landholders that could be affected; there is the potential for new ‘breakaways’ to form if tributaries cannot freely drain.

Also raised, was that people:

- want to see scenarios of what these high flows could look like (the sorts of river heights and rainfall conditions) and how they would be managed (i.e. not just a flow target)
- need a better understanding of the role and unpredictability of tributaries in order to piggy-back environmental water on top of flow pulses.

Priority actions for 2014

MDBA consultation has captured a broad range of overbank flow issues likely to be experienced in the Goulburn River. The next step requires better

understanding of the issues and their scale of impact; and the identification and cost of potential mitigation options including:

- continued commitment to active community involvement
- improved understanding of the opportunities to supplement tributary flows
- enabling environmental watering coordination between catchments
- enhanced ability to forecast tributary inflows
- improving the accuracy and confidence in flow inundation maps
- identifying mitigation options for private and public assets
- ensuring levee banks are to a standard strong enough to contain environmental flows
- quantifying the broad range of impacts of delivering higher flows including issues and mitigation options
- exploring opportunities to make policy changes to river operations
- scoping out a regional flood warning and notification system.

Figure 14 Goulburn River at Yambuna

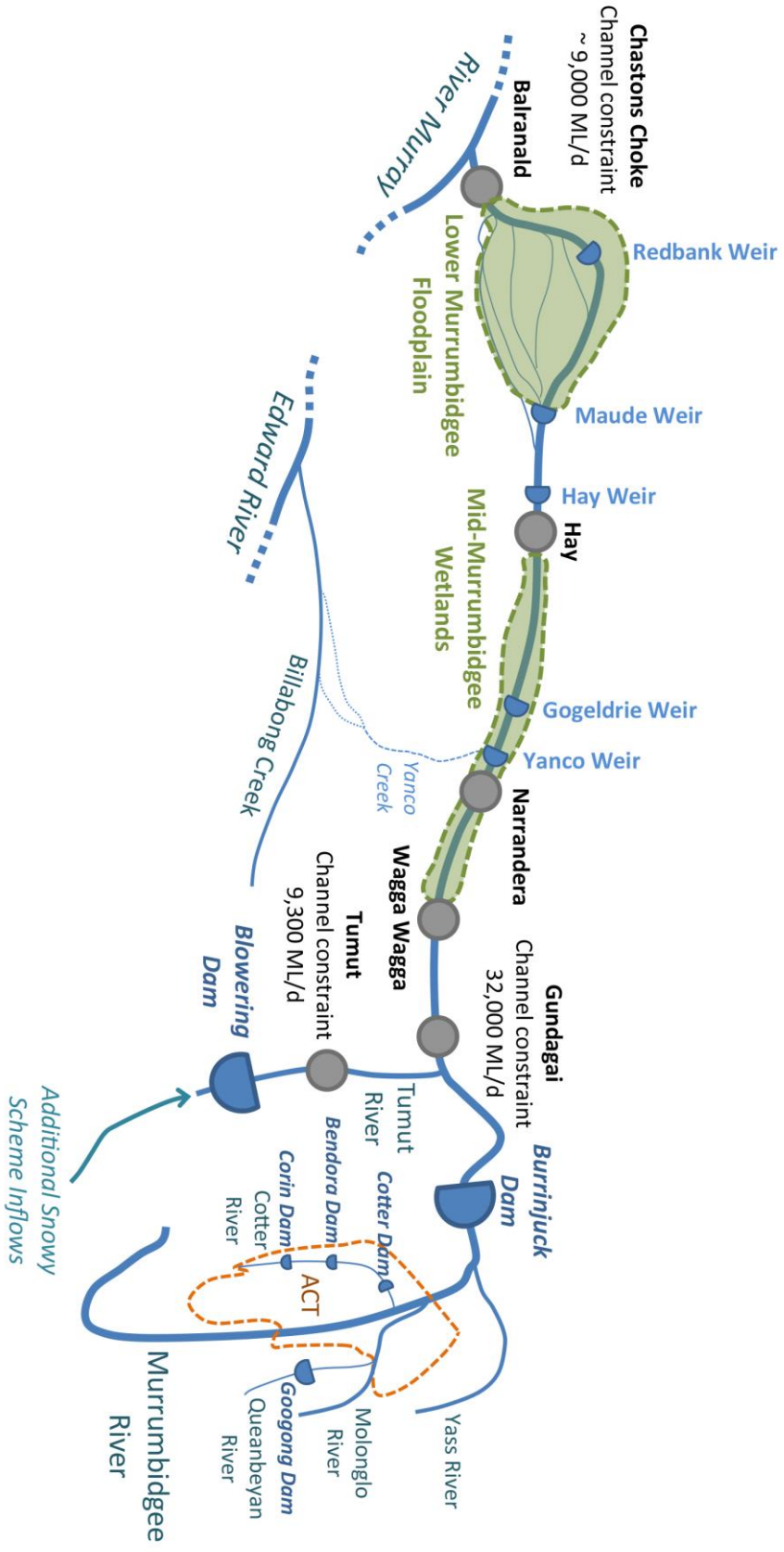

Figure 15 Schematic drawing of the Murrumbidgee

Murrumbidgee

The Murrumbidgee supports a rich assemblage of river channel and floodplain habitats, including the Mid-Murrumbidgee Wetlands and Lowbidgee Wetlands. The Murrumbidgee is also an important tributary of the River Murray.

