# Efficiency review of River Murray Operations capital and operating expenditure

Report

Prepared for Commonwealth Department of Environment

28 November 2014

Cardno
Shaping the Future

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## Document Information

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# Glossary

| Term | Definition |
|---|---|
| ACCC | Australian Competition and Consumer Commission |
| ALARP | As Low as Reasonably Practical |
| AMAP | Asset Management Advisory Panel |
| ANCOLD | Australian National Committee on Large Dams |
| BCC | Basin Community Committee |
| BOC | Basin Officials Committee |
| CAPEX | Capital Expenditure |
| CPI | Consumer Price Index |
| CRC | Current Replacement Cost |
| DEA | Data Envelopment Analysis |
| DSEP | Dam Safety Emergency Plans |
| EAP | Emergency Action Plan |
| EC | Electrical Conductivity |
| ESC | Essential Services Commission |
| ESCOSA | Essential Services Commission of South Australia |
| EWMP | Environmental Works and Measures Program |
| FMMS | Facility Maintenance Management System |
| FTE | Full-time Equivalent (employee) |
| GMW | Goulburn Murray Water |
| I&C | Investigations and Capital Expenditure |
| IPART | Independent Pricing and Regulatory Tribunal |
| IRORG | Independent River Operations Review Group |
| JV | Joint Venture |
| KPI | Key Performance Indicator |
| MDB | Murray Darling Basin |
| MDBA | Murray Darling Basin Authority |
| MoU | Memorandum of Understanding |
| MP | Planned Maintenance |
| MR | Routine Maintenance |
| NoW | NSW Office of Water |
| NPR | National Performance Reports |
| NWC | National Water Commission |
| NWI | National Water Initiative |
| O | Operations |
| O&M | Operations and Maintenance |
| Ofwat | The Water Services Regulation Authority (UK) |
| OHS | Occupational Health and Safety |
| OLS | Ordinary Least Squares |
| OPEX | Operating Expenditure |
| P90 | 90%ile probability |
| PLC | Programmable Logic Contoller |
| PR09 | Periodic Review, 2009 (UK) |

| Term | Definition |
|---|---|
| PRA | Portfolio Risk Assessment |
| RCM | Reliability-Centered Maintenance |
| RMO | River Murray Operations |
| RMW | River Murray Water |
| RPI | Retail Price Index |
| SA Water | South Australia Water |
| SCA | State Construction Agency |
| SCADA | Supervisory Control And Data Acquisition |
| SIS | Salt Interception Scheme |
| STW | Southern Training Wall |
| TFP | Total Factor Productivity |
| WCIR | Water Charge Infrastructure Rules |
| WDV | Written Down Value |

# Executive Summary

**Purpose**

Synergies, in association with Cardno and Economic Insights, has been appointed by the Basin Officials Committee (BOC) to undertake an expenditure efficiency review and develop a Building Block model covering the Murray Darling Basin Authority's (MDBA's) River Murray Operations (RMO). The purpose of this report is to present the approach taken and findings of the review of the efficiency of the RMO. This work has been undertaken by Cardno. A separate report has been completed covering an assessment of total factor productivity of the RMO. This efficiency review is an input into the overall Building Blocks mode

**Methodology**

To complete this efficiency review, we have undertaken the following activities:

- Analysis of historic and forecast capital expenditure projections submitted by MDBA
- Review of documents supporting the expenditure projections including business processes
- Interviews with MDBA staff responsible for managing the RMO and developing capital and operating expenditure forecasts
- Interviews with the State Constructing Authority staff involved in undertaking RMO activities.
- Reviewing the current asset valuation to determine an optimised replacement cost value
- Assessment of the scope for efficiency gains in the expenditure proposed for River Murray Operations considering both 'top-down' and 'bottom-up' approaches including the Total factor Productivity analysis completed as part of this project.
- Application of adjustments and efficiency gains to arrive at our recommended levels of prudent and efficient capital and operating expenditure.

**Strategic Management**

We note that the River Murray Operations are subject to considerable governance under the Water Act 2007. The regulatory framework for the River Murray Operations specifies important strategic management tools including the Corporate Plan, Asset Management Plan and Objectives and Outcomes Document. We consider that this regulatory framework, while robust, constrain the ability of River Murray Operations to act compared with other infrastructure operators.

**Asset Management**

From our discussions with MDBA, the State Construction Agencies (SCAs) and a review of documents provided we concluded that the asset management and project delivery processes were robust and appropriate.

MDBA's approach to asset management and project delivery is through a consensus and partnership style to achieve the desired outcomes.

Currently the asset management process works because a co-operative, consultative relationship exists between MDBA and the SCA's. All the organisations have highly experienced, technically proficient staff who are able to work together in a professional manner and able to prioritise investments through discussion and determination of priorities based on engineering judgement. This approach is likely to continue provided MDBA is able to attract and retain senior staff with expertise and a collaborative approach.

The asset management plan is comprehensive. We have possible improvements that could be considered in the next update of the Plan. It is considered that implementation of the improvement opportunities would better place the Asset Management Plan in driving the Corporate Plan as it would provide the relevant statistics (e.g. asset condition and risk profile, short/medium and long term renewals and planned maintenance forecasts)

Relevant service and asset performance targets should be listed in one location, for example, the Asset Management Plan. An annual report which compares performance against the relevant service and asset performance targets would be a useful tool in assessing overall performance in a quantifiable manner.

The asset register is comprehensive and well developed. We have proposed the inclusion of a condition rating score and consequence of failure (criticality) score from which an asset risk score can be generate

**Scope for treating RMO as a regulated business**

The context of this review is that the principles of the WCIR should be applied to the Murray Darling Basin Authority, even though the Authority is not subject to regulation under these Rules. We have assessed the information provided to us for the River Murray Operations against guidance for infrastructure operators who come under the rules (*A guide to the water charge (infrastructure) rules: Pricing application for Part 6 operators* (ACCC, October 2011)). We have found that there are numerous areas where the River Murray Operations do not yet fully meet the requirements for information under the rules. These are summarised in the following table. We make these observations to identify where a lack of information has limited the extent that we have been able to undertake this prudence and efficiency assessment compared to a regulatory review under the WCIR and to identify areas where the MDBA may be able to move towards being more fully treated as a regulated business.

We also note that the information requirements are not an end in themselves. They are a guideline of good practice for how an infrastructure operator can demonstrate the links between its customers, the services provided to the customers, risk and costs.

**Assessment of River Murray Operations against WCIR information requirements**

| Criteria | Observations | Recommendations |
|---|---|---|
| Customer consultation including response to feedback | ▸ Consultation is currently limited to important stakeholders, in the main the SCAs and the State Governments | ▸ Consider wider and more formal consultation regarding its RMO activities and expenditure plans<br>▸ Include consultation between SCAs and their customers impacted by RMO costs |
| Detail the regulatory, legislative and other obligations that have been or are forecast to be imposed on the business | ▸ The MDBA's River Murray Operations are subject to considerable governance under the Water Act that constrains how it manages its business | ▸ Consider reduced governance for Corporate Planning process, e.g. gain approval for a one to four year period only and MDBA is provided freedom to manage amendments during that period within defined levels of authority and triggers of variance to approved Plan |
| Detail the projected service standards including a clear definition, units of measure, how they are calculated and target performance | ▸ Currently standards are not clear or readily understood and are located In various documents<br>▸ There is limited linkage between some of the existing standards and capex/opex investment<br>▸ Not given primacy and not flexible | ▸ Develop a consolidated set of explicit service standards for RMO<br>▸ Following consolidation, remove other quasi service standard obligations on MDBA |
| Historic (4 years past) and forecast (4 years forward) forecasts for opex and capex to be included | ▸ Historic expenditure well documented<br>▸ Corporate Planning process has four year horizon but focuses on current year only<br>▸ Accounts are structured around cost-sharing arrangements, not economic regulation.<br>▸ Distinction between capex and opex not clear. The RMO Joint Funding Capex and Opex report and RMW Budget spreadsheet are not always consistent in relation to categorisation of capex and opex. MDBA have | ▸ Develop firm four year projections for operating and capital expenditure<br>▸ Develop guiding five to ten year forecasts for operations and maintenance<br>▸ Use renewals annuity as basis for long term capital expenditure forecast<br>▸ Consider distinction between operating and capital expenditure and develop accounting definitions to be adopted consistently by MDBA and SCAs |

| Criteria | Observations | Recommendations |
|---|---|---|
| | recently prepared a draft Accounting manual. The capitalisation threshold is $10K. | |
| Drivers for operating expenditure identified and generally classed as being due to either business-as-usual, changes in input costs, changes in demand, to deliver higher levels of service for customers , to meet regulatory, legislative or other obligations, intermittent asset maintenance. | ▸ Drivers for operating expenditure not well defined and not aligned to these suggestions<br>▸ A real index is applied to operating costs from the previous year to arrive at a starting point current year costs<br>▸ Funding constraints lead to expenditure items being deferred<br>▸ Requirements for major maintenance generally well justified and programmed | ▸ All variations from base year costs to be justified and linked to a driver<br>▸ No real escalation to be applied. Real escalation to be linked to changes in input costs (but mitigation of increased input costs to be demonstrated) |
| Productivity improvements identified | ▸ Incentives are self-imposed by MDBA and SCAs<br>▸ Arbitrary funding constraints impose some level of efficiency but this may not be optimal when the full asset lifecycle is considered<br>▸ Onerous governance arrangements exist to ensure transparency and accountability for expenditure<br>▸ Limited freedom exists for MDBA to manage resource to meet required outputs | ▸ A review should be undertaken to determine the feasibility of implementing a less onerous budget (corporate planning) process while maintaining accountability and transparency<br>▸ MDBA and SCAs to identify and document productivity improvements and quantify budget impact |
| Drivers for capital expenditure broadly one of the following: to meet increased or declining demand, to maintain existing service levels or to deliver higher levels of service for customers , to meet regulatory, legislative or other obligations | ▸ Drivers for capital expenditure are unclear and do not align with these suggestions.<br>▸ Relationship between service levels and expenditure not clear | ▸ Expenditure proposals should relate to a specific driver or drivers and service levels |

**Recommended prudent and efficient capital and operating expenditure**

We have assessed the expenditure proposed for River Murray Operations for the period 2014/15 to 2017/18 and the scope for efficiency gains. The following table summarises the capital and operating expenditure proposed for River Murray Operations for the period 2014/15 to 2017/18 and the adjustments we have made to arrive at our recommended levels of prudent and efficient operating and capital expenditure. The adjustments we have made to the proposed expenditure are as follows:

- We have re-based the proposed expenditure forecasts to present all costs in $14/15
- We have necessarily allocated some expenditure classified as I&C (capital) as operating expenditure
- We have not applied the reduction to Salt Interception Scheme (SIS) operating expenditure we identified in our preliminary findings as MDBA identified further efficiency savings in this area and made further cost reductions which were reflected in its re-submitted proposed expenditure forecasts
- We have not applied the reduction in operating expenditure on locks and weirs, initially identified through internal cost benchmarking as MDBA provided further information on asset values
- Applied an ongoing efficiency gain of 1% per annum to operating expenditure
- Removed capital expenditure associated with contingency items.

**Recommended prudent and efficient capital and operating expenditure**

| Ref | | 2014/15 | 2015/16 | 2016/17 | 2017/18 |
|---|---|---|---|---|---|
| *Proposed expenditure* | | | | | |
| A | O&M (i.e. O + MR) | 31,841,795 | 33,818,330 | 34,139,312 | 37,395,717 |
| B | O&M costs classified as I&C in summary sheet | 10,023,795 | 10,464,151 | 11,045,658 | 12,134,430 |
| C = A+B | Sub-total - Operating expenditure | 41,865,590 | 44,282,481 | 45,184,970 | 49,530,147 |
| D | MP | 9,362,780 | 9,332,237 | 8,431,377 | 10,206,042 |
| E | I&C Renewals | 2,575,000 | 6,447,888 | 15,084,876 | 12,677,955 |
| F | I&C Enhancement | 1,444,282 | 1,798,431 | 1,494,817 | 1,044,057 |
| G = D+E+F | *Sub-total - Capital expenditure* | *13,382,062* | *17,578,556* | *25,011,070* | *23,928,054* |
| **H = C + G** | **Total proposed expenditure** | **$55,247,652** | **$61,861,037** | **$70,196,040** | **$73,458,201** |
| Proposed adjustments to operating expenditure | | | | | |
| I | SIS opex reduction (removed) | $0 | $0 | $0 | $0 |
| J | Lock and Weir Internal Benchmark (Euston) (removed) | $0 | $0 | $0 | $0 |
| K =C - I - J | *Subtotal operating expenditure* | *$41,865,590* | *$44,282,481* | *$45,184,970* | *$49,530,147* |
| L | Operating expenditure efficiency | | | | |
| M | Ongoing efficiency (%) | 1 | 0.990 | 0.980 | 0.970 |
| N = (1-M)*K | Ongoing efficiency (amount) | $0 | $442,825 | $908,218 | $1,500,813 |
| | Catch-up efficiency | | (none specifically applied) | | |
| O=I+J+N | *Total adjustments to operating expenditure* | *$0* | *$442,825* | *$908,218* | *$1,500,813* |
| **P=K-O** | **Recommended efficient operating expenditure** | **$41,865,590** | **$43,839,656** | **$44,276,752** | **$48,029,334** |
| | Comparison to proposed operating expenditure | 0.00% | -1.00% | -2.01% | -3.03% |
| **Proposed adjustments to capital expenditure** | | | | | |
| Q | Contingency adjustment | $90,195 | $91,417 | $90,724 | $90,483 |
| **R=G-Q** | **Recommended capital expenditure** | **$13,291,867** | **$17,487,139** | **$24,920,346** | **$23,837,571** |
| | Comparison to proposed capital expenditure | -0.67% | -0.52% | -0.36% | -0.38% |

# Table of Contents

# Tables

## Figures



## Appendices



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# 1 Introduction

## 1.1 Purpose

Synergies, in association with Cardno and Economic Insights, has been appointed by the Basin Officials Committee (BOC) to undertake an expenditure efficiency review and develop a Building Block model covering the Murray Darling Basin Authority's (MDBA's) River Murray Operations (RMO). The purpose of this report is to present the approach taken and findings of the review of the efficiency of the RMO. This work has been undertaken by Cardno. A separate report has been completed covering an assessment of total factor productivity of the RMO. This efficiency review is an input into the overall Building Blocks model.

## 1.2 Murray Darling Basin Authority

The Murray-Darling Basin Authority is a Commonwealth statutory authority established by the Water Act 2007 (the Act). The MDBA sits within the Environment Portfolio and reports to the Parliamentary Secretary to the Minister for the Environment. The policy and strategic direction of the MDBA's activities are set by the six-member Murray-Darling Basin Authority consisting of a part-time chair, four part-time members and the MDBA Chief Executive. The Authority reports to the Parliamentary Secretary to the Minister for the Environment in relation to the Murray-Darling Basin Plan. For joint programs the Authority reports to the Murray-Darling Basin Ministerial Council (Ministerial Council) through the Basin Officials Committee.

The MDBA has significant functions under the Water Act and in particular, the Murray-Darling Basin Agreement (the Agreement) which is Schedule 1 to the Act. The Agreement establishes the Authority to deliver, in conjunction with the Contracting Governments[1], jointly funded programs for the Contracting Governments. This includes giving effect to decisions of the Ministerial Council and the Basin Officials Committee in relation to Natural Resource Management programs and River Murray Operations, advising these bodies, and providing them with administrative support. There is a long history of collaboration between the States and the Commonwealth in the joint management of the River Murray assets.

## 1.3 The River Murray System and River Murray Operations

The scope of this review applies to River Murray Operations. River Murray Operations are the activities required to manage and operate the assets in the River Murray System. The River Murray System is the main regulated river system that drains the southern part of the Murray Darling Basin. The River Murray System is defined under Clause 86A(3) of the Act as the aggregate of:

a. the main course of the River Murray upstream of the eastern boundary of South Australia; and

b. all tributaries entering that part of the main course upstream of Doctors Point (near Albury); and

c. all effluents and anabranches of that part of the main course; and

d. the watercourses connecting Lake Victoria to the main course; and

e. the Darling River downstream of the Menindee Lakes Storage; and

f. the upper River Murray storages, namely:

   i. Lake Victoria; and

   ii. the Menindee Lakes Storage; and

   iii. the storages formed by Dartmouth Dam and Hume Dam; and

   iv. the storages formed by the weirs, and weirs and locks, described in Schedule A to the Agreement that are upstream of the eastern boundary of South Australia; and

[1] The Contracting Governments are defined under the Act as being any of the Governments of the Commonwealth, New South Wales, Victoria, South Australia, Queensland and the Australian Capital Territory. Note however, as explained following, the governments of Queensland and the Australian Capital Territory are not involved in the River Murray Operations that are the subject of this review.

g. the River Murray in South Australia.

The River Murray System is shown in Figure 1-1. This figure shows that the scope of the River Murray System includes New South Wales, Victoria and South Australia. These three state governments, along with the Australian Government, jointly control the River Murray Operations assets. The governments' control is exercised through the Murray Darling Basin Ministerial Council and the Basin Officials Committee. The MDBA manages the River Murray Operations assets in accordance with the functions, powers and duties set out in the Murray Darling Basin Agreement.

The River Murray Operations activities include[2]:

- Constructing and maintaining River Murray infrastructure assets (dams, weirs, salt interception schemes and environmental works)
- Operating the River Murray system - providing direction to the State Constructing Authorities to deliver state water shares
- Supporting water trading through the management of water trade accounts.

The State Constructing Authorities (SCAs) have been appointed by each of the State governments to carry out construction, operation, maintenance and implementation of works and other measures required to deliver the River Murray Operations. This power is conferred under Section 52 of the Murray-Darling Basin Agreement. The state constructing authorities are:

- New South Wales: State Water Corporation and the NSW Office of Water
- Victoria: Goulburn–Murray Water
- South Australia: South Australian Minister for the River Murray, including the operating agents South Australian Water Corporation (SA Water) and the South Australian Department for Environment, Water and Natural Resources.

The regulatory requirements relating to the River Murray Operations and the obligations of the Murray Darling Basin Authority are discussed in more detail in Section 2.1.

[2] http://www.mdba.gov.au/what-we-do/managing-rivers/river-murray-system

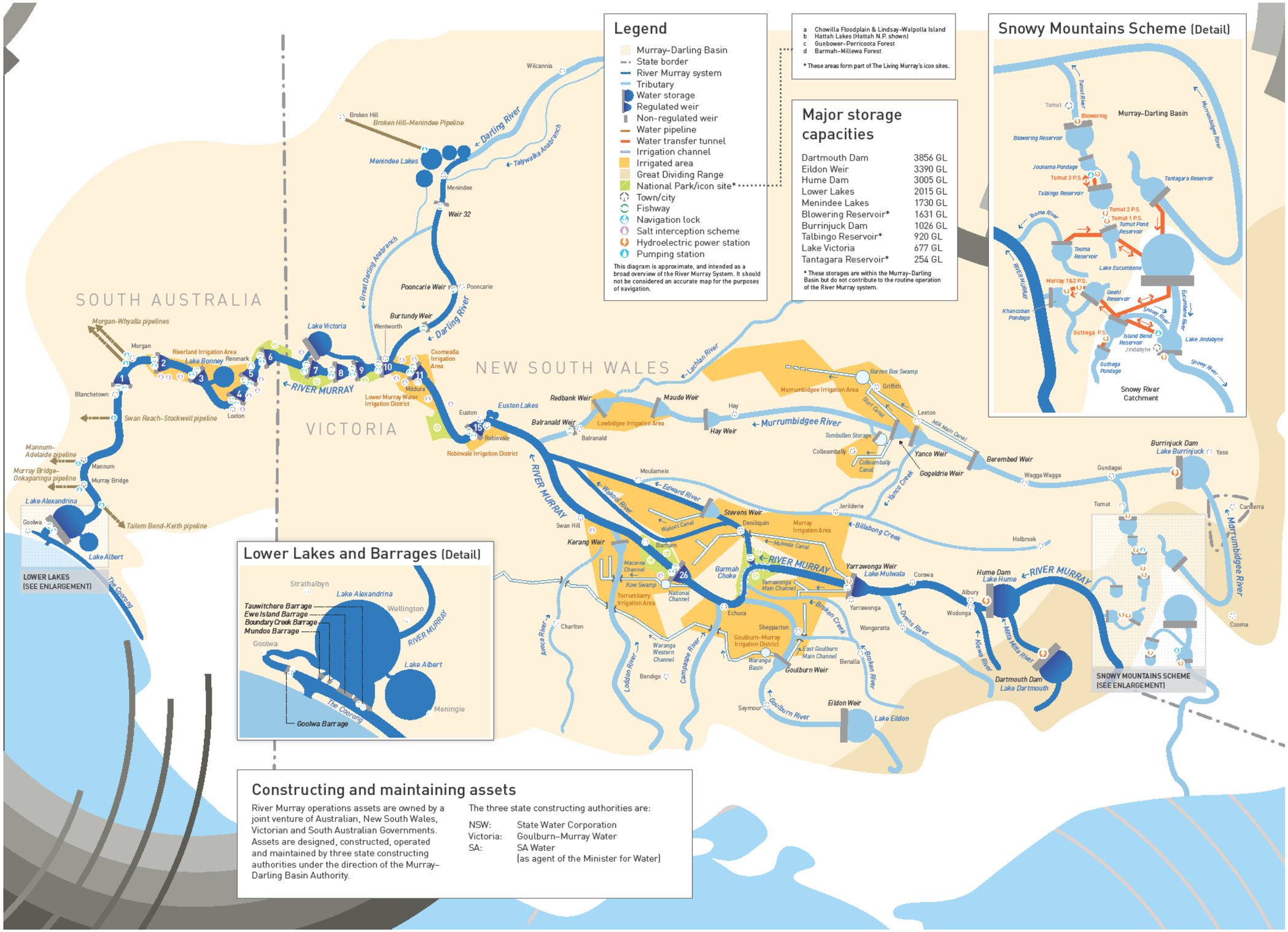


Figure 1-1 River Murray System (*Source: Murray Darling basin Authority)*

## 1.4 Scope of work for efficiency review

Under the terms of reference set by BOC, the objective for this efficiency review is to undertake a rigorous efficiency assessment of the RMO to establish the efficient cost base to be input to the Building Blocks model. The efficiency assessment is to be in accordance with the National Water Initiative (NWI) and the requirements of the Water Charge (Infrastructure) Rules 2010 (WCIR). The WCIR is an instrument under the Water Act 2007 and apply to management of water resource in the Murray-Darling Basin. The WCIR are administered by the Australian Competition and Consumer Commission (ACCC) or an accredited state regulator. Although the Murray-Darling Basin Authority is not subject to price regulation under the WCIR or by the ACCC, it wishes for this efficiency review to follow the principles of the WCIR and guidance issued by the ACCC.

The scope set by BOC for the efficiency assessment of RMO includes:

a. Discussion and advice on efficiency and productivity assessment methodologies such as Total Factor Productivity, Data Envelope Analysis and Stochastic Frontier Analysis in relation to RMO

b. Discussion and advice on any other methodologies that might be appropriate - including less technical methodologies - for evaluating efficiency of RMO;

c. Discussion and advice on benchmarking RMO efficiency levels;

d. Discussion and advice on potential scope to improve efficiency in RMO;

e. Discussion and advice on the impact of different service standards on the measurement of efficient costs for each type of RMO asset; and

f. Specific technical issues that will need to be addressed include how to undertake efficiency assessments for different assets, how to aggregate or compare efficiency across different assets and jurisdictions, and how to address or work around data gaps and methodological issues.

Tasks (a) and (b) from the above scope are the subject of a separate report.

## 1.5 Definitions - prudence and efficiency

The ACCC document *Pricing principles for price approvals and determinations under the Water Charge (Infrastructure) Rules 2010* (July 2011) sets out in section 3.4 the principles for assessing the prudence and efficiency or capital and operating expenditure. For completeness, relevant extract from section are reproduced following.

> *A forecast of the prudent and efficient cost of providing infrastructure services means, based on forward estimates of operating and capital expenditure, the operator would be expected to:*
>
> a. *Cost-effectively meet regulatory, legislative and other obligations and requirements*
>
> b. *Define reasonable service standards, and cost-effectively comply with these standards, and*
>
> c. *Make decisions on providing goods and services expected of a commercially successful infrastructure operator in the same position, and cost-effectively deliver these goods and services.*
>
> *3.4.1 Operating expenditure*
>
> *In making an assessment of the prudent and efficient operating expenditure for the next regulatory period, the regulator must assess:*
>
> - The prudency and efficiency of operating expenditure in the previous regulatory period
> - The reasons and evidence supporting changes to service standards in the next regulatory period
> - The reasons and evidence supporting changes to operating expenditure in the next regulatory period

- Reasonable productivity improvements in providing services over the next regulatory period.

*Where relevant, a regulator must compare and take into account operating expenditure of similar businesses.*

*Forecasts must be based on reasonable assumptions of the efficient costs likely to be incurred in this period.*

#### *3.4.2 Capital expenditure*

*In making an assessment of the prudent and efficient capital expenditure for the next regulatory period, the regulator must assess:*

- The prudency and efficiency of capital expenditure in the previous regulatory period (where relevant to proposed capital expenditure in the next regulatory period)
- The reasons and evidence supporting the commencement of new major capital expenditure projects in the next regulatory period, including whether such projects are consistent with efficient long term expenditure on infrastructure services.
- The reasons and evidence supporting levels of capital expenditure in the next regulatory period
- Whether the timeframe for delivering the proposed capital expenditure program is reasonable, having regard to the operator's delivery of major projects in the past
- Whether the asset management and planning framework of the operator reflects best practice.

*Forecasts must be based on reasonable assumptions of the efficient costs likely to be incurred in this period.*

*The above will be used as our basis for assessing prudence and efficiency of expenditure.*

These definitions of prudence and efficiency will be applied in this efficiency assessment of RMO operating and capital expenditure.

## 1.6 Methodology

Our methodology for undertaking this efficiency assessment is based on:

- Historic and forecast capital expenditure projections submitted by MDBA
- Review of documents supporting the expenditure projections including business processes
- Interviews with MDBA staff responsible for managing the RMO and developing capital and operating expenditure forecasts
- Interviews with the State Constructing Authority staff involved in undertaking RMO activities. The following meetings were held:
  - State Water – 8th September 2014
  - New South Wales Office of Water – 3rd, 12th September
  - Goulburn Murray Water - 1st and 2nd September
  - SA Water, 1st and 2nd September
- Reviewing the current asset valuation to determine an optimised replacement cost value
- Considerations of the outcomes of the total factor productivity work undertaken by Economic Insights
- Determination of the prudent and efficient levels of capital and operating expenditure required to support RMO for the period 2014-2018. .

To determine prudent and efficient capital and operating expenditure for the RMO we have endeavoured to apply the following methodology:

- Adjustments to reflect better information being available.

- Rebasing of expenditure profiles where required to achieve a common price base (if applicable).
- Removal of items of expenditure that are determined to be unjustified in the regulatory period.
- Adjustment to the timing of items of expenditure where there is sufficient evidence that the timing proposed is unrealistic.
- Adjustment of any top down factors applied to expenditure categories where it is believed that the factors applied are unreasonable (for example cost contingencies and real escalation factors).
- Adjustments to reflect the scope for efficiency gains.

# 2 Operating Environment

## 2.1 Governance arrangements

The Murray Darling Basin Authority is an independent Commonwealth agency that is responsible for planning for and managing water resources in the Murray Darling Basin. The governance arrangements relating to the Authority as described in the Water Act 2007 are summarised in Figure 2-1.

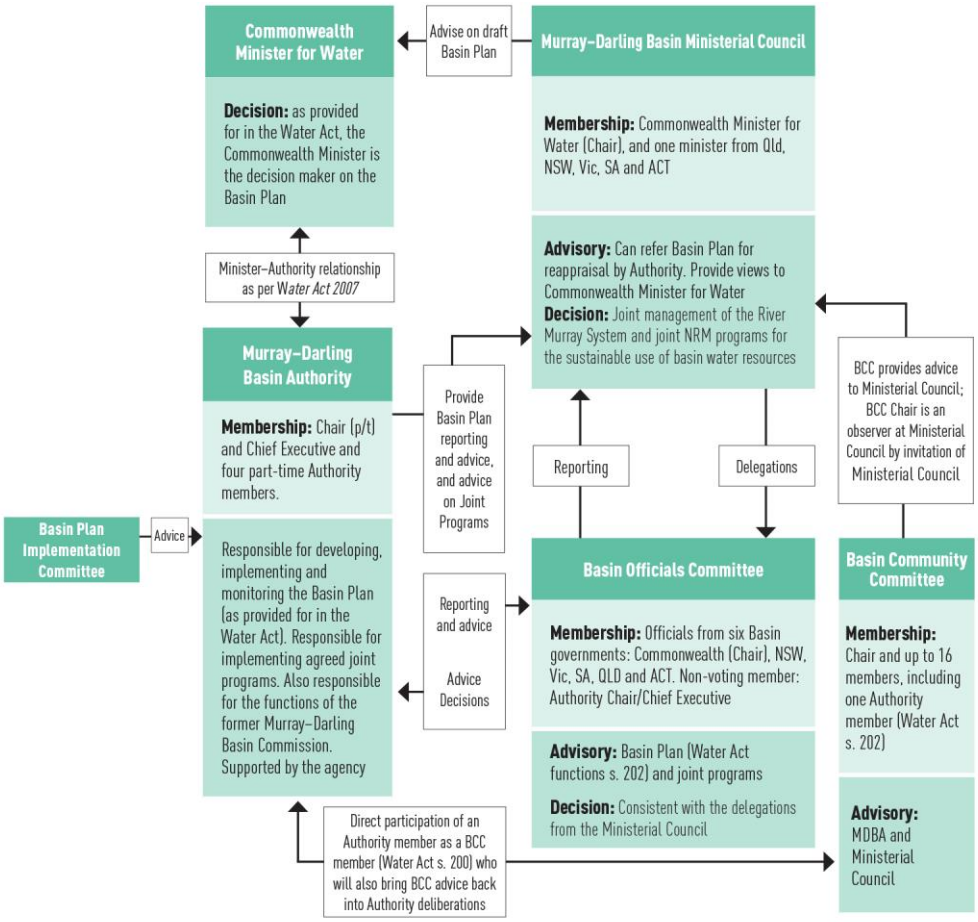


**Figure 2-1 Governance arrangements under Water Act 2007**

*Source: http://www.mdba.gov.au/about-mdba/governance*

The Ministerial Council has important advisory and decision making roles. Its most important function in relation to River Murray Operations is its role as the approving body for the Authority's Corporate Plan which covers a period of four years but is updated annually. The Corporate Plan process is discussed further in Section 2.2.

