Sustainable Diversion Limit Adjustment

Phase 2 Assessment

Supply Measure Business Case:

Wallpolla Island Floodplain Management Project

Department of Environment and Primary Industries

Disclaimer

This business case is one of nine Victorian environmental works projects. It was developed over two years ago and submitted for assessment in early 2015 by the Sustainable Diversion Limit Adjustment Assessment Committee (SDLAAC) in accordance with the inter-jurisdictional governance procedures that pertain to the Murray Darling Basin Plan.

This business case relies on assumptions, estimates and other variables that were considered true, accurate and the best available information at the time of development.

As a result of queries raised during the SDLAAC assessment process, there have been changes to certain elements of some projects, including engineering designs, methods of water supply and future operation. These details have not been incorporated or encapsulated in this or any of the other eight business cases relevant to the Sustainable Diversion Limit Adjustment Mechanism within the Murray Darling Basin Plan.

There has, however, been no material changes to the environmental objectives and outcomes proposed to be achieved through these projects. All nine projects will be revisited for final development once Commonwealth funding is made available.

The detailed cost estimates and other commercial-in-confidence information that originally formed part of this and the other eight business cases have been deliberately omitted from this version of the document. This is in recognition that this detail is no longer relevant given the time that has passed since these business cases were originally developed, new delivery methods are applicable in some cases and to ensure that value for money is achieved when these projects are issued for tender.

Executive Summary

The *Wallpolla Island Floodplain Management Project* is a proposed supply measure that is designed to off-set water recovery under the Murray-Darling Basin Plan by achieving equivalent or better environmental outcomes on the ground. The Victorian Government's long standing position is that efficient environmental watering is critical to the long-term success of the Basin Plan.

This view is based on the understanding that engineering works like flow control regulators, pipes and pumps can achieve similar environmental benefits to natural inundation, using a smaller volume of water to replenish greater areas. Works also allow for environmental watering in areas where system constraints prevent overbank flows and, due to the smaller volumes required, can be used to maintain critical refuge habitat during drought.

This project is one of several proposed by the Victorian Government as having the potential to meet the Basin Plan's environmental objectives through smarter and more efficient use of water.

Wallpolla Island is located within the larger Lower Murray floodplain downstream of the junction of the Murray and Darling Rivers. The floodplain includes Chowilla, Mulcra Island and Lindsay Islands and is recognised nationally for its high environmental and cultural values. The site is part of the Murray-Sunset National Park, which is managed for environmental conservation.

The *Wallpolla Island Floodplain Management Project* presents a unique opportunity to protect and enhance an environmentally significant area that is critically important to the biodiversity of the entire Lower Murray region. The ecological significance of the Wallpolla Island floodplain is underpinned by its location, providing longitudinal connection to the River Murray and its floodplains, as well as lateral connection into the semi-arid Mallee environment.

The River Murray flow at Wallpolla Island has been altered significantly by storages, regulation and diversion upstream on both the upper Murray and Darling Rivers. This has caused a reduction in large winter and spring flow peaks and an increase of low summer flows. Locks and weirs have further altered the hydrology of the local floodplain by removing fluctuations in river levels.

Through the construction of two major regulating structures, supported by supplementary works and levees, this project will enable the connection of many parts of the floodplain through tiered watering events, including areas of flowing aquatic habitat through to sections of black box, lignum and higher alluvial terraces. Watering will be able to occur at a landscape scale restoring ecosystem function to more than 2,651 ha of highly valued floodplain, mimicking flows of 30,000 ML/day to greater than 120,000 ML/day.

This project will achieve vital environmental improvements beyond what is expected to be possible under the anticipated increase in River Murray flows delivered through the implementation of the Murray-Darling Basin Plan. It will complement existing environmental infrastructure to greatly expand the watering options available and provide the flexibility to tailor watering to ecological cues and requirements.

The operation of the proposed *Wallpolla Island Floodplain Management Project* in conjunction with the Mulcra Island, Lindsay Island and Chowilla Floodplain infrastructure, River Murray weir pool manipulation and other nearby environmental watering events, will dramatically increase and improve available floodplain habitat for flood-dependent fauna beyond that provided by the operation of these projects, or Basin Plan flows, in isolation.

The project will provide significant benefit to nationally important species, ecological values, carbon cycling and downstream water quality at the site and for the Lower Murray region more generally.

A broad level of community support exists for this project, which is the result of working directly with key stakeholders and community members to ensure the integration of local knowledge and advice into the project. Stakeholders materially affected by the *Wallpolla Island Floodplain Management Project* such as Parks Victoria and private landholders have provided in-principle support for the progression of the project, along with a number of individuals, groups and organisations central to the project's success, including adjacent landholders, Aboriginal stakeholders and community groups.

Further confidence in the success of this project can be taken from the extensive knowledge, skills, experience and adaptive management expertise of the agencies involved in the development of this project. This is evidenced by more than a decade of environmental water delivery and successful construction and operation of environmental infrastructure projects that have delivered measurable ecological benefits across the region.

The *Wallpolla Island Floodplain Management Project* has been developed by the Mallee Catchment Management Authority (CMA), on behalf of the Victorian Government, and in partnership with the Department of Environment and Primary Industries, Parks Victoria, Goulburn-Murray Water and SA Water, through funding from the Commonwealth Government.

Project risks have been comprehensively analysed and are well known. They can be mitigated through established management controls that have been successfully applied to previous watering projects by the Mallee CMA and project partners, together with the Murray-Darling Basin Authority (MDBA), the Commonwealth and Victorian Environmental Water Holders. The adoption of these standard mitigation measures minimise the risks associated with the implementation of this project.

Project costs that will be subject to a request for Commonwealth funding total $59,523,808 in 2014 present value terms. Victoria is seeking 100 % of these costs from the Commonwealth. In terms of project benefits, the value of water savings is not estimated within this business case.

This business case presents the cost to fully deliver the project (i.e. until all infrastructure is constructed, commissioned and operational), including contingencies. Cost estimates for all components in this proposal are based on current costs, with no calculation undertaken of future cost escalations. To ensure sufficient funding will be available to deliver the project in the event that it is approved by the Murray Darling Basin Ministerial Council for inclusion in its approved Sustainable Diversion Limit (SDL) Adjustment Package to be submitted to the MDBA by 30 June 2016, cost escalations will be determined in an agreed manner between the proponent and the investor as part of negotiating an investment agreement for this project.

Contents

Acronyms

AEM	Airborne Electromagnetic datasets
AH Act 2006	*Aboriginal Heritage Act 2006* (Vic)
ANCOLD	Australian National Committee on Large Dams
ARG	Aboriginal Reference Group
AS/NZS ISO 31000:2009	Australia and New Zealand Risk Management Standard 2009
BSMS	Basin Salinity Management Strategy
CEMP	Construction Environmental Management Plan
CEWH	Commonwealth Environment Water Holder
CFA	Country Fire Authority
CHMP	Cultural Heritage Management Plan
CMA	Catchment Management Authority
CPI	Consumer Price Index
CRG	The Living Murray Community Reference Group
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CWA	Country Women's Association
DEPI	Department of Environment and Primary Industries
DO	Dissolved Oxygen
DTF	Department of Treasury and Finance
EE Act 1978	*Environmental Effects Act 1978* (Vic)
EMP	Environmental Management Plan
EPBC Act 1999	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EVC	Ecological Vegetation Class
EWMP	Environmental Works and Measures Program
FERC	Federal Energy Regulatory Commission
FFG Act 1988	*Flora and Fauna Guarantee Act 1988* (Vic)
G-MW	Goulburn-Murray Water
GST	Goods and Services Tax
IGA	Intergovernmental Agreement on Murray-Darling Basin Water Reform 2014
ISO	International Organisation for Standardisation
LWAC	Land and Water Advisory Committee
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority
MER	Monitoring, Evaluation and Reporting
MERI	Monitoring, Evaluation, Reporting and Improvement
MLDRIN	Murray Lower Darling Rivers Indigenous Nations
MNES	Matters of National Environmental Significance
NP Act 1975	*National Parks Act 1975* (Vic)
NSW	New South Wales
OPBR	Office of Best Practice Regulation
OH&S	Occupational Health and Safety
O&M	Operations and Maintenance

PCB	Project Control Board
PE Act 1987	*Planning and Environment Act 1987* (Vic)
PMBOK	Project Management Body of Knowledge
PPE	Personal Protective Equipment
RGG	Regulatory Governance Group
SA	South Australia
SDL	Sustainable Diversion Limit
TEV	Total Economic Value
TLM	The Living Murray
TSMP	Threatened Species Management Plan
USBR	United States Bureau of Reclamation
VEAC	Victorian Environmental Assessment Council
VEWH	Victorian Environment Water Holder
VMIA	Victorian Managed Insurance Authority
WRP	Water Resource Plan
WTP	Willingness to Pay