Potential constraints to environmental water delivery in the Murrumbidgee include: the low level Mundarlo Bridge; the channel capacity of the Tumut River; the channel capacity of the Murrumbidgee River near Balranald; and possible third party inundation and impeded access impacts, particularly around the upper Yanco Creek, Collingullie and Darlington Point. Additionally, high flows may cover sections of low-lying local roads or require the closing of stormwater gates in areas such as Wagga Wagga.

Consultation

Consultation has begun with stakeholders in the Murrumbidgee. Those involved include riparian landholders, irrigators, local councils and agencies involved in river management and operations. Consultation has focused on communicating the scope of the work and gaining feedback on potential impacts (positive and negative) of potential environmental flows.

Key issues raised by stakeholders during the public comment period included the importance of:

- ongoing discussions with local people to understand the potential impacts of addressing constraints and developing appropriate options to mitigate any impacts
- further work to refine potential flow regimes; as impacts are driven not only by the height of additional flows, but also by the duration, frequency and timing of flows
- providing accurate, timely and easily-accessible information about river flows, particularly when media reports may contain inaccuracies which can have significant impacts on tourism
- recognising the needs of all water users including irrigators, towns, communities, recreational users and the environment
- effective management of environmental watering events; including understanding the impact when environmental flows are followed by natural events
- considering if dam imbalance (as a result of large ‘piggy-back flows’) could reduce reliability of supply

- considering a wide range of mitigation options not just flood easements; including enhancing flood mitigation works, en route storages, constructed floodways and formed waterways to channel flows and land topography projects
- understanding local riverine impacts of higher flows such as erosion, bank slumping and tree fall
- considering infrastructure, agricultural production, risk of localised flooding with stormwater gate closures and social and economic impacts that may be associated with higher flows.

Priority actions for 2014

Further work is required to understand the range of third party impacts and includes:

- working with environmental water managers and ecologists to better define and refine the optimal flow height, frequency, duration and seasonality of environmental deliveries
- verifying modelling and mapping of inundation areas already undertaken for the Murrumbidgee mainstem
- development of modelling and mapping of potentially affected watercourses not previously undertaken; particularly for Old Man/Beavers Creek and the Upper Yanco Creek system
- working with landholders to validate the above mapping and identify the types and scale of any potential impacts
- identifying and undertaking a preliminary assessment (through literature review and community input) of potential mitigation measures, including a regulator at the Yanco Creek offtake.

