



Australian Government



MDBA technical report for Department of Agriculture and Water Resources

Lock 8 & 9, Carrs, Capitts and Bunberoo Creeks
and Frenchman's Fish passage

Engineering Assessment of SDL Adjustment
Business Case submitted by NSW



2015

Table of Contents

Executive Summary	3
Introduction.....	6
Due Diligence Review Approach.....	6
Summary of Key Issues	7
Scope of assessment for technical feasibility and cost	8
Business Case Review.....	10
Technical Feasibility and Fitness for Purpose	10
Hydrology	10
Hydraulics	10
Operating Regime	11
Structure type and Functionality.....	11
Constructability.....	13
Quality Assurance Method & Review	13
Ownership and O&M Arrangements	14
Cost Considerations.....	14
Detailed design and approvals.....	14
Construction	15
Risk Assessment of Project Implementation	15
Flooding	15
Cultural Heritage	16

Executive Summary

NSW has submitted a Business Case for the SDL adjustment project *Lock 8 & 9 weir pool manipulation, Carrs, Capitts and Bunberoo Creeks connectivity and Frenchmans Creek Fish passage*

The MDBA has reviewed the Business Case against the engineering related criteria in the Phase 2 assessment guidelines.

The proposal can be divided into three components that link to provide and integrated ecological outcome:

- *Lock 8 & 9 weir pool manipulation* represents a continuation of the trial of weir pool manipulation. No engineering works are associated with this component.
- *Carrs, Capitts and Bunberoo Creeks connectivity* involves modifying a number of existing structures to use the head difference between Lock 9 and Lock 8 to create high quality fast flowing habitat in the creek system. This will be of particular benefit to native fish.
- *Frenchmans Creek Fish passage* involves the addition of a fishway to the Lake Victoria Inlet regulator to allow native fish that have entered Lake Victoria as larval drift to migrate back to the River Murray. This will remove one of the highest priority fish barriers in the Basin.

Technical Feasibility and Fitness for Purpose

The component projects are presented at feasibility design stage. The level of investigation, costing, stakeholder engagement is consistent for a feasibility level of project development.

As presented there is nothing of a technical nature that would indicate that the project should not proceed to developing a full concept design. It is expected that as part of the development of full concept designs the following actions would be undertaken:

- The development and calibration of a hydraulic model and the subsequent application of this to refine the operating regime and associated flow rates. This will in turn inform the engineering design for gates and fishway head differentials.
- The development and simulation of a proposed long term operating regime. This will help to understand the interaction of the operation of the works with the filling of lake Victoria and the operation of adjacent works (Mulcra, Lindsay stage 1 and proposed works at Lindsay stage 2 and Walpolla). This will further inform key design criteria for critical features such as the fishway operating levels.
- Land tenure would be reviewed, both for the land new assets will be located upon and for the access routes to construct, operate, and maintain the works.
- Geotechnical investigation for all major water retaining structures.
- Engineering concept design will be developed, informed by outputs of the above studies.

The proposed works are on structures that retain the Lock 9 weir pool. The Lock 9 weir pool is essential for the ability to supply of water into Lake Victoria. As such it would be reasonable to expect a very high level of rigour to be undertaken in the concept and detailed design phase to

ensure that the construction or ongoing operation of the new works will not pose an undue risk to the ability to operate Lake Victoria.

Asset Ownership and Operation & Maintenance Funding

The major assets that the project is seeking to modify (Carrs 1 & 2, Block bank #3, Block bank #6, Block Bank B, and the Lake Victoria inlet regulator) are part of the River Murray Joint Venture asset base. As such it will be necessary for NSW to seek agreement from the other partner governments in the Joint Venture that the proposed works can be carried out on joint Venture assets and how ongoing operations and maintenance costs are to be shared between the partner governments.

Costs

The cost estimates for the proposed works, based on the feasibility level designs, are of an order that would be expected for these works. The adopted contingency rate of 40% is on the low side for a feasibility design.

Risk Assessment of Project Implementation

The Business Case has conducted a high level risk assessments and proposed mitigation strategies that are appropriate for projects that are in the feasibility design stage. The majority of risks on this type of project can be addressed through contemporary project management with the actions explicitly costed or within the scope of the project contingency to meet the costs.