The role of the Basin Officials Committee is to provide advice to the Authority about performing its functions and to facilitate cooperation and coordination between the Commonwealth, the Basin States and the Authority. An important item of advice provided by the Committee to the Authority relating to River Murray Operations is the annual 'Objectives and Outcomes' for the operations. This is discussed further in Section 4.2.

## 2.2 Corporate Plan and funding process

The fundamental planning document for the Murray Darling Basin Authority's activities is the Corporate Plan which is a requirement under s213A of the Water Act. The Act requires that the Corporate Plan:

- Be prepared at least annually

- Cover a planning period of four financial years
- Be approved by the Ministerial Council annually
- Include:
  - The objectives of the Authoirty
  - The Authority's planned activites for the planning period that relate to its functions under the Water Act
  - The budget for the planned activities.

The Corporate Plan process is illustrated in Figure 2-2. The Corporate Plan process applies to all joint activities, including River Murray Operations.

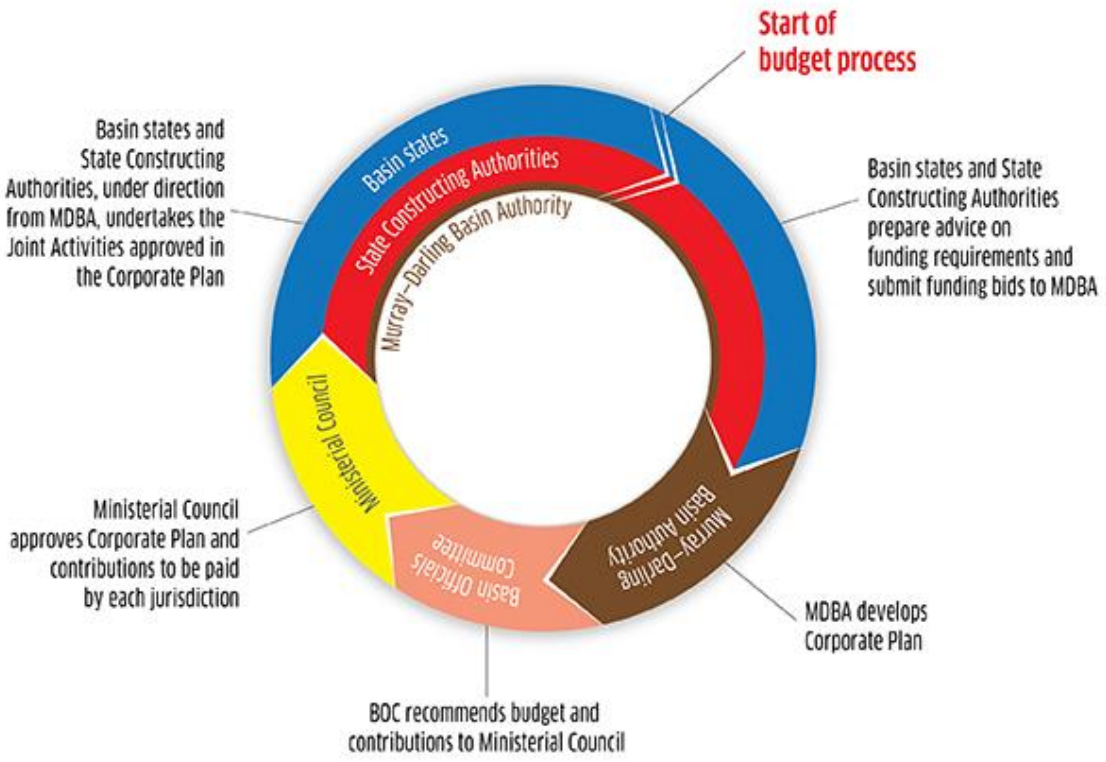


**Figure 2-2 Joint Activities planning cycle**

*Source: [http://www.mdba.gov.au/what-we-do/joint-activities/funded-activities](http://www.mdba.gov.au/what-we-do/joint-activities/funded-activities)*

The Corporate Plan can include any matters that the MDBA sees fit. The Corporate Plan is provided in draft to the Base Official Committee; the Committee then considers the draft Plan and then provides the draft Plan, and its advice in relation to the Plan, to the Ministerial Council for approval. The Ministerial Council may then approve the Corporate Plan or refer it back to the Authority for further consideration.

Once approved, the Corporate Plan can be amended if the Authority considers that a 'significant variation' is required. The approval process for amendments to the Plan is the same as for the original Plan – the amendment is first considered by the Basin Officials Committee and the Committee then submits the amendment, and its advice regarding the amendment, to the Ministerial Council for consideration. In conjunction with approval of the Corporate Plan, the funding shares between the States and Commonwealth for the activities are determined.

The Corporate Plan includes (amongst the wider activities of the MDBA) the activities proposed by SCAs and the MDBA for River Murray Operations. The following extract provided by the MDBA sets out how the Corporate Plan and funding arrangements develop in practice:

1. *State Contracting Government proposes the construction of a work and submits an estimate to MDBA for inclusion in Corporate Plan.*
2. *MDBA submits draft Corporate Plan to Basin Officials Committee.*

3. *BOC submits the draft Corporate Plan to Ministerial Council together with its advice.*
4. *Ministerial Council decides to construct a work (or not) and includes the funding for the work in the Corporate Plan.*
5. *As work proceeds through investigation and design to construction ready, estimates are updated and subsequent Corporate Plans amended appropriately.*
6. *MDBA approves general scheme of work, designs, specifications, estimates and award of contract provided all are in accordance with Corporate Plan and authorises SCA to proceed with construction.*
7. *SCA implements project and makes all payments relevant to project.*
8. *SCA submits claim for reimbursement of actual costs incurred to MDBA.*
9. *MDBA pays SCA the costs claimed.*
10. *If, during construction, a project encounters costs increases, they are first met from any anticipated savings on an item in the estimates, which savings can be applied to any item which it is estimated will be overspent.*
11. *If there are insufficient funds available from underspends in the current year to cover additional costs, then an amendment to the Corporate Plan may need to be approved by Ministerial Council, utilising in the first instance any accumulated underspends from previous years or any other available joint venture funds (such as interest equivalency). It is possible that partner governments could be requested to provide additional funds, although instances of this are rare and tend to have been in response to an emergency (such as Hume event 1996).*
12. *Once an amended Corporate Plan is approved, the MDBA is able to authorise the SCA to incur the additional expense.*
13. *It should be noted that the Murray-Darling Basin Agreement does not provide for how additional costs should be met if the Ministerial Council does not agree to a proposed amendment to the Corporate Plan.*

## 2.3 Other governance documents

The Water Act also defines other important documents relevant to River Murray Operations and assets. These documents, and the relationships between each, are summarised in Figure 2-3.

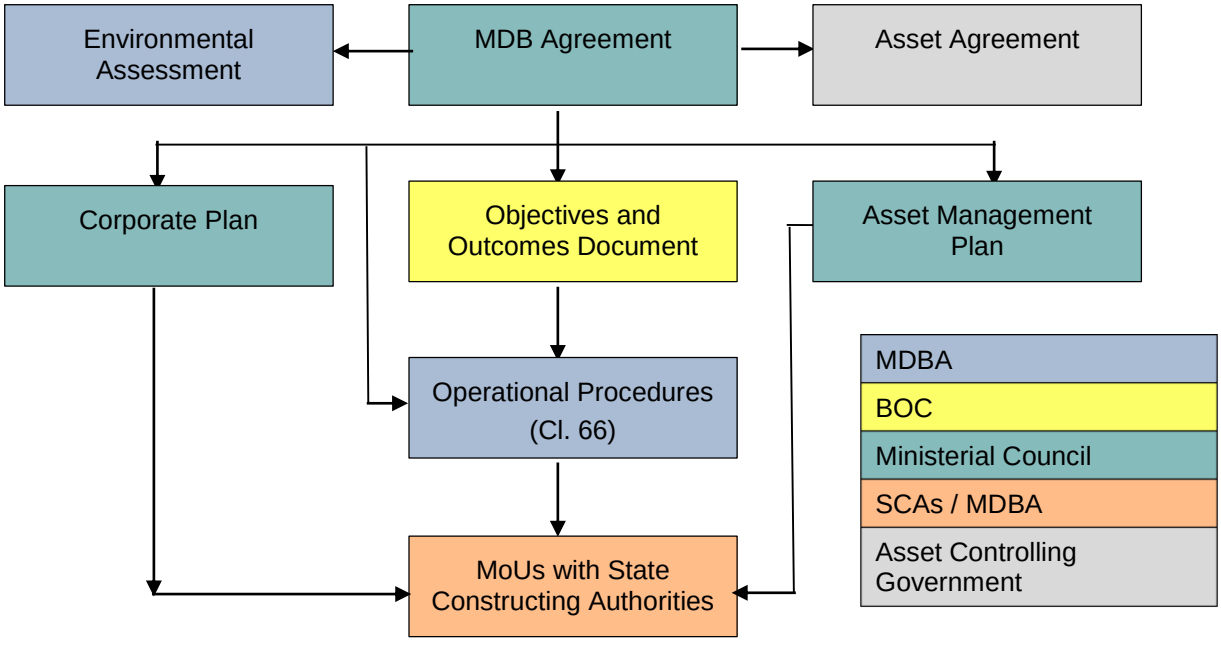


**Figure 2-3 Important River Murray Operations governance documents**

*Source: Objectives and Outcomes for the River Murray Operations in the River Murray System, February 2014*

An overview of each of these documents is provided following and we discuss each further in Section 4.

- **Objective and outcomes** – is a document approved by the Basin Officials Committee each year that sets out 'objectives and outcomes to be achieved by the Authority in relation to River Murray Operations. The oobjectives and outcomes are classified as 'general' and 'specific'. The general objectives and outcomes cover the areas of water storage and delivery accounting, RMO assets, people and communities, environment and communication and information management. The specific objectives and outcomes are mostly defined operating rules or guidance relating to specific assets or reaches of the River.
- **Asset Management Plan** – this is required to cover all River Murray Operations assets and be updated annually. The Asset Management Plan is to be reviewed by the Basin Officials and apprvoed by the Ministerial Council. The Asset Management Plan is to set out for each asset how the it will be 'managed, maintained, repaired, renewed or replaced'. Authority is obliged to follow the asset managmeent strategies set out in the approved Asset Management Plan.
- **Memoranda of Understanding** (MoUs) – the MDBA has entered into Memoranda of Understanding with each of the individual SCAs. These MoUs provide more detail around the processes through which the MDBA and the SCAs cooperate to deliver the joint activities and achieve the set objectives and outcomes.

# 3 Strategic Management Overview

## 3.1 Organisational Arrangements

Within the MDBA, there are four Divisions: Corporate and Business Services, River Management, Policy and Planning, and Environmental Management. The River Management Division is responsible for River Murray Operations. This corporate structure reflects the multiple objectives of the MDBA to deliver water entitlements, plan for the Basin's future and increasingly, manage delivery of water for environmental purposes. The River Management Division is organised into the areas of Assets, Operations and Water Resources.

The MDBA has prepared a 2012-2015 Strategic Plan. This is a high level document that states that the Authority's vision is 'to achieve a healthy working Basin through the integrated management of water resources for the long-term benefit of the Australian community'. Four goals have been set to support this vision:

- Goal 1: Integrated water management: Improved water security and access through transparent, statutory, Basin-wide planning arrangements for trans-boundary water management.
- Goal 2: River and ecosystem health: Protect, restore and improve the ecological health and resilience of the Basin's key environmental assets, water-dependent ecosystems and biodiversity.
- Goal 3: Knowledge into action Develop authoritative information, monitoring and research, in partnership with governments, scientists and communities.
- Goal 4: River Murray asset management: To equitably, efficiently and effectively manage, operate and sustain the River Murray assets to:
  - deliver states' water allocations and environmental outcomes in the River Murray system
  - manage the portfolio of water entitlements of the Living Murray joint venture.

There are no specific actions in the Strategic Plan. As noted in Section 2.2, the Corporate Plan and annual budget are the important tools that are used to manage River Murray Operations activities.

There are a number of formal and informal information sharing and decision making forums to support cooperation between the SCAs and the Authority to deliver River Murray Operations. These include the Asset Management Advisory Panel (which we discuss further in Section 4), the Water Liaison Working Group, and informal discussions between the SCAs and the Authority as part of the annual budgeting process. We have observed that these formal and informal forums that facilitate cooperation between the SCAs and the Authority are very important to the delivery of River Murray Operations.

## 3.2 Service Delivery

The Murray Darling Basin Agreement sets out the framework in which River Murray Operations services are delivered. Section 54 of the Agreement states that 'RMO assets are controlled jointly by the Commonwealth Government and the Governments of South Australia, New South Wales and Victoria ('the asset controlling governments')'. This clause gives rise to the point of view that the River Murray Operations are a joint venture between the relevant States and the Commonwealth. Under s.62, State Governments have responsibility for grating 'all powers, licenses or permissions' for construction, operation and maintenance of works within their territories. This means that River Murray Operations can only be delivered through means decided by the State Governments. In practice, the State Governments have delegated their authority to their State Constructing Authorities (SCAs). As noted in Section 1.3, these SCAs are:

- New South Wales: State Water Corporation and the NSW Office of Water
- Victoria: Goulburn–Murray Water
- South Australia: South Australian Minister for the River Murray, including the operating agents South Australian Water Corporation (SA Water) and the South Australian Department for Environment, Water and Natural Resources.

For each SCA, River Murray Operations are one functional area among other functions that they deliver. Therefore, how River Murray Operations services are delivered by each SCA reflect the unique circumstances of the SCA and the nature of the River Murray Operations.

In South Australia, SA Water has put in place a business (called River Murray Operations) that is solely dedicated to delivering River Murray Operations. The business uses the same processes as the wider SA Water but is ring-fenced from the rest of SA Water for cost allocation and geography; the River Murray Operations are located in Berri, most other SA Water functions are located in Adelaide. SA Water's River Murray Operations do sub-contract much of its maintenance work to its parent which has a depot located in Berri.

For State Water and Goulburn Murray Water, River Murray Operations are delivered within their existing corporate structures using the same processes as for their wider businesses. While costs are ring-fenced through cost allocation, business functions such as planning and asset management are not specifically separated for River Murray Operations. Most operations and maintenance activities are locality based and therefore are focused on River Murray Operations assets.

For the New South Wales Office of Water, the River Murray Operations are one small part of its much wider activities. It has one team dedicated to Salt Interception Schemes. A second team is responsible for 'River Works and Management'. Its activities include managing the banks and channels of the River Murray and the hydrometric network. This same team also manages some environmental assets that are NSW responsibility outside of the River Murray Operations.

## 3.3 Business Systems and Processes

The Murray Darling Basin Authority's core business systems relating to River Murray Operations include its:

- Finance system, Finance One
- Asset Register – spreadsheet based and updated every quarter with disposals and additions with a full revaluation every three years
- Corporate Plan budget – spreadsheet based with activity codes aligned with the finance system.

The SCAs generally use the business systems adopted by the wider organisation. However, there is an expectation that River Murray Operations are ring fenced in these systems.

## 3.4 Cost Drivers

The following 'services' are used for allocating costs in the budgeting process:

- Water Storage and Supply
- Environmental Management
- Navigation Services
- Recreation and Tourism
- Salinity Interception and Management

There are other services for support functions, e.g. Support Services and Real Estate Services. Underneath each service, different 'activities' are defined with 'job details' a further classification below the activities. The activities generally cover tasks such as routine maintenance and operations but also activities such as dam safety and water quality monitoring.

We note the following regarding these definitions of services, activities and job details:

- There is little alignment between these classifications and the de facto service standards used by the MDBA (as discussed in Section 4.2)
- It is not always possible to make the basic distinction between expenditure to maintain the existing quality and quantity of service and expenditure that leads to a change in the quality or quantity of service provided.
- The distinction between operating and capital expenditure is not always clear with some items we would consider capital expenditure classified as operating expenditure and vice versa.

# 4 Asset Management

## 4.1 Strategic Asset Management Processes

MDBA's approach to asset management is through a consensus and partnership style to achieve the desired outcomes. The MDBA considers that asset management is essentially about asset performance, which in turn seeks to satisfy the three things that matter most to MDBA's stakeholders: sustainability of the assets, level of service and cost of service.

Regular communication occurs between MDBA and SCAs. A quarterly meeting Asset Management Advisory Panel (AMAP) is held to discuss progress and issues on projects and to share experiences/ ideas. An asset management forum is held every two to three years to share learnings as part of a continuous improvement process.

The principal strategic asset management document is the *River Murray Operations Asset Management Plan (June 2011)* which was jointly developed by State Water, G-MW, SA Water and MDBA. The Plan:

- discusses 'ownership' and the Asset Management Agreement
- outlines the strategy for the management of the RMO assets and how asset management performance is measured and reported.
- discusses the documentation covering asset management and how the Asset Management Plan fits within the context of the other documents
- outlines the asset management plans for those aspects that are common across asset groups.
- details the Asset Management Plan for each of the major assets (i.e. the Level 1 elements in the Infrastructure Asset Register).

The requirement for the Asset Management Plan and its annual update is set out in the Murray Darling Basin Agreement. The document provided was Draft version 5.4, June 2011 although the text indicated that it was the third update and developed in 2013.

The Plan outlines the Asset Management Strategic Framework in Section 3 of the Plan. This framework considers the relationship of the Plan with the Corporate Plan, supporting policies and asset life cycle planning. The Plan is comprehensive and provides a good overview of the asset base including an overview of each major asset, its operation and maintenance requirements, resourcing, refurbishment and replacement plan. Possible improvements that could be considered in the next update of the Plan include:

- The standards of service that MDBA is seeking to achieve should be listed
- Summary financial information should be provided including:
  - projections for capex (split by driver – renewals, enhancements and opex (split into operations, planned maintenance, routine maintenance)
  - Renewals, planned maintenance and renewals annuity projections
- High level statistics including percentage of infrastructure (in current cost terms) at various condition grades and risk ratings.
- A summary improvement action plan with a three year horizon, specific targets and priorities should be listed. The current text includes a number of potential improvement opportunities but these are dispersed throughout the body of the report.
- Detailed information on the various facilities (sections 6 to 43 of the Asset Management Plan) could be located in a supporting document.

It is considered that implementation of the above improvement opportunities would better place the Asset Management Plan in driving the Corporate Plan as it would provide the relevant statistics (e.g. asset condition and risk profile, short/medium and long term renewals and planned maintenance forecasts).

Currently the asset management process works because a co-operative, consultative relationship exists between MDBA and the SCAs. All the organisations have highly experienced, technically proficient staff who are able to work together in a professional manner and able to prioritise investments through discussion and determination of priorities based on engineering judgement. Following consultation MDBA makes the final judgement on priorities.

### 4.1.1 Strategic AM Approaches by SCAs

G-MW, SA Water and State Water are mature bulk water utilities that have been managing their asset base since the early 1900s. Each of these organisations has a strategic asset management framework in place for managing its own assets and applies this framework to the management of the MDBA assets.

Both G-MW and State Water are subject to regulatory oversight of their asset management functions. Asset management practices within the three SCAs are also reviewed as part of efficiency reviews undertaken to assess prudent and efficient expenditure in their pricing submissions.

## 4.2 Service Standards and Asset Performance Targets

Service/ performance standards for MDBA are listed in a range of documents. These include:

- the Memoranda of Understanding (MOU) between MDBA and individual SCA's. Schedule 4 of each MOUs lists performance standards in the following categories:
  - Documentation (e.g. availability/ update of operation and maintenance documents)
  - Occupational health and safety (e.g. lost time injuries)
  - Public safety (e.g. public risk assessments)
  - Insurances
  - Dam safety surveillance (compliance with ANCOLD guidelines)
  - Flood planning (e.g. annual flood preparedness exercises)
  - Flood operations (e.g. notified flow changes)
  - Routine operations (e.g. flow change implementation at various sites)
  - Hydrometric data (e.g. station availability)
  - Budgets (e.g. activities performed within budget, investigation and construction projects delivered within budget and agreed program)
  - Staffing (e.g. vacancy filling)
  - Asset registers (e.g. updating of details)
  - handover certificate for major works (e.g. certificate handover and asset register update)
- the Objectives and Outcomes for River Operations in the River Murray System document (Appendix 1 – Specific Objectives) includes specific targets for the various assets in the Murray-Darling system. Examples of targets include:
  - minimum release levels
  - minimum water levels
  - minimum flow
  - maximum rates of fall
  - maximum level rate rise
  - trigger storage levels
  - air space (Hume Dam)
- The Basin Plan includes targets for salinity (95% of the time) at various locations along the Murray and the Darling rivers as well as requiring consideration of impacts on water quality as a result of river management activities.

- Currently the assets are required to be 'fit for purpose' but no criteria are documented as to what this means for individual assets. MDBA and SCA staff have a tacit understanding of the expression.

The Independent River Operations Review Group (IRORG) in its 2012/13 review of River Murray Operations recommended (Recommendation 10) a review of KPIs to identify the most suitable set of indicators, and how they can be better quantified and measured.

As well as the operational service target , possible target indicators to reflect asset performance would be;

- asset availability
- percentage of assets (in current cost terms) in various condition grades
- percentage of critical assets (in current cost terms) in various condition grades
- percentage of assets (in current cost terms) in with various risk ratings

As discussed in section 4.1 relevant service and asset performance targets should be listed in one location, for example, the Asset Management Plan. Where necessary the targets could be summarised with reference to further details.

An annual report which compares performance against the relevant service and asset performance targets would be a useful tool in assessing overall performance in a quantifiable manner.

## 4.3 Asset Base

Table 4-1 provides a summary of the asset base while the replacement cost of this asset base by asset type is illustrated in Figure 3 1.

**Table 4-1 Summary of Asset Base**

| Asset type | No. | Current Replacement Cost | Written Down Value | % of Lifecycle Expended |
|---|---|---|---|---|
| Dam / Weir | 4 | $2,477,372,000 | $1,726,596,854 | 30% |
| Lock and Weir | 13 | $745,322,000 | $314,178,582 | 58% |
| Salt Interception Scheme | 13 | $242,992,340 | $179,529,453 | 26% |
| Barrage | 5 | $166,224,000 | $65,879,741 | 60% |
| Natural Infrastructure | | $28,337,000 | $21,456,909 | 24% |
| Floating Plant | | $7,378,000 | $3,577,407 | 52% |
| Hydrometric | | $5,628,000 | $3,400,451 | 40% |
| Slipway | | $4,060,000 | $2,690,091 | 34% |
| Regulators | | $19,318,000 | $12,962,980 | 33% |
| **Total** | | **$3,696,631,340** | **$2,330,272,470** | **37%** |

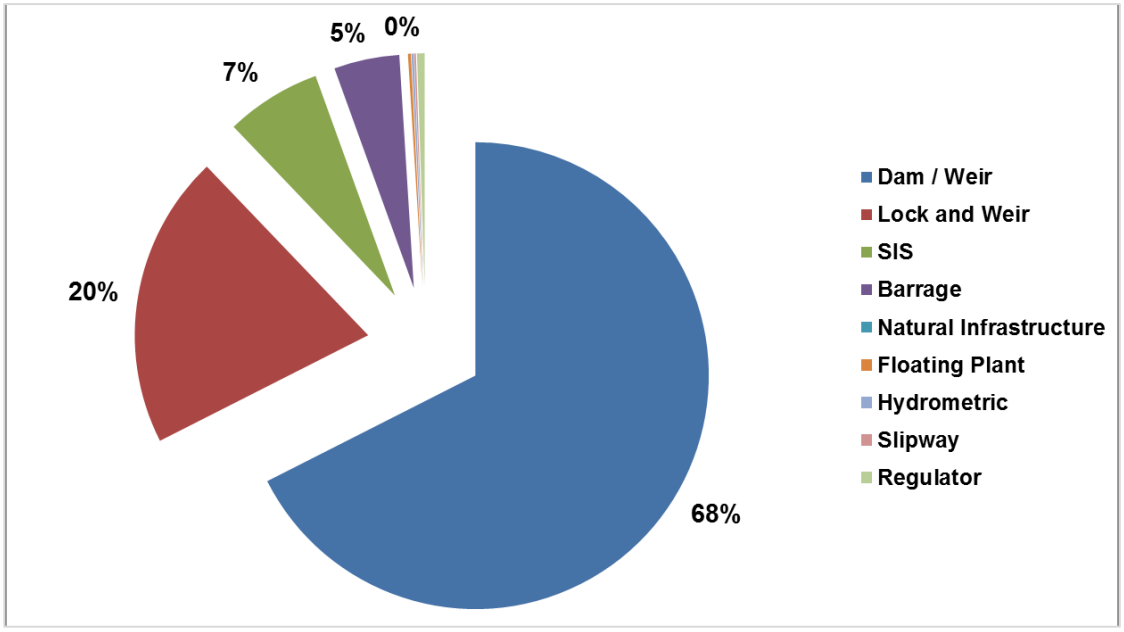


**Figure 4-1 Current Replacement Cost by Asset Type**

RMO Assets are dominated by two major assets (Dartmouth and Hume), which together make up more than 60% of the total asset current replacement cost. Assets classified as dams/weirs account for two thirds of the asset base. The next biggest asset classes (after dams/weirs) are locks and weirs (20% of asset base) and salt interception schemes (7%). The locks are relatively old, and the salt interception schemes are relatively young. Barrages make up about the same value as salt interception schemes (5%). Other asset classes are relatively insignificant (<1% in total).

Most of the RMO assets have very long design lives. 83% of the assets, by current replacement cost, have a useful life of over 80 years, and one third of the total has a useful life of over 200 years. Less than 4% of the total asset current replacement cost has a useful life of less than 30 years. The statistics are illustrated in Figure 4-2 and Figure 4-3. Figure 4-2 shows the current replacement cost by relative age expressed as a percentage of useful life for the RMO assets. The size of the bubbles reflects the current replacement cost.

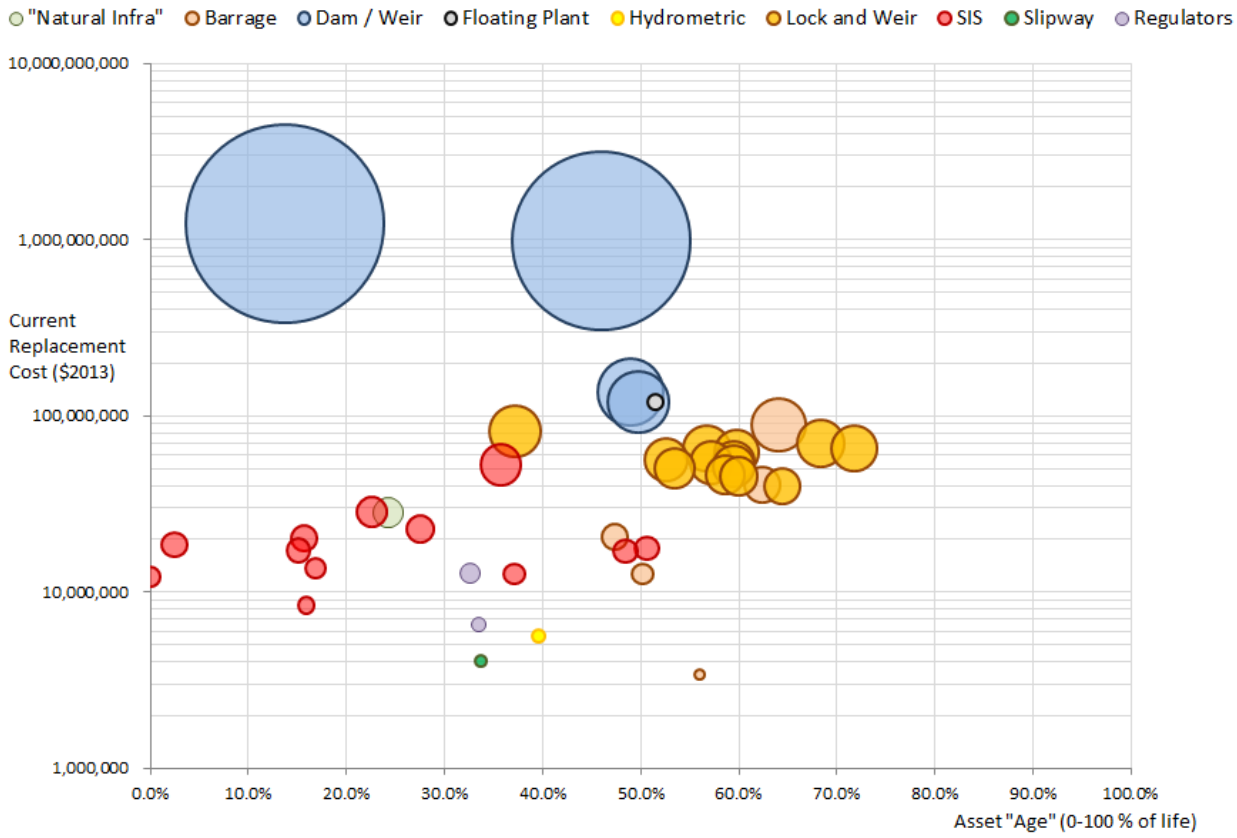


Figure 4-2 Asset Replacement Cost and Relative Age

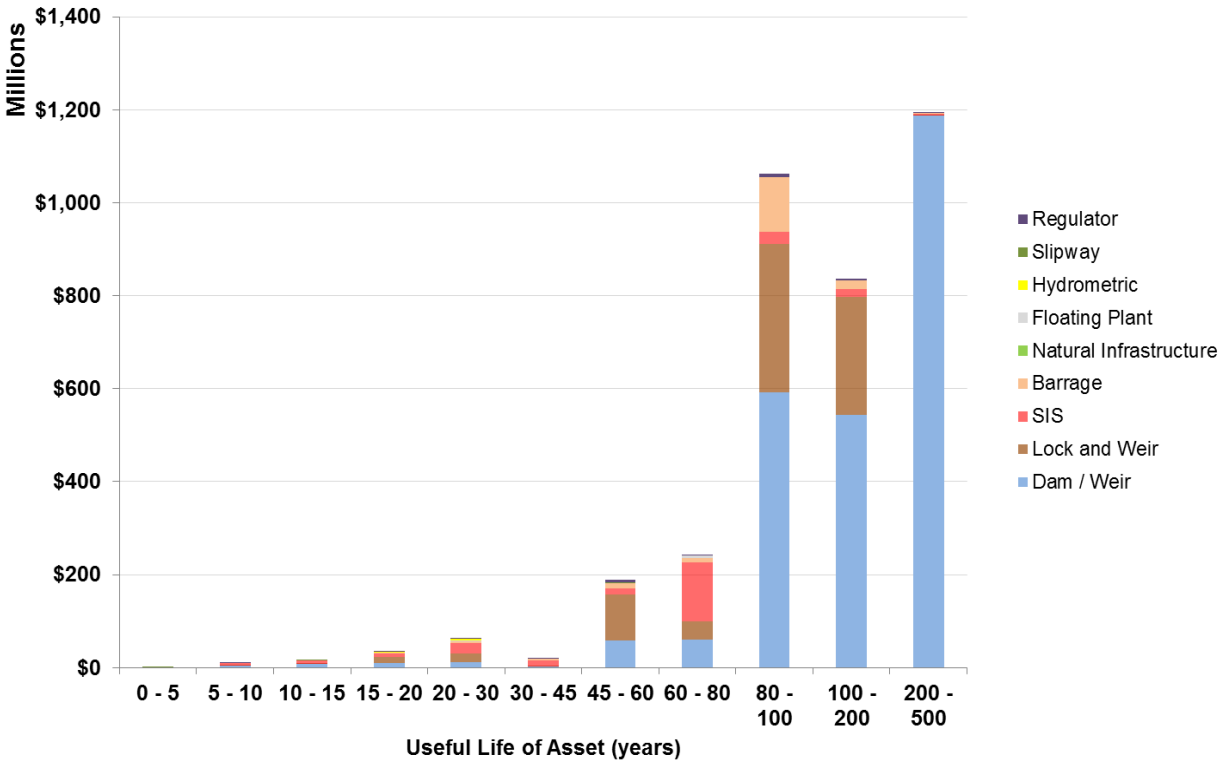


Figure 4-3 Asset Current Replacement Cost grouped by useful life (design)

## 4.4 Asset Condition and Performance

Overall the condition of the assets is considered to be good. Over recent years MDBA has been able to address its high risk public liability and OHS risks and the highest dam safety risks. The challenge now is to maintain the asset base.