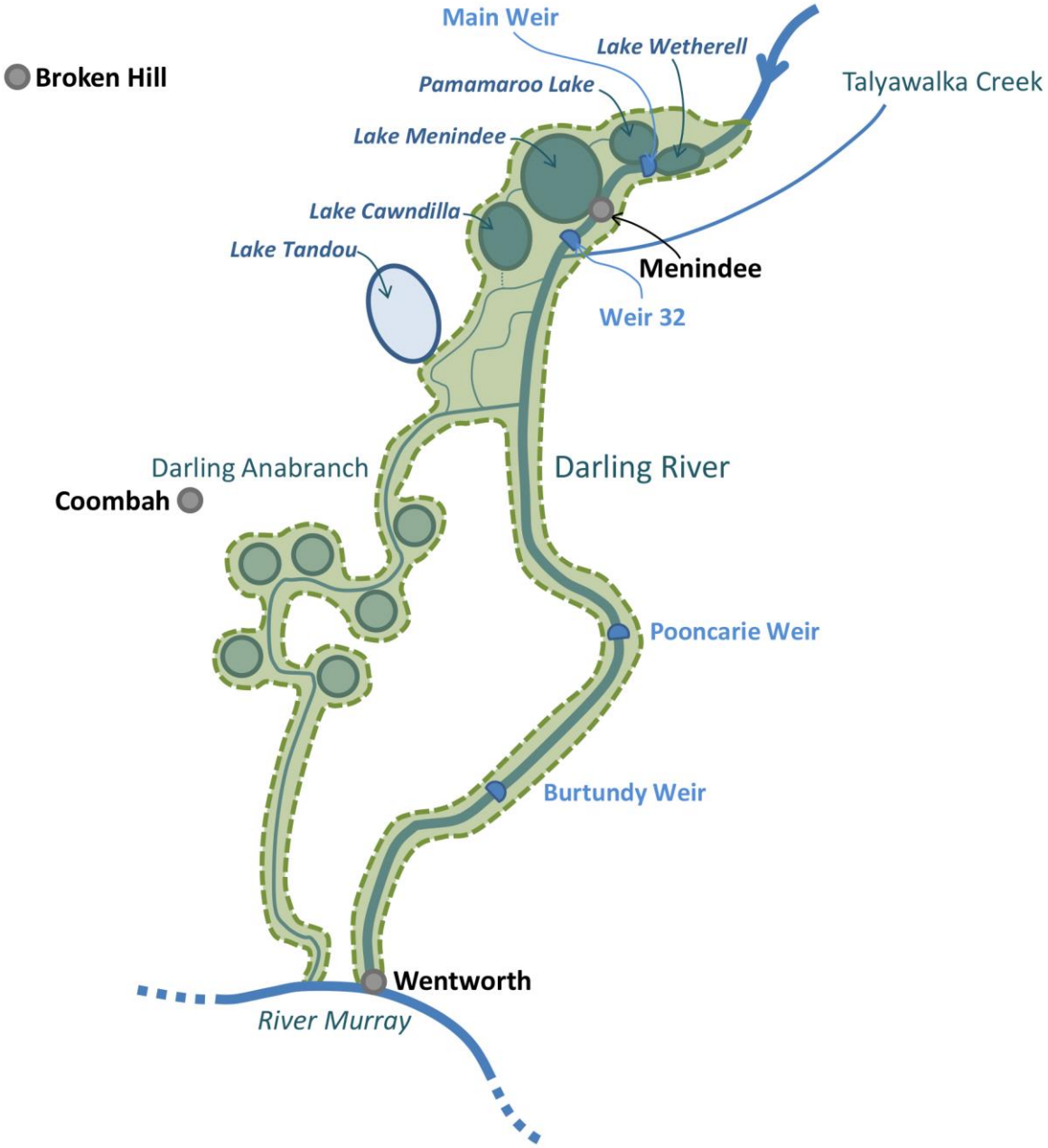

Figure 16 Schematic drawing of the Lower Darling between Menindee and Wentworth

Lower Darling

The Lower Darling River System is located in south-western New South Wales at the lower end of the Darling River, upstream of its junction with the River Murray at Wentworth. All catchments in the northern Murray–Darling Basin drain into the Barwon–Darling River, which is separated from the Lower Darling by Menindee Lakes. The region contains a number of important environmental

assets including Menindee Lakes, the Darling River, Great Darling Anabranch and a number of billabongs, wetlands and floodplains.

The MDBA has identified the main constraints to delivering higher environmental flows as the channel capacity downstream of Weir 32 and the operational strategy and storage release capacity of the Menindee Lakes system.

Consultation

Detailed consultation on constraints in this area has not occurred with landholders and the community to date, because work on some of the issues identified as constraints in the Lower Darling is already being undertaken through the Menindee Lakes Water Savings Project. MDBA did meet with around 20 members of the Lower Darling community — this meeting focused more broadly on the draft Constraints Management Strategy rather than local issues associated with potential higher flows. Given that consultation has been delayed in the Lower Darling there was limited additional local feedback provided during the public comment period.

The feedback received included:

- current status of the Menindee Water Savings Project and the interdependencies with the Constraints Management Strategy
- importance of working with communities, particularly local irrigators, to:
    - build the understanding of how the Lower Darling and the Darling Anabranch function and the potential impacts of changes in flow regimes
    - identify potential options to mitigate impacts of higher flows such as floating pumps
- the need to ground-truth with the community, and to validate the models and assumptions that are used to identify the impacts of constraints
- importance of explaining that the Constraints Management Strategy is about local outcomes as well as allowing more water to be delivered downstream
- impacts of higher flows such as bank erosion, trees falling into the river and the anabranch.

Priority actions for 2014

During 2014 the Commonwealth and NSW governments will continue (in consultation with the Victorian and South Australian governments) to progress the range of issues that underpin the development of the Menindee Lakes Water Savings Project, including issues that impact on the Lower Darling key focus area. This will include the identification of issues relevant to the Constraints Management Strategy not covered in the Menindee Lakes Water Savings Project; and the scoping of those issues.

These activities are to include:

- further development of inundation mapping for a range of flow scenarios
- continued liaison with the Lower Darling community: to increase the understanding of flow pathways under the mapped flow scenarios and identify potential third party impacts and benefits that would result from higher flows
- identify and describe potential mitigation strategies to address third party impacts that may result from higher flows.