The MDBA has identified two risks that are outside the scope of the project to adequately address through the application of a traditional percentage based contingency provision due to the potential for very high costs should they be realised.

Riverine Flooding / Site inundation

Constructing works on the floodplain results in riverine flooding posing a very significant financial risk and one for which there are limited mitigation options.

The cost estimates in the Business Case has not made provision for the flood risk cost to be passed to the contractor and as such it remains with the project proponent. Passing the flood risk cost to the contractor is not a reasonable approach in any case.

Given the Business case is one of several proposed by NSW and these will be delivered over several years it is unlikely that all would be impacted by floods. However, it is not possible to determine in advance which projects will be affected and to allocate appropriate budget to meet associated costs. A suggested approach is to allow a provision for costs associated with flooding across the whole program of works and to draw on this on an as needs basis during construction.

Cultural Heritage

The Carrs Cappits and Bunberoo project proposes major engineering works in the vicinity of Lake Victoria, one of the most culturally rich landscapes along the River Murray. While the Business case has made some allowance for the management of Cultural Heritage the experience in similar landscapes is that a larger allowance for activities should be made.

Despite the best efforts to manage and avoid impact on cultural heritage the potential for cultural items to be exposed during construction remains. This could result in the need to cease work while appropriate steps are taken to address the issue. The Business Case makes no financial provision to address this risk.

However, as with flooding costs described above, the cost associated with managing cultural heritage finds could be significant and beyond the normal contingency provision. A program level contingency fund may also be appropriate to manage this risk.

Introduction

This report has been prepared for the Department of the Agriculture and Water Resources by the MDBA as part of the review of the SDL Business Cases projects submitted under the Sustainable Diversion Limit Adjustment process.

The report provides the Department of Agriculture and Water Resources with an overview of the Business Case for **Locks 8 and 9 weir pool manipulation Carrs, Capitts and Bunberoo Creeks connectivity Frenchmans Creek fish passage**, prepared by the NSW Department of Primary Industries.

Due Diligence Review Approach

In conducting this due diligence assessment the MDBA has drawn on long experience in managing and delivering major engineering works associated with the River Murray System. In the last decade the Authority has been responsible for the delivery of the Living Murray (TLM) Environmental Works and Measures Program (EWMP).

The EWMP is a \$338 million program that delivered major works to facilitate the provision of environmental water to floodplains and wetlands. The scale of the works varies from major works to small scale strategic infrastructure.

The works proposed in this Business Case is of a scale consistent with the works delivered under the EWMP. Assessment of designs, costs and risks have been made by comparing projects and individual project components to similar works constructed under EWMP.

Summary of Key Issues

The Business Cases has been assessed against a series of engineering / technical criteria as set out in the *Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases*. These are:

Section 4.8 - Technical Feasibility and Fitness for Purpose

- the proposal is able to deliver effectively on its stated outcomes and proposed technology will perform as intended; and
- the project delivery and operation is secure over the long term from a construction and maintenance perspective.

Section 4.10.1 Costs, Benefits and Funding Arrangements

- rationale and justification is provided for the estimate of the total cost of the project design, construction and commissioning;
- the level of contingency appears consistent with the level of risk identified;
- the benefits are appropriately described (quantitatively or qualitatively); and
- Ongoing operation and maintenance costs are realistic.

Section 4.11.4 Risk Assessment of Project Implementation

- all significant project development and delivery risks and impacts have been identified, adequately described and analysed and robust treatments and mitigations proposed;
- the risk management strategy complies with the AS/NZS ISO 31000:2009 Risk management—Principles and Guidelines; and
- all other risks are negligible or adequately mitigated.

Scope of assessment for technical feasibility and cost

The Business Case has been assessed to determine whether or not:

- The proposal is able to deliver effectively on its stated outcomes and proposed technology will perform as intended; and
- The project delivery and operation is secure over the long term from a construction and maintenance perspective.

The approach adopted for the assessment focusses on assessing the adequacy of the engineering design and includes the following elements and concepts:

- Review of engineering processes applied to design (e.g. extent and form of hydraulic/hydrologic functional requirements, application of defensive design principles for water control structures)
- Source and quality of base data and associated assumptions
- Consideration of constructability issues and temporary works requirements
- Peer review processes used to develop designs

This assessment does not extend to an assessment of the security of ongoing operation and maintenance funding or appropriateness of asset ownership arrangements.

