
MURRAY FUTURES: COORONG, LOWER LAKES &
MURRAY MOUTH RECOVERY PROJECT

Date of Issue
24 July 2013

MANAGEMENT ACTION 8

CONSTRUCTION OF FISHWAYS

Summary Paper
of Design Development Report
for Murray-Darling Basin Authority



Government of South Australia
Department of Environment,
Water and Natural Resources

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1 Purpose

That the Murray Darling Basin Authority:

- note the Background Paper and Design Development Report as per notification per Schedule 1 of the Murray Darling Basin Agreement, Clause 58 of the 2007 Water Act (Commonwealth);
- confirm support for the proposed fishway's location and design (as previously provided in-principle per letter of 29 Feb 2012, refer [Attachment 1](#))

2 Background

Construction of Fishways Management Action

The Construction of Fishways management action within the Coorong, Lower Lakes and Murray Mouth (CLLMM) Recovery Project aims to facilitate movement of fish to enable the completion of natural life cycles that occur between the ocean, Coorong Lagoons, Lakes and River Murray.

Fishways are designed to allow fish to pass both ways through or around a barrier to restore connectivity, support lifecycles and populations of fish. The restoration and improvement of connectivity would achieve environmental objectives by preventing the loss of target fish species, which are defined in the ecological character description for the CLLMM site.

Planning and design components of the Construction of Fishways management action have been undertaken since late 2011. This progress has been guided by a Working Group comprising representatives of SA Water, Murray-Darling Basin Authority (MDBA) and Department of Environment, Water and Natural Resources (DEWNR).

CLLMM Funding Approval

Funding for the Construction of Fishways management action is compliant but conditional under the CLLMM Recovery Project Schedule SA-07 to the South Australian and Commonwealth Water Management Partnership Agreement.

Meeting this compliant but conditional element required completion of the following actions:

- seek agreement of the Australian Government and the Murray-Darling Basin Authority on the cost sharing arrangements, asset management and a detailed project proposal;
- determine the number, location and preferred design of fishways to be installed in the CLLMM Site; and
- complete detailed designs and costings for fishways

The Working Group has prepared a number of technical documents, to support the Construction of Fishways management action in meeting the compliant but conditional elements.

Papers of most relevance to this document are:

- MDBA Barrage Fishways Letter to CLLMM Recovery Project, 29 Feb 2012 ([Attachment 1](#));
- DENR (2012) Construction of Fishways Background Paper for Technical Workshop ([Attachment 2](#)); and
- SA Water (2013) Barrage Fishways Design Development Report ([Attachment 3](#)).

A version of this paper (including planning and monitoring aspects) has been provided to the Commonwealth to demonstrate that the Compliant but Conditional Elements have been met. As a key project partner and as per notification requirements under the *Water Act 2007 (Commonwealth)*, this information is also provided to the Murray Darling Basin Authority.

3 Cost Sharing and Asset Management

The Construction of Fishways project involves the development of assets within MDBA owned structures. Therefore it was identified early, during the Technical Feasibility and Due Diligence Assessment process that both involvement in the fishways construction and agreement to take on the asset and ongoing maintenance from MDBA needed to be sought.

On 16 February 2012 the Basin Officials Committee approved a decision paper seeking approval to accept a grant of up to \$2,900,000 from the South Australian Government to construct fishways at the Murray Mouth barrages (subject to approval of the required funding). This approval also committed to registering the assets on the River Murray Operations asset register and funding for incremental operation and maintenance. This decision was formalised in a letter dated 29 February 2012 ([Attachment 1](#)).

The Fishways Working Group includes an MDBA representative who has provided regular input to the group.

To enable the MDBA to add an asset to the River Murray Operations register, the funding must transfer through their accounts. Therefore if approved, funding from the Australian Government to South Australia will be managed as a grant to the MDBA with SA Water as the constructing authority for installation of fishways. DEWNR will work with MDBA (and SA Water) to manage the contract to achieve maximum ecological outcomes within available budgets.