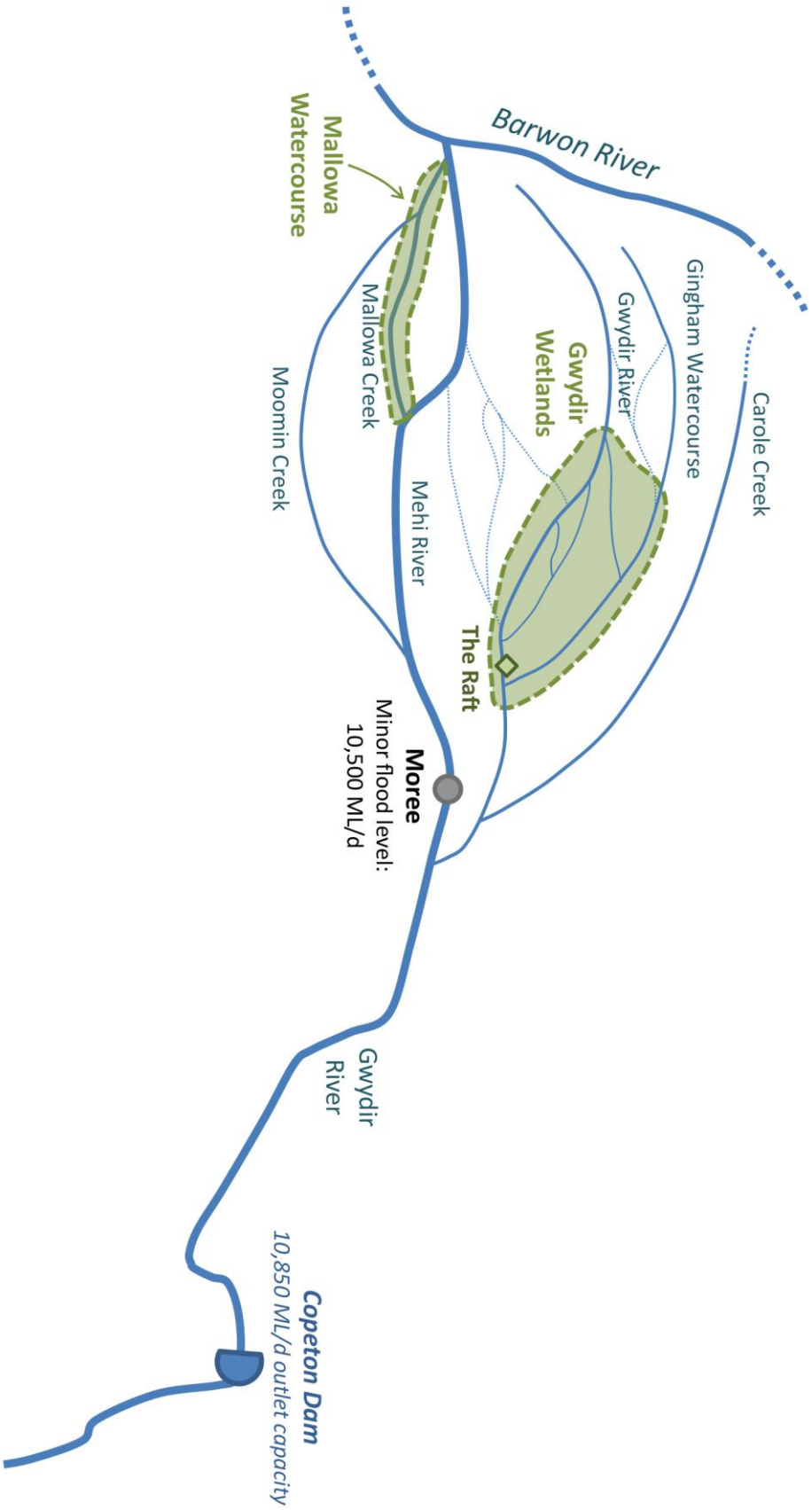

Figure 17 Schematic drawing of the Gwydir

Gwydir

The Gwydir Wetlands (Gingham and Lower Gwydir) and Mallowa Wetlands, in Northern NSW, are some of the most important semi-permanent wetlands in the Murray–Darling Basin. They provide significant habitat and breeding sites for many threatened colonial waterbirds, wetland plants and native fish. Changes in land use, an increase in river regulation and extended drought conditions have significantly altered the flow regime and reduced the area of the wetlands within the Gwydir system. Given the reduction in the extent of the Gwydir wetlands, there is significant risk of further decline in extent and health of the system if flood pathways and more natural flow regimes are not maintained or reinstated.

Constraints to environmental flow delivery in the Gwydir consist mainly of possible third party inundation impacts in the lower reaches of the river system and potentially the storage release capacity of Copeton Dam.

Consultation

In recognition of current water planning processes being undertaken by the NSW government and at the request of the local community, detailed consultation with landholders and communities has not commenced in the Gwydir. However, preliminary discussions have occurred with water managers and experts from the region, landholder representatives and community groups. The potential effects of environmental watering on private properties in the Gwydir are not fully understood and will require further analysis and input from landholders in the region.

Given that consultation has been delayed in the Gwydir, there was limited local feedback on impacts provided during the public comment period. There was general support for consideration of the Gwydir, given historical changes to cropping areas; but respondents felt that this must be done through working with landholders to identify the best way of supporting environmental watering. Conversely, the inclusion of the Gwydir as a key focus area was also questioned; as it was suggested it did not contribute to the Basin-scale environmental outcomes. A number of people expressed the need to more strongly recognise the benefits to all users of reconnecting to the floodplains in the northern Basin. People stressed the need for the Strategy to work within and be mindful of current water planning processes, to avoid overlap.

The key issues raised were in relation to how changes to the operational and management constraints may influence the Gwydir landholders and water entitlement holders, including:

- potential impacts to the water market if there are significant rule changes proposed

- significant concerns with the application of shepherding
- water access licences within the same category should be treated with equal merit.

Priority actions for 2014

Work is required to understand the range of third party impacts which may result from changes in the frequency, timing, duration and predictability of proposed environmental flows. Work into 2014 will include working with landholders, traditional owners and the community to undertake the pre-feasibility assessment including:

- further development of inundation maps and increasing the understanding of flow pathways
- analysing proposed inundation and flow pathways to identify potential impacts and benefits; including potentially affected land and infrastructure (land tenure, land use, infrastructure etc.)
- identify and describe potential mitigation strategies of addressing constraints in the future.