From discussions with SCA's and documents provided we formed the opinion that The SCA's have their 'finger on the pulse' in relation to the condition of MDBA assets and a sound understanding of the criticality of the various assets to the operation of the River Murray system. This knowledge has been gained through regular inspections of the assets as part of the planned maintenance program supplemented by a comprehensive annual inspection (or at least every two years) of the assets and 5 year surveillance reviews of major dams. The teams undertaking the annual inspection and 5 year surveillance inspections are typically multi-disciplined and a senior MDBA representative is usually part of the team. For the 5 year surveillance inspection external specialists may also be involved. The inspection programs for major dams and weirs are mandated by the relevant State dam regulator to comply with the relevant ANCOLD guidelines.

SCAs generally apply a condition score to each asset within their asset register contained in the relevant maintenance management system. There are some differences in the condition ratings applied by the SCAs which need to be taken into account when comparing condition ratings across the assets.

## 4.5 Asset Maintenance

Maintenance is classified as routine or planned. Routine maintenance primarily consists of scheduled maintenance but incorporates corrective maintenance to address minor deficiencies in asset condition or performance. Planned maintenance is maintenance that is typically undertaken every few years, at significant cost, to ensure that an asset reaches its design life. Very few asset failures were reported, this was due to the effective routine and planned maintenance program supported by the annual and five year inspections. These ensure that assets do not deteriorate to a level where major refurbishment or replacement is required. Many of the MDBA assets have a very high consequence of failure and a scheduled/ planned maintenance approach for these assets is appropriate. It is likely that the current approach is able to extend asset useful life except in cases where the useful life is based on technology or availability of spare parts.

Maintenance schedules are developed from manufacturer's recommendations, past operational experience and standards. Some activities can only be undertaken on an opportunistic basis (e.g. during the non-irrigation season, low water levels)

In most instances maintenance is undertaken by in-house staff supplemented by external providers for specific tasks. A number of reasons were provided for the use of in-house staff including:

- many of the SCA staff were multi-skilled, often had trade qualifications, and were able to undertake both operations and maintenance
- as staff were required to be based on sites much of the maintenance could be undertaken on an opportunistic basis

We noted that MDBA has not assigned a consequence of failure (criticality) rating to its asset base. State Water already have criticality ratings for MDBA assets in its FMMS system while G-MW should have ratings in Maximo within the next one to two years. Assigning a criticality rating to each asset would allow MDBA to review its maintenance strategies for the full asset base and develop maintenance strategies appropriate to the criticality of the asset with lower criticality assets having a lower level of maintenance.

State Water manages the maintenance of MDBA assets through its FMMS. A new asset management system is proposed to meet the needs of the entity that will result from the merger of State Water and Sydney Catchment Authority (Water NSW). G-MW manages maintenance through a spreadsheet/paper based system but is currently setting up MDBA assets in its Maximo system. It is expected that maintenance of MDBA mechanical/electrical assets will be managed through Maximo in mid2015 with civil assets scheduled by mid2016. SA Water uses Maximo for managing maintenance but also uses spreadsheets to track the maintenance carried out on each asset. NoW has recently implemented SAP which it uses to capture maintenance costs but activity tracking is performed in spreadsheets. We were of the view that

maintenance activities were generally well managed and appropriate for the activities being undertaken. Implementation of computerised maintenance management systems will allow better opportunities for analysis and optimisation of maintenance tasks.

Condition monitoring is mainly visual complemented by monitoring of important measurements such as seepage and piezometers at dams.

State Water has commenced trials on using Reliability-Centred Maintenance (RCM) on three of its dams to enable it to focus its maintenance on critical activities. They reported that no significant changes to current practices were found but identified some gaps in current tasks.

## 4.6 Asset Information Systems

The MDBA approach is that they specify formats for submission of data (typically an Excel spreadsheet) with SCA's using their own systems to provide the data. This is an efficient approach as each SCA does not have to run separate systems. The MDBA financial system is a Tech One financial system. It's asset register is stored in a spreadsheet. The information systems used by each SCA is summarised in Table 4-2.

MDBA is able to monitor key operating parameters at various sites through the SCADA system.

**Table 4-2 SCA Information Systems**

| State Constructing Authority | Maintenance Management System | Financial System | GIS |
|---|---|---|---|
| G-MW | Maximo | Tech One | Dekho |
| NSW Office of Water (NoW) | (none) | SAP | ArcView |
| SA Water | Maximo | Ellipse | ArcView |
| State Water | FMMS | Tech One | ArcView (through NoW) |

## 4.7 Asset Register

The MDBA asset register was initially developed in 2000 and has been revised and updated since that period. The asset register is located in a spreadsheet with individual worksheets for each asset (e.g. Dartmouth Dam), unit rate tables and a summary worksheet.

Assets are disaggregated to four levels, as follows:

- Level 1 Dartmouth Dam
- Level 2 Embankment
- Level 3 Instrumentation
- Level 4 Hydraulic Piezometers

SCA's are responsible for advising MDBA of any additions, modifications and disposals each year. An independent valuation by an experienced consulting engineer is undertaken every three years and valuations are undertaken to level 4. SCA's participate in the process though meetings/ workshops to identify any anomalies, errors or changes in the asset listing and to advise on asset remaining lives. Inputs on unit rates, based on recent contracts, where available, is also sought from the valuer, an experienced consulting engineer. A site visit is made to a large percentage of sites, but not all.

A valuation report which outlines the methodology, assumptions and results is provided to MDBA along with an updated spreadsheet.

We considered that the asset register was comprehensive and MDBA has a robust annual additions and disposals process. The process for a three independent valuation with indexing of costs in the intermediate years is sound and consistent with accounting standards. From our review of the process, valuation report

and discussions with MDBA and SCA's we consider that the register provides a reliable source of information on the assets controlled by MDBA.

We reviewed a sample of the unit rates included in the report and compared them to rates adopted by Cardno. Generally, we found that rates (inclusive of on-costs) were consistent (within a +/- 25% band). We considered that the on-costs (35% to 39%) were higher than the on-costs typically used by Cardno but since the total rates are fairly consistent then this is not a major problem.

The useful lives adopted were consistent with typical industry values. We noted some inconsistences in the useful lives of similar assets but on further investigation found that in many cases there valid reasons for the variance. However, in some instances errors were noted but these were not considered material.

Possible improvements to the asset register include:

- the inclusion of a condition rating score and consequence of failure (criticality score) from which an asset risk score can be generated. A process for moderating the various condition/ criticality scores would need to be developed.
- Developing a separate register for the River Murray banks and channel rehabilitation works which would include asset details (location, attributes, etc.), condition rating, consequence of failure and risk rating. This would likely to be GIS based and we understand that MDBA already has some datasets that could be incorporated in the register.

## 4.8 Risk Management

MDBA and the SCAs each have a risk framework in place. The MDBA Risk Management Policy is included in Appendix B of the Asset Management plan. The MDBA Business Case template includes a section and guidance fir identifying and managing risks during the project phase.

Each SCA applies its own framework to assessing risks associated with MDBA assets.

The principal risks associated with the MDBA's assets are:

- risk reduction at the five large storages with the relevant ANCOLD guidelines. These storages include Hume Dam, Dartmouth Dam, Yarrawonga Weir, Torrumbarry Weir and Lake Victoria. The aim has been to reduce risk to below the 'Limit of Tolerability' in the short term then aim to meet ANCOLD 'As Low as Reasonably Practical (ALARP) principles in the long term. A Portfolio Risk Assessment (PRA) was undertaken in 2007 and this study has been the basis of the MDBA's risk reduction strategy for its larger storages. Hume Dam had the three highest priority risks.
- OH&S risks at older structures where traditional work methods are no longer compliant with contemporary OH&S practices. Most of the higher risks in this category have been addressed over the past few years but some still remain (e.g. Mildura Weir stop-logs).
- Flood risks. MDBA has prepared the River Murray System Emergency Action Plan (EAP) which sets out roles and responsibilities of MDBA staff, procedures, communication processes as well as resourcing and training requirements for emergencies relevant to RMO assets. The EAP operates concurrently with the Dam Safety Emergency Plans (DSEPs) developed by the SCAs.

## 4.9 Renewals Forecasting

MDBA has developed a 35 years renewal forecast that has been reviewed and updated by MDBA as an input into the building blocks model. The main input into the renewals forecast is the asset register. As outlined in section 4.7, the remaining life of assets in the short term is based on the asset condition while in the medium and longer term the remaining life is based on the original useful life (i.e. design life) minus age.

Other inputs to renewals forecasting are derived from the comprehensive annual and five year inspections. Minor works arising from these inspections are accommodated within the SCAs' routine maintenance budget while more costly works would be addressed though the planned maintenance budget or I&C budget and programmed by MDBA based on the priority and budget constraints.

Dam safety works are included in the 35 year renewals forecast. The program for this investment was initially determined though the 2007 PRA study. The expenditure is classified under renewals as there is no increase to service capacity (yield) of the dam/weir as a result of dam safety upgrades.

The renewals and planned maintenance expenditure over the first four years is based on the 2014-18 budget estimates.

## 4.10 Investment Appraisal

The need for asset investment is identified through the:

- 2007 Portfolio Risk Assessment (PRA) in relation to dam safety upgrades
- annual inspections and five year surveillance inspections which address asset condition, performance and compliance

Priorities for progressing any capital investment, initially though undertaking a pre-feasibility/ feasibility report, are agreed between the MDBA and SCA's. A pre-feasibility report provides an indicative forward budget. Once MDBA has approved the project to proceed a feasibility report is prepared to provide an indicative budget which evaluates options, assesses risks, and provides cost estimates. Based on the feasibility report the MDBA will prepare a Business Case for consideration by BOC. MDBA has a business case template which is required for all projects greater than $100,000 in value. This template includes the standard components of a contemporary business case.

The resources assigned to the feasibility report is commensurate with the project scop, cost and risk.

Challenge to projects occurs through internal SCA processes and through MDBA challenge. MDBA is involved throughout the project lifecycle with its involvement increasing with scope, budget and project risk. For the larger projects MDBA chairs the project steering committee.

## 4.11 Cost Estimating Process

The SCAs use a range of methods for estimating depending on the project size, level of project development. These methods included:

- analogous estimating based on similar projects
- schedule of rates
- risk-based estimating for larger projects.

Estimates are developed by SCA staff, consulting engineers and for larger projects specialist estimators. MDBA requires that pre-tender estimates have a contingency of 10% which is reasonable. No guidance is provided on the contingency to be applied at the various stages of the project lifecycle with selection of an appropriate contingency being left to individual SCAs and their consultants.

## 4.12 Capital Delivery Processes

MDBA is aware of all the capital projects through its involvement from the needs identification stage and regular communication with the SCAs. MDBA is involved throughout the project lifecycle with its involvement increasing with project scope, budget and project risk. For the larger projects MDBA is involved on the project steering committee while it chairs the project steering committee.

Projects are prioritised based on discussions held between MDBA and SCAs with MDBA making the final decisions based on its extensive experience and knowledge of RMO assets and associated risks and the available budget. The current process works well but it relies on the MDBA retaining the high calibre senior that it currently has and ensuring adequate succession planning for the key decision makers. Assigning risk scores to each asset as previously mentioned would facilitate the prioritisation process. Documenting broad guidelines on project priority criteria may also be useful.

For high risk/cost projects involve external peer review.

Monthly reports on projects are submitted by SCAs and projects are reviewed at the quarterly AMAP meetings.

MDBA applies hold points at various stages of the project lifecycle including:

- completion of the feasibility report/ business case prior to progressing to detailed design
- detailed design prior to progressing to tender
- tender stage.

## 4.13 Procurement

MDBA and SCAs' procurement processes are aligned with the relevant Commonwealth and State procurement policies.

Significant use is made of engineering consultants who are selected based on value for money criteria.

The major construction projects are undertaken following detailed design. Some projects (e.g. Mildura Trestle Replacement) have involved early contractor involvement.

## 4.14 Continual Improvement

Continual improvement in asset management and project delivery is achieved through:

- regular communication and interaction between MDBA and SCAs including quarterly AMAP meetings
- asset management forum held every 2 -3 years
- preparation of construction reports and benefits realisation reports for major projects by SCAs
- preparation of lessons learnt reports by MDBA (e.g. EWMP Lessons learnt – Interim Report (draft 13) Feb 2013)
- the collaborative culture that exists between MDBA and SCAs.

## 4.15 Conclusions

From our discussions with MDBA, SCAs and a review of documents provided we concluded that the asset management and project delivery processes were robust and appropriate.

MDBA's approach to asset management and project delivery is through a consensus and partnership style to achieve the desired outcomes.

Currently the asset management process works because a co-operative, consultative relationship exists between MDBA and the SCA's. All the organisations have highly experienced, technically proficient staff who are able to work together in a professional manner and able to prioritise investments through discussion and determination of priorities based on engineering judgement. This approach is likely to continue provided MDBA is able to attract and retain senior staff with expertise and a collaborative approach.

The asset management plan is comprehensive. We have possible improvements that could be considered in the next update of the Plan. It is considered that implementation of the improvement opportunities would better place the Asset Management Plan in driving the Corporate Plan as it would provide the relevant statistics (e.g. asset condition and risk profile, short/medium and long term renewals and planned maintenance forecasts)

Relevant service and asset performance targets should be listed in one location, for example, the Asset Management Plan. An annual report which compares performance against the relevant service and asset performance targets would be a useful tool in assessing overall performance in a quantifiable manner.

The asset register is comprehensive and well developed. We have proposed the inclusion of a condition rating score and consequence of failure (criticality) score from which an asset risk score can be generated.

# 5 Asset Valuation

## 5.1 MDBA Asset Register

The development of and content in MDBA's asset register have been discussed in Section 4.7.

We considered that the asset register is comprehensive and MDBA has a robust annual additions and disposals process. The process for a three yearly independent valuation with indexing of costs in the intermediate years is sound and consistent with accounting standards. From our review of the process, valuation report and discussions with MDBA and SCA's we consider that the register provides a reliable source of information on the assets controlled by MDBA.

The useful lives adopted were consistent with typical industry values. We noted some inconsistences in the useful lives of similar assets but on further investigation found that in many cases there valid reasons for the variance. However, in some instances errors were noted but these were not considered material.

## 5.2 Adjustments to Asset Values to Account for Modern Equivalent Assets

We have reviewed as constructed drawings and the asset register for the River Murray Operations assets to assess whether there are opportunities for optimised designs that would have a lower replacement cost then the current assets. In undertaking this assessment we focused on Hume and Dartmouth Dams as these account for over two thirds of the asset base on a current replacement cost basis.

We found that the form of the Hume Dam is relevant to the site even by modern standards. The concrete works are not suited to roller compacted concrete construction. Gate technology is still relevant although the control mechanisms would be vastly improved. Assuming all foundation anchors are functioning normally, they would continue to be relevant to a modern dam. For the embankment, an earth core would more likely be adopted today rather than a concrete core (thereby avoiding the more recent problems). Over the life of the dam various augmentations, modifications, strengthening and remedial works have been undertaken. It would be expected that a modern equivalent dam would be constructed in a different manner and would not require the extensive remedial works that have had to be carried out. It would be difficult to determine the cost of a modern equivalent dam without undertaking significant preliminary concept design. However, given the extent and cost of remedial works and the potential opportunities for cost savings using modern equivalent we consider that a 10% reduction in costs could be achievable.

We found that the form of Dartmouth Dam is still relevant. There are possible alternative modern options available such as concrete faced rock fill or roller compacted concrete. However, without undertaking concept design for these alternatives it is not possible to determine whether these are lower lifecycle cost alternatives. Therefore, no adjustments for a modern equivalent have been made for this structure.

We compared the replacement cost of Mildura Lock 11 as estimated by URS in 2009 (*Mildura Weir Replacement Options Evaluation, URS, March 2009*) with the current replacement cost in the asset register and found that the difference was not significant. Also, we noted that navigation is a requirement under the Murray Darling Basin Agreement and therefore inclusion of locks at weirs is necessary. On this basis, we have accepted that the current replacement costs for locks and weirs are appropriate for an optimised modern equivalent.

## 5.3 Unit Rate Adjustment

We compared a range of unit rates (inclusive of overheads) with rates (inclusive of overheads) adopted by Cardno in undertaking asset valuations for water utilities including bulk water suppliers. Overall we considered that the MDBA rates generally compared quite well against the Cardno rates as shown in Figure 5-1.

MDBA rate for mass concrete appeared to be high at $\$1115/m^3$ (including overheads). We consider a rate of $\$695/m^3$ (including overheads) to be adequate for Hume Dam and $\$975/m^3$ (including overheads) for Dartmouth Dam. We found that this had a significant impact on the Hume Dam value but negligible impact on Dartmouth Dam.

We found that the rates applied for valves rates appear to be high. Dams include a number of specialist valves and it is likely that the high costs reflect the nature of the valves.

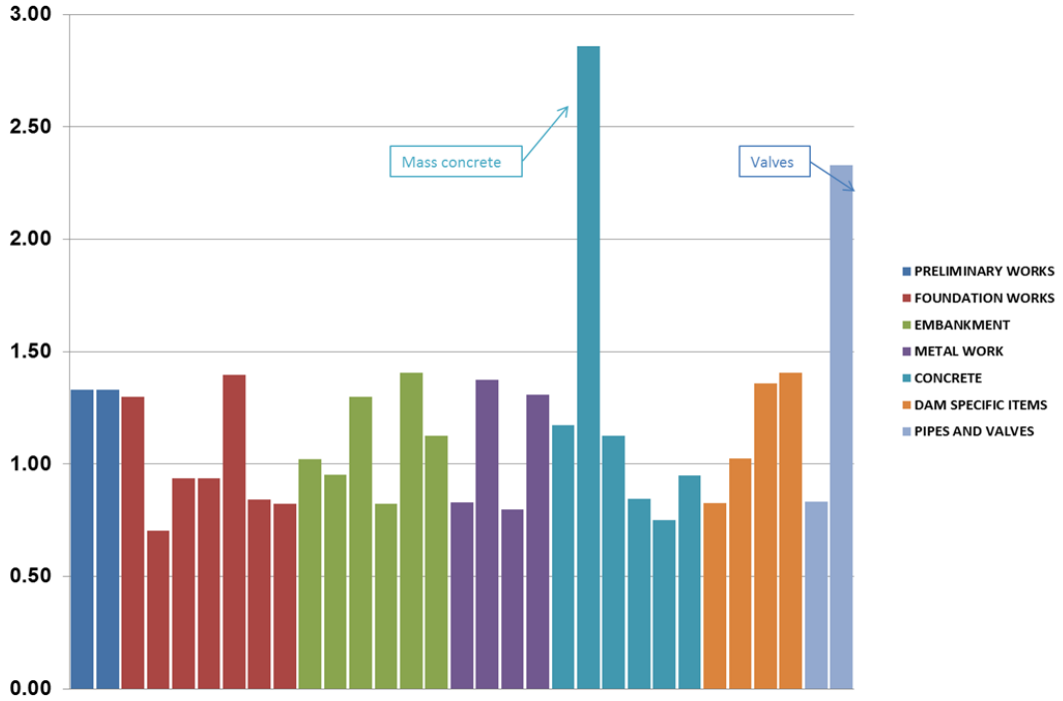


Figure 5-1 Ratio of MDBA Rates to Cardno Rates

### Useful Lives

We reviewed the useful lives adopted in the asset register. We observed some variances in useful lives adopted for similar assets but on more detailed assessment and discussion with SCAs valid reasons were provided for many of the variances. A few variances could only be attributed to an error but the impact of this on the overall values was considered immaterial.

### Impact of Adjustments

The impact of reducing the replacement cost of Hume Dam to take into account modern equivalent construction and the mass concrete unit rate adjustment is shown in Table 5-1. However, the overall impacts on the MDBA asset portfolio is not significant with its current replacement cost reduced by 6% as shown in Table -5-2

Table 5-1 Adjustment Impacts on Hume Dam

| | Current replacement Cost | Written Down Value |
|---|---|---|
| Modern Equivalent Adjustment | | |
| Hume Dam 2013 asset register | $1,001,391,907 | $532,553,303 |
| Adjustment for modern equivalent | $100,139,191 | $53,255,330 |
| Hume Dam adjusted for modern equivalent | $901,252,716 | $458,692,395 |
| **Percentage reduction** | **10%** | **10%** |
| | | |
| Unit Rate Adjustment | | |
| Hume Dam 2013 asset register | $1,001,391,907 | $532,553,303 |
| Adjustment | $119,165,303 | $69,915,745 |
| Hume Dam adjusted for unit rates | $882,226,604 | $462,637,558 |
| **Percentage reduction** | **12%** | **13%** |

| | Current replacement Cost | Written Down Value |
|---|---|---|
| Modern Equivalent and Unit Rate Adjustment | | |
| Hume Dam 2013 asset register | $1,001,391,907 | $532,553,303 |
| Adjustment | $219,304,494 | $123,171,075 |
| Hume Dam adjusted for modern equivalent and unit rates | $782,087,413 | $409,382,228 |
| **Percentage reduction** | **22%** | **23%** |

**Table -5-2 Adjustment Impacts on MDBA Asset Portfolio**

| No. | Asset | 2013 MDBA Valuation | | Adjusted Values | |
|---|---|---|---|---|---|
| | | Current Replacement Cost | Written Down Value | Current Replacement Cost | Written Down Value |
| A1 | Dartmouth Dam | 1,246,694,664 | 1,070,949,379 | **1,246,694,664** | 1,070,949,379 |
| A2 | Hume Dam | 1,001,391,907 | 532,553,303 | **782,087,413** | 409,382,228 |
| A3 | Yarrawonga Weir | 138,633,329 | 69,381,280 | **138,633,329** | 69,381,280 |
| A4 | Millewa Forest Regulators | 13,880,541 | 9,455,573 | **13,880,541** | 9,455,573 |
| A5 | Barmah Regulators | 6,573,561 | 4,295,111 | **6,573,561** | 4,295,111 |
| A6 | Torrumbarry - Lock 26 | 83,447,551 | 51,442,842 | **83,447,551** | 51,442,842 |
| A7 | Euston - Lock 15 | 40,118,384 | 13,780,901 | **40,118,384** | 13,780,901 |
| A8 | Mildura - Lock 11 | 66,979,785 | 18,835,060 | **66,979,785** | 18,835,060 |
| A9 | Wentworth - Lock 10 | 71,021,119 | 21,716,812 | **71,021,119** | 21,716,812 |
| A10 | Kulnine - Lock 9 | 62,912,903 | 24,869,072 | **62,912,903** | 24,869,072 |
| A11 | Wangumma - Lock 8 | 51,454,882 | 23,518,567 | **51,454,882** | 23,518,567 |
| A12 | Lake Victoria | 121,522,746 | 59,652,644 | **121,522,746** | 59,652,644 |
| A13 | Rufus River - Lock 7 | 57,470,644 | 26,748,000 | **57,470,644** | 26,748,000 |
| A14 | Murtho - Lock 6 | 55,211,630 | 23,226,244 | **55,211,630** | 23,226,244 |
| A15 | Renmark - Lock 5 | 66,311,655 | 28,106,194 | **66,311,655** | 28,106,194 |
| A16 | Bookpurnong - Lock 4 | 52,792,562 | 21,199,350 | **52,792,562** | 21,199,350 |
| A17 | Overland Corner - Lock 3 | 47,158,333 | 19,087,654 | **47,158,333** | 19,087,654 |
| A18 | Waikerie - Lock 2 | 46,642,396 | 18,657,469 | **46,642,396** | 18,657,469 |
| A19 | Blanchetown - Lock 1 | 55,631,318 | 22,211,738 | **55,631,318** | 22,211,738 |
| A20 | Goolwa Barrage | 90,142,717 | 31,473,771 | **90,142,717** | 31,473,771 |
| A21 | Mundoo Barrage | 12,863,096 | 6,245,091 | **12,863,096** | 6,245,091 |
| A22 | Boundary Creek Barrage | 3,448,941 | 1,481,935 | **3,448,941** | 1,481,935 |
| A23 | Ewe Island Barrage | 20,936,359 | 10,793,705 | **20,936,359** | 10,793,705 |
| A24 | Tauwitchere Barrage | 41,284,906 | 15,394,485 | **41,284,906** | 15,394,485 |
| A25 | Barr Creek SIS | 17,340,243 | 8,751,363 | **17,340,243** | 8,751,363 |
| A26 | Pyramid Creek SIS | 20,449,390 | 16,810,761 | **20,449,390** | 16,810,761 |
| A27 | Buronga SIS (MDBA Share 29%) | 2,463,302 | 2,018,441 | **2,463,302** | 2,018,441 |
| A28 | Mildura-Merbein SIS (MDBA Share 17%) | 0 | 0 | **0** | 0 |
| A29 | Mallee Cliffs SIS | 29,035,762 | 22,149,235 | **29,035,762** | 22,149,235 |
| A30 | Rufus River SIS | 0 | 0 | **0** | 0 |
| A31 | Woolpunda SIS | 53,356,721 | 33,425,156 | **53,356,721** | 33,425,156 |
| A32 | Waikerie SIS | 23,291,244 | 16,430,594 | **23,291,244** | 16,430,594 |
| A33 | Bookpurnong SIS (MDBA Share 69%) | 9,556,839 | 7,718,839 | **9,556,839** | 7,718,839 |
| A34 | Loxton SIS | 17,502,132 | 14,484,654 | **17,502,132** | 14,484,654 |
| A35 | River Murray | 29,177,957 | 21,914,462 | **29,177,957** | 21,914,462 |
| A36 | Floating Plant | 7,477,603 | 3,462,790 | **7,477,603** | 3,462,790 |
| A37 | Berri Slipway | 4,353,501 | 2,887,096 | **4,353,501** | 2,887,096 |
| A38 | HYDROMETRIC | 5,703,978 | 3,229,073 | **5,703,978** | 3,229,073 |
| A39 | Upper Darling SIS | 0 | 0 | **0** | 0 |
| A40 | Pike-Mundic SIS (100% SA Asset) | 0 | 0 | **0** | 0 |
| | | **3,674,234,594** | **2,278,358,646** | **3,454,930,101** | **2,155,187,570** |
| | | | % Reduction | 6.0% | 5.4% |

# 6 Overview of Related Efficiency Reviews

## 6.1 Context

River Murray Operations are typically one, small, part of the overall business of SCAs. The SCAs are all subject to oversight by State or Commonwealth economic regulators that review the efficiency of the costs of the SCAs to deliver their services that are within the scope of this regulatory oversight.

While River Murray Operations are not within the scope of current regulatory oversight by State and Commonwealth regulators, the SCAs use similar, or the very same, processes to deliver their River Murray Operations activities as they do for their activities that are subject to regulatory oversight. Therefore, the findings of the reviews of the SCAs undertaken by the State and Commonwealth regulators provide a relevant and useful guide to the scope for efficiencies within River Murray Operations.

However, we recognise that there are limitations in applying the findings from these other reviews to this review. For example, many River Murray Operations are generally well ring-fenced from other activities within the SCAs.

The following sub-sections summarise the findings from the most recent review of each SCA.

## 6.2 State Water

In 2014, for the first time, the ACCC was responsible for assessing and determining State Water's charges in the Murray Darling Basin, in accordance with the Water Charge (Infrastructure) Rules 2010 (WCIR). This function had previously been carried out by the New South Wales Independent Pricing and Regulatory Tribunal (IPART). IPART has responsibility for State Water's pricing reviews outside of the Murray Darling Basin. The ACCC Review commenced in 2013 with the Final Determination published on the 26 June 2014 to apply for three years.