Abbreviations

Basin	Murray-Darling Basin
Basin Plan	The Murray-Darling Basin Plan adopted by the Commonwealth Minister under section 44 of the *Water Act* 2007 (Cth) on 22nd November 2012
Guidelines	Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases
H	Horizontal
MoU	Memorandum of Understanding
No.	Number
N/A	Not applicable
temp	Temperature
V	Vertical
VIC	Victoria
4WD	Four wheel drive

Units

cm/day	Centimetres per day
EC	Electrical conductivity
GL	Gigalitres
Ha	Hectares
km	Kilometres
m AHD	Elevation in metres with respect to the Australian Height Datum
m/s	Metres per second
ML	Megalitres
ML/d	Megalitres per day
ha	Hectares
m	Metres
mm	Millimetres
mS/cm	Millisiemens per centimetre
µS/cm	Microsiemens per centimetre
$M	Million dollars

1. Introduction

1.1 Context

This Business Case for the *Wallpolla Island Floodplain Management Project* has been developed in accordance with the Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases. This project is one of nine proposed works-based supply measures within Victoria, and one of seven within the Mallee Catchment Management Authority (CMA) region which are listed below:

- Lindsay Island
- Wallpolla Island
- Hattah Lakes North
- Belsar-Yungera Floodplain Complex
- Burra Creek
- Nyah, and
- Vinifera.

These sites will work in conjunction with proposed altered river operations and existing environmental infrastructure to deliver environmental outcomes set under the Basin Plan, using less water.

Figure 1-1 provides a conceptual overview of the distribution of sites in the Mallee CMA region and the longitudinal connection to the lower Murray region.

1.2 Forest overview

Wallpolla Island is located downstream of the junction of the Murray and Darling Rivers and within the larger lower Murray floodplain. Wallpolla Island is formed by the Wallpolla Creek which diverges from the River Murray below Lock 10 and reconnects above Lock 9 (Figure 1-2). The island has an area of approximately 9000 ha and extends 29 km from east to west and is approximately seven km in width.

Wallpolla Island is part of the Chowilla-Lindsay-Wallpolla Icon Site identified under The Living Murray initiative (TLM). The proposed works complement the existing Horseshoe Lagoon regulator, funded through TLM's Environmental Works and Measures Program (EWMP).

The Wallpolla Island site forms part of the Murray-Sunset National Park, managed by Parks Victoria. The southern area of the site also includes a small section of privately owned land.

Wallpolla Island holds great significance to the local indigenous community. Aboriginal occupation at Wallpolla Island dates back thousands of years and was sustained by the rich productivity of the floodplain and woodland systems. There is a diverse range of site types and complexes; shell middens, hearths and culturally scarred trees can still be found throughout the area (Bell, 2013).

Being close to Mildura, Wallpolla Island is a popular recreation site for visitors to the region and local communites. Recreational use of the site includes fishing, camping, boating, canoeing, bird and wildlife watching, photography, horse riding, motor biking and four-wheel driving. Wallpolla Island attracts campers especially in spring and autumn.

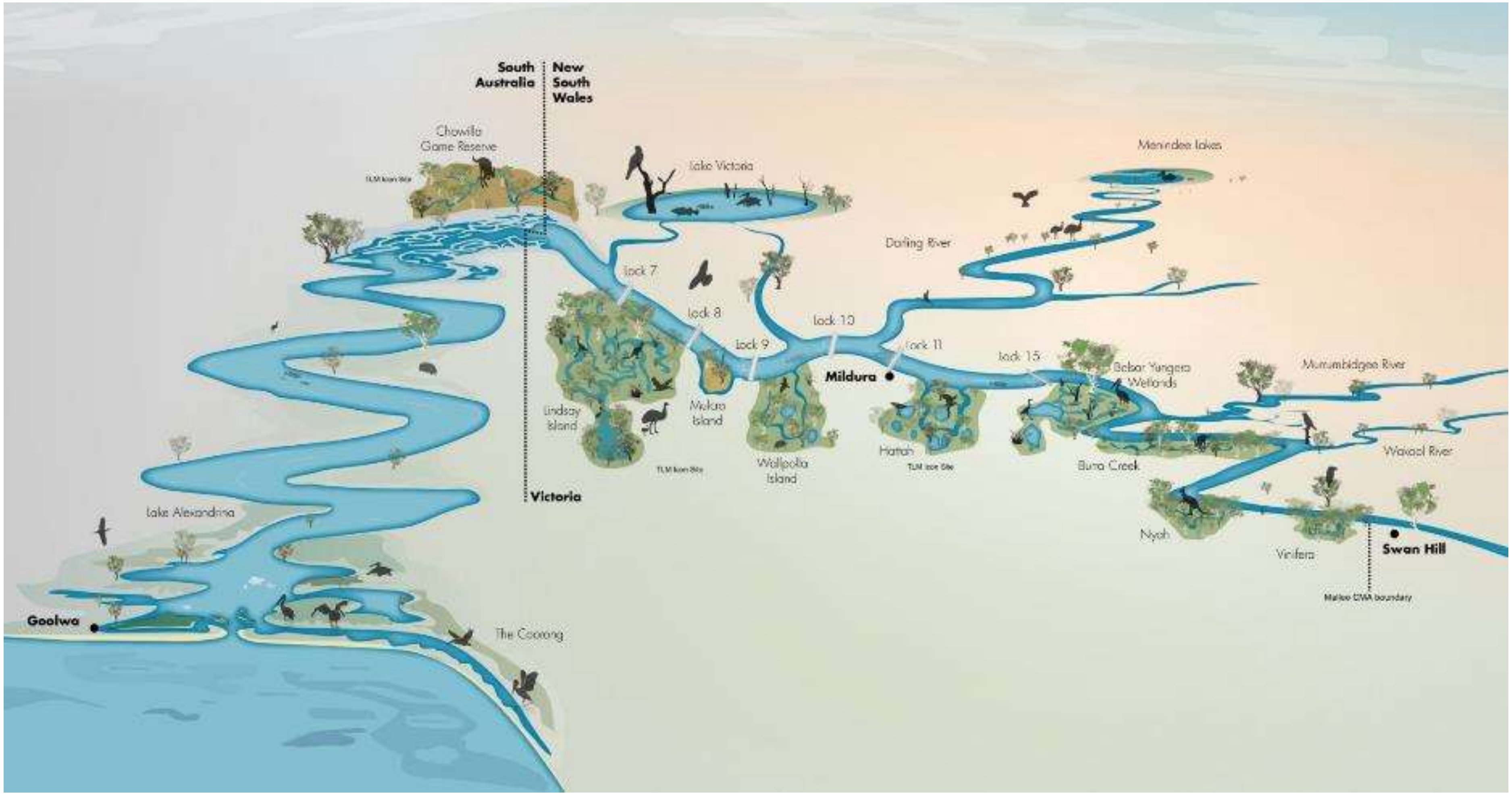


Figure 1-1. Distribution of proposed supply measure sites across the Mallee CMA region (Vinifera, Nyah, Burra Creek, Belsar-Yungera, Hattah (North), Wallpolla, Lindsay Island) and TLM EWMP sites (Hattah Lakes, Mulcra Island, Chowilla Game Reserve, and parts of Lindsay Island); diagram is not to scale

Key threats to Wallpolla Island and its values include the reduction in the frequency, duration and size of floods, as well as the loss of variability in hydrological regimes, caused by river regulation. Over time, these have resulted in the gradual degradation of the flood-dependent components of the Wallpolla Island ecosystem.

1.3 The proposal

This project will improve connectivity across this vast floodplain, restore ecosystem function, and result in environmental benefits beyond those that can currently be achieved under the Murray-Darling Basin Plan through increased flows alone. The aim is to protect and restore the health of the floodplain ecosystem by increasing the frequency and duration of watering events at this site.

This project provides a unique opportunity to reverse decline and to protect and restore landscape condition, which will provide significant benefit to nationally important species, threatened vegetation communities, ecological values, carbon cycling and downstream water quality. This will benefit both Wallpolla Island and the broader Lower Murray region.

A range of options have been investigated to address the changes to hydrology to achieve defined ecological objectives. Feasibility, cost effectiveness and ability to meet objectives have been considered in the analysis of all options. This has resulted in the development of a cost effective package of environmental works that achieves the ecological objectives for Wallpolla Island by providing a hydrological regime that meets the requirements of the native fauna and flora.