Detailed risk management and liability will be addressed in the grant agreement, however the main mitigation mechanisms will include;

- Utilising the expertise of River Murray Operations team within SA Water that are familiar with local site conditions to propose realistic work schedule and costings;
- Annual review process to award grant agreements where project time, cost and/or scope can be adjusted as required;
- Assessing the River Murray flow predictions and potential implications into the annual review process; and
- Agreed standby, stand down rates and policy detailed in grant agreements.

4 Number, Location and Design of Fishways

There is a high diversity (>30) of fish species moving or attempting to move between the Coorong and Lower Lakes, comprising a variety of life stages (young-of-year, juveniles, sub-adults and adults). A Construction of Fishways Background Paper ([Attachment 2](#)) was compiled in June 2012 with input from Working Group members and includes:

- fish ecology, hydrology and barrage operations specific to the site;
- specified ecological objectives for native fish passage;
- a summary assessment of seven standard types of fish passage designs; and
- summary of fishway options specific to the site.

Table 1 below outlines the ecological objectives which apply to both upstream and down stream movement.

Table 1: Ecological Objectives for Fish Passage

Objective	Description
High biomass	The lower and tidal reaches of large rivers usually have high biomass of fish. High biomass of fish can arrive at the barrages in migration pulses, either post-spawning or in the recession of high flows. The 2009 acoustic tracking of congolli reveals the extensive movement of this species and their need to pass the barrages at the same time.
Fish spread over a wide area	The five barrages present a combined barrier to fish passage of 4.23 km. The multiple sites and the wide barrages result in fish that are attempting to migrate both upstream and downstream being attracted to several locations. While the existing fishways are working, four passages stretched over 4 km is a very large distance especially for fish less than 100 mm in length. The provision of increased fish passage options on all barrages is a key priority.
Variety of fish species and body size.	A broad size range of fish (20 to 600 mm total length) migrate at the barrages. Swimming ability is directly related to body size which changes the hydraulic requirements of fishways for different size groups. For the purpose of fish passage at the barrages, three groups of fish body size were defined as having similar swimming ability that all need to be catered for: <ul style="list-style-type: none"> • Large-bodied fish (250-600 mm) • Medium-bodied fish (100-250 mm) • Small-bodied fish (20-100 mm).
Passage of fish at low flows	During summer it is common for little to no flow through some or all of the barrages, particularly during drought. It is important that any fish passage can be designed effectively with little water so that operation can be continuous or extended as long as possible when water is scarce.
Fish at moderate/high flows	Fishways must be designed to work when moderate to high discharge of water is flowing through. The targeted fish sizes must be able to swim through the water velocities, integrated with suitable attractant flow placement.
Surface-dwelling fish	Some species, such as mullet, will only swim near the surface and will not enter a submerged entry of a fishway.
Bottom-dwelling (benthic) fish	Some species, such as congolli, are benthic and need fishways with low, submerged entrances.

4.1 Propose Designs and Locations

On 26 June 2012 the Working Group held a technical workshop, where the background paper was used as the basis to discuss the designs and locations for new fishways. Each potential location was considered in terms of its bathymetry, existing fishways, and the length and structure of surrounding gates and stop logs. As a result, a matrix was developed to prioritise what fishways designs should be built at each location to meet required ecological outcomes. Ranking considerations included the cost, functionality, construction window, operations and maintenance.

Table 2 summarises the proposed preferred fishway locations and designs. The list ensures that, at the completion of the Management Action, all of the five barrages have at least one suitable fish passage, with additional structures at Goolwa and Tauwither where which are much longer barriers to fish passage. Figure 1 provides a map of the barrages and proposed fishway locations.