The ACCC assessed State Water's proposed operating and capital costs as higher than was required to meet prudent and efficient costs. State Water's proposed WACC was also considered too high. This was offset to some extent by the likely rate of depreciation of assets, which the ACCC considered to be higher than State Water's forecast. The main elements of the ACCC's draft determination that will reduce State Water's total revenue and charges relative to the proposal are:

- A cost of capital of 6.92 per cent, compared with State Water's proposed 8.96 per cent
- Forecast capital expenditure of $132.0 million (real 2013–14), compared with State Water's initial proposal of $204.1 million ($2013–14), which as subsequently reduced by State Water to $132.0 million
- Forecast operating expenditure of $116.5 million ($2013–14), compared with State Water's proposed $127.5 million ($2013–14), a reduction of 8.6 per cent
- That State Water is capable of achieving an ongoing efficiency gain of 1 per cent per year on opex.

The base opex was reviewed for efficiency (response to incentives to increase efficiency), benchmarked with other utilities, and then steps for new obligations were added. Steps were also reviewed for reasonableness (assumptions, forecasts, expected productivity gains compared with historical etc).

## 6.3 New South Wales Office of Water

The last pricing review was undertaken by IPART in 2010 with the Final Report issued in February 2011. The scope included the review of actual and forecast Water Management Costs for 2006-07 to 2014/15 and assessing the efficiency of opex and capex required to deliver identified monopoly services.

Expenditure was examined using a variety of methods including (but not limited to) benchmarking, assessments of whether adequate business cases have been prepared, whether project monitoring and evaluation frameworks have been developed, whether consideration has been given to alternative ways of delivering the service, and whether there is evidence of 'valued outcomes' being produced with current levels of investment.

The adjustments resulted in a revised base level of expenditure of $45.4 million, which was a 6.9 per cent reduction on NoW's proposal ($48.8m). Recommendations included a decrease in proposed number of FTE. Minor adjustments were made to the proposed capital program which resulted in an increase (from $9.42m to $11.39m). Adjustments to the historical capital program included a reduction on allow spend (mainly for deferral but also for some imprudent expenditure on metering).

The ACCC and IPART determinations used a 'building block' approach. One of the IPART findings was that NoW needed to ring-fence regulated (monopoly) expenditure.

## 6.4 G-MW

In late 2012 Essential Services Commission (ESC) undertook a review of forecast expenditures in Goulburn-Murray's Water Plan 3 (2013-2016) to ensure expenditure was efficient, will meet required services levels, and takes a long term view. As an agency accredited under the WCIR by ACCC, ESC undertook the review. ESC also required a review of the implementation of the recommendation of the 2011 Asset management Audit.

The approach included a review of submitted data including business cases and other supporting documents and data, interviews and benchmarking using the National Performance Reports prepared by the National Water Commission.

G-MW's submission included an accumulated opex productivity gain of 1% per annum, as required by ESC. No further adjustments were made to opex and capex projections.

## 6.5 SA Water

In late 2012, the Essential Services Commission of South Australia (ESCOSA) undertook a review of SA Water's forecast operating and capital expenditures to inform a pricing review covering the period 2013 to 2016. While SA Water's River Murray Operations were not within the scope of the review, SA Water uses the same processes and resources to deliver the River Murray Operations as it does for its wider business. This review applied efficiency factors of 1%, 2% and 2% to opex (in years 1, 2 and 3) and efficiency factors rising from 1.1% in year 1 to 3.26% in year 3 to capex.

# 7 Scope for treating River Murray Operations as a regulated business

## 7.1 Context

The context of this review is that the principles of the WCIR should be applied to the Murray Darling Basin Authority, even though the Authority is not subject to regulation under these Rules. The Rules set out different classes of infrastructure operators and consequently different principles that apply to each. For this review, we have assumed that the MDBA, as the provider of River Murray Operations services, is equivalent to a 'Part 6 Operator', under the WCIR. That is, the MDBA is non-member owned, and provides services in relation to more than 250GL of entitlement in the MDB.

Schedule 1 of the WCIR sets out the information requirements for an application from a Part 6 operator for approval or determination of regulated charges. The information requirements relevant to determining prudent and efficient capital and operating expenditure are:

- Consultation with customers
- Regulatory and legislative obligations
- Infrastructure service standards
- Capital expenditure
- Operating expenditure
- Demand or consumption (only as far is it drives capital and operating expenditure).

The information that the ACCC expects an infrastructure operator to be able to provide is further detailed in *A guide to the water charge (infrastructure) rules: Pricing application for Part 6 operators* (ACCC, October 2011). In the following section, we assess the extent to which the MDBA would be able to meet the information expected by the ACCC for the purposes of the pricing review. The purpose of this assessment is twofold:

1. To identify where a lack of information has limited the extent that we have been able to undertake this prudence and efficiency assessment compared to a regulatory review under the WCIR
2. To identify areas where the MDBA may be able to move towards being more fully treated as a regulated business.

Further to the above two objectives, the information requirements are not an end in themselves. They are a guideline of good practice for how an infrastructure operator can demonstrate the links between its customers, the services provided to the customers, risk and costs.

It should also be noted with respect to the information expectation of the ACCC for a regulatory review that the MDBA has not made an 'application' for a review. This means that our assessment is a hypothetical application of the methodology to establish an efficient cost base/revenue requirement based on consideration of 'business as usual' processes and documents. This is in part desirable because it reduces the possibility that the MDBA has presented a perspective of its activities that doesn't match actual practices, as may happen when a regulated business focuses its attention on a regulatory submission. The drawback though is that the links between customers, service standards, infrastructure, risk and expenditure are not readily apparent but instead need to be found.

## 7.2 Observations

Table 7-1 sets out the criteria in the document *A guide to the water charge (infrastructure) rules: Pricing application for Part 6 operators* (ACCC, October 2011) that are relevant to this review of prudence and efficiency of the MDBA's River Murray Operations, and our assessment of the degree to which the criteria are currently satisfied by the MDBA.

**Table 7-1 Assessment of MDBA status against information requirements for pricing application under WCIR**

| Area | Criteria | Observations | Implications | Recommendations |
|---|---|---|---|---|
| Consultation | Information on customer consultation should include:<br>▸ a statement of consultation policy<br>▸ objectives of the consultation undertaken and describe process including timing<br>▸ a summary of feedback received from customers and other stakeholders<br>▸ explanation of how feedback in consultation has been addressed | ▸ Consultation is currently limited to important stakeholders, in the main the SCAs and the State Governments | ▸ Objectives for RMO activities set by stakeholders<br>▸ No formal means for end customers to provide feedback | ▸ Consider wider and more formal consultation regarding its RMO activities and expenditure plans<br>▸ Include consultation between SCAs and their customers impacted by RMO costs |
| Obligations, and projected service standards | Detail the regulatory, legislative and other obligations that have been or are forecast to be imposed on the business | ▸ The MDBA's River Murray Operations are subject to considerable governance under the Water Act that constrains how it manages its business | ▸ Governance arrangements are likely to be a source of inefficiency | ▸ Consider reduced governance for Corporate Planning process, e.g. gain approval for a one to four year period and MDBA is provided freedom to manage amendments during that period within defined levels of authority and triggers of variance to approved Plan |
| | Detail the projected service standards including a clear definition, units of measure, how they are calculated and target performance | ▸ Currently standards are not clear or readily understood and are located In various documents<br>▸ There is limited linkage between some of the existing standards and capex/opex investment<br>▸ Not given primacy<br>▸ Not flexible | ▸ Not able to readily relate expenditure proposals to a measurable outcome | ▸ Develop a consolidated set of explicit service standards for RMO<br>▸ Following consolidation, remove other quasi service standard obligations on MDBA |
| Expenditure | Historic ( 4 years past) and forecast (4 years forward) | ▸ Historic expenditure well documented<br>▸ Corporate Planning process has four year | ▸ Limited certainty over forward expenditure | ▸ Develop firm four year projections for operating and capital expenditure |

| Area | Criteria | Observations | Implications | Recommendations |
|---|---|---|---|---|
| | forecasts for opex and capex to be included | horizon but focuses on current year only<br>▸ Accounts are structured around cost-sharing arrangements, not economic regulation.<br>▸ Distinction between capex and opex not clear. The RMO Joint Funding Capex and Opex report and RMW Budget spreadsheet are not always consistent in relation to categorisation of capex and opex. MDBA have recently prepared a draft Accounting manual. The capitalisation threshold is $10K. | projections and therefore cost (contribution) impacts<br>▸ Some uncertainty over categorisation of expenditure into regulatory building block model and regulatory asset base | ▸ Develop guiding five to ten year forecasts for operations and maintenance<br>▸ Use renewals annuity as basis for long term capital expenditure forecast<br>▸ Consider distinction between operating and capital expenditure and develop accounting definitions to be adopted consistently by MDBA and SCAs |
| | Drivers for operating expenditure identified and generally classed as being due to either:<br>▸ business-as-usual activities<br>▸ changes in input costs<br>▸ changes in demand<br>▸ to deliver higher levels of service for customers<br>▸ to meet regulatory, legislative or other obligations<br>▸ intermittent asset maintenance. | ▸ Drivers for operating expenditure not well defined and not aligned to these suggestions<br>▸ A real index is applied to operating costs from the previous year to arrive at a starting point current year costs<br>▸ Funding constraints lead to expenditure items being deferred<br>▸ Requirements for major maintenance generally well justified and programmed | ▸ Not able to readily relate expenditure proposals to a driver or customer need<br>▸ Operating expenditure largely reflects previous year budget. Variance in expenditure not clearly linked to drivers or risk | ▸ All variations from base year costs to be justified and linked to a driver<br>▸ No real escalation to be applied. Real escalation to be linked to changes in input costs (but mitigation of increased input costs to be demonstrated) |
| | Productivity improvements identified | ▸ Incentives are self-imposed by MDBA and SCAs<br>▸ Arbitrary funding constraints impose some level of efficiency but this may not be optimal when the full asset lifecycle is considered<br>▸ Onerous governance arrangements exist to ensure transparency and accountability for | ▸ The level of governance imposes some level of Inefficiency | ▸ A review should be undertaken to determine the feasibility of implementing a less onerous budget (corporate planning) process while maintaining accountability and transparency<br>▸ MDBA and SCAs to identify and document productivity improvements and quantify budget impact |

| Area | Criteria | Observations | Implications | Recommendations |
|---|---|---|---|---|
| | | expenditure<br>▸ Limited freedom exists for MDBA to manage resource to meet required outputs | | |
| | Drivers for capital expenditure broadly one of the following:<br>▸ to meet increased growth in demand<br>▸ to address declining demand<br>▸ to maintain existing service levels or to deliver higher levels of service for customers<br>▸ to meet regulatory, legislative or other obligations | ▸ Drivers for capital expenditure are unclear and do not align with these suggestions.<br>▸ Relationship between service levels and expenditure not clear | ▸ Not able to readily relate expenditure proposals to a driver or customer need<br>▸ A regulator cannot identify priority for an investment | ▸ Expenditure proposals should relate to a specific driver or drivers and service levels |

## 7.3 Recommendations for meeting information requirements under WCIR

Based on our assessment in the preceding sections of the ability of the River Murray Operations to meet the information guidelines for a regulatory review under the WCIR, we make the following recommendations for the consideration of the MDBA. We reiterate that these recommendations are not made with any consideration that the River Murray Operations should or would be treated as a regulated infrastructure operator under the WCIR but rather that these recommendations reflect good practice for how an infrastructure operator can demonstrate the links between its customers, the services provided to the customers, risk and costs.

Our recommendations are as follows:

- MDBA to consider wider and more formal consultation regarding its RMO activities and expenditure plans
- Consider reduced governance for the Corporate Planning process, e.g. gain approval for a one to four year period and MDBA is provided freedom to manage amendments during that period within defined levels of authority and triggers of variance to the approved Plan
- Develop a consolidated set of explicit service standards for RMO. Refer to the discussion in Section 4.2
- Following consolidation, remove other quasi service standard obligations on MDBA
- Develop firm four year projections for operating and capital expenditure
- Develop guiding five to ten year forecasts for operations and maintenance
- Use renewals annuity as basis for long term capital expenditure forecasts
- Consider distinction between operating and capital expenditure and develop accounting definitions to be adopted consistently by MDBA and SCAs
- All variations from base year costs to be justified and linked to a driver
- No escalation to be applied. Real (i.e. net of inflation) changes in costs to be linked to changes in underlying input costs (but mitigation of increased input costs to be demonstrated).By having expenditure forecasts presented in real (today's) dollars it is easier to identify where costs are increasing above CPI. Where this occurs the increases should be justified and efforts to minimise these increases documented
- A review should be undertaken to determine the feasibility of implementing a less onerous budget (corporate planning) process while maintaining accountability and transparency
- MDBA and SCAs to identify and document productivity improvements and quantify budget impact
- Expenditure proposals should relate to a specific driver or drivers and service levels.

# 8 Scope for efficiency gains in RMO activities

## 8.1 Approach

We are required to determine efficient levels of capital and operating expenditure for the RMO. These efficient levels of expenditure are inputs into the Building Block model. In determining the scope for efficiency gains within the RMO, we have considered a top down ('continuing efficiency') approach combined with some detailed analysis ('bottom up') to determine the scope for a hypothetical 'catch-up' efficiency. We have also considered the findings of the Total Factor Productivity analysis completed by Economic Insights.

The final agreed approach was to apply an ongoing general efficiency measure, based on similar recent regulatory outcomes, with some specific 'bottom up' adjustments based on line-item analysis (SIS, contingency) and internal benchmarking (locks and weirs)

## 8.2 Top down efficiency

### 8.2.1 Overview

The typical approach to efficiency measurement of regulated businesses considers two aspects of efficiency. The first, referred to as 'technical' efficiency (or sometimes, 'productive' efficiency) essentially considers the regulated firm's ability to produce a specified output while minimising the quantities of inputs required to make the output. The second type of efficiency considered is allocative efficiency. This reflects the firm's ability to use the inputs in the optimal proportions taking into account their price (not just their quantities). The combination of technical and allocative efficiency gives the firm's total economic efficiency.

Utility economic regulation developed in the United Kingdom (by Ofwat) considers that there is a technological limit to the 'technical' efficiency that can be achieved by a firm, and that the range of different inputs used, and outputs produced, by different firms gives rise to a technical 'frontier'. A firm can be said to be operating at the 'efficiency frontier' if it minimises the inputs required for its given set of outputs. To the extent that the firm minimises the combined price of the inputs required to produce those outputs, it may also be allocatively efficient.

This approach recognises that measurement of the firm's efficiency must take into account input prices in the economy as a whole (which is typically represented by the retail price index RPI or consumer price index, but may also be represented by the construction price index), and technological changes which may allow the firm to improve its technical efficiency. Firms operating at the frontier are therefore limited in their ability to increase their total economic efficiency by technological change and input prices, while firms operating 'behind' the frontier also have the opportunity to 'catch up' to the frontier.

Using this framework, Ofwat commissioned economic studies at each price review to consider potential changes in the 'frontier' – the productive capacity of utilities relative to input prices in the rest of the economy. In addition to its estimates of frontier change, Ofwat then used parametric methods[3] to consider the relative efficiency of the regulated utilities. By default, the efficiency frontier was defined as the utility with the largest negative residual (i.e. highest efficiency). This approach has been adopted by various Australian regulators.

### 8.2.2 Continuing efficiency

The concept of 'Continuing efficiency' is the movement of efficiency at the 'frontier'. It is in fact a combination of two factors: changes in input prices, and technological or productive changes within the utility. The studies

[3] '*The parametric approach specifies a set of independent variables that are likely to explain differences in the dependent variable. It then applies statistical methods to the data for the companies to estimate the best relationship between the dependent and independent variables. The difference between an actual data point for any company and the value implied or predicted by the estimated relationship is known as the residual. The most widely used parametric approach is known as Ordinary Least Squares (OLS). This method estimates the coefficients so that the relationship minimises the sum of the squares of the residuals, in other words it estimates the line of best fit. Entities with a positive residual have higher than expected costs, and vice versa*' - The Evolution of Ofwat's Approach to Efficiency Analysis; Indepen Consulting, April 2006.

commissioned by Ofwat typically combined both of these distinct factors into one 'continuing efficiency' determination. For example, the study carried out for Ofwat by Reckon LLP in 2008 projected a continuing efficiency of 0% for the PR09 (2010-15) period, stating 'A growth rate of 0 per cent does not imply no ongoing productivity improvements at the industry level; simply that productivity growth will be cancelled out by above-RPI increases in input prices'[4].

Recent work in the UK and Australia defines the followed expected movements in 'continuing efficiency' for water utilities as follows:

- The Deloitte report commissioned by the ACCC into State Water's price determination (which itself was originally carried out by Atkins-Cardno). The original recommendation by Atkins-Cardno was for a 0.8% p.a. continuing efficiency to be applied to State Water, with an additional 0.6 – 1.2% p.a. for 'catch up'. Deloitte determined that an overall efficiency of 1% p.a. was applicable (to controllable opex only). Deloitte also determined that State Water was not subject to any particular 'catch up' requirements, suggesting that the utility is operating at the efficient frontier
- The ESC does not follow the 'continuing / catch-up' efficiency approach taken by Ofwat and IPART. However in their guidance paper from October 2011, the ESC informed water businesses that it would expect a minimum 1% continuing efficiency on base operating costs to be built into price submissions[5]. Following the inclusion of a 1% efficiency, the ESC made insignificant further adjustments (in the case of Goulburn Murray Water, a further 0.07% reduction was made[6])
- A study into the productivity gains made by Australian Water Utilities[7] concluded that over the period 2005-06 to 2008-09 '*annual productivity growth averaged 1.04 per cent across all utilities, with a range of 0.09–2.98 per cent*'. The report noted that only 0.17-0.29% came from 'frontier shift' or technological change.
- The Productivity Commission Staff Working Paper, *Productivity in Electricity, Gas and Water, March 2012* found that multi factor productivity (MFP) in the water, sewerage and drainage sector fell by 0.7% per annum on average from 1974 to 2010. The Productivity Commission found that over the period 1997-98 to 2009-10 the productivity of the water, sewerage and drainage industry declined at an average annual rate of 4.3 per cent per year. However, the Productivity Commission examined the effects on productivity of demand management due to drought, and improvements in the quality of water supply and sewerage services, particularly the levels to which sewage was treated. It estimated that the drought effects and the quality improvements explained about 80 per cent of the productivity decline after 1997-98. This means that there was an underlying productivity decline of less than one per cent per year.
- Prior to each price review in the UK, Ofwat commissions an economic study into the potential movement in the 'frontier' for the regulated utilities. In 2008 Ofwat asked Reckon LLP to estimate the expected productivity gains for a frontier company over the 2010-15 period. Reckon estimated the gains relative to RPI to be 0% per year. The same report notes that over the period 1992-2008, water opex costs declined by 1.9% p.a. in real terms, and sewerage by 1.5%. However all of these improvements occurred before 2001. Between 2001-2008, water opex increased by 0.2% p.a. relative to RPI and sewerage opex by 0.9%
- For the 2014 price review, Ofwat has adopted a significantly more complicated economic model and approach. There does not appear to be a single overall continuing efficiency expectation, however Ofwat has made draft determinations for the wholesale cost assessment for water and wastewater for each company, comparing the company submissions to a draft determination 'threshold'[8]. The average reduction proposed by Ofwat for the 4-year period was 4% for water wholesale costs, and 5% for sewer wholesale costs for the industry as a whole

[4] Reckon LLP, Ofwat Final report: PR09 Scope for efficiency studies, 17 October 2008
[5] '*Businesses should also be disciplined by a desire to improve efficiency and manage controllable costs. The Commission requires all businesses to achieve a minimum of 1 per cent per year productivity improvement on its baseline operating expenditure*' 2013 Water Price Review, ESC, pp 33.
[6] pp 24, PRICE REVIEW 2013: RURAL WATER BUSINESSES Final Decision, ESC June 2013
[7] Productivity, efficiency and technological progress in Australia's urban water utilities, Andrew C Worthington, Griffith University, Waterlines Report Series No 62, October 2011
[8] http://www.ofwat.gov.uk/pricereview/pr14/prs_web140404pr14wholesalecostasses

- Water Corporation in Western Australia is subject to an annual 2% efficiency gain on 'base' opex, after allowances for growth and inflation. Given Water Corporation benefits from reasonably high rates of growth and the input price index used is higher than CPI, our analysis suggests that the true 'underlying' opex efficiency relative to CPI, taking into account the economies of scale delivered by growth, is about 0.4% p.a. In practice, the WA treasury required efficiencies beyond the target 2%, and so the 'real' ongoing efficiency is higher than 0.4% p.a. This measure does not necessarily represent a 'continuing' efficiency, as Water Corp may not be 'at the frontier', but gives another 'data point' for efficiencies required of a large Australian regional and urban utility

### 8.2.3 Catch-up efficiency

As mentioned above, 'catch-up' efficiency is usually determined from a utility's position in the industry relative to a defined 'frontier'. Ofwat's methodology defines the frontier as being a line through the most efficient company (but the frontier could conceivably be ahead of all companies). Scope for catch up is determined from parametric analysis of panel data provided by the companies – inputs and outputs. This statistical analysis requires considerable amounts of input and output data; Ofwat collects more than 2,000 values each year for each water and sewerage company it regulates.

In the case of MDBA, we do not have an 'industry' of river basin managers, bulk water suppliers, salinity removers, hydrometric modellers with which to make comparisons. As a result we cannot directly compare RMO costs with similar organisations apart from comparing Total Factor Productivity (TFP) (refer to Section 8.2.4).

However, we have made some internal comparisons between different RMO assets to identify relative cost differences. We also do not have large amounts of 'panel' data regarding the inputs and outputs and we have been constrained in our selection of yardsticks by which we can measure the efficiency of the assets. We have used a combination of asset value (replacement cost) and age to form a view on the relative efficiency of operating costs. This approach was limited to assets where there are a significant number of comparable assets (locks and weirs, salinity programs). As a result, we have only been able to apply 'bottom up' (or 'catch up' efficiency determinations for these assets.

We have also made some adjustments to contingencies where these are included every year.

Details of our approach to what is in effect 'catch-up' efficiency are outlined in Section 8.3. .

### 8.2.4 Findings of Total Factor Productivity (TFP) study

Economic Insights Pty Ltd undertook economic benchmarking in parallel with this efficiency review (refer to their report *River Murray Operations Economic Benchmarking Study, 2014*). The aim of the study was to develop an appropriate economic benchmarking methodology, and carry out an initial trial benchmarking exercise for River Murray Operations. Methods of benchmarking and of measuring economic variables such as outputs and inputs, in the context of rural water services such as those provided by RMO, were evaluated.

The evaluation of methodologies concluded that data envelopment analysis (DEA) was the most suitable, given the small sample available for the study, and the scarcity and likely unreliability of data on output prices. DEA is a method of efficiency frontier analysis that can be used to measure the comparative technical efficiency and cost efficiency of a set of businesses, and can also be used to calculate total factor productivity (TFP) indices based on the changes in technical efficiency of firms from year to year.

An initial trial benchmarking study was presented which relied largely on existing data collected to date by the National Water Commission (NWC), and aimed only to demonstrate a feasible method of benchmarking that could be used to complement other methods of analysis within a regulatory or cost control framework. The preliminary results for technical and cost efficiency suggested that River Murray Operations had scores that were comparable to the more efficient comparator businesses in the sample as shown in Figure 8-1. River Murray Operations' average annual TFP growth over the period 2007 to 2013 was estimated at 3.1 per cent, considerably higher than the sample average TFP growth rate of 1.0 per cent per year.

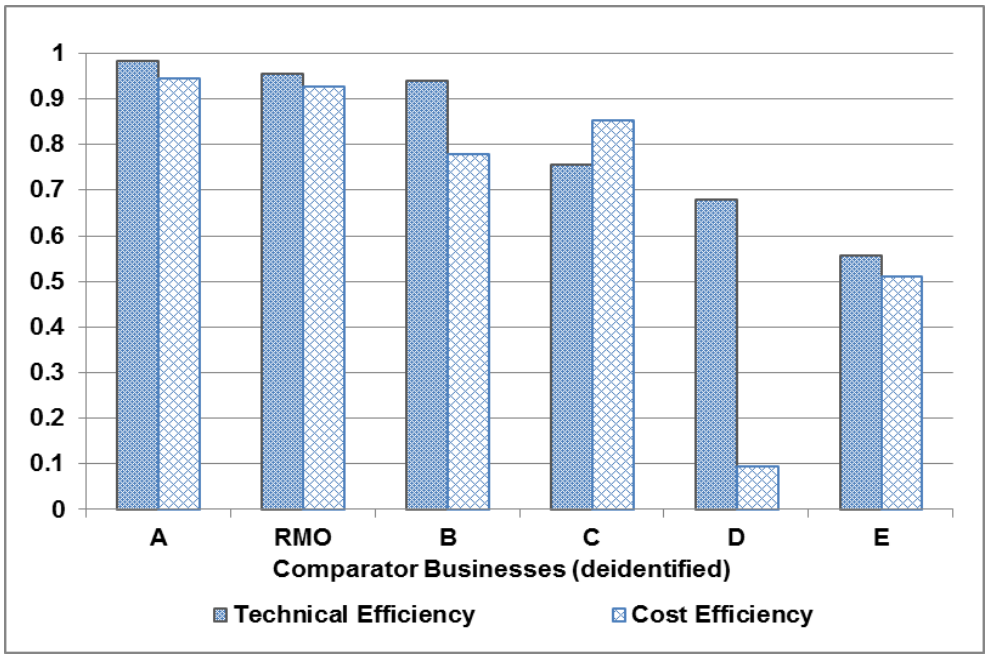


**Figure 8-1 DEA efficiency scores**

Economic Insights qualified their findings through highlighting the relatively small sample of comparative businesses, limited capital input quantities and little or no data available at present on relevant operating environment conditions that influence the efficiency of businesses beyond the control of management. However, the available outputs appear to confirm our findings that River Murray Operations is a relatively efficient operation.

### 8.2.5 Analysis of long term operating expenditure trends

We analysed long-term historic operating cost data provided by MDBA in the file RMO – 10yr trend analysis to 2013/14. The trend was compared with other available sets of opex data, including the RMO Joint Ventures file (data from 2009/10 to 17/18) and the Budget 5.9 data (budgets from 13/14 to 17/18). The results are presented in Figure 10-1 Figure 10-1 shows that the high variance between budgets and actuals observed in the RMO data for the years 2009/10 to 13/14 was in fact not the norm over the period 2001/02 to 09/10. (The diverging red and green dashed lines show differences in the totals for the RMO Joint Ventures data and the Budget 5.9 data).

The key result of this analysis that that operating costs appear to be approximately plateauing, although the Budget 5.9 data does show a real increase – albeit at a lower rate of increase than seen between 2001-2013:

- Opex (including renewals) between 2001/02 and 2012-13 grew at a compounded rate of 4.8% p.a. in real terms. We do not have data on the split between O&M and renewals for this period.
- By contrast, from 2013/14 to 2017/18, opex (including renewals) is forecast to grow at only 0.37% p.a in real terms[9]. This is a combination of real O&M increases of about 3.7% p.a and real renewals decreases of 5.4% p.a.

## 8.3 Bottom up efficiency

We were unable to take a statistical approach to the determination of ‘catch-up’ efficiency due to a lack of comparable organisations, and above all due to a lack of detailed ‘panel’ data showing RMO outputs in terms of inputs and input costs.

As a result, we pursued a ‘bottom up’ review of projected expenditure by asset, and project budget lines, looking for unexplained variances and carrying out cost benchmarking using asset value / age as a yardstick. This approach clearly has limitations, notably:

[9] Following the SIS adjustment made during this efficiency review

- We did not have an external organisation with which we could compare RMO costs
- We did not have directly comparable historical data and future budgets – the RMO joint ventures data includes some renewals (MP) in the figures which we could not separate out. While renewals could be included in future data from Budget 5.9 (and are by default included in the RMO joint ventures data), we would have preferred to remove renewals due to their 'lumpy' nature which creates a lot of noise and obscures underlying 'outlying' operating costs.
- Only two asset classes had enough sites to provide a range of points with 'outliers' (SIS and Locks and Weirs). Of these asset classes, SIS assets are not really suitable for benchmarking by asset value as each scheme operating costs will vary considerably with flows and salt levels, not asset value. A future SIS benchmarking would consider cost per tonne of salt removed etc.
- A further complication was the fact that budget data appears to have been escalated inconsistently, including within projects undertaken by the same SCA. Price escalation was not distinguished from genuine, underlying increases in input or output quantities, but for projects with small budget increases, apparent escalation values of 0%, 3%, 3.1%, 4% and 4.6% were common (see Figure 8-2).

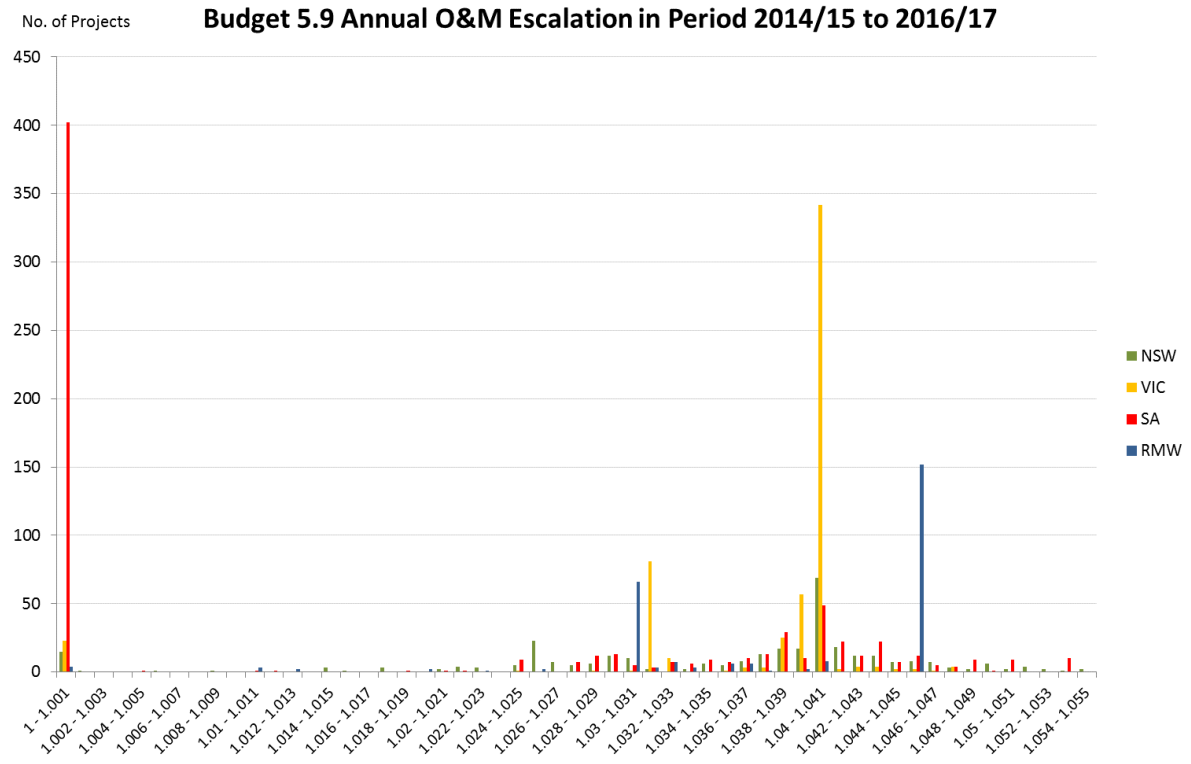


**Figure 8-2 – Apparent annual escalation used in Budget 5.9 sheet, by project**

Our approach to determining the potential for bottom-up efficiency gains was as follows:

- A default 2.5% escalation was assumed to be included in all future budgets, and removed from them to get budgets in $2014.
- Renewals were defined by I&C projects where MDBA had specifically identified the project as a renewal, and MP projects (in the Budget 5.9 file)
- O&M was defined by O & MR expenditure lines (in the Budget 5.9 file)
- Expenditure lines were allocated to a site and compared against asset current replacement cost.