Section 4.10.1 Costs, Benefits and Funding Arrangements

The Business Case is assessed to determine whether or not:

- Rationale and justification is provided for the estimate of the total cost of the project design, construction and commissioning;
- The level of contingency appears consistent with the level of risk identified;
- The benefits are appropriately described (quantitatively or qualitatively); and
- Ongoing operation and maintenance costs are realistic.

The approach adopted for the assessment will focus on assessing the adequacy of the cost estimate and includes the following elements and concepts:

- Development of indicative cost ranges for typical infrastructure by size/capacity (e.g. regulators, bridges, culverts, levees). Data sources to include estimates and actual cost data from recent construction activity within the MDBA and associated agency programs
- Development of generic cost estimate line items for typical projects
- Development of typical project on-cost rates
- Consideration of construction scheduling

This assessment does not extend to a review of project scope to ensure optimisation of cost-effective environmental outcomes.

Section 4.11.4 Risk Assessment of Project Implementation

The Business Case should be assessed to determine whether or not:

- all significant project development and delivery risks and impacts have been identified, adequately described and analysed and robust treatments and mitigations proposed;

- the risk management strategy complies with the AS/NZS ISO 31000:2009 Risk management—Principles and Guidelines; and
- all other risks are negligible or adequately mitigated.

The approach adopted for the assessment is to

- Prepare a generic risk register (Appendix A) for environmental watering projects. This has been used as a basis to assess the comprehensiveness of risks identified in Business Cases and by extension contingency provisions based on past experience.
- Review of the risk costs presented in the Business Cases
- Identify any major risks that are not costed appropriately.

Business Case Review

The NSW Department of Primary Industries Water has prepared the *Locks 8 & 9 Weir Pool Manipulation, Carrs, Capitts and Bunberoo Creeks Connectivity and Frenchmans Creek Fish Passage Business Case* for consideration under the SDL Adjustment process. This Business Case has been prepared with consultation of SA Water as the State Constructing Authority responsible for the major existing assets that are proposed to be modified.

Technical Feasibility and Fitness for Purpose

The Business Case presents works that are logical and realistic but the level of detail is quite limited. The investigations, designs, and costings are consistent with a feasibility level of project development rather than a concept design. As such the assessments that can be made is limited and the project should go through a further two stages of project review:

1. Concept design
2. Detailed design

The advantage of the two stages is that it manages the risk of funding detailed design for works that are not cost effective.

The limited level of detail available in the Business Case means that issues such as design considerations (including application of defensive design principles) cannot be realistically assessed.

Hydrology

The Business Case clearly outlines the changes from the natural hydrology to the current hydrological regime and the proposed regime under Basin Plan.

The works proposed will re-introduce water level variability, higher velocity sections of creek and connectivity for fish across a wide range of landscapes. This will reinstate some of the hydrologic and hydraulic conditions that have been lost through regulation of the River Murray system

The proposed operations utilising the MDBA Joint Venture and proposed structures appear reasonable for this stage of project development.

Hydraulics

The project has not developed a hydraulic model that covers the full scope of the proposed works. The proposed works have the potential to adversely affect the ability to deliver inflows to Lake Victoria but until this is quantitatively assessed through a hydraulic model it remains as an unknown risk.

The extension and refinement of the hydraulic model referred to in Figure 7-9 of the Business Case is a critical step for the proposed works to deliver the required flow regime in Carrs Cappits and Bunberoo creeks as it is required to define the extent of inundation, velocity regimes in the

waterways and to size structures. The hydraulic modelling will also need to look at the implications of Weir pool raising and drawdown on the hydraulics through Carrs, Cappits and Bunberoo Creeks as this may have implications on achievable velocities, operating regimes, structure design and geomorphic stability (particularly with drawdown in the Lock 8 weir pool).

The MDBA is of the view that the development of a hydraulic model is a critical input to the design process. There appears to have been no specific allowance, either funding or schedule, for this task in the Business Case. The development of a hydraulic model should also include scope for an expert independent review of the model to review the base data underpinning the model, assumptions and limitations within the model and sensitivity of key parameters.