Table 2: Summary of Locations and Proposed Designs

Site	Large Vertical Slot	Dual Vertical Slot	Fish Lock	Small Vertical Slot	Trapezoidal #	Modified box culverts#
Boundary Creek				●		
Ewe Island		●				
Goolwa	E ●		●			
Mundoo		●				
Tauwitchere	E			E	●	
Spillways						●

● = proposed new fishway

E = existing fishway already installed

= subject to available funds as a result of construction cost savings



Figure 1: Map of Barrage Locations in Coorong, Lower Lakes and Murray Mouth Region

4.2 Alignment with Objectives

Table 3 was adapted from Ecological Objectives and Fishway Options Table ([Attachment 2](#), p32). The revised table disregards designs originally considered and not recommended and incorporates new information learnt through the detailed design process. Table 3 shows that the cumulative effect of the proposed fishways will meet all ecological objectives stated in Table 1.

Table 3: Ecological Objectives Addressed by Proposed Fishways

Site	High Biomass (*)	Fish spread over a wide Area (*)	Large-bodied fish (250-600mm)		Medium bodied fish (100-250mm)		Small bodied (20-100mm)	
			Low flows	Mod/High flows	Low flows	Mod/High flows	Low flows	Mod/High flows
Boundary Creek Small Vertical Slot	✓	✓					✓✓✓	✓✓
Ewe Island Dual Vertical Slot	✓✓	✓			✓✓✓	✓✓	✓✓✓	✓✓
<i>Goolwa Large Vertical Slot (E)</i>	✓✓	✓	✓✓✓	✓✓				
Goolwa Large Vertical Slot (#)	✓✓	✓	✓✓✓	✓✓✓				
Goolwa Fish Lock	✓	✓			✓✓✓	✓✓✓	✓✓✓	✓✓✓
Mundoo Dual Vertical Slot	✓✓	✓			✓✓✓	✓✓	✓✓✓	✓✓
Tauwitchere Trapezoidal	✓	✓			✓✓	✓✓✓	✓✓	✓✓✓
<i>Tauwitchere Large Vertical Slot (E)</i>	✓✓	✓	✓✓✓	✓✓				
<i>Tauwitchere Small Vertical Slot (E)</i>	✓	✓					✓✓✓	✓✓
Spillways Culvert Modifications	✓	✓				✓✓		✓✓✓
Cumulative	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓	✓✓✓

✓ Contributes to objective

✓✓ Partially meets objective

✓✓✓ Meets objective

(E) = existing fishway already installed.

(*) Objective is cumulative. Passage at all barrages is needed to meet the objective.

(#) Large Vertical slot builds on existing design at Goolwa with improved baffles and ability for modifications to improve operation during moderate and high flow.

Note: Objectives of allowing suitable passage for surface and benthic dwelling fish are not included in this summary table. Having a range of fishway design types addresses these objectives. For example vertical slots provide the broadest range of access down the water column for different types of fish, while the fish lock is highly suitable for surface dwelling fish.

5 Approvals

5.1 Murray Darling Basin Authority

Cost Sharing and Asset Management approval was gained in February 2012 as outlined in letter from MDBA ([Attachment 2](#)).

In accordance with this approval, the MDBA are provided a copy of the Background Paper and Design Development Report ([Attachments 2&3](#)) as notification per Schedule 1 of the Murray Darling Basin Agreement, Clause 58 of the *Water Act 2007 (Commonwealth)*;

58. *Preparation and Submission of Designs etc of Works for Authority Approval.*
- (1) *A Contracting Government nominated to construct a work pursuant to this Agreement must submit a general scheme of the work to the Authority for its approval.*
 - (2) *Before beginning to construct that work, the Contracting Government must submit designs, specifications and estimates of the work to the Authority for its approval.*
 - (3) *The Authority may approve the general scheme, designs, specifications or estimates with or without alterations or additions, or may, from time to time, refer any of them for amendment to the Contracting Government submitting them.*
 - (4) *The Contracting Government must carry out an authorised work in accordance with:*
 - (a) *the designs and specifications approved by the Authority; and*
 - (b) *any directions given by the Authority pursuant to clause 61.*

5.2 Other Approvals

Other approval requirements for the management action are anticipated to be minor as construction works remain within the footprint of the existing barrage structures. An assessment of potential approval requirements has been conducted following the CLLMM Recovery Project legislative compliance procedure. The list of relevant acts assessed and their requirements for the proposed works are included in Table 4.