The *Wallpolla Island Floodplain Management Project* consists of the construction of Structure 1 including a fishway and Structure V, eight containment and regulation support structures and 285 m of raised tracks[1] to promote widespread inundation. A maximum inundation level of 30 m AHD at will inundate 1071.82 ha of the Wallpolla Island floodplain, river benches and wetlands. This is referred throughout this document as the Mid Wallpolla component. A second component, referred to as the Upper Wallpolla component, involves the construction of Structure 2 and Structure S, 14 containment and regulation support structures and 4.2 km of raised tracks which will be used to inundate an additional 864.16 ha of floodplain. Minor structures and temporary pumps can be used to deliver water to an additional area of floodplain, referred to as South Wallpolla.

For ease of reference, a fold-out map of the proposed project has been included as Appendix A to provide a spatial representation of the planned works discussed in this document.

1.4 Project development

The feasibility study and business case for this proposed project has been developed by the Mallee CMA, on behalf of the Victorian Government and in partnership with the Department of Environment and Primary Industries (DEPI), Parks Victoria, Goulburn-Murray Water (G-MW) and SA Water, through funding from the Commonwealth Government.

This proposal draws on a decade of collective experience from all project partners in the construction of large-scale environmental works and measures programs and environmental water delivery in the Mallee region. A recent example of collaborative work successfully delivered by this team includes the $32 million Living Murray environmental infrastructure project at Hattah Lakes; a project that delivered environmental water to more than 6000 ha of Ramsar lakes and floodplain.

[1] 'Track raising' is used in this business case to refer to the building up of existing tracks to form minor levees to contain water on the floodplain. This method enables duration targets to be met while minimising the construction footprint.

1.5 Project stakeholders

The Mallee CMA has worked with key stakeholders and interested community groups to develop the concept for the *Wallpolla Island Floodplain Management Project* over an extended period of time from 2012 to 2014. Consultation has been undertaken with Aboriginal stakeholder groups, land managers, key partner agencies, and targeted community groups. The project has high visibility among materially affected and adjacent landholders/managers, along with Aboriginal stakeholders and other interested parties. To ensure the advice and concerns of those involved have been considered and responded to accordingly, a detailed Communication and Engagement Strategy has been developed and implemented for this project. This strong commitment to working directly with project partners and the community will be ongoing throughout the construction and implementation phases of the project, further cementing community support for the *Wallpolla Island Floodplain Management Project* and ensuring it will continue to be a successful project.

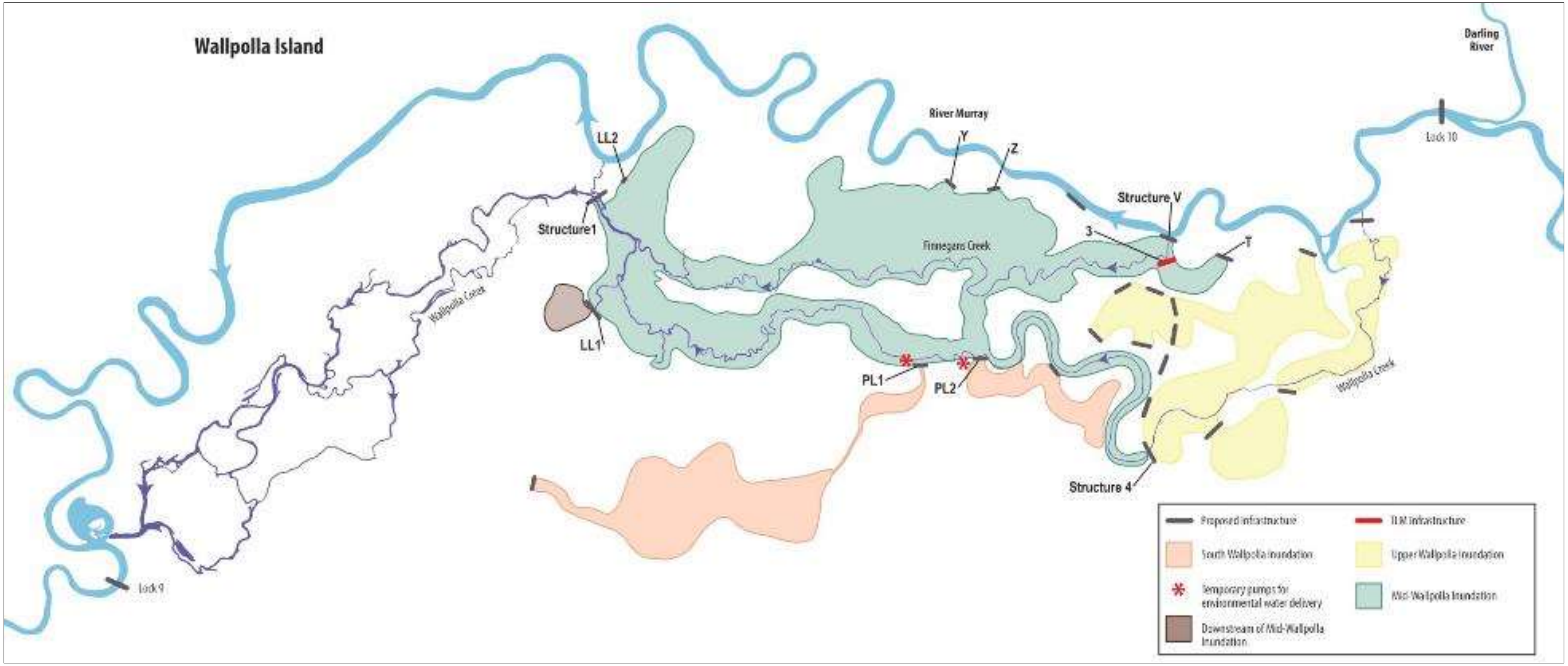


Figure 1-2. Representation of planned works and inundation at the Wallpolla Island site (diagram is not to scale)

2. Eligibility (Section 3.4)

Victoria considers that this supply measure meets the relevant eligibility criteria for Commonwealth supply measure funding.

In accordance with the requirements of the Murray-Darling Basin Plan (Basin Plan), Victoria confirms this is a new supply measure, additional to those already included in the benchmark assumptions under the Plan.

Pending formal confirmation of off-set potential, the operation of this measure is expected to:

- Increase the quantity of water available for consumptive use
- Provide equivalent environmental outcomes with a lower volume of held environmental water than would otherwise be required under the Basin Plan, and
- Be designed, implemented and operational by 30 June 2024.

This business case demonstrates in detail how each of the criteria (above) is met.

Other than the provision of financial support to develop this business case, this proposal is not a 'pre-existing' Commonwealth funded project, and it has not already been approved for funding by another organisation, either in full or in part.

Horseshoe Lagoon, Wallpolla Island (2009)

3. Project Details (Section 4.1)

3.1. Description of proposed measure, including locality map

The *Wallpolla Island Floodplain Management Project* is a supply measure project located on the River Murray floodplain, 40 km west of Mildura in northwest Victoria (Figure 3-1). In accordance with the Phase 2 Assessment Guidelines, this project falls within the category of environmental works and measures at point locations. Victoria is seeking 100 % of the project costs from the Commonwealth Supply or Constraint Measure Funding.

The project will restore the integrity and productivity of the aquatic, riparian and floodplain ecosystems by increasing the frequency and duration of floodplain inundation.

The supply measure works at Wallpolla Island comprise the four main regulators including one fishway, 22 containment and regulation support structures and 4.5 km of raised track to inundate 2,651 ha of Wallpolla Island floodplain, wetlands and river benches (Figure 3-2).