The MDBA is aware of significant recent improvements in hydraulic modelling software and is of the opinion that hydraulic models to support detailed design should be of the new triangular mesh hydraulic modelling format to allow for greater resolution at key sites. The better representation of the landscape should improve the calibration and provide greater confidence in the application of the models to the detailed design process.

Operating Regime

Weir Pool manipulation: The proposed operating regime for the weir pool variation mimics the natural seasonal variations in river levels through this reach. The indicative manipulation scenarios are within the safe structural operational limits of Locks 8 and 9 and have been tested during recent years. Through the recent manipulation trials the operational risk associated with operating within the proposed limits are well understood.

Lake Victoria Fishway: Generally the fishway proposed at the Lake Victoria Inlet Regulator would operate continually and would represent a small component of total flow into Lake Victoria.

Carrs Cappits and Bunberoo creeks: The proposed operating regime is sound and logical, including baseflows, spring freshes and flood events. While the overall concept is defined a detailed operating plan is not provided and will need to be developed as the project progresses. This will need to be informed by the hydraulic model to refine the proposed operations and intended operation of each structure, which in turn will underpin the functional design requirements of the structures (i.e. flow rates, the need for fishway and over what range the fishway needs to operate, etc.).

Structure type and Functionality

The designs for the structures are all effectively at feasibility level with no geotechnical information to support the design. As such the assessment does not consider defensive design principles, this would be a key issue to be considered in the development of concept designs and throughout the detailed design process.

Lake Cullulleraine pumps

The proposed replacement pumps for supply of water to Lake Cullulleraine are roughly twice the capacity of the current pump and have been notionally sized to cope with a complete drawdown of Lock 9. Both of these criteria appear excessive, with no information provided to support the choice of these criteria. It is understood that the two pumps reflect the current ability to swap the existing pump for a replacement (held in store locally) in less than a day. If this is confirmed the

proposal reflects the current capability. Refinement of the level of drawdown that the pumps are able to manage may deliver cost savings but these are likely to be relatively small.

Carrs 1&2

The Carrs Cappitts and Bunberoo creeks structures are at a limited stage of development and other than feasibility layout drawings no designs are provided for the proposed replacement of the two largest structures, Carrs 1 and 2. In addition there have been no geotechnical assessments undertaken. As such the cost of the structures remains quite uncertain at this stage.

The Carrs 1 and 2 structures are key assets that underpin the operation of the River Murray system. They are integral to the maintenance of Lock 9 weir pool, and thus the ability to divert water into Lake Victoria. As such the designs for these two structures will need to be robust, including appropriate consideration to coffer damming/dewatering works during construction.

The proposal to fully replace the existing structures is supported. The existing structures are 90 years old with minimal cut-off provisions. Retro-fitting regulating gates and a fishway to structures of this age (90 years old) is not considered prudent as the investment is reliant on non-contemporary design principles (eg the structures would not have a sheet pile cutoff).

The flow rates proposed as part of the preliminary operating regime with (maximum flow 1,500 ML/d for Carrs 1 Weir and 500 ML/d for Carrs 2 Weir) appear quite high. There may be opportunities to refine the required flow rates and functional design requirements following development of a hydraulic model.

There are no details provided on the functional requirements of the fishways (eg fish species, seasonality of operation, head difference for optimal operation) which have the potential to significantly influence cost and these will also need to be informed by the hydraulic model including confirmation that fishways are required at both regulators.

Blocking bank regulating structures

Two small regulating structures (Structures #3 and #6) are proposed within existing blocking banks to manage flows through the CCB system. Although the justification for these structures appears sound the functional requirements should be confirmed and refined following development of hydraulic model. It is unclear why these structures are single celled structures while the box culvert road structures further downstream (Structures #4 and 'A') are 6 cell and 4 cell structures, respectively.

Road culverts

Five road crossings are proposed to maintain access through the CCB system. While the justification for the crossings is clear a number of the structures are quite large and there will likely be opportunities for refinement of these designs. The current proposal is for the road crossings to have a cross sectional area in excess of the stream cross sectional area. This is an extremely conservative approach and should be refined based on hydraulic parameters (eg maximum velocity, afflux) rather than an arbitrary approach.

A separate line is included in the CCB construction cost estimate table to clear waterway obstruction at Structure #5. It is unclear what this work involves and why it is required and there is no cost included against this item. These works should be confirmed and appropriate cost provided.