- Specific projects which were identified and discussed during interviews were also treated on an exception basis

The main findings of this analysis were:

1. Operating costs as a % of asset value appear to be approximately constant over time (see Figure 10-2). There is a slight real increase in operating costs projected in Budget 5.9, but the long-term trend is that unit costs (i.e. O&M costs per $ of assets) are remaining roughly constant at ≈1.4% of asset cost.

2. Renewals expenditure is decreasing from 13/14 and O&M increasing. The combined effect is a slight decrease in O&M and renewals combined. O&M is increasing at a rate of 6.3% based on the nominal budgets in Budget 5.9 (which is 3.7% if an assumed 2.5% inflation is removed). Renewals are decreasing at 3% p.a. in nominal terms (i.e.5.4% in real terms). The combined effect is an increase of 2.88% p.a. in nominal terms, and 0.37% without inflation.

3. We determined that the following line-item adjustments should be made as a 'proxy' catch up efficiency. These are:

   > Continuing contingency values should not be included every year ($90k savings p.a.)

   > We expected some efficiency improvements from the SIS as these schemes are optimised (≈$320k savings p.a.). Following the release of our preliminary findings, RMO has made an adjustment to the SIS budget which further decreased costs in this area and we have therefore removed this proposed efficiency.

   > A benchmarking exercise using MDBA asset register data suggested Euston Lock was an outlier in terms of operating costs relative to its asset value (see Figure 8-3 below). However MDBA provided more up to date valuation data for Euston Lock which reduced the O&M/ CRC percentage from the outlying 1.84% to 1.32% which is of a similar order to the South Australian locks and weirs. We found that the benchmarking process was complicated by the fact that MDBA sometimes incorrectly classify planned maintenance expenditure as routine maintenance, making any economic regulation efficiency analysis problematic.

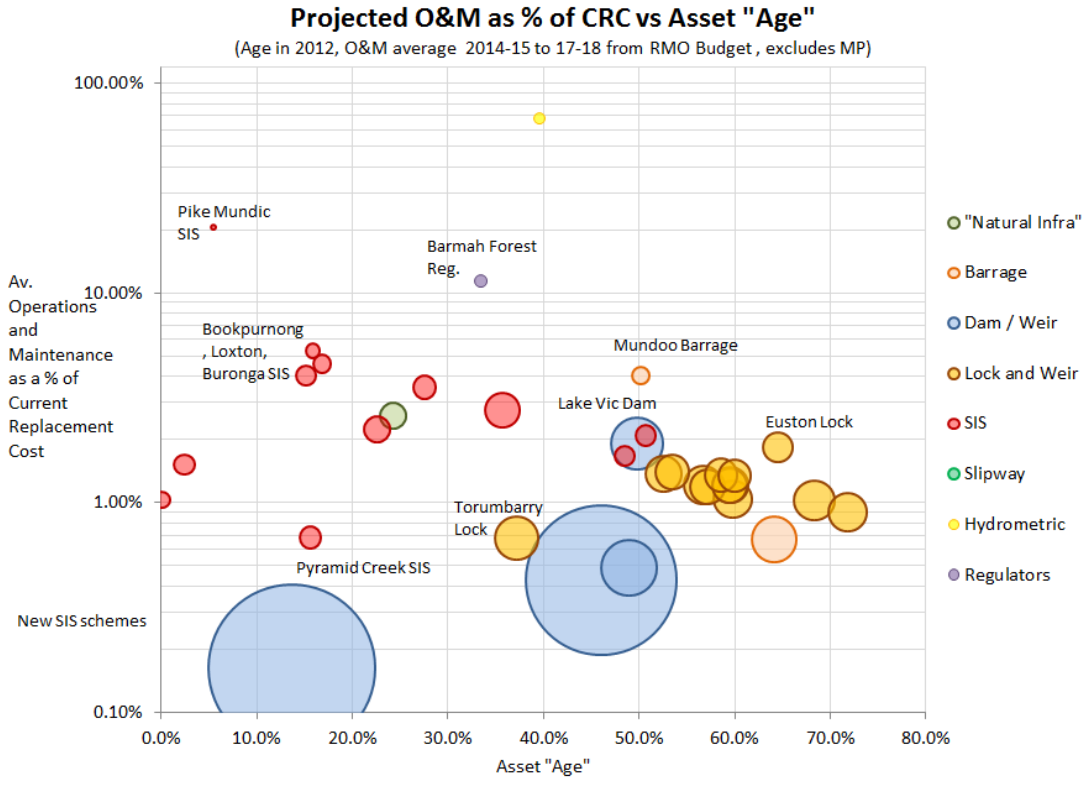


**Figure 8-3 – Opex Efficiency Analysis; Benchmarking by Asset Current Replacement Cost and Age**

## 8.4 Efficiency gain conclusion

Our analysis of MDBA projected operating costs shows that MDBA expects O&M costs to increase by 4.7% p.a. on average over the period. This equates to 2.2% p.a. in real terms. If costs which are classified by MDBA as I&C, but are actually O&M are included, the figures rise to 6.3% and 3.7% respectively.

In section 8.2.2 we discuss various recent efficiency targets and productivity gains. Most of the studies and figures cited show productivity improvements and efficiency gains of the order of 1%, however we note the Productivity Commission report for urban utilities, which shows a decline of 1% (after drought and service quality improvements are accounted for). Based on this review, we recommend an ongoing efficiency of 1% p.a. should be applied to MDBA's proposed O&M costs from year 2 of the price period.

However, as we have previously mentioned, MDBA do not apply rigorous regulatory accounting definitions; their accounts are developed for the purposes of cost allocation rather than economic efficiency analysis or building block modelling. As such, OMDBA &M costs are not always O&M costs in the building block model, I&C costs are not always I&C, etc. When we challenged MDBA on some of the operating costs are particular assets (e.g. Euston lock), we learned that large variances in O&M costs were actually planned maintenance. As such, the only way we can really consider the proposed budgets when comparing with other utilities is holistically.

The combined total budget proposed by MDBA for the 2014-15 to 2017-18 period showed an average increase of 2.88% in nominal terms (0.37% in real).

The overall effect of the 1% O&M efficiency deduction is that costs remain roughly constant in real terms (nominal increases of 2.35% on average, or -0.17% in real terms, assuming 2.5% inflation). This result is the an approximate mid-point between the various studies cited in section 8.2.2; some of which show productivity improvements of up to 1% per year, others of which show annual declines of up to 1%.

# 9 Capital Expenditure

## 9.1 Data Sources

We have utilised the following data sources of information for the analysis of operating expenditure:

- RMO Joint Funding spreadsheet. This data source was used where analysis of historical expenditure was required.
- Budget 5.9 spreadsheet. This spreadsheet provided the most up-to date budget information.
- Infra 2012 Annuity Calculations. This spreadsheet, based in the fixed asset register, was used by MDBA to calculate a long term replacement capex annuity

Both spreadsheets presented information in nominal dollars. Our analysis has utilised a common baseline ($14/15) to provide a clearer comparison of variation in expenditure over a number of years. To bring historical expenditure up the $14/15 we applied the relevant state CPI. We noted that for future expenditure each agency had applied different indices, with no clear single index applied to all project by each agency. Our analysis of the indexes applied for each project, for each agency, did not correspond with the rate indicated by each agency. As a result all forecast expenditure, for all projects and agencies has been deflated by a default 2.5% per annum. This may either be advantageous or disadvantageous to the different agencies (e.g.it will be advantageous to Victoria, which typically applied a 4% index, and disadvantageous to South Australia, which usually did not index project budgets at all)

Our analysis highlighted several limitations of the data provided:

- The RMO Joint Funding spreadsheet contained historical expenditure, but this was not disaggregated by the expenditure categories of Operations (O), Routine Maintenance (MR), Planned Maintenance (MP), Investigations (I) and Construction (C). RMO Joint funding data was disaggregated into:
  - RM Operating & Maintenance,
  - RM Construction & Investigation (Excluding EWMP & Hume southern training wall upgrade & Flood Loss)
  - Environmental Works and Measures Program and
  - RM Construction & Investigation (Flood Loss Only)
- When analysing RMO Joint venture data, we classified ‘RM Operating & Maintenance ,’ as O&M, and the other expenditure categories as ‘Capex’. This necessarily means that the RMO data is not directly comparable with the Budget 5.9 data (see below).
- The data in Budget 5.9 was more detailed than the RMO Joint Venture data and included a classification for O, MR, MP, I or C, as well as a further classification for I&C to indicate if the expenditure was renewals or enhancement Capex. However Budget 5.9 data includes no historical data other than the approved budget for 2013/14.
- Future totals for RMO Joint Venture data and the Budget 5.9 data did not reconcile exactly
- In Budget 5.9, projects classified as MP are renewals rather than operating maintenance. A large majority of I&C projects are also renewals rather than enhancement capex.

The key implications of these limitations are:

- The RMO Joint Venture historic data appears to include MP, which is actually a form of capital expenditure (renewals) – the same as I&C.
- We cannot easily observe historical trends in renewals, or O&M.

We suggest that MDBA consider the following approaches in future budgets:

- Future budget projections are initially set at the current year dollars. This allows easier identification of real budget increases

- MDBA can set the final budget projections in nominal dollars using a consistent index for all agencies.
- As part of our general recommendation (see Section 7.3), MDBA institute a chart or regulatory accounts which distinguishes between types of operating and capital expenditure for the purposes of the building blocks method.

## 9.2 Overview

Over the past few years MDBA has undertaken a significant capital investment program which peaked at $100M in 2010/11 as shown in Figure 9-1. The historical expenditure has been dominated by the Environmental Works and Measures Program (EWMP) which accounted for $262M over the past five years. The Figure also shows a decline in capital investment within the RMO program

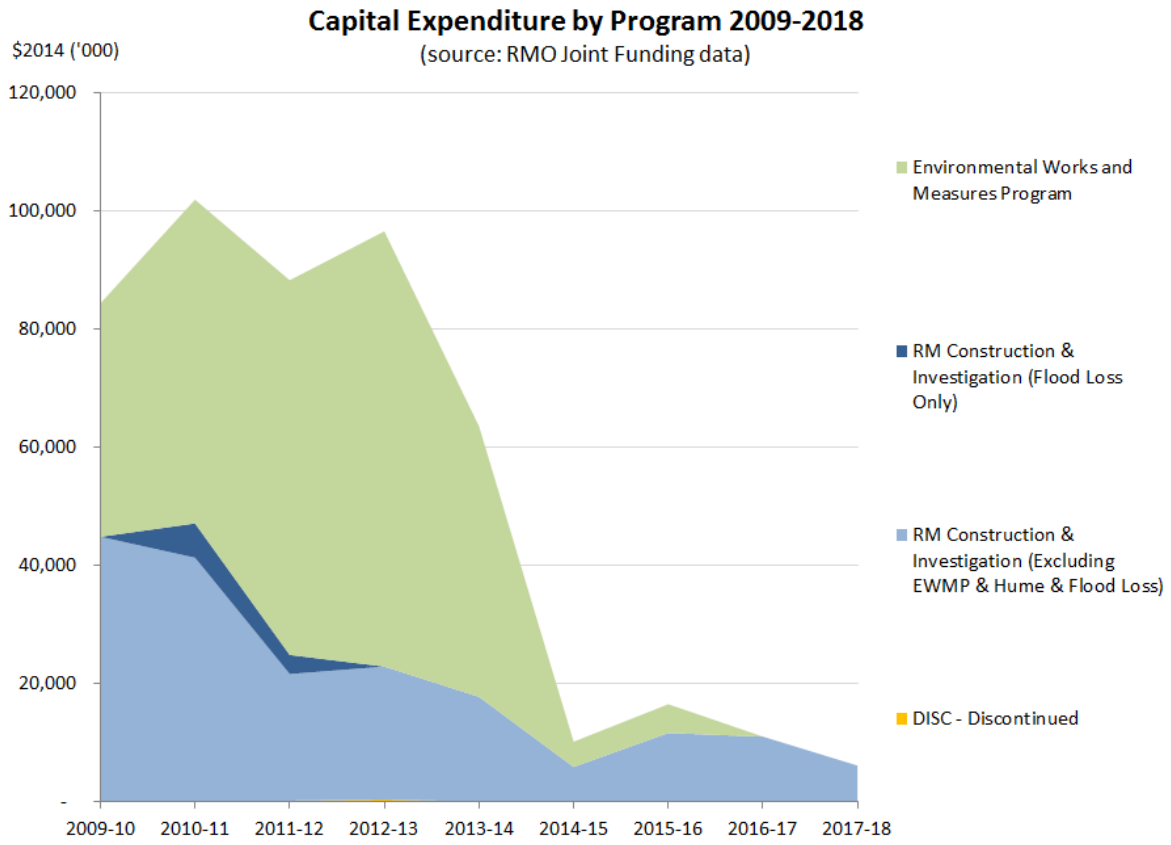


**Figure 9-1 Historical and forecast capital expenditure ($14/15)**

## 9.3 Historical and forecast capital expenditure

The River Murray Operations (RMO) program (excluding Hume Dam southern training wall upgrade and EWMP) is shown in Figure 9-2, Figure 9-3. This shows a significant drop from a peak of $47.1M in 2010/11 to $6.1M in 2017/18.

Figure 9-3 shows a significant decline in capital investment by asset type, in particular salt interception schemes and locks & weirs. Expenditure on dams and weirs, barrages and natural are relatively stable compared to 2012/13 expenditure but much less than in the period 2009-2012 which was significantly increased by the navigable pass upgrade program underway at the time.

Figure 9-4 provides a comparison between capital expenditure on the major assets between 2009-13 and 2014-18. This figure provides an alternative presentation on expenditure. . Between 2009 and 2013, twenty assets had significant average expenditure (>$200K p.a.) with eleven assets having greater than $1M average expenditure. However, between 2014 and 2018 only nine assets have any significant average

expenditure (>$200K p.a.), with the largest by far being Dartmouth Dam ($2.3M p.a. average which allows for preliminary works related to a major spillway capacity upgrade).

Going forward (in the 2014/15 to 17/18 budgets) 97% of capital expenditure is renewals

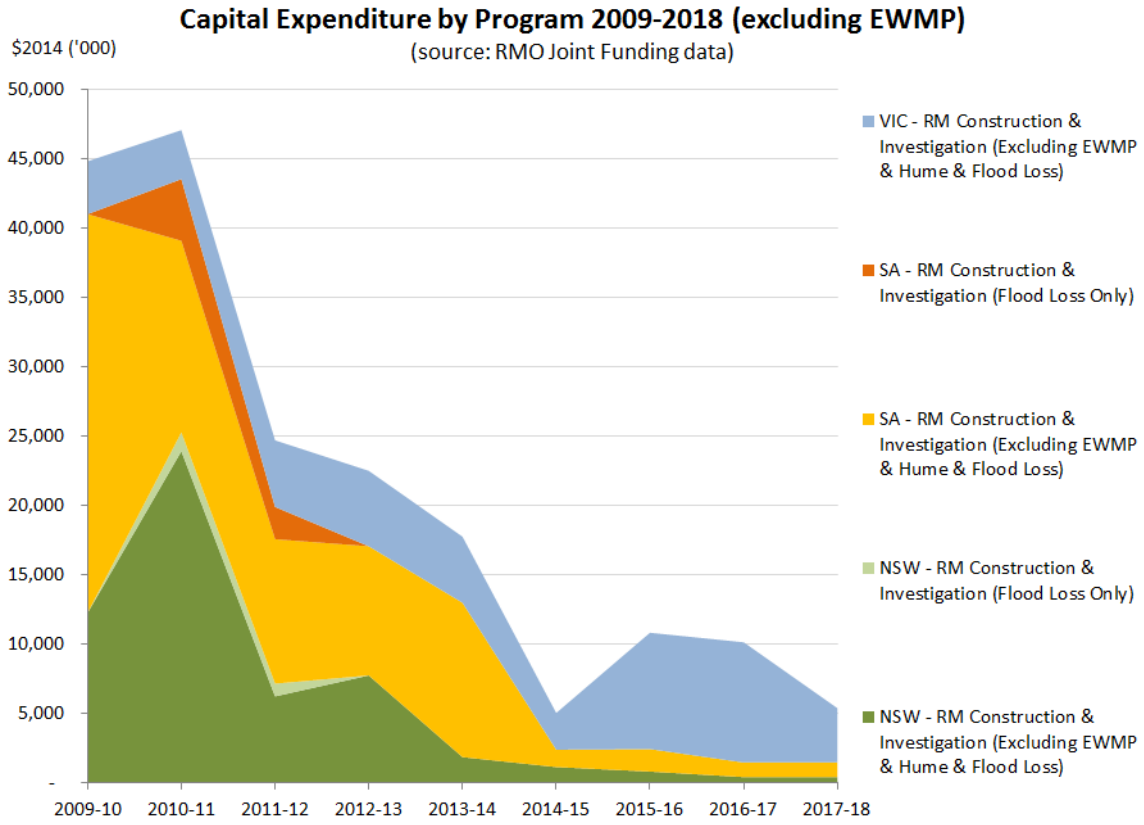


Figure 9-2 Capital expenditure by program (excluding EWMP & Hume Dam) 2009-18($14/15)

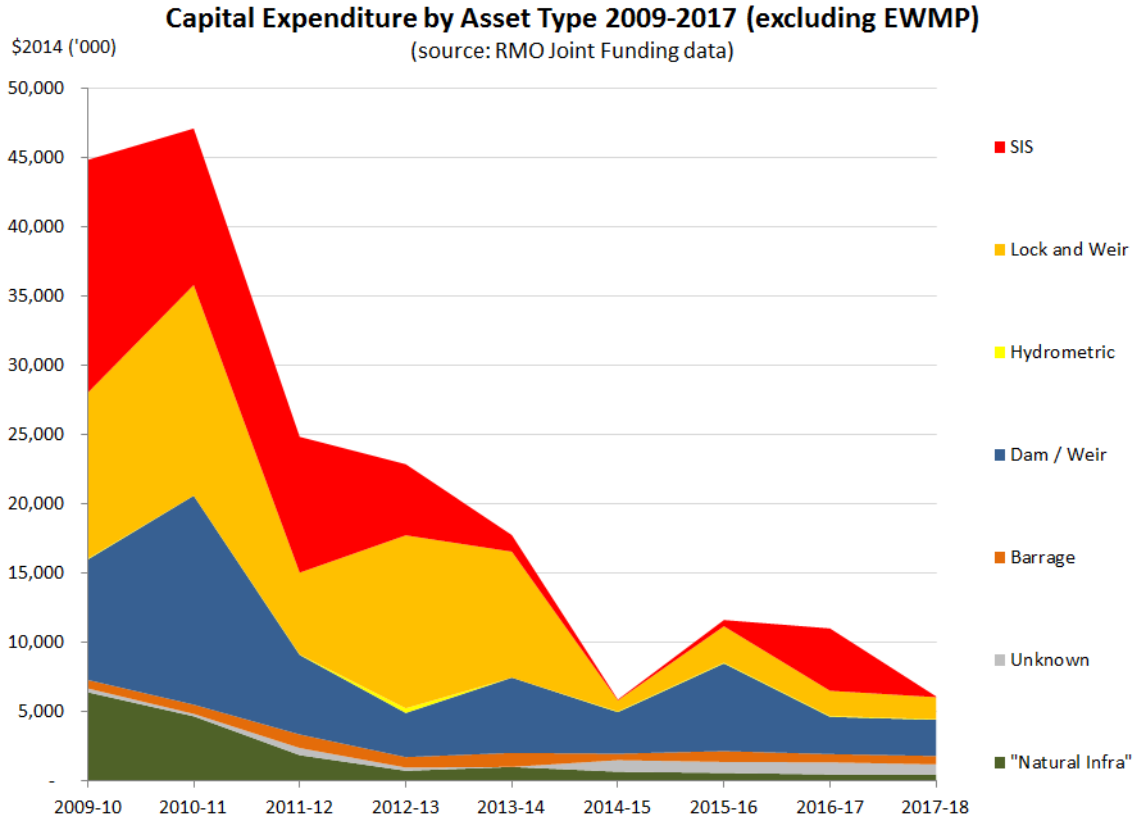

**Figure 9-3 Capital expenditure by asset type (excluding EWMP and Hume dam) 2009-18 ($14/15)**

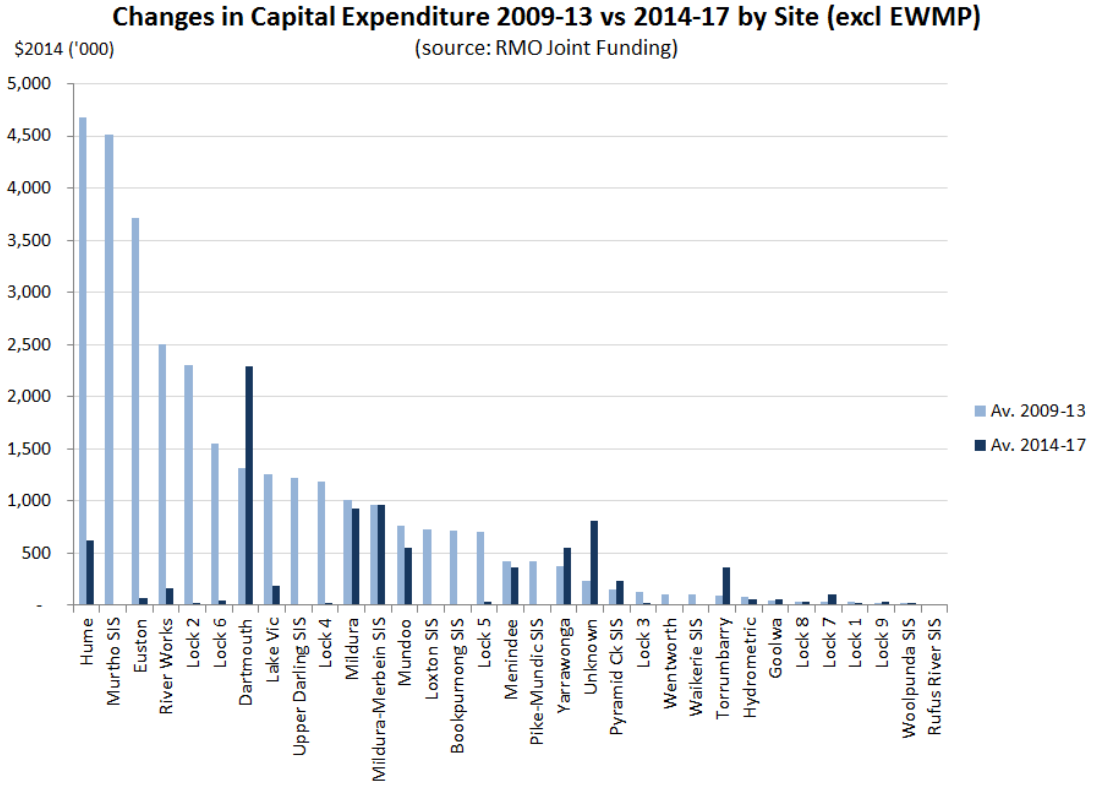


**Figure 9-4 Comparison of historical and forecast capital expenditure**

(Note that the above chart excludes some renewals which are classified as MP / Opex)

As mentioned previously, almost all the future capital budget is allocated to asset renewals. The total capital budget proposed by RMO over the 2014/15 to 2017/18 period is $88M, of which $85.7M is renewals (I&C, MP) and only $2.4M is for I&C enhancements.

This equates to around $22M p.a. capex, of which 97% ($21.4M, $20.1M in $2014) is for renewals.

Figure 9-5 shows the longer term renewals (construction and planned maintenance) projections for the RMO assets based on the forecasts in the renewals annuity model. Figure 9-6 compares the budget expenditure and renewals annuity model expenditures between 2014 and 2018. In part the difference reflects works deferred in recent years being brought back into the program along with refinement of immediate priorities for investigation and delivery into a program that can be resourced. The annuity profile is a higher level planning tool that does not include this refinement but typically provides for projects in a single year. This indicates that over the next four years renewals expenditure will not be significant, equating to 0.56% of the asset current replacement cost. This will rise significantly between 2018 and 2022 but is still less than 1% of current replacement cost. The percentages presented in Table 9-1 suggest that the level of renewals investment over the next 10 years is not excessive.

**Table 9-1 Renewals Expenditure as a Percentage of Current Replacement Cost ($2014)**

| | Average Expenditure ($'000) | | Average Expenditure ($'000) | |
|---|---|---|---|---|
| | Budget 5.9 | % of Current Replacement Cost | Annuity - Replacement & Planned Maintenance | % of Current Replacement Cost |
| 2014-2018 | $20,565 | 0.56% | $16,058 | 0.43% |
| 2018-2022 | | | $35,997 | 0.97% |
| 2022-2026 | | | $26,878 | 0.73% |

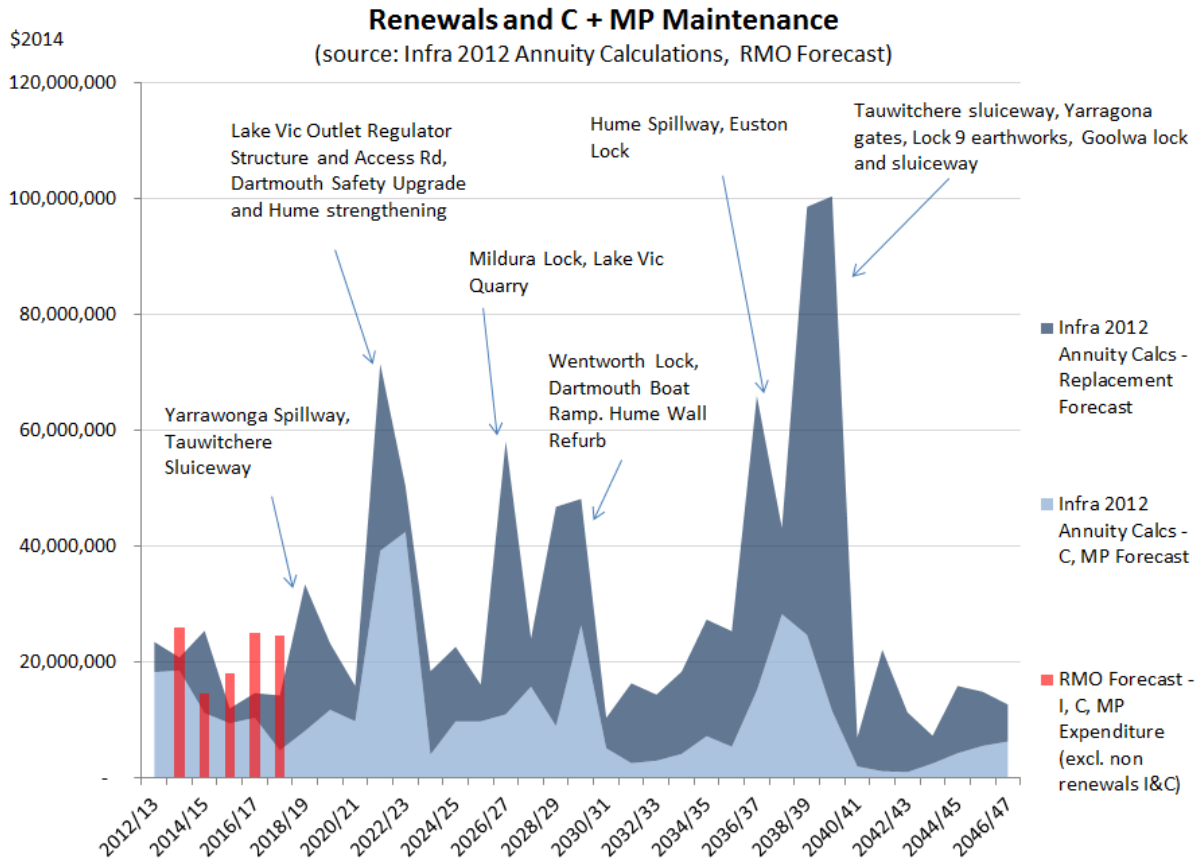


Figure 9-5 Renewals –Construction and Planned Maintenance projections (long-term)

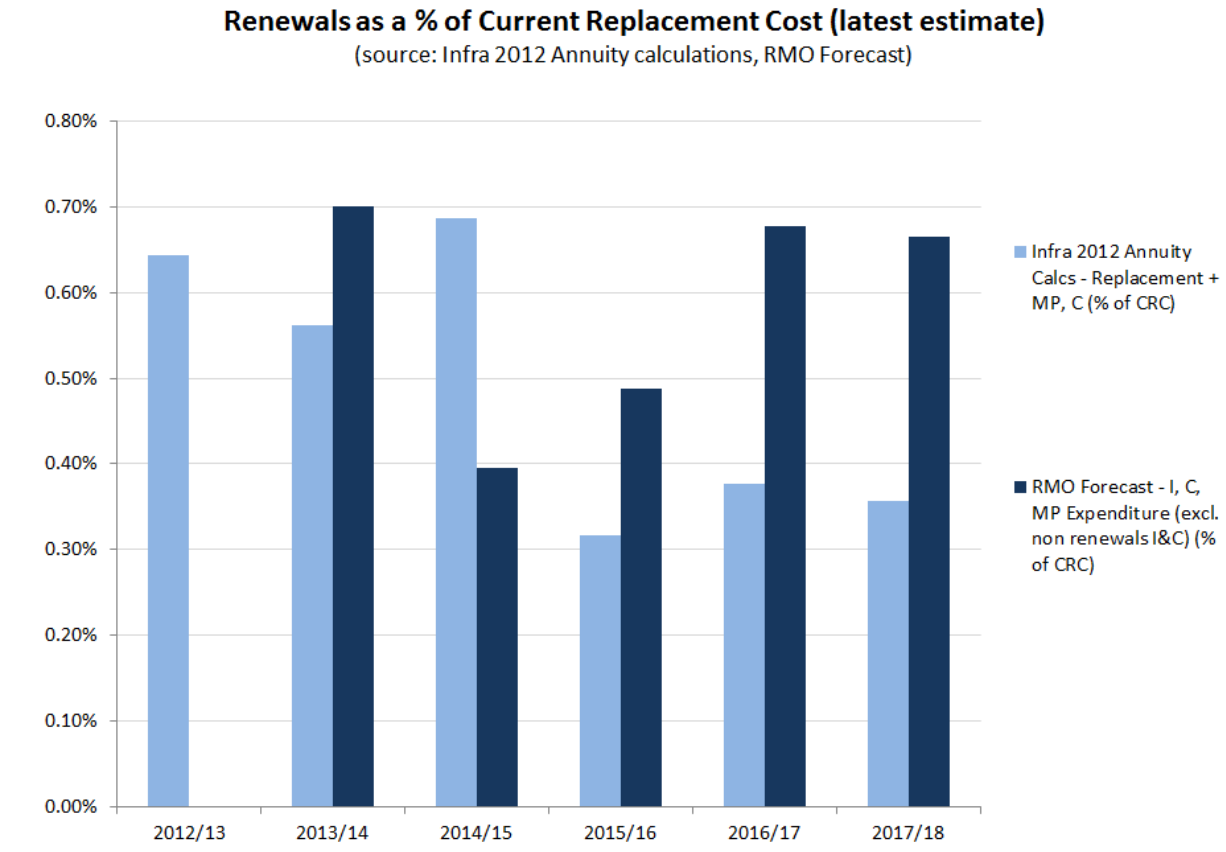

**Figure 9-6 Renewals (Construction & Planned maintenance as a % of Current Replacement Cost (short-term)**

## 9.4 Review of Capital Projects

We undertook a review of a range of capital projects across the SCA's. These are listed in Table 9-2

| State Constructing Authority | ID | Project |
|---|---|---|
| Goulburn Murray Water | 24292 | Hattah Lakes Project Implementation |
| | 10506 | Mildura Lock 11 Trestle Structure |
| | 12154 | Upgrade Telemetry - Torrumbarry |
| New South Wales Office of Water | 11206 | Priority Reach Program |
| SA Water | 11561 | Murtho Salt Interception Scheme |
| | 10760 | Bookpurnong Lock 4 – Modify Navigable Pass |
| | 12121 | Dam Improvement Program Investigations |
| State Water | 10410 | Euston Lock 15 Future Remedial Works Program |
| | 12369 | Hume Dam Spillway Southern Training Wall |

**Table 9-2 Capital Projects Reviewed**

**Hattah Lakes Project Implementation**

Hattah Lakes is one of six Icon Sites identified under the Murray Darling Basin Ministerial Council's 'The Living Murray Initiative'. Hattah Lakes is an extensive wetland complex covering approximately 13,000 ha within the 48,000 ha Hattah-Kulkyne National Park. It is located in Victoria on the River Murray between Robinvale and Mildura. The project involved:

- Lowering sills in Chalka Creek to assist the flow of water into the system.
- Constructing 4. new regulators and 2. stopbanks/levees on the floodplain to retain water.
- Constructing a permanent pumping station at the mouth of Chalka Creek to top up natural floods and fill the lakes during extended dry periods.
- Refurbishment of 1. existing regulator.