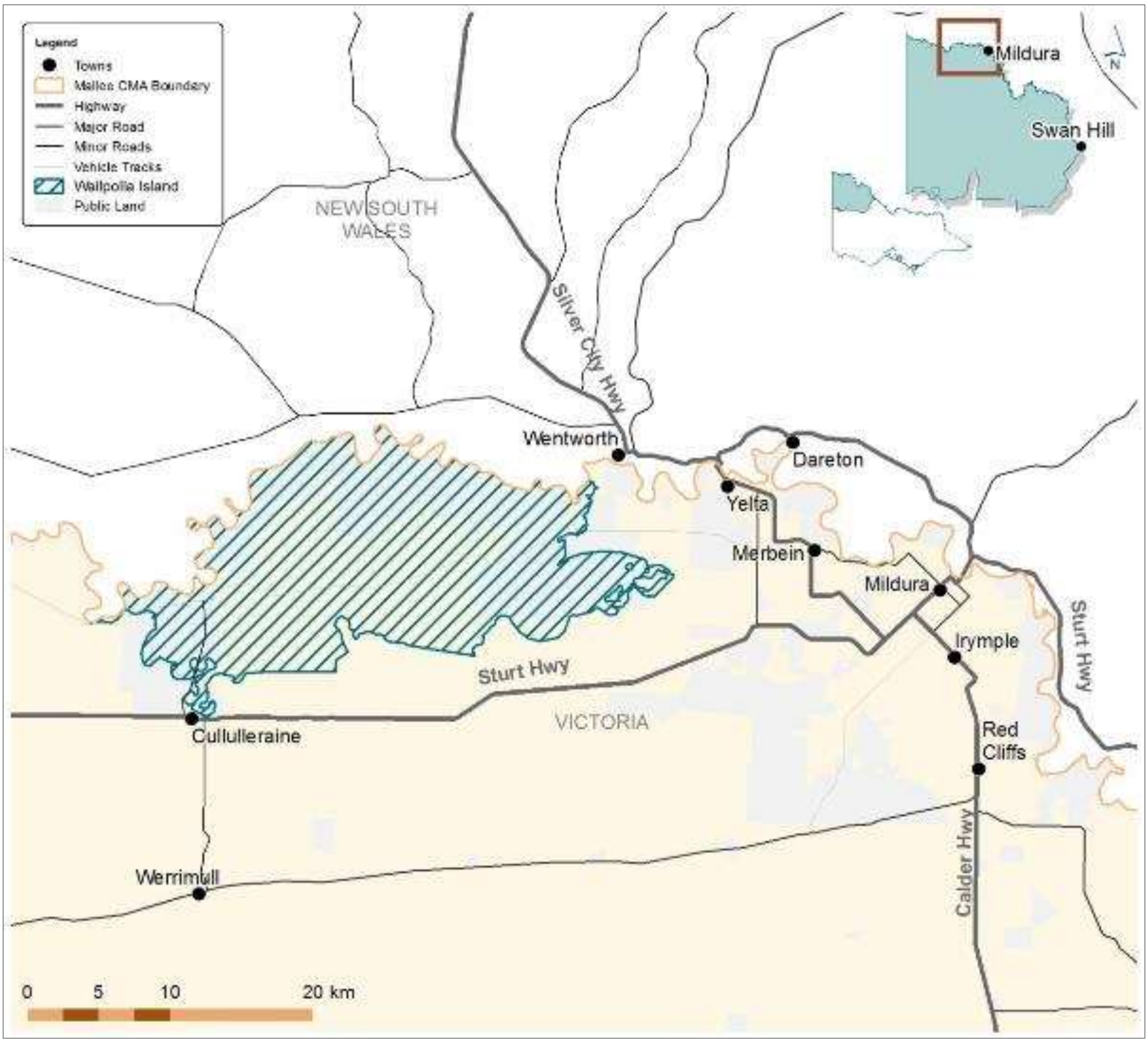


Figure 3-1. Location of the Wallpolla Floodplain Management Project

3.2. Environmental works and measures at point locations

The proposed *Wallpolla Island Floodplain Management Project* comprises three main components, Mid Wallpolla, Upper Wallpolla and Wallpolla South, providing beneficial impacts to three defined areas on the floodplain (Figure 3-2). Each area has a different target inundation water level and the areas are designed to cascade water to extend the inundation benefits by reusing water. Weir pool manipulation of the Lock 9 weir pool can create further floodplain inundation in the western end of the island as well as better flow regimes in Wallpolla Creek. The proposed works have been designed to complement weir pool manipulation activities. Figure 3-3 illustrates proposed inundation according to land tenure.