Lake Victoria inlet regulator fishway

The Business Case presents a vertical-slot fishway as the preferred fishway type for the lake Victoria Inlet regulator. Based on analysis completed to date and presented in the Business Case there are two feasible fishway options for this site, vertical-slot fishway and a fishlock. The primary reason for putting forward the vertical-slot fishway option in the Business Case is concern around the reliability and O&M issues with a fishlock. However, a vertical-slot fishway requires a significantly greater footprint and cost to construct.

It is the MDBA's view that a thorough review of both options be undertaken to confirm the most feasible fishway type for this site. This review should include analysis of the biological requirements of the site and historic flow and water level data as well as reviewing the fishway types with respect to functionality, O&M, constructability, environmental and Cultural Heritage impacts.

The reliability and O&M concerns with regards to fishlocks are primarily around the premature wearing of a particular component of the actuator which prevents the gates from operating. This has been an issue with the River Murray fishlocks over the past few years and significant work has been undertaken by the State Constructing Authorities to look at options to resolve this. Recent trials by SA Water have included the use of a different material for the actuator component and these have been successful with a significant increase in the life of the part. With the support of the state fisheries agencies, changes to the operation of the fishlocks have also been implemented to optimise fish passage including increasing cycle times and turning the fishlocks off during the night and winter. These changes are expected to significantly reduce the O&M challenges and associated reliability concerns at these fishlock sites.

The proposed design head for the fishway provided in the Business Case is 4.5m. This is the maximum historical head range and designing a fishway to cater for this maximum limit is not considered to represent value for money. Previous analysis undertaken by the MDBA shows that the design head can be reduced to 3.5m if the 95th percentile is used as the criterion, consistent with fishway design for the Sea to Hume project.

Constructability

None of the proposed works appear to be outside the scale or complexity of works that have been constructed under the Living Murray program. As such the works should be able to be constructed.

It must be noted that the works are proposed on structures that control the supply of water into Lake Victoria and as such it would be reasonable to expect a very high level of rigour to be undertaken in the detailed design phase to ensure that the construction or ongoing operation of the works will not pose an undue risk to the ability to operate Lake Victoria.

Quality Assurance Method & Review

No external review has been undertaken for the proposed works. This is consistent with a feasibility level of development. It would be logical for the concept designs to be subject to independent review before proceeding to detailed design. Given the impact on Joint Venture

assets SA Water, as the responsible State Constructing Authority, should be actively involved in the development of the concept designs.

Given the scale of the proposed works, and the critical nature of them in the operation of the River Murray System, the detailed designs should be subject to a rigorous review by independent experts. Appropriate allowance should be made in project planning for both the cost and time of this review.

Ownership and O&M Arrangements

The major assets that the project is seeking to modify (Carrs 1 & 2, Block bank #3, Block bank #6, Block Bank B, and the Lake Victoria inlet regulator) are part of the River Murray Joint Venture asset base. As such it will be necessary for NSW to seek agreement from the other partner governments in the Joint Venture that the proposed works can be carried out on joint Venture assets. This agreement should be obtained as early as possible in the project as it will define which agency (SA Water as the State Constructing Authority, or NSW DPI Water) has responsibility for the concept design, detailed design and construction phases of the project.

The Business case does not identify an owner for the roads and road crossings that will be impacted by the project. This should be addressed, including responsibility for ongoing Operations and maintenance of the crossings, during the concept design stage.

The operating cost estimates are based on a percentage of capital cost and are consistent with the costs incurred on other Joint Venture assets.

The Business Cases proposes that these costs would be met through the Joint Venture. It is assumed that this would be confirmed at the same stage that the Joint Venture partners consider the proposed modifications to Joint Venture assets.

The pumps for the Lake Cullulleraine supply are currently owned by Lower Murray Water. It is assumed that the proposal is for the new pumps to be owned by Lower Murray Water but no confirmation of this is provided and no detail is given as to who takes responsibility for detailed design and construction of the works and who carries the risk during construction.

The Business case notes that the works are to occur on land of 'mixed tenure'. No specific detail is given. It would be expected that land tenure and any issues arising from this – both for access to the work sites and for the works would be presented in the concept design.