The contract included provisions for risk sharing during flood events that limited the extent of variations. The project had a number of challenges/ risks including multiple stakeholders and working in an environmentally sensitive area.

The project is substantially complete but requires a second stage commissioning as insufficient water allocation was available for the initial commissioning. It is likely that the project will be delivered for $27.3M against a budget of $32.2M.

**Mildura Lock 11 Trestle Structure**

The project involves replacement of five drop-bar trestles (out of a total of 19) with mechanised trestles that incorporate vertical overshot gates. Eventually it is proposed replace all trestles with drop bars so that the weir is fully mechanised. The labour intensive operation of manually positioning and removing drop bars within the weir trestles has been identified as a high OH&S risk.

Mildura Weir, constructed in 1927, is located on the Murray River at Mildura in north-western Victoria. It is the last of the Dethridge type weirs remaining along the river. Previous works have included the initial construction of one prototype mechanised trestle, able to replace any one of the existing standard trestles (Phase 1 of project). After a satisfactory period of testing, the design drawings were revised to reflect any required modifications and five new 'modified' mechanised trestles are to be manufactured and delivered, to be installed by weir staff (Phase 2).

Phase 1 and 2 of the project will cost $6.94M. Phase 2 trestles will be fabricated by the end of 2014 with installation/ commissioning occurring in 2015.

**Upgrade Telemetry – Torrumbarry**

The project includes a review of existing hydraulic system and operational function of the weir followed by design and construction of the control system. The Torrumbarry Weir electrical control system is nearly 20 years old and approaching the end of its expected life span and many of the components and technologies used are no longer supported or available. This introduces a risk that failure of a PLC or Network hardware could disable control and monitoring of the Weir gates for an extended period of time. The Torrumbarry Weir is totally reliant on the SCADA control system for automatic operation and the primary reason for undertaking this project is to reduce these high risks associated with operating the structure with an old outdated control system

The project is estimated to cost $1.33M with completion scheduled by 2016/17.

**Murtho Salt Interception Scheme**

Murtho has been identified as a potential salt interception site dating back to the Basin Salinity Management Strategy in 2001. Salinity in the Basin is managed with reference to conductivity levels at Murtho. Feasibility work for salt interception at this site identified a potential salinity reduction contribution of 20.2 EC and a cost benefit ratio of 1.53.

At this feasibility stage, the proposed design was identified as including 52 abstraction boreholes and 54km of pipeline ranging in diameter from 40mm to 563mm. Through field testing, the number of boreholes required was reduced to 23.

The scheme was commissioned in early 2014 and proving work is continuing. SA Water advised that it had encountered some difficulties in procurement and construction where the contractors engaged did not meet expectations in some areas. We reviewed the lessons learned report and found this to be comprehensive and frank. Most of the contracts let had substantial approved variations to cost.

**Bookpurnong Lock 4 – Modify Navigable Pass**

SA Water has been undertaking upgrades to RMO navigable passes in an ongoing program following a finding by the health and safety regulator in the 1990s that the reinstatement of the navigable pass at Lock 7 (in New South Wales) following flooding was unsafe. The investigation for this particular project was largely undertaken in a 2001 Feasibility Study which identified an acceptable design employing reduced height concrete piers and removable steel decking that are able to be removed by cranes in times of flood.

Design and procurement was managed by SA Water's Major Projects team located in Adelaide. Locks 7, 8 and 9 in New South Wales were upgraded first from 2002/03 to 2004/05. As construction progressed, wet weather was encountered in the late 2000s. The wet weather significantly affected the upgrades for Lock 2 and Lock 4 and we observe that the costs for these sites are considerably higher than the costs for the other locks. While managing the risks of wet weather will add to construction costs, we consider that there was scope for the costs for Lock 2 and Lock 4 to be reduced through alternative contractual risk management measures. SA Water noted that the wet weather and high river levels encountered were significantly different to preceding years. A "lessons learned" report has been prepared following completion of the works.

**Dam Improvement Program Investigations (Lake Victoria Outlet Regulator)**

The driver for this project was the dam portfolio risk assessment commissioned by MDBA which identified a prioritised work program. A supplementary report relating to Lake Victoria was prepared by URS in 2007 which identified that failure of the outlet regulator was the most significant contributor to the observed level of risk being above the limit of tolerability for all confidence levels. Remediation of the regulator was recommended at a cost of $3M ($2007).

Further assessment was undertaken in 2009 and 2010 and a detailed options assessment and concept design was completed in 2013. The proposed remediation works are to install a secant pile cut-off and contiguous pile reinforcing of wing-walls, a downstream sand drain/filter and upgrade to all stop-log guides.

This project is being delivered by SA Water Major Projects. We reviewed various procurement documents including the tender evaluation and found that the procurement was appropriate to the scope of works.

**Euston Lock 15 Future Remedial Works Program**

This was part of a program for upgrading navigable passes on the Murray River (Locks 1-10) that would allow river craft to navigate through the weir once the lock chambers become inoperable during flood

periods. The procedure for reinstatement of the navigable pass was considered to be a high-risk activity, needing divers to operate in strong currents with poor visibility, in conjunction with heavy machinery. The navigable pass can now be reinstated in less than 3 hours compared to 3-5 days previously.

Other reasons were improvement in flood safety and improved environmental outcomes (fishway). The lock and weir were a barrier to upstream fish movement.

Construction was significantly delayed due to flooding. The contractor demobilised on three separate occasions within three years (between Dec10 and Apr11, Aug11 and Jan 12, and Mar12 to Feb13). Construction costs increased from $11.0M to $15.2M due to the multiple flood disruptions.

**Hume Dam Spillway Southern Training Wall**

In 2007, MDBC carried out a portfolio Risk Assessment (PRA) of five major storages. The study identified that the three highest risks across the portfolio were at Hume Dam. A risk reduction action for one of the high risks was remedial works associated with the Southern Training Wall (STW) anchors.

The STW had been an area of special interest for some time as the deformations of the adjacent embankment 1A continued to increase beyond previous estimates. As a result, horizontal anchor bars installed during the program of remedial works at Hume Dam in the period 1995-2003 had been, or will in the foreseeable future be, bent beyond design limits.

The project involved remedial work at Hume Dam on the Southern Training Wall (STW); the downstream concrete gravity wall supporting the earthfill embankment on the southern (Victorian) side of the spillway. The project included the construction of mass concrete upstream and downstream buttresses.

The final total project cost was $28.8M which was well under the initial Business Case estimate of $42M and the risk based estimate of $36.4M (P90). Due to uncertainties involved in relation to ground conditions a number of Prime Cost items were included. Construction conditions were quite favourable with some variations being negative.

## 9.5 Conclusions

Almost all the proposed capital program is renewals, and so the justification of investment is maintenance of existing service levels and avoidance of risk to those service levels.

The best approach to assessing the prudence of renewals investments is to consider the asset performance trends (looking for signs of serviceability deterioration), and the assessed risk of asset failure (probability x consequences). In the absence of this information, a ‘sanity check’ can be carried out by comparing overall levels of investment to asset value and the design lives of assets in the Fixed Asset Register.

Our analysis has focused on the justification for the sample projects (discussed above), and a comparison of the projected renewals expenditure compared to MDBA’s own analysis of their long-term renewal needs, shown in Figure 9-5.

Over the next 30 years, according to MDBA’s fixed asset register and estimates of planned maintenance, an average of $32M will need to be spent every year in order to maintain existing assets. Over the next 10 years this figure is $28M (both figures in $2014).

RMO have budgeted $20.1M per year in $2014 over the next four years. While this figure exceeds the theoretical requirement of $16.5M per year for this four year period, it reflects the upcoming investment needs beyond the four-year horizon and represent some investment ‘smoothing’ We usually consider investment smoothing to be desirable, both in terms of the avoidance of price shocks for customers and in terms of procurement (avoiding undue spikes in construction activity and prices).

# 10 Operating Expenditure

## 10.1 Data Sources

We have utilised the following data sources of information for the analysis of operating expenditure:

- RMO Joint Funding spreadsheet. This data source was used where analysis of historical expenditure (2009/10 to 13/14 Budgets and Actuals) was required. Each line of data could be attributed to 'O&M or 'Capex' only (no split into O, MR, MP, I, C).
- Budget 5.9 spreadsheet. This spreadsheet provided the most up-to date budget information, including budgets for 13/14 through to 17/18 forecasts Importantly, the Budget 5.9 data allowed disaggregation of Operating (O), Routine Maintenance (MR), Planned Maintenance (MP), Investigations (I) and Construction (C).
- Long-term total O&M expenditure, actuals vs budgets (summary data provided by MDBA)

Due to the inconsistent application of operating and capital cost definitions, our operating expenditure analysis suffers from the limitations described in Section 9.1. The key limitations are:

- The RMO Joint Venture historic data appears to include MP, which is actually a form of capital expenditure (renewals) – the same as I&C.
- We cannot easily observe historical trends in renewals, or O&M

A comparison of the totals for O&M (including MP, but excluding I&C) is shown in Table 10-1.

**Table 10-1 Comparison of operating expenditure data sources**

| | Expenditure ($'000) | | | | |
|---|---|---|---|---|---|
| Source | 2013/14 | 2014/15 | 2015/16 | 2016/17 | 2017/18 |
| RMO Budget (version 5.9) (O, MR, MP) | 48,609 | 49,383 | 52,284 | 52,237 | 57,306 |
| RMO Joint Funding ('O&M') | 48,640 | 48,602 | 48,944 | 48,717 | 53,274 |

## 10.2 Operating Expenditure

RMO O&M costs have increased in real terms at an average rate of 4.85% between 2001/02 and 2013/14 (which was 7.8% p.a. in nominal terms). However cost increases have levelled off since 2009/10 as shown in Figure 10-1. Between the 2013/14 budget and the 2017/18 forecast, operating costs including renewals are expected to increase by 0.0.36% in real terms (O, MR, MP and I&C renewals), assuming 2.5% inflation (i.e. grow at 2.88% in nominal terms).

Note that there are two stories to this 'low growth' phase – operating costs alone are projected to grow at 3.7% p.a. in real terms[10] , while renewals are expected to decline by 5.4% in real terms. The combined effect of the increase in O&M, and the decrease in renewals (MP, I&C) on the overall operating budget is an increase of 0.36% p.a. in real terms.

These figures are before the application of any efficiencies resulting from this review. If the 1% p.a. O&M efficiency is applied to the RMO budget, overall costs (capex and opex) will increase at 2.35% p.a. in nominal terms between 2013/14 and 2017/18, rather than the 2.88% p.a. projected by the RMO budget. It should be noted that the 1% p.a. O&M efficiency is only applied from 2015/16 to 2017/18.

[10] Assuming 2.5% annual inflation

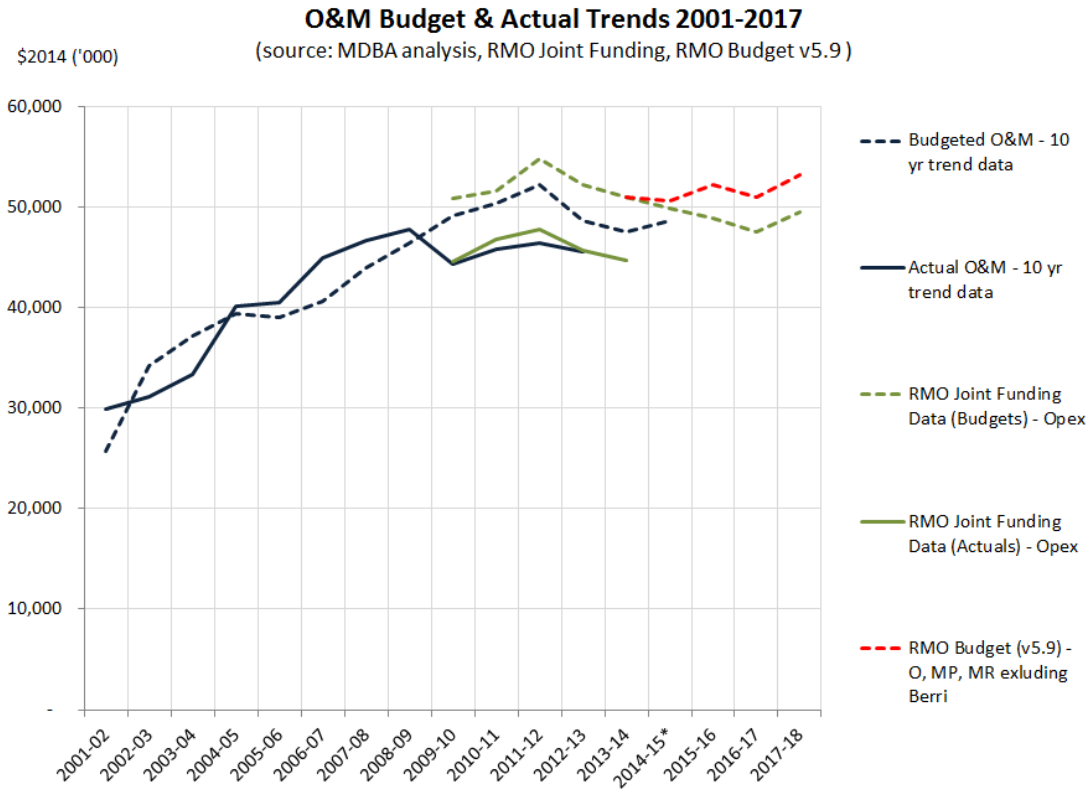


**Figure 10-1 O&M Budget & Actual Trends 2001- 2017**

Changes in operating expenditure need to consider the asset base being operated. When the operating expenditure takes into account the value of assets there has been a slight decline since 2005/06 as shown in Figure 10-2. However differences between data sources make it difficult to conclude if there have been any significant changes. Overall, O&M appears to be broadly constant as a % of the asset replacement cost.

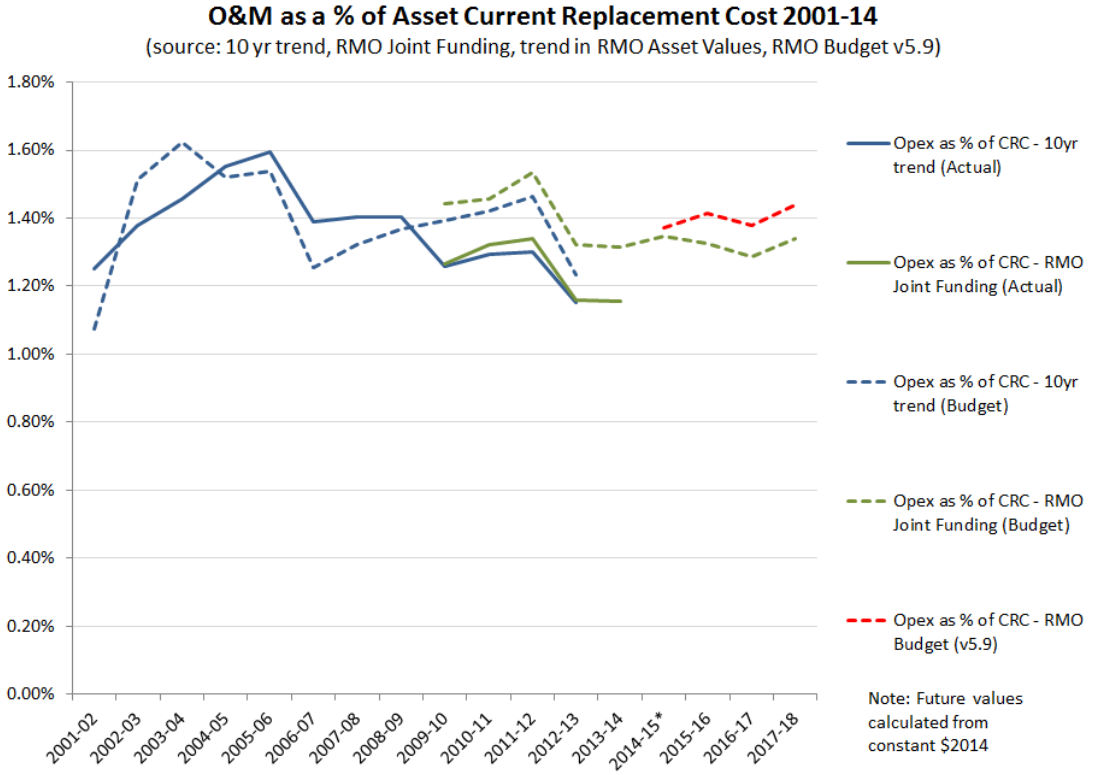


**Figure 10-2 O&M as a % of Asset Current Replacement Cost 2001-2014**

## 10.3 Actuals vs Budget

Over the five year period from 2009/10 to 2013/14, the RM Operations and Maintenance costs were underspent, compared to the budget, in the order of 10% (ranging from 9% to 13%, or $4m to $6m per year). MDBA provided the following response to our query as to the reasons for the underspend:

*Some of the main reasons underlying this seemingly consistent variance can be explained by the following factors:*

- *changes in priorities resulting in planned maintenance activities being deferred, in some instances over a number of years;*
- *delays in the commissioning of works (in part caused by flooding), meaning that allocated O&M budgets were not able to be used as anticipated;*
- *budgets allocated to meet contingencies not fully utilised;*
- *projects budgeted to fix the impacts of drought, being made redundant by subsequent floods;*
- *salinity levels below thresholds for operation at Pyramid Creek, requiring reduced level of pumping activity;*
- *unfilled staff positions;*
- *change in program nature and scale following the introduction of the Water Act leading to reduced expenditure on consultancies and travel; and*
- *a small number of activities that appear to have been consistently over-budgeted, however the budgets for which have been reviewed during the period in question.*

*In addition, as there is no capacity to overspend the total budget (including carry-overs), the tendency is to err on the side of under-expenditure.*

*Further, it is noted that the longer term analysis of trends in RMO expenditure*[11] *(which covers the period from 2001/02 to 2013/14, and excludes carry-overs) shows both over and under-expenditure of the O&M budget, which average out over the period analysed to be marginally (about 2%) underspent* [12].

MDBA provided a listing of operational projects where there had been a significant and consistent overspend. We also challenged the SCA's on major underspends in operating expenditure. The responses provided were considered reasonable and were consistent with the reasons provided by MDBA. Another reason provided by one SCA was that there were circumstances where operational staff became involved in construction projects, in which case they would book time to the construction project, a correct approach.

We noted that there were a few projects where the budget figure was assigned to an activity as a contingency which may only occur under certain circumstances (e.g. major flood). A listing of these projects, based on information provided by MDBA and SCAs, with the current annual allowance is listed in Table 10-2.

**Table 10-2 Opex Contingency Items**

| State | Site | Activity | Forecast 2014/15 | Forecast 2015/16 | Forecast 2016/17 | Forecast 2017/18 |
|---|---|---|---|---|---|---|
| VIC | Mildura | Upstream de-silting | $0 | $0 | $0 | $965,743 |
| NSW | Barmah Forest | Use of Mulwala Canal | $375,000 | $380,488 | $373,111 | $366,797 |
| SA | River Works | Lower Murray Channel Maintenance | $40,000 | $39,024 | $38,073 | $39,001 |
| RMW | Canberra | Contingency - O & M | $186,300 | $189,935 | $193,641 | $197,420 |
| | | Total | $601,300 | $609,447 | $604,825 | $1,568,961 |

[11] Analysis of River Murray Operations Expenditure 2001/02 to 2014/15.
[12] Note, that the two sets of analysis are not directly comparable, as the budget data in the longer-term trend analysis is exclusive of budgets carried over from one year to the next. In this analysis, over-expenditure (to the extent of any amounts carried-over) is allowed

## 10.4 Drivers of Change in Operating Expenditure

As discussed above, Figure 10-1 and Figure 10-2 show an increase in operating expenditure in the years 2014-18. The total (nominal) increase proposed by 2017/18 is $10.7M for O&M alone (including O&M expenditure classified as I&C), representing an annual compounded increase of 6.3% on the 2013/14 Budget. Assuming 2.5% inflation, this represents a real increase of 3.7% per year.

When comparing changes in projected operating expenditure, we have two main sources of data:

- The RMO Joint funding data (from 2009/10 actuals to 2017/18 forecasts)
- The RMO Budget (v5.9) data (from 2013/14 budget to 2017/18 forecasts)

The data sources differ in one important aspect: operating costs classified as MP (which we understand to be renewals) are included in the 'O&M' costs in the RMO Joint Venture data (we cannot disaggregate these), while MP costs can be disaggregated from the RMO Budget version 5.9 data to give a better picture of underlying changes in O&M.

A further complication is that some budgeted O&M costs are re-classified as I&C costs in the high level RMO summary for the purpose of funding allocation, and some renewal I&C costs are re-classified as enhancements at the summary level. Our analysis draws on the detailed costs (not the high level summary) and considers cost by their true nature – not according to how they are funded. In addition to this, only 75% of the costs for Menindee are passed through to the budget total, as RMO only funds 75% of the O&M costs. However, in order to apply efficiencies we have adopted the RMO summary cost classification (so that our numbers can be reconciled with the RMO budget).

These anomalies are part of a general tendency for costs to be classified according to funding priorities, rather than regulatory accounting priorities. Regulatory accounts require that costs be split into broad service areas that can be measured in terms of specific outputs. At a minimum, operating and capital costs need to be clearly distinguished. Funding sources are less relevant for the purposes of an efficiency analysis.

As previously mentioned, it is important to extract renewals expenditure out of O&M to get an understanding of changes in the base operating costs, isolated from the 'lumpy' renewals expenditure which can obscure underlying trends. Finally, using budget 5.9 data we can consider the combined effect of including all renewals (i.e. those classified under I&C as well as MP), to get a more complete picture of overall expenditure than can be observed using the RMO Joint Ventures data.

Note that all of the following charts use the original RMO Budget v5.9 figures expenditure classification (O&M, MR, MP, I&C) with the additional classification provided by RMO which split I&C expenditure into renewals and enhancements. The figures will therefore by slightly different from the totals split out according to funding, but the findings are applicable.

Below we consider all three approaches:

**Approach 1** – Using RMO Joint Ventures data; longer-term, inclusive of some renewals expenditure

The changes in O&M (including MP) costs are listed in Table 4-1.

**Table 10-3 Changes in O&M (longer-term, RMO Joint Venture Data, inclusive of MP renewals)**

| $ '000 | Average Actual Expenditure 2009-13 (5 years) | Average Budgeted Expenditure 2014-17 (4 years) | Change |
|---|---|---|---|
| Dam / Weir | 10,769 | 10,800 | +31 |
| SIS | 6,886 | 7,459 | +573 |
| Hydrometric | 6,050 | 6,691 | +642 |
| "Natural Infra" | 3,766 | 6,854 | +3,088 |
| Regulators | 150 | 249 | +99 |
| Lock and Weir | 11,080 | 9,987 | -1,093 |
| Barrage | 1,832 | 1,662 | -170 |
| Total | 40,533 | 43,702 | +3,169 |

The same information is presented graphically in Figure 10-3.

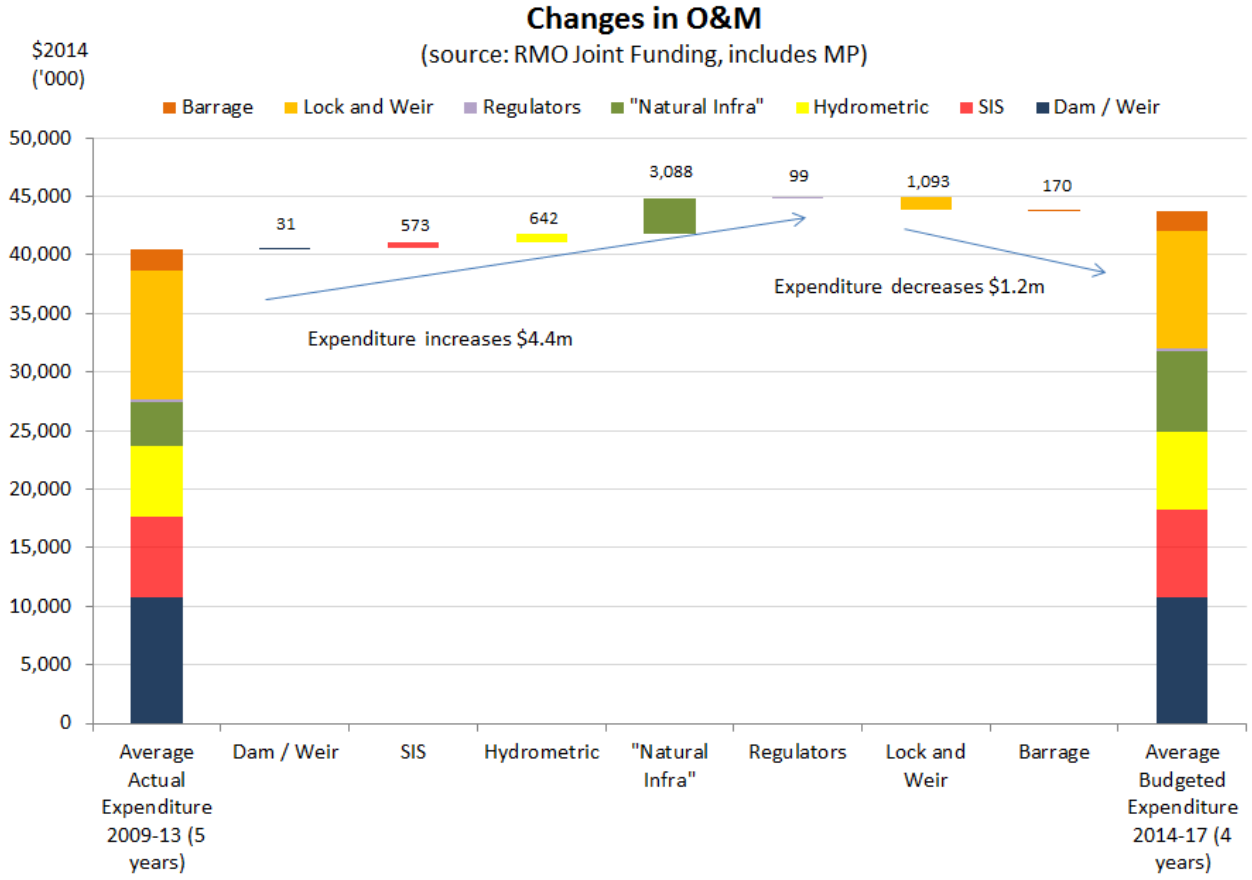


**Figure 10-3 – Changes in O&M (longer-term, RMO Joint Venture Data, inclusive of MP renewals)**

Figure 10-3 shows, to the left, the categories where expenditure increases. To the right, categories where expenditure decreases are shown.