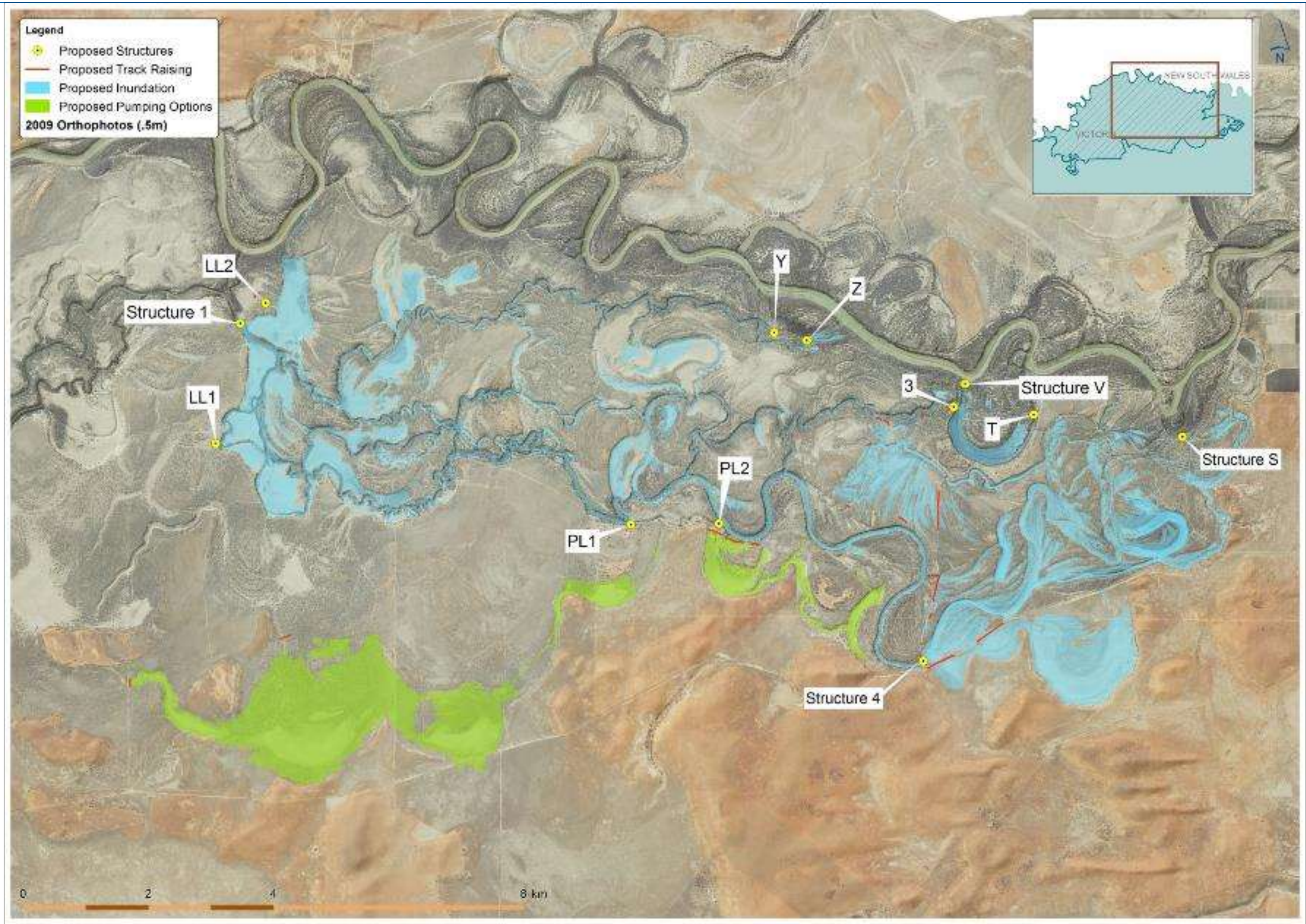


Figure 3-2. Project concept showing proposed works and inundation extent

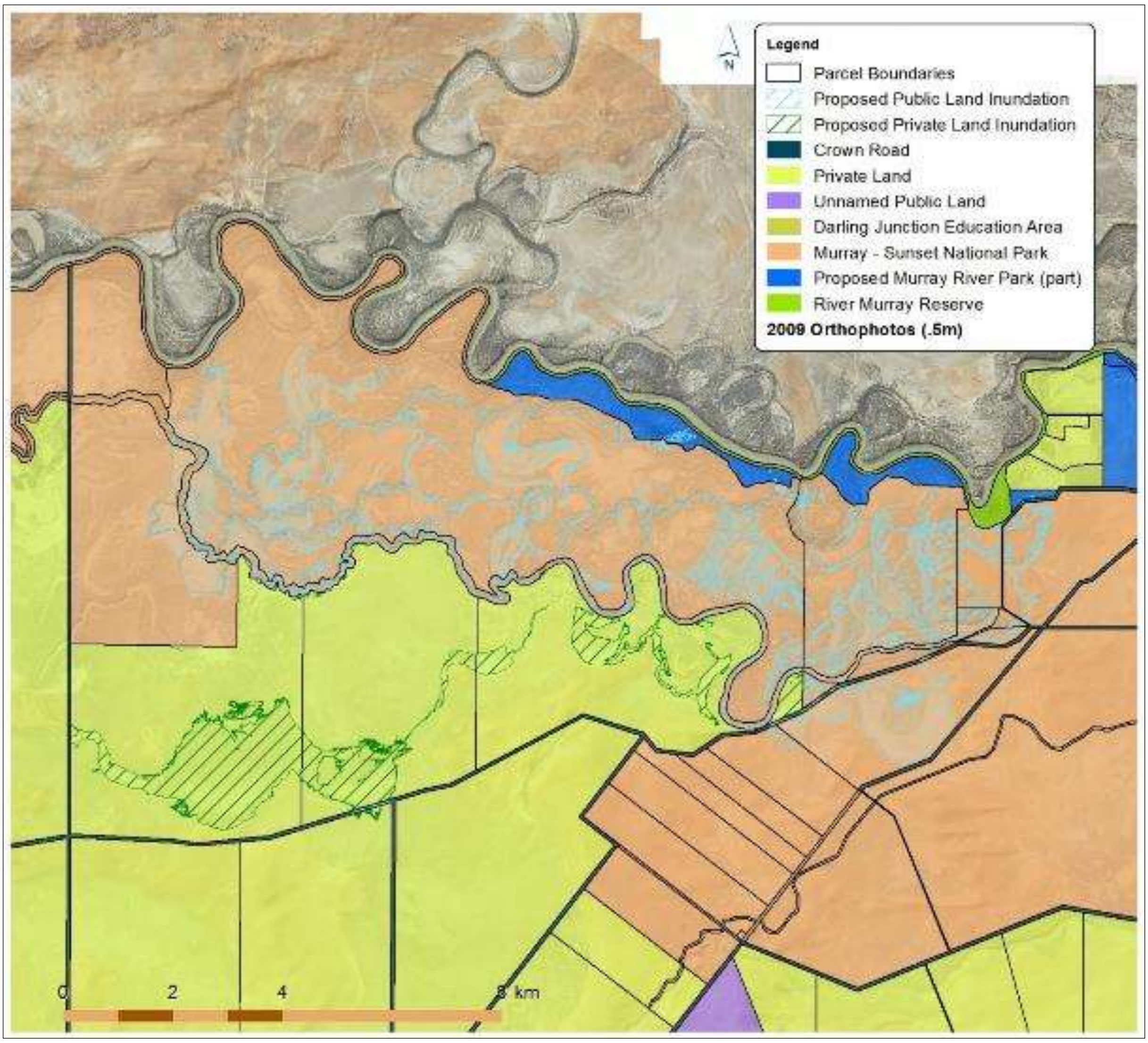


Figure 3-3. Proposed inundation according to land tenure.

Figure 3-3 shows that the proposed works have the capacity to water 817 ha of private land at maximum inundation extent, affecting a single landholder. This area has been watered previously by the Mallee CMA however, due to the early stage of project development, appropriate agreements (e.g. covenants/flood easements) have not yet been established with the landholder. This will be resolved in the detailed design stage and provision has been made in the overall project costs to allow this. Preliminary discussions have been held with the affected landholder, who has provided a letter of support for the project (see Appendix G).

Flooding of private land can be avoided by operating the works at below the maximum design level. Formalised flooding agreements therefore are not critical to the feasibility of the project.

Mid Wallpolla

The Mid Wallpolla component will inundate up to 1,072 ha of public land to 30 m AHD. This will require:

- Structure 1, the main regulator in Wallpolla Creek, will be located just upstream of Dedmans Creek and built to a top water level of 31 m AHD. This higher structure provides for inundation of an additional 817 ha of private land, if desired, and will also include a vertical slot fishway to maintain fish passage during operations.
- Structure V, a second large regulator, will be built to a top water level of 30 m AHD and will allow water to pass into the Mid Wallpolla area.

- Two levees (LL1 and LL2) will retain water to 30.0 m AHD. Both will be designed to convey traffic during natural floods or managed watering events.

Upper Wallpolla

The Upper Wallpolla component will water up to 864 ha to 32.0 m AHD. Approximately 20 ha of this area would have already been inundated from Mid Wallpolla operation. It will require:

- A large regulator (Structure 4) on Wallpolla Creek at the main entrance to contain water to 32.0 m AHD.
- A second large regulator (Structure S) to contain water to 32 m AHD to allow water to pass into the Upper Wallpolla area.
- Two bridges over creeks, a system of levees and five medium sized regulators to contain the proposed top water level. This is shown in Figure 3-4.

South Wallpolla

The South Wallpolla component will enable watering of higher terrace Black box Woodlands by diverting water from the Mid Wallpolla pool with temporary pumps, inundating 715 ha. Small levees are to be constructed to direct flow on private land.

These combined works will provide efficient watering at a large landscape scale producing high ecological benefits that are well above what is expected to be achieved by the planned Basin Plan flows of up to 80,000 ML/d (Aurecon, 2014a). By delivering these outcomes through works, a smaller volume of water will be required.

The Mid Wallpolla and Upper Wallpolla works are listed in Tables 3-1 and 3-2 respectively. South Wallpolla works are described above. Table 3-1 provides detailed information on Structure 1 and Structure V and includes associated support structures. Table 3-2 provides detailed information on Structure 4 and Structure S and includes associated support structures.

These structures will be operated in response to the seasonal flow in the River Murray and ecological cues in order to meet environmental watering targets.

Table 3-1. Mid Wallpolla Area works components (Aurecon, 2014a); more detailed information is provided in Section 12

Mid Wallpolla Component Works	
Name	**Description and function**
Structure 1 Regulator and Fishway	Structure 1 is located at the downstream end of the Mid Wallpolla area on Wallpolla Creek. Its function is to retain water during a watering event to 30.0 m AHD. It will include a single lane bridge to provide public access to Wallpolla Island and a vertical slot fishway.
Structure V	Structure V is located on a minor channel with connection to the River Murray and the Mid Wallpolla area. It will allow water into the Mid Wallpolla area at River Murray flows >10,000 ML/d or be closed to allow portable pumps to supply water to the Mid Wallpolla area.
LL1	A minor levee (55 m long) located on an existing track. It will contain watering events on public land.
LL2	A minor levee (52 m long) that contains flood water within the Mid Wallpolla area.
PL1	This minor regulator/crossing (40 m long) prevents a breakout of water to the south of the Mid-Wallpolla and into private land.
PL2	This minor levee (30 m long) prevents a breakout of water to the south of the Mid Wallpolla and into private land.
T	This minor regulator/crossing prevents a breakout of water to the north returning to the River Murray.
Y	This minor levee (6 m long) prevents a breakout of water to the north and returning to the River Murray.
Z	This large regulator controls the breakout of water to the north and into the Lily Pond area.
3	Minor regulator and crossing (20 m long) that provides access over Finnigans Creek.

Table 3-2. Upper Wallpolla Area works components (Aurecon 2014)

Upper Wallpolla Area COMPONENT WORKS	
Name	**Description and function**
Structure 4	Structure 4 is a large regulator located on the downstream end of the Upper Wallpolla area on Wallpolla Creek. Its function is to retain the water during a watering event to 32 m AHD. It will include a single lane bridge to provide public access to Wallpolla Island.
Structure S	Structure S is located on a minor channel with connection to the River Murray and the Upper Wallpolla area. It will allow water into the Upper Wallpolla area if the River Murray flows are >55,000 ML/d L 30.3 m) or be closed to allow use of temporary pumps. During all other conditions (normal and flood operations) the structure will remain completely open (i.e. stop logs removed) to allow free passage of water and fish.
B	This minor levee (15 m long) is located along Dedmans Track and prevents a breakout of water to the west of the track.
C	This minor levee (90 m long) along Dedmans Track prevents breakout of water to the west of the track.
D	This levee (425 m long) prevents a breakout of water to the west of the Dedmans Track.
DR	This levee (480 m long) will be located along Dedmans Track to maintain vehicle access while allowing connectivity (via ungated culverts).