Table 4: Review of Potential Legislative Approvals

Relevant Legislation	Requirement for Approval for Management Action Delivery
<i>Native Title Act 1993 (Cth)</i>	Notification is required pursuant to s 24KA
<i>Aboriginal Heritage Act 1988 (SA)</i>	Notification will be provided via Ngarrindjeri heritage assessment protocols developed through the KNYA Agreement for information only.
<i>Environment Protection and Biodiversity Conservation Act 1999 (Cth) (EPBC)</i>	Not required
<i>Environment Protection Act 1993 (SA)</i>	Not required
<i>River Murray Act 2003 (SA)</i>	Not required
<i>Development Act 1993 (SA)</i>	Not required – subject to an exemption under section 3, Schedule 14 of the Development Regulations 2008
<i>Harbours and Navigation Act 1991 (SA)</i>	Exclusion Zones may be required, to be confirmed during construction as part of annual planning process.
<i>Natural Resources Management Act 2004 (SA)</i>	Not required - Water Affecting Activity works covered under broad permit granted to SA Water for operational works on existing structures.
<i>Water Act 2007 (Cth)</i>	Not required – notification see 5.1

Relevant Legislation	Requirement for Approval for Management Action Delivery
<i>Murray Darling Basin Act 2008 (SA)</i>	Not required
<i>Crown Land Management Act 2009 (SA)</i>	Not required
<i>Native Vegetation Act 1991 (SA)</i>	Not required
<i>National Parks and Wildlife Act 1972 (SA)</i>	Not required
<i>Fisheries Management Act 2007 (SA)</i>	Not required
<i>Coast Protection Act 1972 (SA)</i>	Not required
<i>Water Industry Act 2012 (SA)</i>	Not required

6 Designs

A summary of the designs are provided below for each proposed fishway. Additional detail can be sought from the SA Water Design Report ([Attachment 3](#)), however central aspects to all Fishways proposed include:

- Designed for optimal 0.75m AHD lake levels in line with target operations, but for as wide an operational range as possible of 0.5m - 0.8m AHD;
- All designs are within the barrage apron at a minimum and barrage sills where possible;
- All fishway designs can be blocked when required for flow management; and
- All fishways will have monitoring capacity for both upstream and downstream movements.

6.1 Boundary Creek – Small Vertical Slot Fishway

Boundary Creek Barrage is 243m long across the small channel through Mundoo Island and currently has no fishway. A small vertical slot fishway is proposed to facilitate passage for small bodied fish known to be in this shallow channel. Vertical slot designs provide a broad range of access through the water column for different types of fish. An attractant flow is required as part of this design to enable the fishway to operate effectively and has been incorporated into the costings.

This design and location has been identified as a high priority in improving fish passage in an ecologically sensitive location.

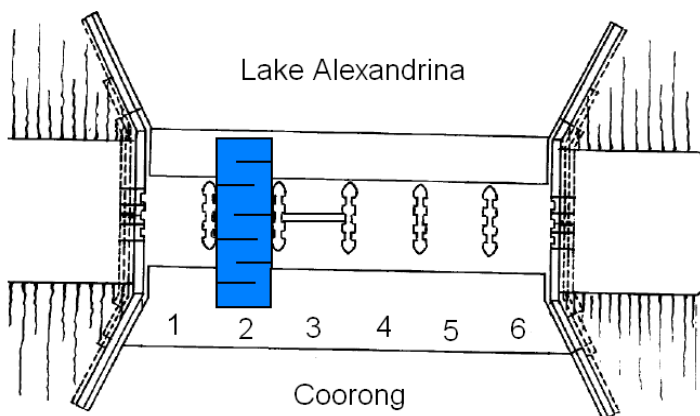


Figure 2: Small vertical slot fishway to be located in bay 2 (out of 6 bays) at Boundary Creek Barrage. Attractant flow to be in bay 3.