Figure 18 Gwydir Wetlands on the Gingham Watercourse

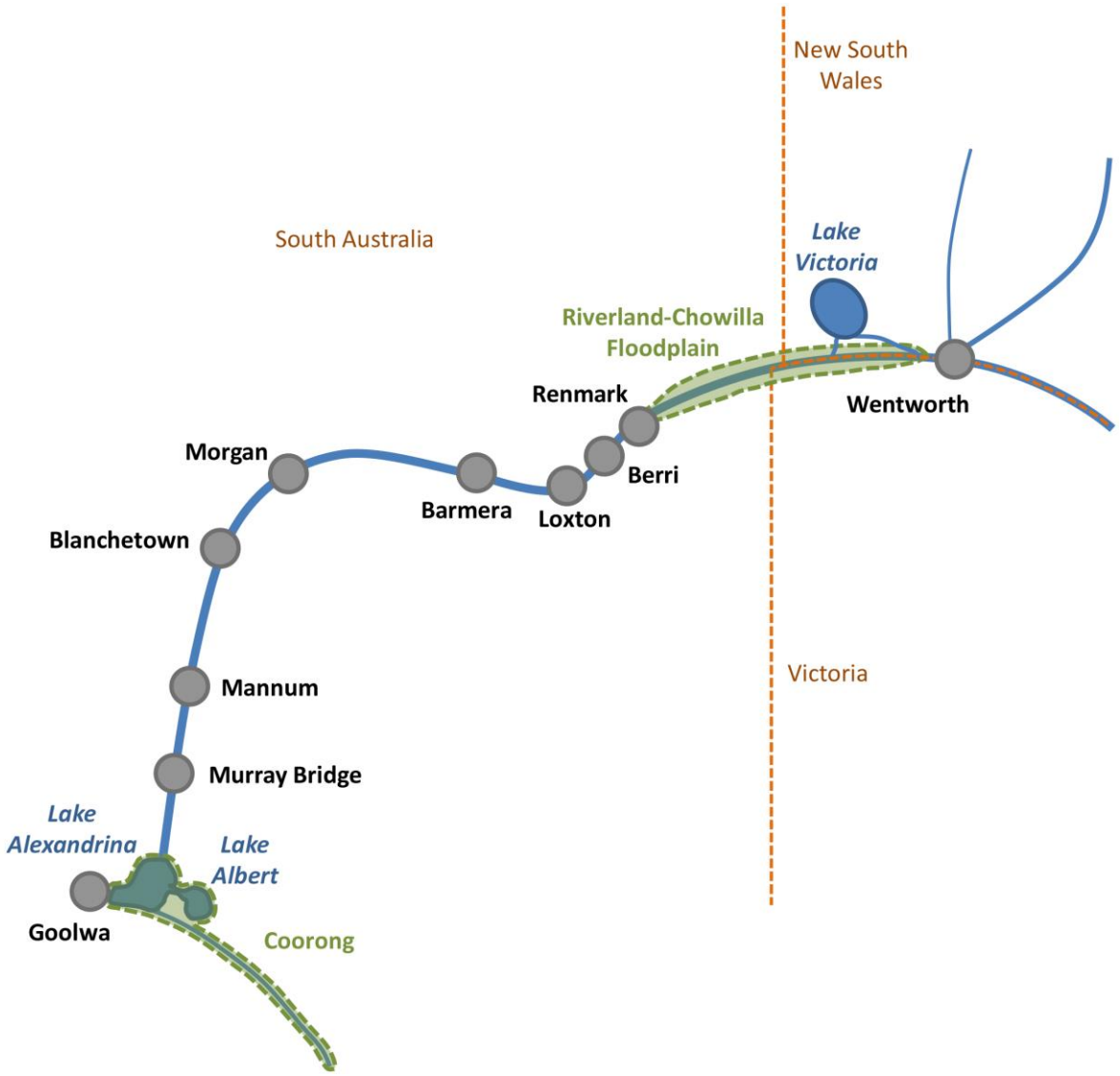

Figure 19 Schematic drawing of the River Murray in South Australia

The River Murray in South Australia

The South Australian (SA) River Murray system is a complex interconnected system comprising the main river channel; extensive areas of floodplain; temporary and permanent creeks and wetlands; sprawling floodplains; swamps; the large freshwater Lakes Albert and Alexandrina; and the unique Coorong and estuarine Murray Mouth region.

Regulated flows of up to 80,000 ML/day in the River Murray at the SA border have significant environmental, cultural and social benefits. These flows are necessary to inundate areas of floodplain in order to drive biological processes, improve water quality and remove salt out the system. Issues with such flows could include inundation of private property (e.g. shacks), council property and infrastructure (e.g. boat ramps, unsealed roads along the floodplain).

Consultation

A review of the implications of flow events in the 60,000 to 90,000 ML/day range (measured at the border) has begun in SA. In May 2013, the MDBA met with local government and community leaders to seek recommendations on the appropriate method of engagement in SA. Consistent with these recommendations, the MDBA has held meetings with local councils, indigenous leaders and other stakeholders.