E	This levee (65 m long) and minor regulator prevents a breakout of water to the south of the Upper Wallpolla and into the Mid Wallpolla. The exact location is yet to be confirmed.
G	This crossing/regulator (175 m long) prevents a breakout of water to the south of the Upper Wallpolla and into the Mid Wallpolla. It will be built on an existing track
H	This minor levee (6 m long) prevents a breakout of water to the south of the Upper Wallpolla and into the Mid Wallpolla.
I	This minor regulator and levee (80 m long) controls the breakout of water to the north.
J	This minor regulator and crossing (90 m long) prevents a breakout of water to the north. It will be located on an existing track.
K	This minor regulator/crossing (120 m long) prevents a breakout of water to the north. It will be located on an existing track.
M	This minor regulator/crossing (75 m long) prevents a breakout of water to the north. It will be located on an existing track.
N	This minor regulator/crossing (75 m long) prevents a breakout of water to the north. It will be located on an existing track.
P	This minor regulator/crossing (15 m long) prevents a breakout of water to the north and into the River Murray. It will be located on an existing track.
R	This minor regulator/crossing (35 m long) prevents water moving north onto private land.

3.3. Name of proponent and proposed implementing entity

As the project owner, DEPI will have oversight responsibility for project implementation, pending confirmation of construction funding. Further information regarding the proposed governance and project management arrangements for implementation is provided in Section 17.

3.4. Summary of estimated costs and proposed schedule

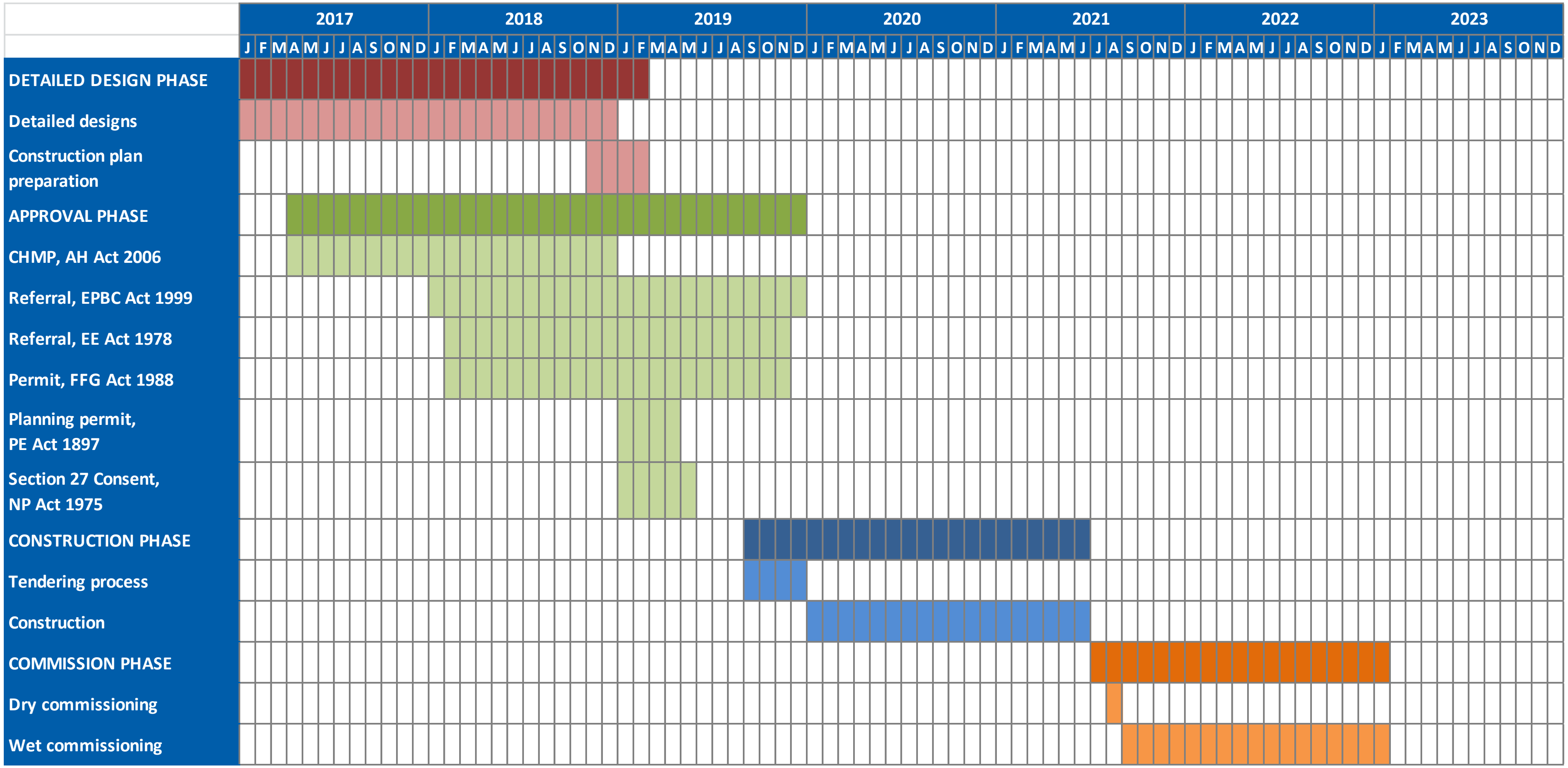
The total cost of the *Wallpolla Island Floodplain Management Project* is $59,523,808. Further details on costs are provided in Section 14.

This business case presents the cost to fully deliver the project (i.e. until all infrastructure is constructed, commissioned and operational), including contingencies. Cost estimates for all components in this proposal are based on current costs, with no calculation undertaken of future cost escalations. To ensure sufficient funding will be available to deliver the project in the event that it is approved by the MDB Ministerial Council for inclusion in its approved SDL Adjustment Package to be submitted to the MDBA by 30 June 2016, cost escalations will be determined in an agreed manner between the proponent and the investor as part of negotiating an investment agreement for this project.

Table 3-3 outlines a high-level program schedule for the project. The program does not include durations for hold points at project gateways, as these are yet to be confirmed. The works will be fully operational prior to 2024.

The Horseshoe Lagoon Regulator, Wallpolla Island, constructed under The Living Murray Program in 2006.

Table 3-3. Proposed project delivery schedule. Timelines are indicative only and will depend on finalisation of funding agreements



4. Ecological values of the site (Section 4.2)

4.1. Fauna values

The ecological significance of the Wallpolla Island floodplain complex is underpinned by its location, providing longitudinal connection to the River Murray and its floodplains, as well as lateral connection into the semi-arid Mallee environment. The floodplain forms part of the broader Murray-Sunset National Park, which extends 100 km to the west and south, encompassing 677,000 ha. This provides essential biodiversity corridors allowing species to move between environments essential to their life-cycles (Ecological Associates, 2014). Many mammals, reptiles and birds, including Giles' planigale, little broad-nosed bat, beaked gecko, and many species of bush and water birds, live in both the floodplain and terrestrial landscapes (Ecological Associates, 2014).

Wallpolla Island is listed in the Directory of Important Wetlands in Australia as a wetland of national significance (Environment Australia, 2001). It is also part of the Chowilla-Lindsay-Wallpolla Icon Site, one of six icon sites under The Living Murray for their high environmental values.

The floodplain incorporates a diverse range of landforms including creeks, temporary anabranches, wetlands, woodlands and grasslands, providing a mosaic of habitat. This, in turn, supports a vast array of species including two species listed under the *Environmental Protection and Biodiversity Conservation Act 1999 (EPBC*): the growling grass frog (*Litoria raniformis*) and Murray cod (*Maccullochella peelii*). A further 32 fauna species of conservation significance have been recorded at Wallpolla Island (Ecological Associates, 2014).

Wallpolla Island supports 129 known bird species, of which 17 have conservation significance at the state or national level (Ecological Associates, 2014a). The island is also important as habitat for both nomadic and migratory bird species listed under the Japan-Australia and China-Australia migratory bird agreements (Ecological Associates, 2014a). Semi-permanent wetlands on the island, such as Lily ponds and Horseshoe Lagoon, provide habitat for and can support breeding of significant numbers of waterbirds including egrets, glossy ibis, spoonbills, cormorants and night herons. Areas of lignum, when inundated, provide nesting platforms for waterbirds including ibis, cormorants, pelicans and waterfowl. Woodlands higher on the floodplain provide productive habitat for woodland birds (Ecological Associates, 2014a).

Eleven fish species are encountered regularly in the vicinity of Wallpolla Island (Henderson et al., 2013). Small fish species that inhabit localised riparian and wetland habitats include flat-headed galaxias, southern pygmy perch and hardyhead species. Large-bodied fish that specialise in deeper channel habitat include Murray cod, golden perch and silver perch. Freshwater catfish spends time in deep channel habitats but use these wetlands to spawn (Ecological Associates, 2014a).