6.2 Ewe Island – Dual Vertical Slot Fishway

Ewe Island Barrage is 853m long, blocking fish passage between Mundoo and Ewe Islands. Ewe Island currently has no fishway. A dual vertical slot Fishway is proposed to facilitate passage for small-medium bodied fish. The dual design has two jets of water, providing excellent hydraulics for fish passage (velocities are dampened reducing time required for fish to swim through) and ability for higher biomass passage during peak fish migration times.

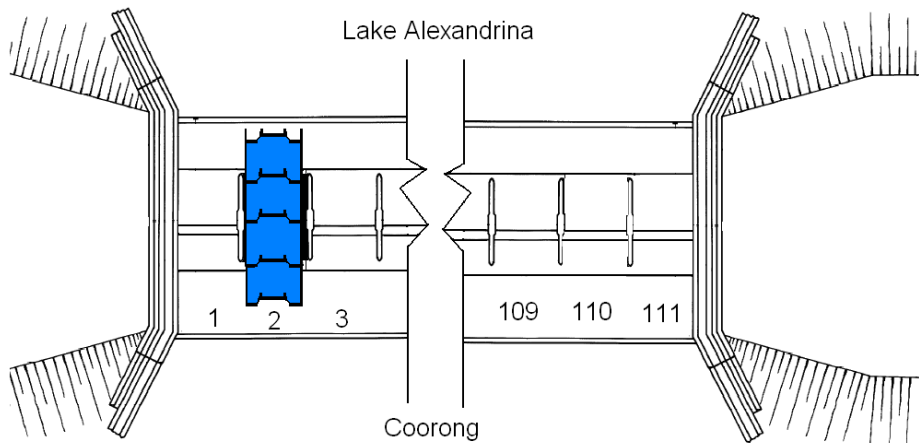


Figure 3: Dual vertical slot fishway to be located in bay 2 (out of 111 bays) at Ewe Island Barrage. Attractant flow to be in bay 3.

6.3 Goolwa – Large Vertical Slot Fishway

Goolwa Barrage is 632m long and blocks the main river channel as it heads towards the Murray Mouth past Goolwa. Due to its location on the main channel it is a very important site for fish passage, where the highest volume of fish attempt to migrate at peak times.

A Large Vertical Slot Fishway is already installed at Goolwa in the middle of the barrage which works well, however is only partially meeting the needs for the high volume of fish at peak migration times. An additional large vertical slot is proposed on the Hindmarsh Island side of the barrage to both increase the capacity for high biomass of fish passage and spread the access better across the large barrier.

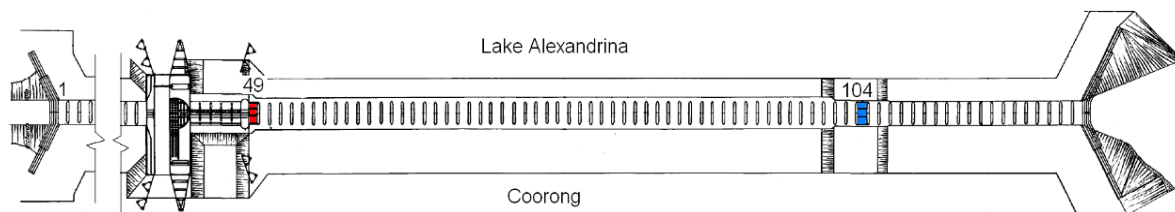


Figure 4: Large vertical slot fishway to be located in bay 104 (out of 123 bays) at Goolwa Barrage. Existing large vertical slot fishway in bay 49 near the navigation pass.

6.4 Goolwa – Fish Lock Fishway

In addition to large bodied fish needs in section 6.3 above, Goolwa Barrage currently has no passage suitable for small bodied fish. A number of options including Denil and Slot designs were considered, but due to the barrage depth, a fish lock with a tidal float gate was proposed. The fish lock will have a tidal gate on the downstream side and be positioned on the Hindmarsh Island side of the barrage where smaller fish are likely to congregate. A fish lock design is also highly suitable for surface dwelling fish (e.g. mullet) which may be shy to enter a submerged fishway entry.