Cost Considerations

Detailed design and approvals

The allowance for the detailed design and approvals has been estimated based on a percentage of construction cost. While this may be appropriate for general works the allowance for environmental / cultural heritage assessments and approvals (\$400K) appears to be very low given the location of the works immediately adjacent to Lake Victoria which is one of the most culturally rich landscapes along the river. By comparison the estimate for statutory approvals for Victorian SDL projects at Lindsay and Walpolla are double the allowance in this Business Case.

The Authority would suggest that as part of the development of concept designs a strategy for approvals and cultural heritage management be developed and costed. This should also inform the timeframe for obtaining the relevant approvals.

The cost estimate also does not specifically allow for the development of a hydraulic model. This will be a critical part of the development of concept designs (eg head range for fishways).

The allowance of 10% for survey, investigation, design and documentation is considered to be of the right magnitude.

Construction

The cost estimates for the proposed works, based on the feasibility level designs, are of an order that would be expected for these works.

The costs assume that the major structures can be constructed on a slab foundation. Until geotechnical investigations are undertaken this is an appropriate assumption but should a piled foundation be required the costs will rise.

Construction Contingency

A 40% construction contingency is on the low side for a feasibility level design and the Authority would suggest a contingency of at least 50% would be a better reflection of the level of unknowns that the cost estimate is based upon.

Risk Assessment of Project Implementation

A risk assessment and proposed mitigation strategies is included in the Business Case. The risk assessment is very high level - consistent with a project in the feasibility stage.

A more robust risk assessment should be undertaken as part of concept design once further information (e.g. Geotechnical investigations, preliminary cultural heritage field surveys) have been undertaken.

As set out in the Risk Report (Appendix A) the majority of the risks that a project will be exposed to can be contained and managed within the project.

The MDBA has identified two risks that are outside the scope of the project to adequately address through the application of a contingency.

Flooding

The experience of the EWMP program is that flood risk is the greatest financial risk to a project and one for which there are limited mitigation options. During the EWMP program the definition of a flood, when a flood delay would occur, and associated costs payable was altered in the construction contracts to reflect the learnings from flooding at early projects which incurred major costs.

The key learnings from EWMP that are relevant to the SDL Business Cases are:

- it is not financially realistic to pass the risk of flooding to the contractor;

- there is a practical limit to the amount of flood mitigation that can be achieved by use of temporary works, beyond this level it is cheaper to accept the cost of demobilising / remobilising site;
- projects need to plan the timing of the works to minimise the flood risk (this is something that should be addressed in the detailed design / approvals phase of the projects);
- sufficient funds need to be allocated to cover the risk that a flood(s) will require a work site to be demobilised and remobilised at a later date. This incurs large costs to both the construction team and for the project management team.

An indication of the potential cost of a flood based demobilisation and remobilisation can be obtained from the Mullaroo regulator and fishway work that was demobilised in 2014. At the time of demobilisation:

- the site crew and associated plant was minimal;
- the demobilisation occurred at a stage where flood clean-up costs were absolutely minimised; and
- the contract only allowed for payment for the crew and plant that had to be demobilised and only for a very efficient demobilisation / remobilisation.

Despite this the demobilisation / remobilisation cost the project \$300K. Assuming the two Carrs weirs would be built concurrently the cost would be expected to be greater than this. A further note is that the cost at Mullaroo did not include any costs for wet weather delays that preceded the decision to demobilise site.

No allowance is made in the Business Case for flood risk.

Cultural Heritage

As noted earlier the Carrs Cappitts and Bunberoo project proposes major engineering works in the vicinity of Lake Victoria, one of the most culturally rich landscapes along the River Murray.

In this context the management of cultural heritage at the proposed works, including all access tracks for the works, is expected to be a key challenge. The Business Case recognises the issue but no engagement with traditional owners or native title claimants is presented (NSW National Parks and Wildlife Services represented native Title claimants in the engagement process)

Despite all of the best intention and planning the potential for cultural items to be exposed during construction remains. This could result in the need to cease work and potentially demobilise the site while investigations are undertaken and appropriate steps taken to address the issue.

The overall magnitude of the proposed allowance is a matter of judgement and risk appetite. If significant cultural heritage is found in places that were not identified in the CHMP process, as occurred in the EWMP Koondrook project, the costs can be very significant and the allowances will not be adequate.

The Business Case has made no allowance for costs incurred due to approval delays. This would appear to be a significant oversight.