In addition to information gathered through early consultation activities, consultation during the public comment period generally provided support for the Strategy (allowing higher flows into SA). Many people wanted to discuss the negative impacts on their areas that resulted from the millennium drought and they generally considered that higher flows in the range under consideration represented low levels of concern.

Key issues raised included:

- timing of flows, particularly with regard to impacts of higher flows on recreation and tourism activities
- limitations to environmental flow delivery as a result of current river infrastructure (e.g. weirs)
- avoiding low flows or the drying out of wetlands because of the impacts on water quality
- ensuring any higher flows do not impact on infrastructure such as council roads, ferries, shacks and new environmental watering infrastructure.

Priority actions for 2014

The MDBA and the South Australian government will continue to engage with stakeholders to better understand the implications of potential changes to flow rates through delivery of environmental water. This work will include an assessment of mitigation options that could address potential issues.

Operational and management constraints explained

10. Operational and management constraints explained

This section presents more information about the generic operational and management constraints identified so far. It categorises the constraints against three environmental outcomes sought by environmental water holders, namely:

1. using environmental water in response to natural cues, and restoring natural variability including seasonality
2. that environmental water remains in-stream to target a range of sites and ecosystem functions in and between rivers
3. promoting the management of all water in the system to contribute environmental benefit.

This section also identifies priority actions for further consideration by governments and for discussion with water users – irrigation and environmental.

In line with Basin Plan requirements and this Strategy's principles, any detailed consideration of the constraints outlined below will include the identification of mechanisms by which impacts on third parties can be addressed.

1. Use environmental water in response to natural cues, and restore natural variability including seasonality

Environmental watering in regulated systems is most effective and efficient when it is used in response to natural cues such as rainfall and runoff. When natural cues occur, ecosystem functions (such as nutrient exchange and bird/fish breeding) are more likely to be triggered and opportunities are presented to provide critical ecological support. Environmental water can then contribute to overbank flows, connecting rivers and floodplains and support in-stream functions.

Building on natural flow cues by contributing additional environmental water also ensures the most efficient use of environmental water, as much less water is required to reach flow/site targets. Manufacturing events in the absence of natural cues is usually very inefficient as significantly more environmental water is required to achieve the same outcomes.

Delivery of environmental water on top of other in-stream flows

Unregulated flows refer to water in the river which is in addition to anticipated water orders associated with entitlement and other commitments, and which cannot be captured downstream. In some places it may be uncontrolled flows above regulated flows, but at many places it can just mean flows that cannot

be captured by a regulatory structure. Efficient river operations require water orders sourced from the closest storage to conserve water. Water orders may be met by unregulated events in the first instance and releases made from storage only when the unregulated flows are exhausted. Currently, placing a water order will not necessarily lead to a release from dams and therefore the order may not physically add to the river flow height below the dam.

For the environment to benefit, it typically requires a certain flow height or rate to occur, rather than just a volume. Allowing environmental water managers to call upon entitlements during unregulated events will assist in achieving desired flow heights or rates. This will increase the effectiveness of environmental water and optimise environmental outcomes. It is a more efficient use of environmental water, improving the magnitude, variability and/or the duration of the event. In the absence of releasing during unregulated flows, significantly more water is required to achieve the necessary flow height. It is believed that these changes could be developed within some boundaries to ensure that other people's reliability is not affected.

Priority actions

Consider options for the development of formal operational and management practices to allow held and/or environmental water to build on natural flow cues, including (where safe) unregulated in-stream flows.

Channel capacity sharing

The capacity of a river channel to carry water and/or a regulated flow maximum can limit the volumes able to be delivered without spilling over bank. Channel capacity competition can arise at times of both high consumptive and environmental demand which, if apparent, would usually occur in late spring. At times, environmental water has not been delivered when required or delivery times have been moved to reduce competition. Formal mechanisms for sharing channel capacity between consumptive users and the environment aren't in place in all systems.

There is an interaction between this issue and the work at the key focus areas. If some of the constraints in the key focus areas are addressed and higher peak flow volumes can be delivered, then this will minimise the instances of competition.

Priority actions

Consider options for the development of formal supply sharing arrangements to provide a mechanism for managing the delivery of water when demands exceed channel capacity, which are:

- transparent
- equitable, including consideration of the:
    - relative demands and temporal priorities of both consumptive and environmental water
    - consistency between water holders — whether they hold environmental water or irrigation entitlements
    - original location of entitlement and whether environmental demand is in addition to original demand.

Timing of water availability

In the southern system, peak irrigator demand is around the summer months, while environmental watering in response to natural cues typically occurs in winter/spring. Given the water year starts just before the time of optimal environmental water delivery; at times the environment will have insufficient water to commence an event early in the water year, despite subsequently having sufficient allocation later in the year.

Some systems allow part of an unused allocation to be carried over to be available for use in the following year. In the southern Basin, the environment will often rely on carryover to commence watering in winter/spring. There are limits to how much water can be carried over; however, there may be other options which could also address early season allocation issues, like borrow/payback and opportunistic storage rights such as those already applied to the Barmah–Millewa Forest Environmental Water Allocation.

Priority actions

Investigate options to allow the availability of environmental water to respond to natural cues.