This design, once installed, is highly adaptable, especially in adjustments to timing and operation of the tidal gate. It is proposed to be built early in the project schedule to take full advantage of compliance monitoring and modifications if required.

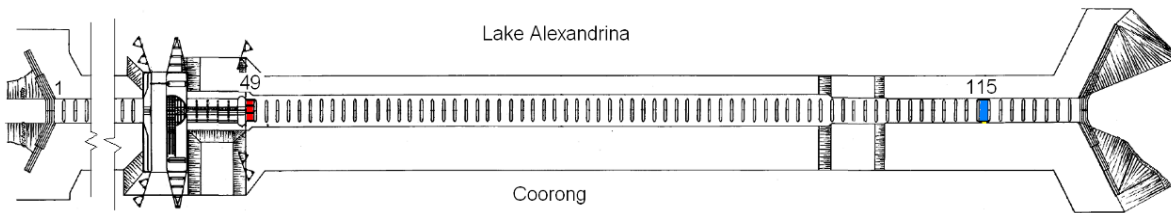


Figure 5: Fish lock fishway to be located in bay 115 (out of 123 bays) at Goolwa Barrage.

6.5 Mundoo – Dual Vertical Slot Fishway

Mundoo Island Barrage expands 800metres between Hindmarsh and Mundoo Islands and currently has no fishway. A dual vertical slot Fishway is proposed to facilitate passage for small-medium bodied fish. The dual design has two jets of water, providing excellent hydraulics for fish passage and ability for higher biomass passage during peak fish migration times.

Small to medium bodied fish usually congregate near edges of water ways which is why a bay close to the island bank has be

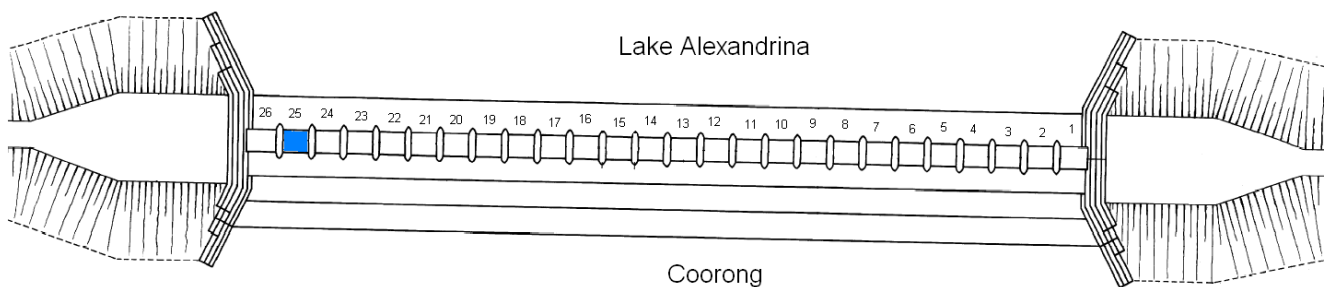


Figure 6: Dual vertical slot fishway to be located in bay 25 out of 26 bays at Mundoo Barrage.

6.6 Tauwitchere – Trapezoidal Fishway

Tauwitchere Barrage is a 1.7 km barrier between Ewe Island and the mainland at Pelican Point. Already installed on Tauwitchere Barrage are a Large Vertical Slot Fishway (located at the centre of the barrage), Small Vertical Slot Fishway and a Rock Ramp Fishway (both at the Pelican Point end of the barrage). An additional fishway is proposed to enable passage for fish spread over a large area. A Trapezoidal Fishway design is recommended which can pass both small and medium fish in the one structure and works especially well in high flow conditions.

The Working Group identified this fishway as potential for investment should any construction savings be made during the program. Higher priority was given to those fishways identified above where no other fishways was present and/or higher biomass of passage through the Goolwa channel. A decision would be made on the Tauwitchere fishway in 2013/14. Cost estimates this work are included in the budget in Table 5.