Wallpolla Island also provides habitat for a range of reptile and frog species. Twenty-one reptile species have been recorded on the island, including five of conservation significance. Seven frog species have also been recorded from the island, including the EPBC-listed growling grass frog (Robertson and Ahern, 2007).

The island has a highly diverse mammal fauna, supporting 22 species, including the EPBC listed Giles planigale. Recent surveys identified 16 bat taxa present (Biosis 2013). Bats prey on insects found in the canopy and understory of floodplain woodland and roost in bark, crevices and hollows (Ecological Associates, 2014a). Two species, large-footed myotis (*Myotis macropus*) and little broad-nosed bat (*Scotorepens greyii*) are near threatened in Victoria.

Further details of the ecological diversity including flora and fauna species of conservational significance are included in Appendix B.

Growling grass frog (Clare Mason, 2006)

4.2. Vegetation values

The vegetation of Wallpolla Island is floristically and structurally diverse. River red gum, black box and alluvial grassland communities feature at the site, supporting a wide range of plant species, including species of conservation significance. Ogyris (2013) reported 194 native plant species from a recent survey of the site. Of these, 30 are floodplain species that are rare or threatened under the Victorian Advisory List of Threatened Plants. One species, soda bush (*Neobassia proceriflora*) is endangered and in Victoria is known only to occur at Wallpolla and Lindsay Islands (Ogyris, 2013 in Ecological Associates, 2014).

Ecological Vegetation Classes

The vegetation communities of Wallpolla Island are distributed across the floodplain according to hydrological regimes, soils type and salinity gradients. In Victoria, vegetation mapping units known as Ecological Vegetation Classes (EVCs) are the standard unit for classifying vegetation types. EVCs are described through a combination of floristics, lifeforms and ecological characteristics, and preferred environmental attributes (DEPI, 2014).

A total of 21 EVCs are present at the Wallpolla Island site (Figure 4-1). Of these, 19 are inundation dependent. The EVCs are:

Inundation dependent EVCs

- Alluvial Plains Semi-arid Shrubland
- Open Water
- Disused Floodway Shrubby Herbland
- Floodplain Grassy Wetland
- Floodway Pond Herbland
- Grassy Riverine Forest

- Grassy Riverine Forest / Floodway Pond Herbland Complex
- Intermittent Swampy Woodland
- Lake Bed Herbland
- Lignum Shrubland
- Lignum Swamp
- Lignum Swampy Woodland
- Low Chenopod Shrubland
- Riverine Chenopod Woodland
- Shallow Freshwater Marsh
- Shrubby Riverine Woodland
- Spike-sedge Wetland
- Sub-saline Depression Shrubland
- Waterbody – Fresh

Dryland EVCs

- Semi-arid Chenopod Woodland
- Semi-arid Woodland

Eight EVC are considered depleted in the Murray Scroll Belt bioregion and seven are considered vulnerable. One EVC, Disused Floodway Shrubby Herbland, is considered endangered in the Murray Scroll Belt bioregion. An additional seven EVCs are considered vulnerable and eight depleted.

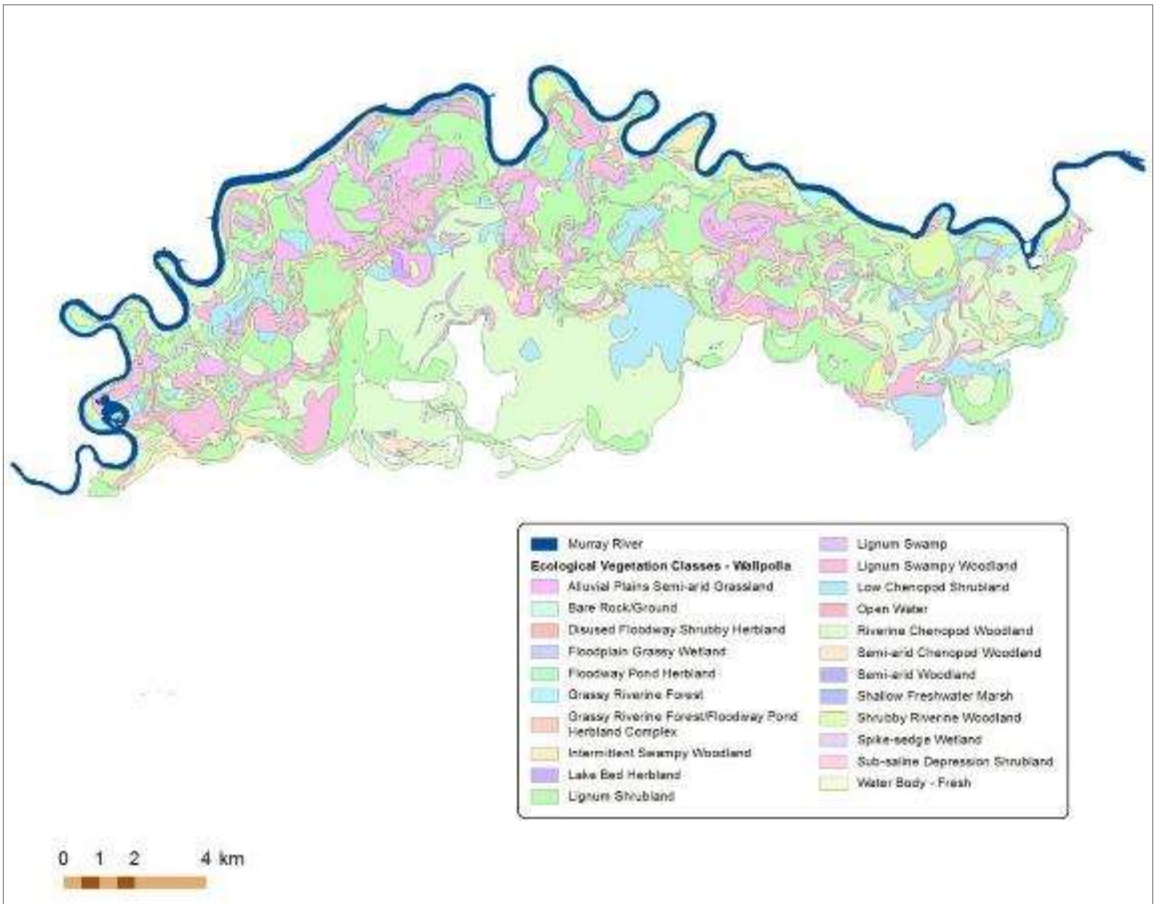


Figure 4-1. Ecological Vegetation Classes present at the Wallpolla Island site

Water Regime Classes

Floodplain ecology is influenced by the duration, depth, frequency and timing of inundation events. Therefore, it is useful to define Water Regime Classes (WRG) to establish objectives for the location, extent and condition of components of the floodplain ecosystem.

Plant communities present on Wallpolla Island have been described and mapped in detail as EVCs. Possible relationships between EVCs and water regimes were assessed. Using topographic data and information on the known spread of water on a rising hydrograph, EVCs were arranged in the order in which they are likely to be flooded and likely frequency and relative durations of flooding. This environmental gradient was refined by reviewing the EVC descriptions, which set out the species present during flooded and dry phases, their relative abundance and their habitat. Species with known relationships to flooding could be used to rank EVCs from most-likely to least likely to be flooded (Ecological Associates 2007).

EVCs were amalgamated into eight water regime classes (Figure 4-2). Table 4-1 provides a brief description of the eight water regime classes at Wallpolla Island. A more detailed description of the characteristics of these water regime classes is provided in Appendix B.