Planned environmental water

Environmental water can be in the form of held entitlements that are actively managed, or as rules embedded in State Water Resource Plans (known as planned environmental water). Some of the planned environmental water provisions attempt to reflect natural cues and seasonal variability. However, some of the rules do not reflect such triggers or predated environmental water

delivery and hence their capacity to influence environmental benefit is diminished.

Priority actions

Review the efficacy of planned environmental water provisions across the Basin to optimise environmental outcomes.

2. Environmental water remains in-stream to target a range of sites and ecosystem functions in and between rivers

Maximising environmental benefits from the use of environmental water will require maintaining hydrological connectivity along the length and breadth of watercourses to protect, enhance and restore ecosystem functions. This will assist the transfer of nutrients and biota throughout the system and will support native aquatic fauna and flora across the Basin. In addition, improved in-stream function will result when rivers and floodplains are connected.

To achieve this connectivity and improved function, environmental water must be permitted to flow throughout the system, to target multiple ecological sites and functions en route to an intended priority environmental asset or the end of the system. It is widely recognised that environmental watering requires the ability to apply water in-stream and overbank at multiple sites (an example of this is the River Murray multi-site environmental watering trials).

Environmental water can be used throughout the length of a river

In order to maximise the benefits, environmental water should be used at multiple sites and target multiple functions throughout its journey through the system.

In regulated systems, water orders associated with entitlements are currently met by placing a water order for extraction of a volume at a specific location. That order is met as efficiently as possible: which is from water in the river first; and releasing from headwater storage last. Therefore, placing a water order does not guarantee flow in the river from a storage to the order point. There is limited capacity to place a water order to apply throughout the length of a river system. By allowing environmental water managers to nominate the storage (often the headwater storage) to meet a downstream demand, environmental water can flow the length of the river system. This, in turn, will provide ecological benefit from the storage release to the delivery point. This will assist in meeting end-of-system targets and support in-stream functions and reconnect wetlands along the way.

Priority actions

Consider options for the development of operational and management practices to enable held environmental water to flow throughout the river via a release from a headwater storage to the end of the system.

Protection of environmental flows from extraction and re-regulation

It is important that environmental watering events are protected from extraction for consumption or re-regulation. Protection relates to either protection of the event, or protection of the long-term average volume of held environmental water. To maximise environmental outcomes, both types of protection are required.

A significant challenge to protecting environmental flows is estimating environmental water use (also known as losses) and thereby estimating how much environmental water remains in the system.

Priority actions

Consider options for the development of operational and management practices to enable held environmental water to be protected from consumptive extraction and re-regulation.

Develop a methodology to estimate environmental use which is:

- transparent
- equitable, that is:
    - not unduly conservative
    - considerate of losses already provided for in the resource assessment
    - applied consistently between water holders
    - considers subsequent reduced conveyance losses due to channel wetting etc.

Substitution of held environmental water with other water

Releasing held environmental water from headwater storage to remain in-stream and flow throughout the river system can result in the substitution of held water for other water; for example, held water substituting for planned water, dilution flows, pre-releases or spills. This is a complex area which will require significant analysis to understand and then develop an equitable policy response.

Priority actions

Undertake analysis to identify the extent to which substitution is an issue.

Develop transparent policies to ensure equitable treatment of held environmental water with planned environmental water or other releases from storages.

3. Promote the management of all water in the system to contribute environmental benefit

It is recognised that all water in the system, regardless of whether it is held or planned environmental water or consumptive water, has the potential to contribute to improving the ecological condition of the rivers, wetlands and floodplains. All water in the system can be managed in ways that optimise environmental outcomes for the Basin.

Coordinated planning and delivery of water delivery

The Basin Plan sets out provisions for water resource planning requirements, long-term watering plans and identification of annual watering priorities for each water resource plan area. The Basin Plan also states that environmental watering is to be undertaken in a way that maximises benefits and effectiveness by coordinating environmental watering with flows regulated for consumptive use (s8.35 (b)).

The existing governance arrangements were generally developed around individual entitlement portfolio objectives or catchment/regional objectives. The current arrangements need to be further enhanced across the Basin to provide a system-wide approach to environmental water planning. Governments are currently developing new soft institutional/governance arrangements to move towards coordinated environmental flow management.

Priority actions

Consider options to further development of governance and policy arrangements for coordinated planning of environmental water, both annually and in the longer-term, for the southern connected system. The arrangements should:

- support the integration of long-term environmental water management plans and annual watering priority setting between each of the connected water resource plan areas
- coordinate the delivery of environmental water between all environmental water holders, planned environmental water and consumptive water.

Assess the feasibility of coordinating environmental flows in the northern Basin.

Current river management practices

Maximising environmental water benefits will require coordination between valleys and between held and planned environmental and consumptive water. Environmental water holders advise river operations of estimated volumes to be delivered under different watering scenarios.

However, in some instances, river operations planning does not include environmental objectives contained in environmental watering plans. To achieve environmental objectives with consumptive water, river operating plans will need to have capacity to implement environmental watering plans. The integration of environmental water planning into river operations and annual planning arrangements will also contribute to achieving the high-level operational and management outcomes (natural cues, variability, and connectivity) and is critical to successful environmental watering and improving the ecological condition of the Basin. Governments have begun embedding environmental considerations into river operations procedures, but there is some way to go.