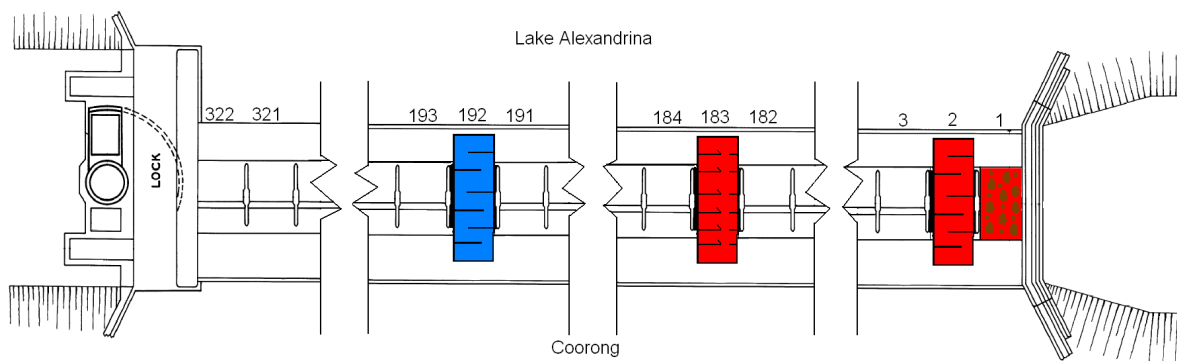


Figure 7: Trapezoidal fishway to be located in bay 192 (out of 322 bays) at Tauwitchere barrage. Three existing fishways are large vertical slot in bay 183, small vertical slot in bay 2 and rock ramp in bay 1.

6.7 Spillways – Culvert Modifications

There a number of locations on Hindmarsh and Mundoo Islands where the channel systems that connect Lake Alexandrina to the estuary could provide enhanced passage if current infrastructure (i.e. pipe culverts) were upgraded. Fish passage could be optimised through the installation of box culverts. The Working Group identified these minor works as potential for investment should any construction savings be made during the program. A decision would be made on this component in 2014/15. Indicative costs for these works are included in the budget in Table 5.

7 Project Budget

The seven fish passage improvements proposed total above the \$2.92M budget allocated in the CLLMM Project Schedule. Therefore the five highest priority fishways can be accommodated within the available budget. Subject to cost savings being realised during construction, Tauwitchere Trapezoidal and Spillway Culvert Modifications **may** be installed in out years.

A construction cost breakdown per structure is provided in Table 5. In addition to these construction costs the project will incur planning and design, compliance monitoring and CLLMM costs (coordination, approvals, reporting etc) which are subject to separate negotiations with Commonwealth.

As a result of recent construction experience SA Water are confident the cost estimates are reasonable. Construction costings have been developed from supplier quotes on prefabrication materials and labour, factoring in materials escalation and include 10% construction contingency.

SA Water has advised that this project will be provided with in-kind contributions subject to available resourcing and workloads. It is anticipated savings may be found through a combination of in-kind labour, unspent contingency and potential re-use of coffer dams.

Budget allocations will be tracked and approved as part of the annual workplan review process. This process will allow budget costs and potential savings to be monitored and re-allocated to additional fishway construction through adjustment of the Grant Agreement if realised.

Table 5: Construction of Fishways Budget Estimate

Construction Costs per Design and Location		
Location	Type	Cost Estimate (ex GST)
Boundary Creek	Small Vertical Slot	\$487,960
Goolwa	Large Vertical Slot	\$466,677
	Fish Lock	\$326,258
Ewe Island	Dual Vertical Slot	\$390,357
Mundoo	Dual Vertical Slot	\$451,025
	Sub Total	\$2,122,277
	Contingency	\$212,228
	Construction Total	\$2,334,505
Potential Additional Deliverables #		
Location	Type	Cost Estimate (ex GST)
Tauwitchere	Trapezoidal	\$325,740
Spillways	Culvert Modifications	\$249,822
	Sub Total	\$575,562
	Contingency	\$57,556
	Construction Total	\$633,118

Potential Additional deliverables are optional plans if management action makes cost savings.