This approach shows that over the longer term, the main driver for operating expenditure change, if some renewals are taken into account (i.e. MP renewals), are the natural infrastructure assets.

The largest component of the change in natural infrastructure expenditure is the River Murray program carried out by NSW Office of Water, however Victoria and South Australia are also significantly investing in new, natural infrastructure operations projects (see Figure 10-4).

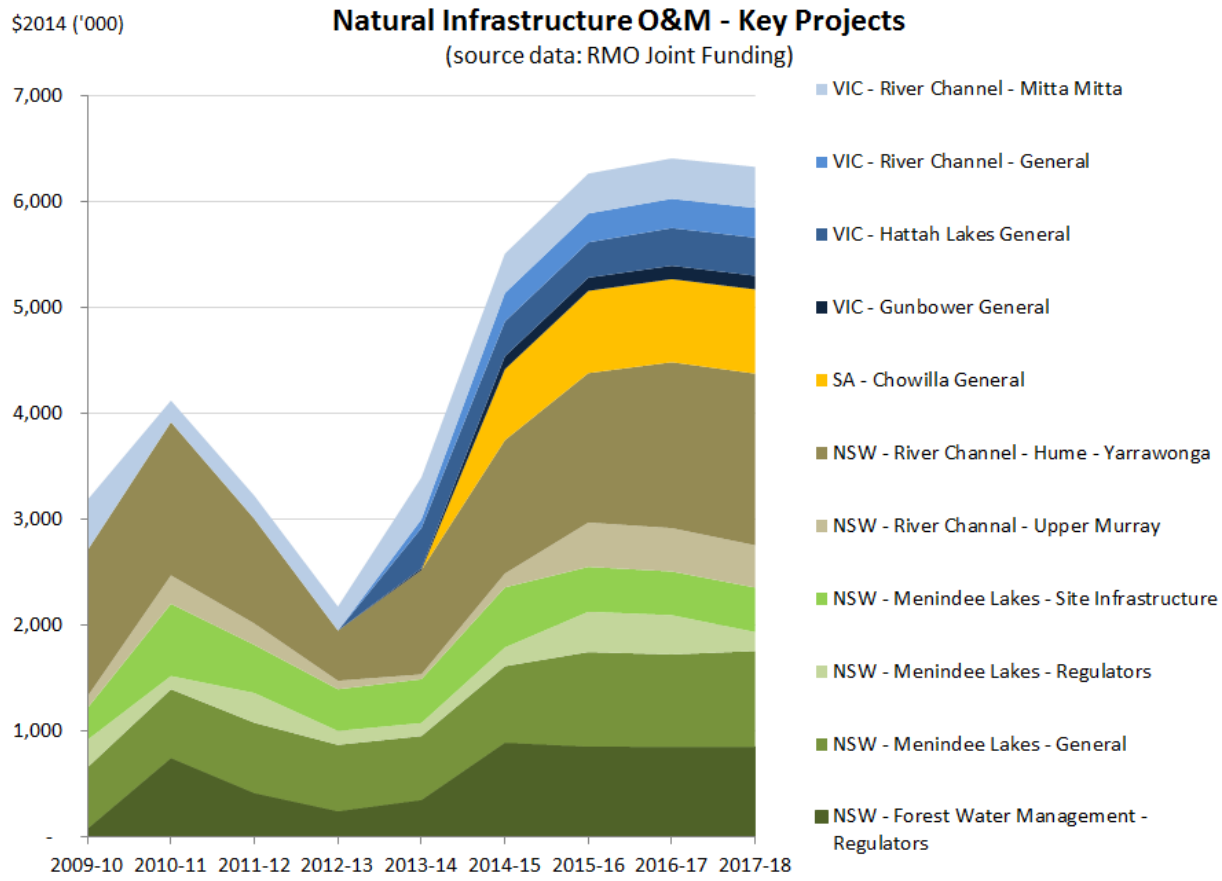


**Figure 10-4 – Changes in Natural Infrastructure O&M costs (including MP renewals)**

**Approach 2**: Use of RMO Budget (v5.9) to consider pure 'O&M' with all renewals excluded

The changes in O&MR costs are listed in Table 10-4.

**Table 10-4 Changes in O&MR Costs**

| $ '000 | 2013-14 Budget (O & MR only) | Average Budgeted Expenditure 2014-15 to-17-18 (4 years) | Change |
|---|---|---|---|
| SIS | 8,641 | 9,176 | +534 |
| "Natural Infra" | 5,823 | 6,116 | +294 |
| Hydrometric | 3,580 | 3,834 | +255 |
| Regulators | 2,944 | 3,629 | +685 |
| Dam / Weir | 605 | 744 | +139 |
| Lock and Weir | 8,419 | 8,710 | +291 |
| Barrage | 1,044 | 1,111 | +67 |
| Overheads | 8,695 | 8,474 | -221 |
| Total | 39,750 | 41,793 | +2,043 |

The same information is presented graphically in Figure 10-5.

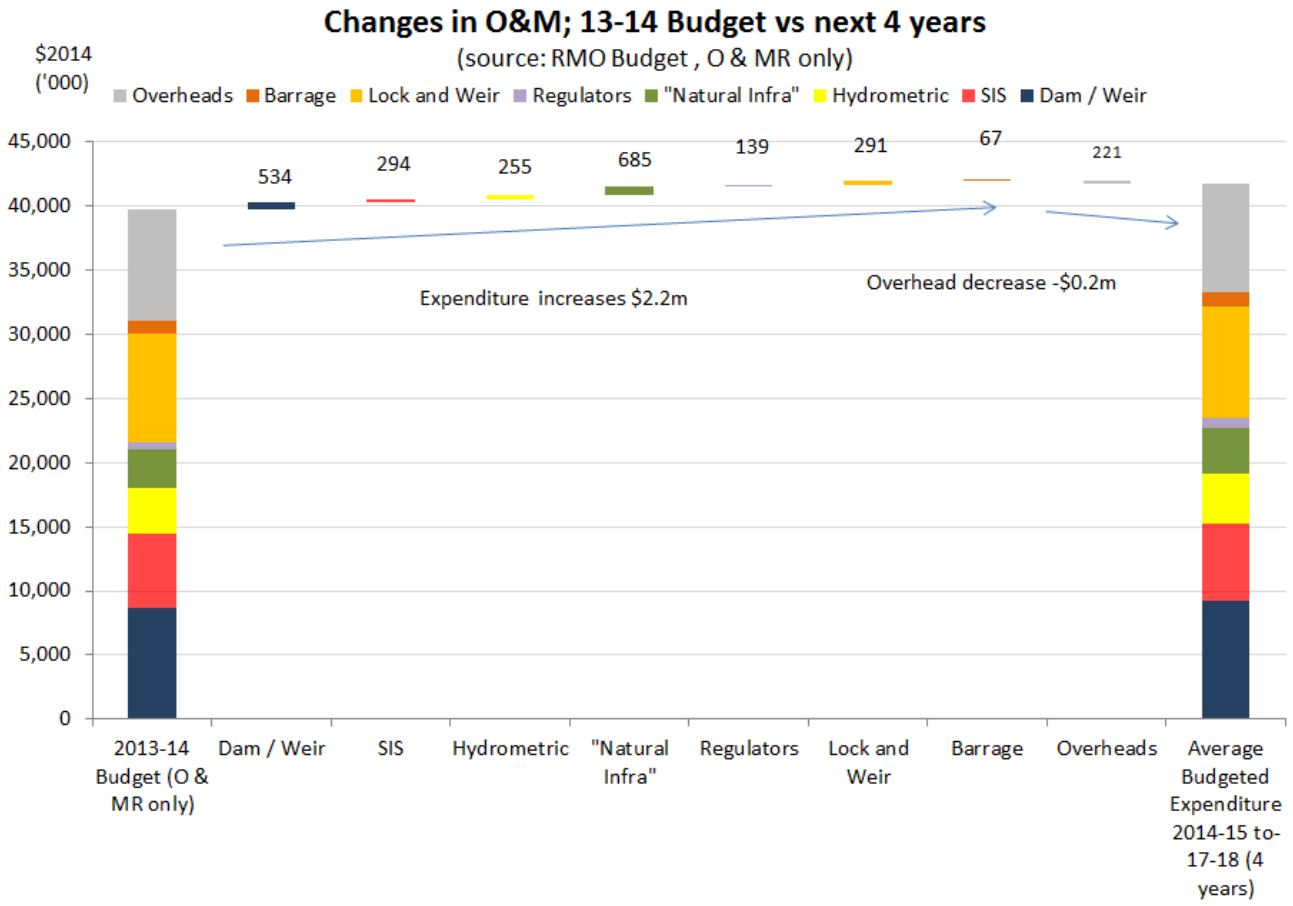


**Figure 10-5 – Changes in 'Pure' O&M Expenditure 2013/14 budget to average expenditure 2014/15 to 2017/18, including full Menindee Budget (approx. $0.2m on average)**

Analysing "pure" O&M budget data shows that RMO expects operating costs to increase in real terms, for all asset types, over the 2013-14 to 2017-18 period. The total average13 increase is $4.7M in nominal terms, or $3.7M in constant $2014.

Figure 10-5 above shows only O&M costs classified as O&M, excluding I&C costs and including the full Menindee costs, giving a real increase of $2M (nominal average of $4.3M).

Using this analysis we see that all categories of O&M expenditure increase in real terms, with the exception of 'overheads', which decreases slightly. The largest component of the increase is for natural infrastructure, reflecting the new schemes, followed by dams.

[13] i.e. the average expenditure over 2014-15 to 17-18 (4-year period)

**Approach 3**: Use of Budget 5.9 data to consider O&M and renewals expenditure movements combined.

Changes in the RMO budget (capex and opex) are listed in Table 10-5.

**Table 10-5 Changes in RMO Budget (Capex and Opex)**

| $ '000 | 2013-14 Budget (O, MR, I&C, MP) | Average Budgeted Expenditure 2014-15 to-17-18 (4 years) | Change |
|---|---|---|---|
| SIS | 7,927 | 8,149 | +222 |
| "Natural Infra" | 5,527 | 7,804 | +2,277 |
| Hydrometric | 3,596 | 3,853 | +257 |
| Regulators | 762 | 798 | +37 |
| Dam / Weir | 19,094 | 16,456 | -2,639 |
| Lock and Weir | 18,052 | 13,818 | -4,234 |
| Barrage | 2,467 | 2,457 | -10 |
| Overheads | 8,695 | 8,474 | -221 |
| Total | 66,120 | 61,809 | -4,311 |

The same information is presented graphically in Figure 10-6.

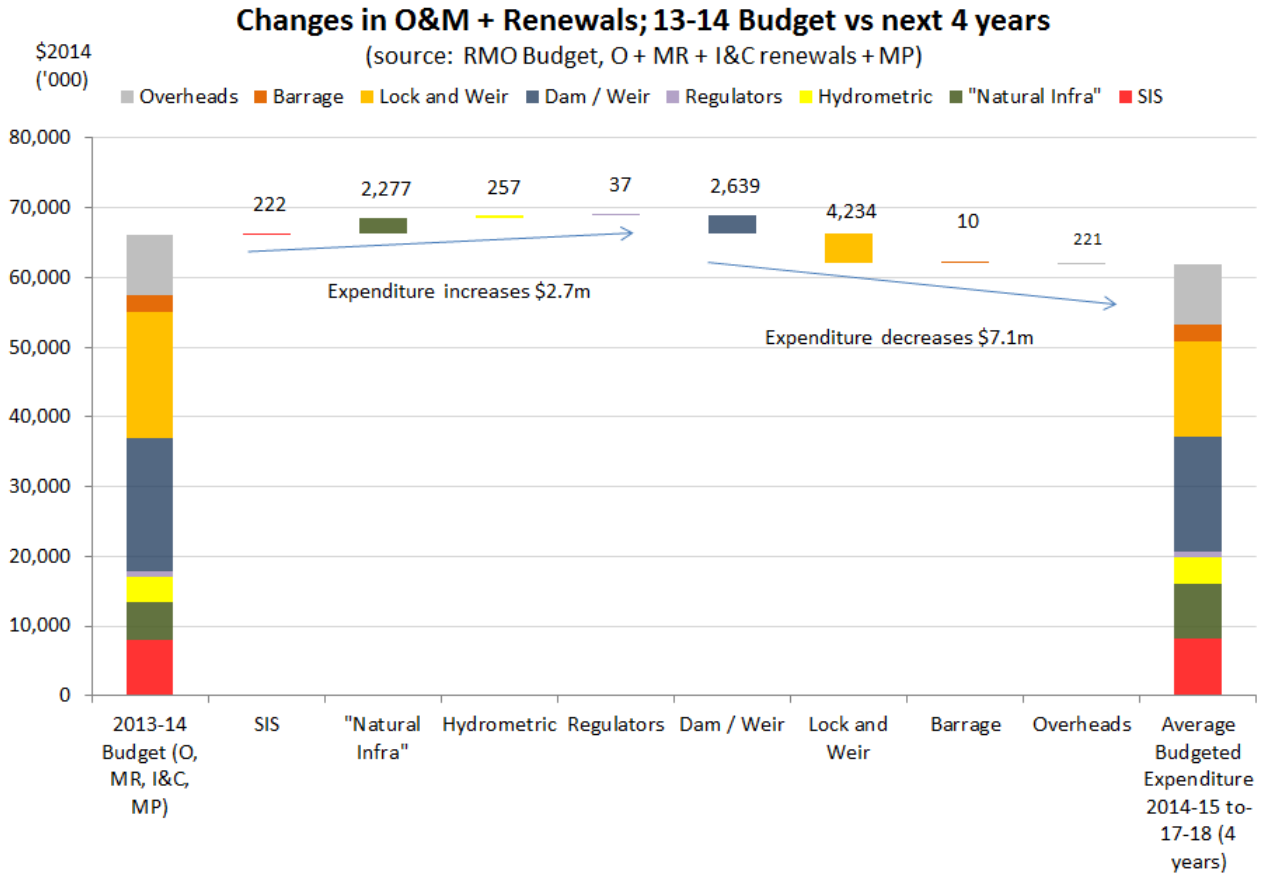


**Figure 10-6 – Changes in O&M plus renewals combined from 13/14 budget to 2014/15 to 17/18 average (including the full Menindee budget)**

In this final analysis, where O&M and renewals are combined, we see the combined effects of changes in O&M and renewals budgets; with large decreases in renewals budgets since the 2013/14 budget in Dams, Locks and Weirs outweighing the increases in O&M to give a real decrease in expenditure since 2013/14.

Again, Figure 10-4 shows O&M costs classified as O&M, as well as MP and I&C costs classified as renewals at the detailed level. The chart also includes the full Menindee costs, giving a real increase of $2M (nominal average of $4.3M).

Total expenditure trends are shown below in Figure 10-7

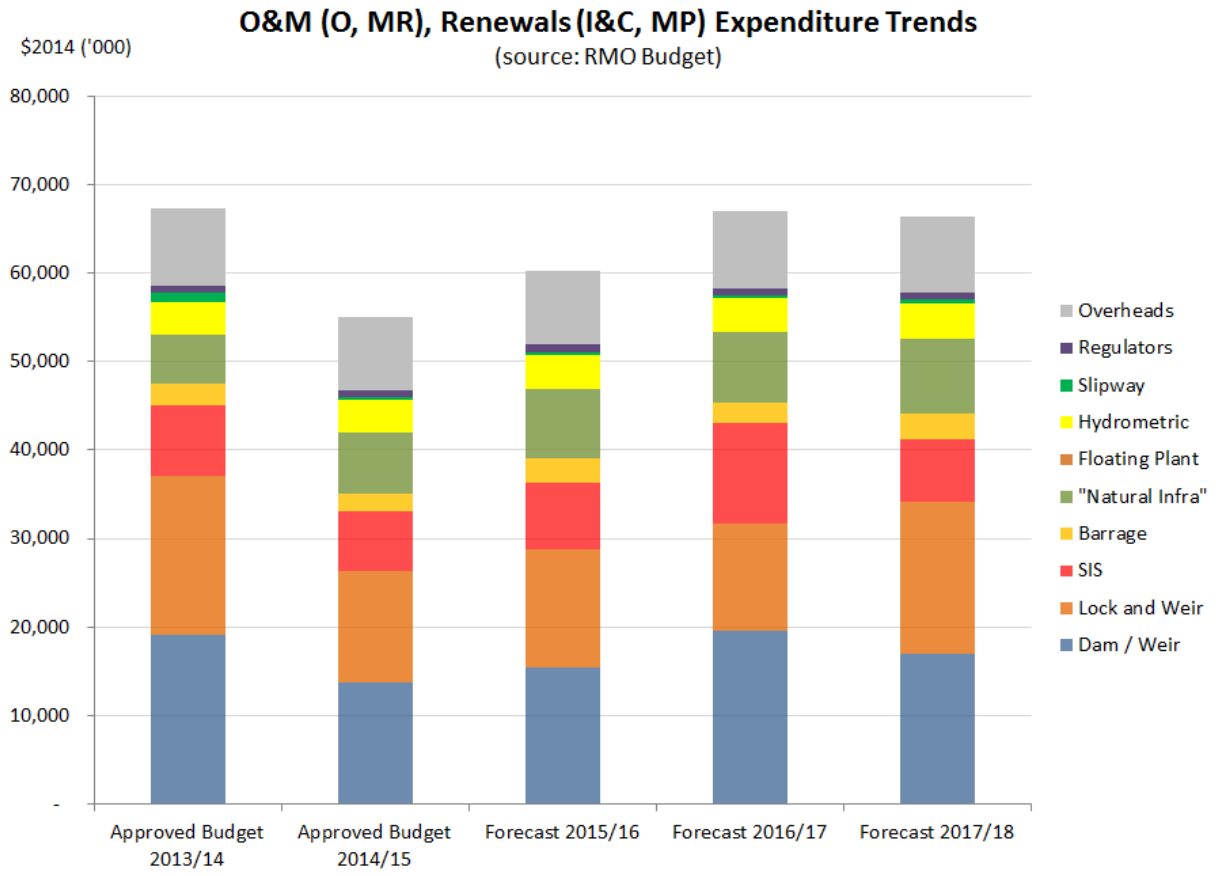


**Figure 10-7 – Changes in O&M plus renewals expenditure since the 2013/14 Budget, by year**

In Figure 10-6 we compared the 2013/14 budget to average expenditure over the 2014/15 to 17/18 period and noted a real decrease in expenditure, however from Figure 10-7 we see that this decrease is mainly due to the low expenditure in 2014/15. MDBA expects total O&M and renewals expenditure to return to about the same level as the 2013/14 budget by 2017/18.

Again, I&C costs which are later classified as O&M in the summary are excluded from the chart, but the overall trends are the same.

## 10.5 Benchmarking of operation and maintenance

We undertook benchmarking of O&M (including planned maintenance) costs across the various asset types to determine whether any trends existed as shown in Figure 8-3. This high level benchmarking indicates that:

- Hume Dam costs more to operate than Dartmouth. Hume Dam is a gated structure and the principal dam on the Murray River. Dartmouth dam is mainly a back-up source. Lake Victoria is the most expensive dam to operate as a ratio of its current replacement cost.
- The locks and weirs typically cost 1% to 1.4% of current replacement cost to operate and maintain. The exception is Torumbarry weir costs at 0.78% which is a reflection of the younger age and more modern design of this facility. When planned maintenance costs are excluded in forecast costs (see Figure 8-3) the picture changes slightly with the O&M cost of Euston Lock significantly higher at 1.84% of CRC compared to the remainder at 0.9% to 1.4%. Torrumbarry continues to be much lower at 0.68%. MDBA

subsequently provided more up to date valuation data for Euston Lock which reduced the O&M/ CRC percentage from the outlying 1.84% to 1.32% which is of a similar order to the South Australian locks and weirs

- There is significant variation on O&M costs for the salt interception schemes. We have not been able to investigate in detail the reason for this variation but it is likely to be based on the extent of pumping equipment and the associated pumping costs.

## 10.6 Allocation of Overheads

We note that in December 2011 the Basin Officials Committee (BOC) agreed that MDBA undertake a comparative analysis of corporate overheads within partner governments. The study found that agencies all had different models for overheads and it was found difficult to ensure consistency in data. However the study found that there was a reasonable level of consistency in the calculated cost per FTE (ranging from $41.7k to $52.2k with a median of $44.8k).

A view was expressed by some SCAs during the interviews that there was insufficient recovery of corporate overheads. It was claimed that the formulae for calculating corporate overheads was agreed some twenty years ago and since that time the need for corporate support services has increased (e.g. IT, legal, communications). We understand that SCAs are in discussion with MDBA on this matter.

We have not made any allowance in our analysis for variations in corporate overheads between the SCAs.

## 10.7 Conclusions

Our analysis of operating costs shows that underlying O&M costs are increasing. However, O&M as a proportion of the total asset value is remaining roughly constant over the long term.

Short-term pressures in operating costs over the 2014/15 to 17/18 period due to new assets have been offset by reductions in renewals expenditure. We note that the projected renewals budget of $85M should include some ‘advance’ renewals for the upcoming spike in expected replacements.

Over the longer-term, we would expect renewals expenditure to increase further, towards an average of $32M p.a. (from the current proposed average of $20.5M p.a. in $2014).

Base operating costs are projected to increase in real terms over the 2014-15 to 17-18 period at 3.2% p.a. in real terms (and 3.7% from the 13-14 base). Clearly, real increases in operating costs should be accompanied by real increases in service or outputs. We have applied some efficiencies to the projected O&M costs which bring the real increases from 14-15 to 17-18 down from 3.2% to 2% (or to 2.8% from the 13-14 base).

If our adjusted O&M budget is combined with the renewals projections from MDBA (which were only modified by the deduction of $0.36M of capital contingency costs), the overall change in RMO expenditure is -0.22% p.a. in real terms (i.e. nominal increases of 2.3% p.a. – slightly less than expected inflation).

In the absence of the sort of output data we would typically use for an efficiency review, we consider this to be a prudent and efficient allowance for new assets and upcoming renewals. It is possible that a higher level of efficiency gains can be made, however without a better understanding of asset performance and risk, further budget cuts may increase service risk and lead to sub-optimal economic outcomes for the River Murray System. The risk of leaving some MDBA ‘inefficiency’ in the budget must therefore be weighed against the risk of causing service reductions and a prudent approach is to err on the side of caution.

Better information regarding service, outputs and risks will increase the ability of an economic regulator to correctly and safely identify efficiencies which can be made without putting the service and end users at risk.

# 11 Recommended prudent and efficient expenditure

We have assessed the expenditure proposed for River Murray Operations for the period 2014/15 to 2017/18 following the methodology set out in Section 1.6. Our analysis has considered the operating environment for the River Murray Operations including the rigorous governance framework under the Water Act 2007. We have considered the strategic management and asset management assessment processes employed by the MDBA and the SCAs. We have also met with the SCAs that are responsible for operating, maintain and delivering capital works for River Murray Operation and reviewed their processes and performance. We have noted in Section 7 how the context of this review has differed from a regulatory review under the WCIR and the limitations this has placed on our assessment. In Section 8 we have assessed the scope for efficiency gains in River Murray Operations considering both 'top-down' and 'bottom-up' approaches including the Total factor Productivity analysis completed as part of this project. In sections 9 and 10 we have analysed the capital and operating expenditure proposed for River Murray Operations in detail.

Table 11-1 summarises the capital and operating expenditure proposed for River Murray Operations for the period 2014/15 to 2017/18 and the adjustments we have made to arrive at our recommended levels of prudent and efficient operating and capital expenditure. The adjustments we have made to the proposed expenditure are as follows:

- We have re-based the proposed expenditure forecasts to present all costs in $14/15
- We have necessarily allocated some expenditure classified as I&C (capital) as operating expenditure
- We have not applied the reduction to SIS operating expenditure we identified in our preliminary findings as MDBA identified further efficiency savings in this area and made further cost reductions which were reflected in its re-submitted proposed expenditure forecasts
- Reduced operating expenditure on locks and weirs to reflect inefficient costs identified through internal cost benchmarking
- Applied an ongoing efficiency gain of 1% per annum to operating expenditure
- Removed capital expenditure associated with contingency items.

**Table 11-1 Recommended prudent and efficient capital and operating expenditure**

| Ref | | 2014/15 | 2015/16 | 2016/17 | 2017/18 |
|---|---|---|---|---|---|
| *Proposed expenditure* | | | | | |
| A | O&M (i.e. O + MR) | 31,841,795 | 33,818,330 | 34,139,312 | 37,395,717 |
| B | O&M costs classified as I&C in summary sheet | 10,023,795 | 10,464,151 | 11,045,658 | 12,134,430 |
| C = A+B | Sub-total - Operating expenditure | 41,865,590 | 44,282,481 | 45,184,970 | 49,530,147 |
| D | MP | 9,362,780 | 9,332,237 | 8,431,377 | 10,206,042 |
| E | I&C Renewals | 2,575,000 | 6,447,888 | 15,084,876 | 12,677,955 |
| F | I&C Enhancement | 1,444,282 | 1,798,431 | 1,494,817 | 1,044,057 |
| G = D+E+F | *Sub-total - Capital expenditure* | *13,382,062* | *17,578,556* | *25,011,070* | *23,928,054* |
| **H = C + G** | **Total proposed expenditure** | **$55,247,652** | **$61,861,037** | **$70,196,040** | **$73,458,201** |
| Proposed adjustments to operating expenditure | | | | | |
| I | SIS opex reduction (removed) | $0 | $0 | $0 | $0 |
| J | Lock and Weir Internal Benchmark (Euston) (removed) | $0 | $0 | $0 | $0 |
| K =C - I - J | *Subtotal operating expenditure* | *$41,865,590* | *$44,282,481* | *$45,184,970* | *$49,530,147* |
| L | Operating expenditure efficiency | | | | |
| M | Ongoing efficiency (%) | 1 | 0.990 | 0.980 | 0.970 |
| N = (1- | Ongoing efficiency (amount) | $0 | $442,825 | $908,218 | $1,500,813 |

| Ref | | 2014/15 | 2015/16 | 2016/17 | 2017/18 |
|---|---|---|---|---|---|
| M)*K | | | | | |
| | Catch-up efficiency | | (none specifically applied) | | |
| O=I+J+N | *Total adjustments to operating expenditure* | *$0* | *$442,825* | *$908,218* | *$1,500,813* |
| **P=K-O** | **Recommended efficient operating expenditure** | **$41,865,590** | **$43,839,656** | **$44,276,752** | **$48,029,334** |
| | Comparison to proposed operating expenditure | 0.00% | -1.00% | -2.01% | -3.03% |
| **Proposed adjustments to capital expenditure** | | | | | |
| Q | Contingency adjustment | $90,195 | $91,417 | $90,724 | $90,483 |
| **R=G-Q** | **Recommended capital expenditure** | **$13,291,867** | **$17,487,139** | **$24,920,346** | **$23,837,571** |
| | Comparison to proposed capital expenditure | -0.67% | -0.52% | -0.36% | -0.38% |

# APPENDIX A
## PROJECTS

SUMMARY SHEETS FOR CAPITAL

Cardno
Shaping the Future

## Projects Reviewed

| State Constructing Authority | ID | Project |
|---|---|---|
| Goulburn Murray Water | 24292 | Hattah Lakes Project Implementation |
| | 10506 | Mildura Lock 11 Trestle Structure |
| | 12154 | Upgrade Telemetry - Torrumbarry |
| SA Water | 11561 | Murtho Salt Interception Scheme |
| | 10760 | Bookpurnong Lock 4 – Modify Navigable pass |
| | 12121 | Dam Improvement program investigations |
| State Water | 10410 | Euston Lock 15 Future Remedial Works Program |
| | 12369 | Hume Dam Spillway Southern Training Wall |

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | Hattah Lakes Project | **Project Number** | **24291 (Investigation)**<br>**24292 (Construction)** |
| **Status** | Complete | **Driver** | **Environmental** |

**SCOPE OF WORKS**

The approved Construction Proposal provides for :

- Lowering sills in Chalka Creek to assist the flow of water into the system.
- Constructing 4 no. new regulators and 2 no. stopbanks/levees on the floodplain to retain water.
- Constructing a permanent pumping station at the mouth of Chalka Creek to top up natural floods and fill the lakes during extended dry periods.
- Refurbishment of 1 no. existing regulator.

**Financial Data $nominal**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $32.2M | **Total Forecast Cost** | $27.3M |
| **Total Historical Budget** | $32.1M | **Total Historical Cost** | $26.7M |
| **Reasons for Cost Variance** | Earlier concept estimates had 40% contingency. As the design/delivery was developed and more refined, the contingency was reduced as the design became clearer. The risk management workshop identified all major risks, which were appropriately managed through the tender documents. Earlier estimates may also have included design costs, which were not part of the Construction proposal estimate. | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | 2013/14 | **Actual Completion Date** | 2014/15 |
| **Reasons for Timeframe Variance** | Flooding in 2010/11<br>Project substantially complete in 2013/14 but a second round of commissioning is required since the Mallee Catchment Authority could not purchase sufficient water in 2013/14 | | |

| $nominal | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 | 17/18 |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | $1,248 | $10,717 | $7,729 | $12,348 | $590 | $76 | | | |
| **Actual ($k)** | $987 | $1,393 | $9,674 | $13,114 | $1,577 | | | | |

**JUSTIFICATION FOR PROJECT**

Hattah Lakes is one of six Icon Sites identified under the Murray Darling Basin Ministerial Council's 'The Living Murray Initiative'. Hattah Lakes is an extensive wetland complex covering approximately 13,000 ha within the 48,000 ha Hattah-Kulkyne National Park. It is located in Victoria on the River Murray between Robinvale and Mildura.

The key threat to the environmental values of the Hattah Lakes is the reduction in the frequency and duration of flooding, caused by the diversion and regulation of flow upstream.