Priority actions

Support the integration of environmental water planning into river operations.

Figure 20 Murrumbidgee River at Balranald, 2013

Phase 1 actions

During phase 1, the MDBA will collaborate with Basin governments, Basin water agencies, environmental water managers and water users to further consider and prioritise operational and management constraints. This will provide for a greater understanding of the nature and extent of operational and management constraints within the Basin in particular, those constraints identified through consultation as high priority or that may arise in relation to the removal of physical constraints in key focus areas.

Key actions

Southern connected system

Agree an approach with relevant Basin governments to further progress the examination of options to address priority operational and management constraints in the southern connected system, including:

- agreeing the role of the MDBA, Basin governments, water agencies and environmental water managers in this phase. Particular consideration needs to be given to the MDBA's role in progressing issues related to multi-jurisdictional arrangements of the River Murray (under the Murray–Darling Basin Agreement)
- addressing links with physical constraints in key focus areas
- a strategy for, and program of engagement with community and industry stakeholder groups
- further detailed prioritisation and scoping of operational and management constraints and the identification and scoping of potential options for their mitigation
- the development of a conceptual model and approach to assess potential third party impacts; in particular any risk of impacts on reliability of water entitlements to be used in the phase 2 (feasibility assessment)
- scoping phase 2 including relationship with water resource planning processes.

Northern Basin

Agree an approach with relevant Basin governments to further progress the exploration of priority constraints in the northern Basin, including:

- agreeing roles and responsibilities and coordination and linkages with the Northern Basin Program

- addressing links with physical constraints in the Gwydir
- a strategy for, and program of, engagement with community and industry stakeholder groups
- further detailed prioritisation and scoping of operational and management constraints and the identification of potential options for their mitigation related to:
    - protection of environmental water on an event basis, in particular, the Barwon–Darling
    - coordination of environmental water between valleys in the northern Basin.
- scoping phase 2, including relationship with water resource planning processes.

At the end of phase 1, MDBA will provide recommendations to Basin Ministers on specific operational and management constraints requiring priority action. Recommendations may not be limited to constraints; they may also identify opportunities to improve environmental water delivery.

Figure 21 Bookit Creek

Appendix A – relevant Basin Plan provisions

Section 7.08 Constraints Management Strategy requirements

Under the Basin Plan (7.08), the MDBA is to develop, in consultation with Basin states and communities, a Constraints Management Strategy, that:

- identifies and describes the physical, operational and management constraints that are affecting, or have the potential to affect, environmental water delivery
- assists all jurisdictions to participate in constraint measures in order to allow environmental water to be used to maximum effect and to maximise the benefits of any increase in held environmental water
- evaluates options, opportunities and risks to water users, communities and the environment, associated with addressing key constraints, including through constraint measures that are relevant to measures that might be notified under section 7.12
- assesses the impacts of modifications of constraints on environmental water delivery and third parties, as well as downstream impacts, and assess options to address those impacts
- identified mechanisms by which impacts on third parties can be addressed.

Appendix B – Modelled constraints used to inform the Basin Plan 2012

Table B1 identifies the constraints that were relaxed in modelling undertaken in 2012. Relaxing constraints up to these levels (or possibly at lower levels) will be examined through implementation of the Constraints Management Strategy.

Table B1 Comparison of modelled existing and constraints-relaxed flows at eight key sites

Location	Existing constraint in model (ML/d)	Relaxed constraint in model (ML/d)
Murray region		
Hume to Yarrawonga	25,000	40,000 (only during winter/spring)
Downstream of Yarrawonga	10,600 during summer/autumn	10,600 during summer/autumn and 40,000 at other times
Lower Darling region		
Weir 32/Increase Menindee outlet capacity	9,300	18,000
Darling Anabranch	Water flows into the anabranch at flows over 9,300 ML/d (no regulator)	Regulator added and closed above 9,300 ML/d when water is supplied from Menindee to meet environmental needs in the Murray
Murrumbidgee region		
Gundagai	30,000	50,000
Balranald	9,000*	13,000
Goulburn region		
Seymour	12,000	15,000
McCoy's Bridge	20,000*	40,000

Notes:

In these scenarios, the peak rate at which environmental flows could be delivered was increased to the maximum flow rates allowed by statutory approvals or procedures (advised by states). In practice, river operators usually plan to deliver environmental flow events below these operational flow limits to provide a buffer against risks such as unpredictable local inflows or to avoid undesirable inundation. For example in the Goulburn, while flows are limited operationally to 26,000ML/day downstream of Shepparton, environmental flows need to be delivered consistently with the Victorian Environmental Water Holder's Seasonal Watering Plan, which generally includes flow limits well below this figure (i.e. 5,000 – 10,000 ML/day), varying to reflect the positioning of movable infrastructure such as pumps.

* Constraint is applied to tributary demands designed to contribute to achievement of downstream environmental water events in the River Murray. MDBA was advised the upper limit at McCoy's Bridge is 26,000 ML/day, however 20,000 ML/day was deemed to be a more accurate definition of regulated flows for the purpose of Basin Plan modelling.