8 Project Schedule

Work is envisaged to be undertaken by SA Water in the timeframe summarised in Table 6. This takes into consideration seasonal constraints, out year work schedules and barrage access requirements. SA Water preferred construction window is October–April due to seasonal constraints in May–September.

Table 6: Schedule of Works

Activity	2013/14		2014/15		2015/16	
	RP5	RP6	RP7	RP9	RP10	RP11
Finalise all designs and order pre-fabrication materials for bulk discount						
Boundary Creek						
Goolwa (LVS)						
Goolwa (Lock)						
Ewe Island						
Mundoo						
Tauwitchere#						
Spillways#						

Potential deliverables

9 Recommendations

That the Murray Darling Basin Authority:

- note the Background Paper and Design Development Report as per notification per Schedule 1 of the Murray Darling Basin Agreement, Clause 58 of the 2007 Water Act (Commonwealth);
- confirm support for the proposed fishway's location and design (as previously provided in-principle per letter of 29 Feb 2012, refer [Attachment 1](#))

10 Attachments

Attachment 1: MDBA Barrage Fishways Letter to CLLMM Recovery Project, 29 Feb 2012

Attachment 2: DENR (2012) Construction of Fishways Background Paper

Attached as a separate document

Attachment 3: SA Water (2013) Design Development Report

Attached as a separate document

Attachment 1: MDBA Barrage Fishways Letter to CLLMM, 29 Feb 2012



Mr John Howard
CLLMM Project
Dept. of Environment and Natural Resources
GPO Box 1047
ADELAIDE SA 5001

Dear John,

As you would be aware, at the Basin Officials' Committee meeting held on the 16 February 2012 the Authority tabled a paper for decision seeking approval to accept a grant of up to \$2,900,000 from the South Australian government to construct up to 8 additional fishways at the Murray Mouth barrages. This recommendation was approved by the committee, subject to the approval of the required funding under the Water for the Future program.

It was also noted in the paper, that by accepting the grant, the assets created would be added to the RMO asset register. This would then result in the incremental operation and maintenance costs being met by the three state contracting governments in accordance with the normal provisions of the Agreement.

A copy of the text of the formal decision is attached to this letter for your information.

Given this decision, I formally note that the Authority can agree to the acceptance of a grant of up to \$2,900,000 for construction of the fishways from the South Australian Government, and commit to the ongoing operation and maintenance of the structures. I understand that you will communicate this agreement to the Australian Government as part of the required progress reporting for the project, which will allow the project to proceed and agreement to be sought for final approvals of funding for the construction of the fishways.

Please contact Dr Ben Dyer on (02) 6279 0114 or ben.dyer@mdba.gov.au to discuss any formal arrangements to implement this decision, including any formal documentation required between the Authority and the South Australian government.

Yours sincerely,

29/2/12

Mr Tony Morse
Acting Executive Director
River Management Division

Trim No: D12/6886

Enc: Attachment 1 - Extract from meeting notes of the Basin Officials' Committee meeting – 16 February 2012

Cc: Brenton Erdmann, Manager River Murray Operations Unit, SA Water

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Facsimile: 02 6248 8053
ABN 13679821382

Agenda Item 11: Grant for Fishways at Murray Mouth Barrages

1. The Basin Officials Committee in the role of exercising control over the RMO assets, as set out in the "Asset Agreement for River Murray Operations Assets dated 12 June 2009":
 - (a) approved the acceptance by the MDBA of a grant of up to \$2.9 million from South Australia for the construction of up to eight fishways on or near the Murray Mouth Barrages, subject to approval of these funds under the Water for the Future program;
 - (b) noted that on completion of construction the new fishways will be added to the RMO asset register; and
 - (c) noted that the incremental operation and maintenance costs will be met by the three state contracting governments in accordance with the normal provisions of the Murray-Darling Basin Agreement.