**PLANNING & OPTIONS APPRAISAL**

| |
|---|
| Initially a feasibility report was prepared through the Mallee CMA which looked at 10-12 options |
| Goulburn-Murray Water were commissioned to progress the project through the feasibility/ design/construction phase |
| A concept design report was prepared in 2009. This was preceded by a number of studies undertaken by the Mallee CMA between 2004 and 2007. The concept/design report included an appraisal of alternative sub-options for locating structures, concept designs, preliminary cost estimates as well as other matters. |
| The design stage included external peer review at 30%, 50% and 80% design stages |

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | Mildura Mechanised Trestles | **Project Number** | **10506** |
| **Status** | In progress, with one of five new mechanised trestles installed | **Driver** | Operational OHS risk |

**SCOPE OF WORKS**

Replacement of five drop-bar trestles (out of a total of 19) with mechanised trestles that incorporate vertical overshot gates. Eventually it is proposed replace all trestles with drop bars so that the weir is fully mechanised.

Mildura Weir, constructed in 1927, is located on the Murray River at Mildura in north-western Victoria. It is the last of the Dethridge type weirs remaining along the river.

Previous works have included the initial construction of one prototype mechanised trestle, able to replace any one of the existing standard trestles (Phase 1 of project). After a satisfactory period of testing, the design drawings were revised to reflect any required modifications. and five new 'modified' mechanised trestles are to be manufactured and delivered, to be installed by weir staff (Phase 2).

Phase 3 will involve determining what remaining trestles should be mechanised while Phase 4 will implement the mechanisation.

Of the 24 trestles one is a 'granny' trestle, 19 are standard trestles and four are ramp trestles. At the end of Phase 2, in addition to the 4 ramp trestles and the 'granny' trestle, there will be 6 mechanised trestles and 13 standard drop-bar trestles.

**Financial Data ($nominal)**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $6.94 M (Phase 1,2 )<br>$3.09 M (Phase 1)<br>$3.85 M (Phase 2) | **Total Forecast Cost** | $6.94M (Phase 1 & 2) |
| **Total Historical Budget** | $9.30M | **Total Historical Cost** | $3.3M |
| **Reasons for Cost Variance** | It was suspected during the removal of in Phase 1 that there were problems with the weir guide rails and top of the concrete base. Subsequent diver inspection confirmed that these elements were in a poor condition and remedial work was required before Phase 2 was implemented. Project No. 12510 Weir Repair Construction was undertaken in 2012 and 2013 at a cost of $1.2M to address this issue.<br>While this impacted on (delayed) the installation program, this work did not impact on the cost of the trestle mechanisation project | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | End of 2014 (Phase 2) | **Actual Completion Date** | Trestles will be completed in 2014, Installation & commission will occur inl 2015 |
| **Reasons for Timeframe Variance** | Delays occurred in starting Phase 2 due to the need to undertake remedial works (see above) | | |

| $ nominal | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 | 17/18 |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | $400 | $1,800 | $2,000 | $800 | $4,299 | $0 | $500 | $1,000 | $1,295 |
| **Actual ($k)** | $589 | $568 | $205 | $208 | $1,753 | | | | |

**JUSTIFICATION FOR PROJECT**

The labour intensive operation of manually positioning and removing drop bars within the weir trestles has been identified as a high OH&S risk.

There are a number of factors contributing to the need for an upgrade of the weir including the need to improve the day to day operation requirements of the weir, which requires the removal and placement of the existing drop bars within the trestles, working at height and over water, to reduce the health and safety risks to staff

**PLANNING & OPTIONS APPRAISAL**

The original business case to upgrade Mildura Weir was presented in 2000 which considered the issue of the strength of the trestles and OH&S

A workshop was held in April 2005 to identify options for improvement and risks associated with current operation

Deer Park Engineering (steel fabricator) was commissioned to work with GMW to identify feasible mechanization options for further consideration.

The Feasibility report prepared in 2006 by NSW Dept of Commerce, reviewed the two preferred options proposed by Deer Park Engineering and included cost estimates. The report recommended that Option 1A vertical overshot gate system be adopted.

In 2009, URS undertook a more detailed evaluation study of the weir replacement options versus the mechanized trestle option proposed in the Feasibility study.. Based on a consideration of capital, lifecycle and risk costs, URS confirmed that Option 1 – Mechanising the existing trestles to be the preferred option in the short to medium term but was considered not viable in the long term due to OH&S risks. The report recommended that Option 3 – Concrete piers on a new apron be considered as the long term solution (50 years at a total cost $58.7M compared to $37.7M for option 1).

The concept design for the mechanised trestles was subsequently developed. In 2010 a prototype mechanised trestle was designed and constructed and installed into the weir. Following two years of operational experience the design was reviewed and updated by SMEC and a contract awarded to manufacture 5 further mechanised trestles. The new trestles are expected to be installed in the weir in winter 2015.

**COST ESTIMATING & COST CONTROL**

Original 2006 Dept of Commerce estimate was $266k per trestle (equates to $306K/trestle and overall cost of $7.2M total cost at $14/15)

URS 2009 estimate was $12.7M ($13M at $14/15) or $542K/trestle

Cost of 5 trestles (Phase 2) is $3.85M or $770K/trestle

Based on these Phase 1 and 2 costs total cost would be $15.5M (20 trestles) or $18M (24 trestles) which is still lower than option 3 estimate of $42.6M (2009) ($49M $14/15)

Phase 2 business case estimate - $3.85M. Forecast expenditure -$3.91M. Variance = 1.5%

**PROJECT DELIVERY PROCESS**

Concept design included consultant from panel plus fabrication company (early contractor involvement)

Phase 1 – fabrication by open tender. installed by GMW

Phase 2 - fabrication by open tender installed by GMW

Investment in a prototype is considered to be a sound approach given the high risks involved and GMW's

| |
|---|
| familiarity with the process for removing and installing the trestles |

**CONCLUSION**

| |
|---|
| Constraints on capital investment means that the project will not be able meet its objective of minimizing OH&S risks for many years |
| Investment in a prototype is considered to be a sound approach given the high risks involved |
| The staged approach to installing the trestles (post-prototype) is not considered efficient but necessary given the funding constraints |
| Possibly the condition of the guide rails should have been considered earlier in the project given that the structure is 91 years old. |
| Overall the project is prudent (justified) and efficient given the funding constraints |

**KEY DOCUMENTS REVIEWED**

| |
|---|
| Mildura Weir Drop Bar Alternatives, Project Status Report 1, March 1997 |
| Lock and Weir 11, Mechanised Trestle Concept design for Goulburn Murray Water, NSW Department of Commerce, Nov 2006 |
| Mildura Weir replacement Options Evaluation, URS March 2009 |
| Business Case – Mildura Weir Trestle Mechanisation Post Prototype,May 2012 |
| Major Investment Projects Committee Minutes – Meeting 5,May 2012 |
| Trestle Mechanisation Project-Five Units- Cost Estimate |
| Trestle Mechanisation – Tender Evaluation Report October 2013 |

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | Upgrade Telemetry- Lock & Weir 26 Torrumbarry | **Project Number** | 12154 |
| **Status** | Planning | Driver | Renewals |

**SCOPE OF WORKS**

| |
|---|
| The project includes a review of existing hydraulic system and operational function of the weir followed by design and construction of the control system. |

**Financial Data $nominal**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $1,330,000 | **Total Forecast Cost** | $1,330,000 |
| **Total Historical Budget** | $200,000 | **Total Historical Cost** | $73,000 |
| **Reasons for Cost Variance** | $200K was included in the MDBA budget, prior to the scope and programof works being understood. On project initiation, $95K was identified as the budget requirement to undertake the necessary investigations and develop the functional description i.e. Stage 1 of the project. | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | **2016/17** | **Actual Completion Date** | |
| **Reasons for Timeframe Variance** | | | |

| **$nominal** | **09/10** | **10/11** | **11/12** | **12/13** | **13/14** | **14/15** | **15/16** | **16/17** | **17/18** |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | $0 | $0 | $0 | $0 | $200 | $160 | $520 | $450 | |
| **Actual ($k)** | $0 | $0 | $0 | $0 | $73 | | | | |

**JUSTIFICATION FOR PROJECT**

The Torrumbarry Weir electrical control system is nearly 20 years old and approaching the end of its expected life span and many of the components and technologies used are no longer supported or available. This introduces a risk that failure of a PLC or Network hardware could disable control and monitoring of the Weir gates for an extended period of time. The Torrumbarry Weir is totally reliant on the SCADA control system for automatic operation and the primary reason for undertaking this project is to reduce these high risks associated with operating the structure with an old outdated control system

**PLANNING & OPTIONS APPRAISAL**

In 2009 GMW determined a standardized approach on telemetry system design and hardware components

In August 2011 the risks, benefits and estimated costs for the proposed electrical control system upgrade works at Yarrawonga Weir, Torrumbarry Weir and Dartmouth Dam were presented to the MDBA Asset Managers Advisory Panel. Based on the order of priority from this, the Torrumbarry Weir was proposed for implementation after Yarrawonga Weir.

A review was of the hydraulic system was undertaken in January 2014. This was then followed by scoping workshops in April which included operational staff

A business case is being prepared (to be completed in October 2014) to progress the project to detailed design.

**COST ESTIMATING & COST CONTROL**

Cost estimates are based on actual costs for Yarrawonga Weir
.

**PROJECT DELIVERY PROCESS**

Two consultancies have been let so far. The work undertaken by SGM was a sole supplier arrangement (<$25) due to SGM's expertise and knowledge of the weir. The Principal of SGM was intimately involved in the construction of the weir, including the control system.

SCD Tech Pty. Ltd. was engaged under an existing services supply contract to assist with the technical, software and cost estimation tasks.

**CONCLUSION**

The control system is nearing the end of its technological life and it is desirable that it is replaced. Based on the information provided at this early stage, it is considered that the project is prudent and efficient.

**KEY DOCUMENTS REVIEWED**

Candidate Form – Torrumbarry Weir – SCADA Upgrade Project

Torrumbarry Weir, Oil Hydraulic System Report, Daryl Pike & Associates, Jan 2014

Torrumbarry Weir Controls Project – Background Briefing Scope Meeting, SGM Consulting April 2014

Project Highlight Report – August 2014

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | Murtho Salt Interception Scheme | **Project Number** | 11561 |
| **Status** | Commissioning | **Driver** | Salt Interception Schemes |

**SCOPE OF WORKS**

The scope of the Murtho Salt Interception Scheme (SIS) involved construction of saline water collection bores, installation of saline water collection pumps and interconnecting pipework and construction of a saline water disposal main. The saline water disposal main was directionally drilled underneath the River Murray. Considerable refinement of the scope of works was undertaken during the project as more information on the hydrogeology was obtained through field tests.

**Financial Data $nominal**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $31,630,000 | **Total Forecast Cost** | $25,881,000 |
| **Total Historical Budget** | $31,430,000 | **Total Historical Cost** | $25,282,000 |
| **Reasons for Cost Variance** | The constructed works were less extensive than the budgeted scope. However, this was offset by additional costs during construction that included re-work, bankruptcy of a contractor and flood costs. | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | 2013/14 | **Actual Completion Date** | 2013/14 |
| **Reasons for Timeframe Variance** | | | |

| **$nominal** | **09/10** | **10/11** | **11/12** | **12/13** | **13/14** | **14/15** | **15/16** | **16/17** | **17/18** |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | 7,500 | 10,000 | 8,200 | 1,860 | 200 | - | - | - | |
| **Actual ($k)** | 8,427 | 3,243 | 6,540 | 2,612 | 599 | | | | |

**JUSTIFICATION FOR PROJECT**

Murtho has been identified as a potential salt interception site dating back to the Basin Salinity Management Strategy in 2001. Salinity in the Basin is managed with reference to conductivity levels at Murtho. Feasibility work for salt interception at this site identified a potential salinity reduction contribution of 20.2 EC and a cost benefit ratio of 1.53.

**PLANNING & OPTIONS APPRAISAL**

At the feasibility stage, the proposed design was identified as including 52 abstraction boreholes and 54km of pipeline ranging in diameter from 40mm to 563mm. Through field testing, the number of boreholes required was reduced to 23. This is typical for SIS works where the final design is proven through field testing.

**COST ESTIMATING & COST CONTROL**

Cost estimates were refined throughout the project delivery process due to the changing scope. Additional costs were incurred due to the need to re-design the works as more information was obtained. The re-design costs were offset by the reduced scope.

**PROJECT DELIVERY PROCESS**

A procurement strategy was prepared as part of the Project Business Plan. This project was identified as an opportunity to trial different approaches to procurement. A constraint to project delivery for SIS is that design needs to be undertaken in parallel with field testing to prove the level of salt extraction due to the inherent uncertainty in hydrogeology. While this led to reduce collection boreholes being in the final scope, significant additional design costs were incurred. It was identified the directional drilling component required specialist skills and a separate contract was engaged for this. We reviewed the lessons learned report and found this to be comprehensive and frank.

**CONCLUSION**

The scheme was commissioned in early 2014 and proving work is continuing. SA Water advised that it had encountered some difficulties in procurement and construction where the contractors engaged did not meet expectations in some areas. We reviewed the lessons learned report and found this to be comprehensive and frank. Most of the contracts let had substantial approved variations to cost.

**KEY DOCUMENTS REVIEWED**

46852 Murtho SIS Final Design Report
Completion Handover Report V6
Murtho SIS LL Improvement Areas
Murtho SIS Successes
Murtho SIS Root Cause Successes
Murtho SIS Root Cause Improvements
Murtho LL notes
MSIS LL Workshop Berri Office Sbeaty
Murtho SIS Improvements_Stock Control at Regional depots

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | **Bookpurnong Lock 4 – Modify Navigable Pass** | **Project Number** | 10760 |
| **Status** | Complete | **Driver** | Operational OHS risk |

**SCOPE OF WORKS**

This project is one part of a larger program to modify navigable passes to address health and safety hazards. The primary hazard identified relates to dismantling and reinstating the navigable pass in times of flood. The original lock design involved significant manual handling and underwater work. A feasibility study was undertaken in 2001 that identified an acceptable design employing reduced height concrete piers and removable steel decking that are able to be removed by cranes in times of flood. The locks along the River Murray have been progressively upgraded.

The specific scope of works included:

- Navigable and reduced pass works, including:
  - Construction and dewatering of a large cofferdam
  - For the navigable pass
    - Removal and disposal of rail beams, deck units, needle beams and boule panels
    - Removal and disposal of trestles and hinges
    - Construction of new reduced height piers
    - Fabrication and installation of new removable deck units
    - Manufacture and installation of new stoplogs
  - For the reduced pass
    - Removal of rail beams, deck units and stoplogs
    - Demolition and disposal of existing full height piers (concrete encased
    - trestles)
    - Construction of new full height piers
    - Modification of the existing rail beams to suit new piers
    - Reinstallation of stoplogs, railbeams and deck units for the reduced pass
  - Rewatering and removal of the large cofferdam
- Fishway works, including
  - Construction and dewatering of a cofferdam
  - Construction of a fishway inlet channel and fish lock within the sluice bay adjacent the gantry side abutment
  - Construction of a multichannel fishway structure within the bank upstream of the weir
  - Construction of a fishway exit channel at the upper upstream end of the fishway structure
  - Fabrication and erection of a gantry

**Financial Data $nominal**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $5.16M | **Total Forecast Cost** | $8.59M |
| **Total Historical Budget** | $8.59M | **Total Historical Cost** | $8.59M |
| **Reasons for Cost Variance** | The project handover report states that project costs are $14.2M. The additional costs over the budget were primarily related to flooding damage and reinstatement costs. | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | 2013/14 | **Actual Completion Date** | 2013/14 |
| **Reasons for Timeframe Variance** | Variance to the project delivery timeframe occurred due to flooding during construction | | |

| $nominal | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 | 17/18 |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | 1,868 | 1,338 | 0 | 1,617 | 337 | - | - | - | |
| **Actual ($k)** | 655 | 3,858 | 1,379 | 1,222 | 1,478 | | | | |

**JUSTIFICATION FOR PROJECT**

SA Water has been undertaking upgrades to RMO navigable passes in an ongoing program following a finding by the health and safety regulator in the 1990s that the reinstatement of the navigable pass at Lock 7 (in New South Wales) following flooding was unsafe.

**PLANNING & OPTIONS APPRAISAL**

The investigation for this particular project was largely undertaken in a 2001 Feasibility Study which identified an acceptable design employing reduced height concrete piers and removable steel decking that are able to be removed by cranes in times of flood.

**COST ESTIMATING & COST CONTROL**

The original contract amount was $7.2M. The final cost was around double this amount due to flooding and changes to scope. The lessons learned report notes that it was felt that reinstatement costs payable to the contractor could have been managed better through a different governance and payment mechanism and that for future contracts more control on reinstatement costs has been recommended.

**PROJECT DELIVERY PROCESS**

Design and procurement was managed by SA Water's Major Projects team located in Adelaide. Locks 7, 8 and 9 in New South Wales were upgraded first from 2002/03 to 2004/05. As construction progressed, wet weather was encountered in the late 2000s. The wet weather significantly affected the upgrades for Lock 2 and Lock 4 and we observe that the costs for these sites are considerably higher than the costs for the other locks. While managing the risks of wet weather will add to construction costs, we consider that there was scope for the costs for Lock 2 and Lock 4 to be reduced through alternative contractual risk management measures. SA Water noted that the wet weather and high river levels encountered were significantly different to preceding years. A "lessons learned" report has been prepared following completion of the works.

**CONCLUSION**

The upgrade of Lock 4 was part of a larger program of works where the design and construction had been tested and improved over time. Despite this ongoing improvement, significant additional costs were incurred for this project due to flooding damage and reinstatement. It has been identified that the contractual mechanisms relating to post-flooding reinstatement can be improved.

**KEY DOCUMENTS REVIEWED**

MDBA Assets Construction Handover report Lock 4 draft

MDBA Assets Construction Handover report Lock 2 draft

Feasibility Report, 2001, URS

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | **Dam Improvement program investigations (Lake Victoria Outlet Regulator)** | **Project Number** | 12121 |
| **Status** | In construction | **Driver** | Dam safety |

**SCOPE OF WORKS**

The scope of works involves installation of a secant pile cut-off and contiguous pile reinforcing of wing-walls, a downstream sand drain/filter and upgrade to all stop-log guides at the outlet of Lake Victoria.

**Financial Data $nominal**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $5.8M | **Total Forecast Cost** | $3.50M |
| **Total Historical Budget** | $5.8M | **Total Historical Cost** | $3.3M |
| **Reasons for Cost Variance** | | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | 2013/14 | **Actual Completion Date** | 2014/15 |
| **Reasons for Timeframe Variance** | | | |

| **$nominal** | **09/10** | **10/11** | **11/12** | **12/13** | **13/14** | **14/15** | **15/16** | **16/17** | **17/18** |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | 1,000 | 450 | 1,196 | 1,750 | 7,327 | 300 | - | - | |
| **Actual ($k)** | 238 | 153 | 526 | 429 | 1,939 | | | | |

**JUSTIFICATION FOR PROJECT**

The driver for this project was the dam portfolio risk assessment commissioned by MDBA which identified a prioritised work program. A supplementary report relating to Lake Victoria was prepared by URS in 2007 which identified that failure of the outlet regulator was the most significant contributor to the observed level of risk being above the limit of tolerability for all confidence levels. Remediation of the regulator was recommended at a cost of $3M ($2007).

**PLANNING & OPTIONS APPRAISAL**

Further assessment was undertaken in 2009 and 2010 and a detailed options assessment and concept design was completed in 2013. The proposed remediation works are to install a secant pile cut-off and contiguous pile reinforcing of wing-walls, a downstream sand drain/filter and upgrade to all stop-log guides.

**COST ESTIMATING & COST CONTROL**

The tendered costs are less than that allowed for in the MDBA's budget. We reviewed the tender evaluation

report and found that a thorough assessment had been undertaken on both cost and non-cost criteria.

**PROJECT DELIVERY PROCESS**

This project is being delivered by SA Water Major Projects. We reviewed various procurement documents including the tender evaluation and found that the procurement was appropriate to the scope of works.

**CONCLUSION**

These works are part of the wider Dam Safety program. The specific need addressed has been identified previously through investigation. Options to address this need and others identified at Lake Victoria have been assessed and refined over time. A competitive tender process was undertaken.

**KEY DOCUMENTS REVIEWED**

CO7253 – Recommendation Report – Phase 2 – 1.0
LV Outlet Regulator Project Budget 31072014
Workshop_final
Chowilla_Design_Report_40650
SMEC Structural Audit Nov 1998 – Lake Victoria
Lake Victoria – Visual Inspection Report 02-05-14
Lake Victoria – Visual Inspection Report 27-04-14

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | Euston Lock 15 – Future Remedial works program | **Project Number** | 10410 |
| **Status** | Complete | **Driver** | Renewals/risk reduction/environmental |

**SCOPE OF WORKS**

This was part of a program for upgrading navigable passes on the Murray River (Locks 1-10) that would allow river craft to navigate through the weir once the lock chambers become inoperable during flood periods. A major driver was the reduction of OH&S and flood risks. The weir was raised in order to provide a mid-stream storage and the capability to operate Upstream Pool Level (UPL) by 720mm higher than the Current Full Supply Level. The project involved

- Modifying and raising the navigable pass
- Modifying and raising the sluice pass
- Extending the Denil fishway
- Constructing a fishlock targeting smaller fish
- Raising the abutment (on NSW side)
- Undertaking downstream erosion control works
- Installation of upstream apron straps to ensure stability against sliding.

**Financial Data $nominal**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $24.4M | **Total Forecast Cost** | $20.24M |
| **Total Historical Budget** | $24.4M | **Total Historical Cost** | $19.7M |
| **Reasons for Cost Variance** | The tender was awarded for $11.03M<br>Construction contractors' cost increased to $15.3M due to the requirement for the contractor to stand down on three occasions in three years | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | Aug 2011 | **Actual Completion Date** | July 2014 |
| **Reasons for Timeframe Variance** | Due the flooding the contractor demobilised between Dec10 and Apr11, Aug11 and Jan 12, and Mar12 to Feb13. | | |

| $nominal | 09/10 | 10/11 | 11/12 | 12/13 | 13/14 | 14/15 | 15/16 | 16/17 | 17/18 |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | 3,300 | 6,596 | 2,872 | 5,284 | 2,134 | | | | |
| **Actual ($k)** | 1,442 | 6,718 | 2,108 | 5,645 | -392 | | | | |

**JUSTIFICATION FOR PROJECT**

The Euston Weir was constructed in 1937

This was part of a program for upgrading navigable passes on the Murray River (Locks 1-10) that would allow river craft to navigate through the weir once the lock chambers become inoperable during flood

periods.

The procedure for reinstatement of the navigable pass was considered to be a high-risk OH&S activity, needing divers to operate in strong currents with poor visibility, in conjunction with heavy machinery. The navigable pass can now be reinstated in less than 3 hours compared to 3-5 days previously.

Other reasons were improvement in flood safety and improving environmental outcomes (fishway). The lock and weir were a barrier to upstream fish movement

The trestles were aging (nearly 70 years old)

The concrete sections were unreinforced or under-reinforced. There has been some strong evidence of alkali aggregate reactivity.

**PLANNING & OPTIONS APPRAISAL**

A number of investigations were undertaken and reports prepared between 1984 and 2009, These were supported by divers surveys in 2001, 2006 and 2008/09.

The Business Case for this project could not be located

**COST ESTIMATING & COST CONTROL**

Pre-tender cost estimate was $10.1M

The tender sum was amended through a reduction in project scope (lock chamber refurbishment reduced) to $11.03M due to financial constraints

Construction cost increased to $15.3M due to the requirement for the contractor to stand down on three occasions in three years. The contractor's claim was for a significantly higher figure.

**PROJECT DELIVERY PROCESS**

NSW Department of Public Works undertook early scoping/ feasibility report and developed an initial budget. The initial estimate was $5.9M

Detailed design advertised by open tender and awarded to URS

Construction works were awarded following an open tender process

**CONCLUSION**

The project is considered prudent. Implementation may have not been efficient but this was due to events outside the State Water's control (three major flood events over 3 years)

**KEY DOCUMENTS REVIEWED**

Project Charter

Pre-tender cost estimate URS Feb 2010

Lock15 Tender Evaluation Comparison

Full tender documentation including specifications and drawings, Feb 2010

Tender Evaluation, Lock 15 Euston Construction, March 2010

Approval to Accept tender, MDBA, May 2010

Final Design Report, Contract No. 3976 – Detailed Design of the Navigable Pass Upgrade, fishways and Ancillary Works at Lock 15, URS, March 2014

Construction of Lock 15 Euston Weir, Construction Summary Report, SMEC, July 2014

**PROJECT DETAILS**

| | | | |
|---|---|---|---|
| **Project Name** | Hume Dam Spillway Southern Training Wall | **Project Number** | 12369 |
| **Status** | Complete | **Driver** | Dam Safety |

**SCOPE OF WORKS**

The project involved remedial work at Hume Dam on the Southern Training Wall (STW); the downstream concrete gravity wall supporting the earthfill embankment on the southern (Victorian) side of the spillway. The project involved the construction of mass concrete upstream and downstream buttresses.

**Financial Data $nominal**

| | | | |
|---|---|---|---|
| **Total Project Budget** | $42M | **Total Forecast Cost** | **$42M** |
| **Total Historical Budget** | $42M | **Total Historical Cost** | **$**28.8M |
| **Reasons for Cost Variance** | Due to uncertainties involved in relation to ground conditions a number of Prime Cost items were included. Construction conditions were quite favourable with some variations being negative | | |

**Project Timetable**

| | | | |
|---|---|---|---|
| **Programmed Completion Date** | June 2013 | **Actual Completion Date** | Nov 2013 |
| **Reasons for Timeframe Variance** | There were some delays with foundations works but the contractor caught up to be within 2-3 weeks of the contract completion date. | | |

| **$nominal** | **09/10** | **10/11** | **11/12** | **12/13** | **13/14** | **14/15** | **15/16** | **16/17** | **17/18** |
|---|---|---|---|---|---|---|---|---|---|
| **Planned ($k)** | 0 | 13,333 | 14,999 | 15,333 | 11,110 | | | | |
| **Actual ($k)** | 0 | 1,441 | 6,765 | 15,458 | 4,112 | | | | |

**JUSTIFICATION FOR PROJECT**

In 2007, MDBC carried out a Portfolio risk assessment (PRA) of five major storages. The study identified that the three highest risks across the portfolio were at Hume Dam. A risk reduction action for one of the high risks was remedial works associated with the Southern Training Wall (STW) anchors.

The STW has been an area of special interest for some time as the deformations of the adjacent embankment 1A continue to increase beyond previous estimates. As a result, horizontal anchor bars installed during the program of remedial works at Hume Dam in the period 1995-2003 have been, or will in the foreseeable future be, bent beyond design limits

**PLANNING & OPTIONS APPRAISAL**

Following on from the PRA a number of studies/ reports were undertaken in 2008 and 2009. These included geotechnical investigations, pre-feasibility report, risk review workshops and concept design report. Four options were considered with only two options considered as being feasible. The upstream and downstream buttress option at an estimated cost of $33.5M- $41.3M was considered to provide a lower cost and superior risk reduction to the alternative.

The design review included an independent Expert Review Panel. The Review Panel was maintained through the construction phase

**COST ESTIMATING & COST CONTROL**

Initial Business Case estimate was $42M.

The Evans & Peck total project estimate (May 2011) was $34.2M (P50) and $36.4 (P90)

The final total project cost was

**PROJECT DELIVERY PROCESS**

**The project was undertaken using** early contractor involvement (ECI) process. Expressions of interest were called from prequalified contractors (NSW T panel). From the EOI four contractors were selected to participate in the ECI process. The ECI process included the development of a risk allocation plan. The design was undertaken by URS on a single select engagement based on their previous knowledge and experience with Hume Dam. this arrangement was approved by the project steering committee.

**CONCLUSION**

From the information provided this project is considered to be prudent and efficient.

**KEY DOCUMENTS REVIEWED**

River Murray Water – Portfolio Risk Assessment of Five Major Storages – Strategy Report, URS, Dec 2007

Portfolio Risk Assessment of Five major Storages – Hume Dam Supplementary Report, URS, Nov 2007

Hume Dam Remedial Works – Pre-Feasibility Report of Southern Training Wall(STW) and Spillway Southern Junction(SST) Stabilisation Concept Final Report, URS

Business Case for Hume Dam: Southern Training Wall – Remedial Works, MDBA, Oct 2009

State Water Corporation, Hume Dam training Wall, Risk Based Cost Estimate, Evans &peck, May 2011

Hume Dam Southern Training Wall Buttress Works – Design report, URS, June 2011

Hume Dam Southern Training Wall Buttress, Tender Assessment Committee report, August 2011

Hume Dam Southern Training wall. Final Claim No. 26, McDonnell Dowell, Nov 2013

Hume Dam STW Buttress Construction Report, URS, July 2014

Hume Dam Remedial Works – Pre-Feasibility Report of Southern Training Wall(STW) and Spillway Southern Junction(SST) Stabilisation Concept Final Report, URS, Feb 2012

# APPENDIX B MEETING & INTERVIEW PROGRAM

Cardno
Shaping the Future

| Entity | Date | Persons interviewed |
|---|---|---|
| Murray Darling Basin Authority | 11 and 12 August 2014 | David Dreverman, |
| | | Andrew Reynolds, |
| | | George Knezevic, |
| | | Harish Madan |
| | | Selase Dugbaza |
| | | Julianne Tanner |
| | | Siobhan Davies |
| Goulburn Murray Water | 1 and 2 September 2014 | Graeme Hannan |
| | | John Calleja |
| | | Martina Cusack |
| | | Mark Bailey |
| | | Chris Kelly |
| | | Rod Mauger |
| | | Daniel Lovell |
| | | Nathan Quinlan |
| | | Don Carroll |
| | | Tony O'Driscoll |
| | | Tony Beamish |
| | | Brendan Espagne |
| | | Peter Watkins |
| | | Marc Lon Ho Kee |
| | | Greg Watkins |
| | | Chan Chong |
| | | Paul Seaward |
| New South Wales Office of Water | 4 and 12 September 2014 | Stephen Elliott |
| | | Digby Jacobs |
| | | Kelly Fyfe |
| | | Patrick Madden |
| SA Water | 1st & 2nd Sept | Nigel Rutherford |
| | | Chris Pfennig |
| State Water | 8th Sept | Graeme Hind |
| | | Christine Berry |
| | | Andrew George |
| | | Lisa Welsh |
| | | Russell Simons |
| | | Stephen Farrelly |
| | | Mark Pearson |