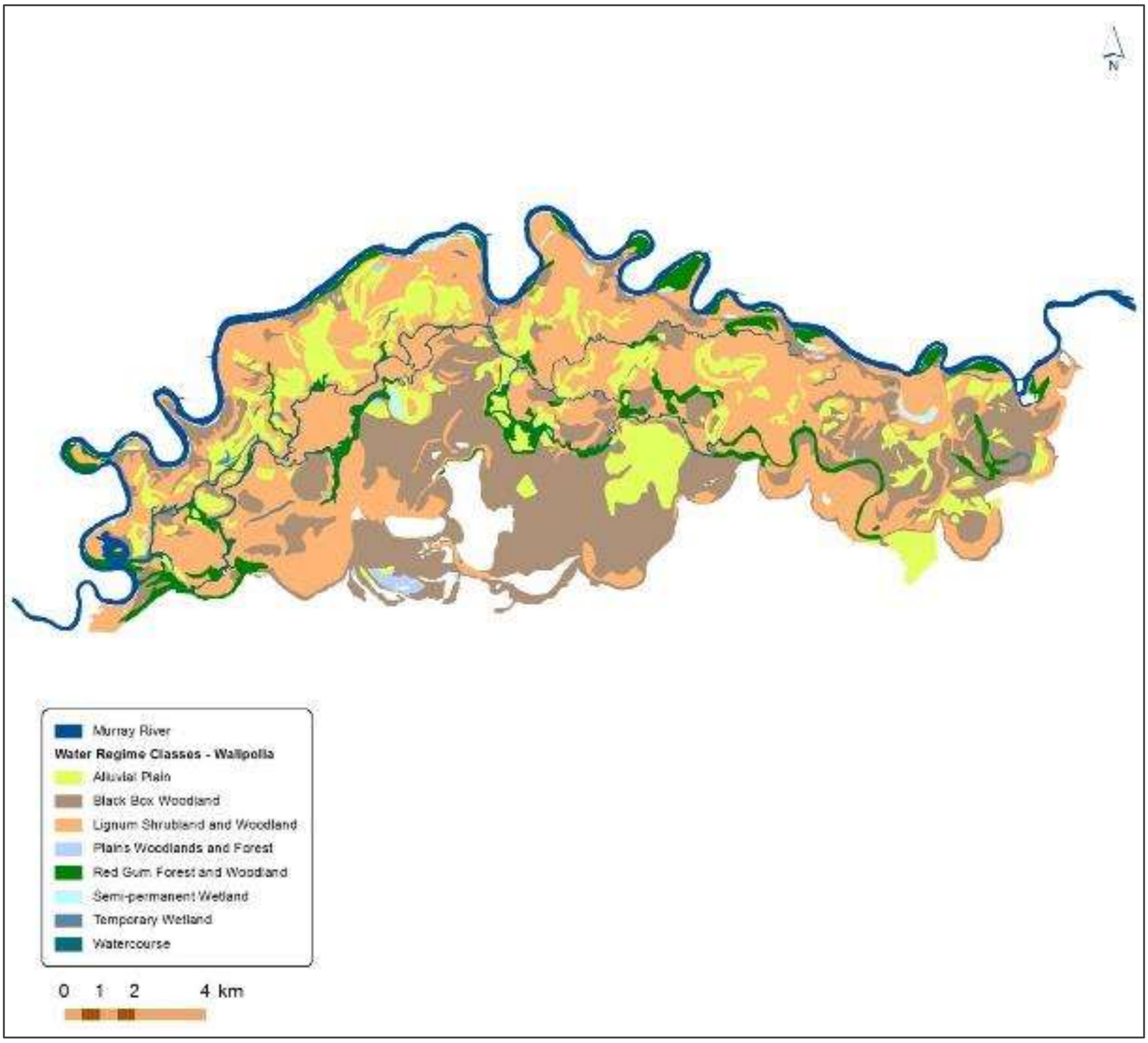


Figure 4-2. Wallpolla Island Water Regime Classes

Table 4-1. Wallpolla Island Water Regime Classes (Ecological Associates, 2014a)

	Area at Wallpolla Island (ha)	Area to be watered within this project (ha)	Component Ecological Vegetation Classes
Semi-permanent Wetlands	122	32	Deep point-bar billabongs and wetlands identified as filling to more than 1 m at flows of 60,000 ML/d by hydraulic modelling Lake Bed Herbland
Temporary Wetlands	82	22	Floodway Pond Herbland Shallow Freshwater Marsh Floodway Pond Herbland Disused Floodway Shrubby Herbland
Watercourses	406	96	Waterbody - Fresh Spike Sedge Wetland
Red Gum Forest and Woodland	1,027	211	Grassy Riverine Forest / Floodway Pond Herbland Complex Grassy Riverine Forest Intermittent Swampy Woodland
Lignum Shrubland and Woodland	7,520	889	Lignum Shrubland Lignum Swamp Lignum Swampy Woodland
Black Box Woodland	5,690	911	Riverine Chenopod Woodland Shrubby Riverine Woodland
Alluvial Plain	2,776	389	Alluvial Plains Semi-arid Shrubland Sub-saline Depression Shrubland Low Chenopod Shrubland
Plains Woodlands and Forest	76	0	Semi-arid Chenopod Woodland Semi-arid Woodland
No EVC mapping*	102	102	
Total	17,679	2,651	

*There is a small area on Wallpolla Island where EVCs have not been mapped which is due to gaps in spatial data

4.3. Current condition

The forests and woodlands of the River Murray floodplain have been declining rapidly in condition over the past two decades. The die back is associated with increasing regulation of the River Murray and extended periods of drought (Cunningham et al., 2011).

During the recent drought, the condition of lignum communities across the Lindsay-Wallpolla Islands Icon Site was found to be poor, while approximately 25% of black box and 80% of river red gums were stressed or dying, with little recruitment observed (Henderson et al., 2008; Cunningham et al., 2006).

In 2010, Cunningham et al (2011) found that 79% of the area covered by river red gum and black box communities across The Living Murray Icon Sites were stressed. Stands of river red gum and black box in good condition occurred only in close proximity to the river channel, permanent anabranches, creeks and wetlands. Conversely, extensive areas of river red gum and black box stands in degraded to severely degraded condition occurred away from water bodies (Cunningham et al., 2011).

Exceptionally high rainfall in 2010 (325 mm recorded over summer 2010-11 compared with a long term average of 60 mm at Werrimull (BOM, 2014, in Henderson et al., 2014)) as well as associated flooding provided some relief to the drought stressed plant communities of the Lindsay-Wallpolla Islands Icon Site.

There was a significant improvement in the condition of river red gum from 2008 - 2012, evidenced by a threefold increase in the number of trees in good condition, and widespread establishment of river red gum seedlings following flooding in 2011 - 2012 (Henderson et al., 2013). While the presence of seedlings and saplings may indicate a successful establishment event, it is the survival of these juveniles to maturity that may be deemed to constitute successful recruitment. Further, recruitment must keep pace with mortality if populations are to persist. This recruitment is dependent on an ecologically appropriate flooding regime.

There was a substantial improvement in the condition of black box from 2009 - 2012, followed by a slight decline in 2013; however recruitment rates are insufficient to sustain populations to historic levels. Despite the high rainfall and flooding events of 2011 and 2012, there has been no significant seedling establishment (Henderson et al., 2013).

The overall condition of lignum has declined substantially since 2007. Some improvement in the condition of lignum was recorded in association with the above average rainfall and flooding of 2010-11 and 2012; however the general condition of lignum is relatively poor, with more than half of the plants originally surveyed in 2007 recorded as dead in 2013 - 2014, with the expectation that these plants will not regenerate from rootstock (Henderson et al., 2014).

Based on the response to inundation observed at Wallpolla Island, it is expected that the ecological condition of this site will improve when the water regime is better aligned with its ecological requirements. Benefits of environmental watering are further discussed in Section 6.1.

4.4. Past management activities and actions

Since 1848, the Wallpolla Island state forest area was managed as a pastoral run and used for grazing cattle and sheep, as well as for timber cutting to supply river trade. In 1989, the Land Conservation Council recommendations resulted in a changed focus of land management at the island, from agriculture to conservation. Recent Victorian Environmental Assessment Council decisions (VEAC, 2008) have seen incorporation of a part of Wallpolla Island as River Murray Reserve, Murray River Park (Proposed) and Murray-Sunset National Park, managed by Parks Victoria.

To prevent catastrophic ecosystem collapse at Wallpolla Island, an emergency environmental watering program was initiated in 2004-05 as an immediate response to the Island's poor condition. Over six years, environmental water was delivered to low lying wetlands and creeklines via portable pumps and contained with temporary earthen levees. Bayes et al (2010), conclude that the environmental watering program made a significant contribution to increasing the resilience and therefore long-term viability of the plant communities and populations of threatened species at Wallpolla Island. In comparison to unwatered sites, watered wetlands supported a diverse and abundant wetland flora, which included a diversity of rare and threatened species. The unwatered wetlands were in a stressed condition, with little or no evidence of flood-dependant ground flora and with many either dead or dying structural woody dominants.

It appears likely that the environmental watering was of considerable benefit for maintenance of local frog populations as evidenced by breeding of one of the three frog species located during the survey (Bayes et al., 2010). The watering provided habitat for an array of waterbird species, including the Victorian listed vulnerable Baillon's Crake (*Porzana pusilla)* observed forging for invertebrates at Wallpolla Island in 2010.

The FFG-listed Baillon's Crake (*Porzana pusilla*) forging for invertebrates at Horseshoe Lagoon, Wallpolla Island 2010

4.5. Other Values

In addition to its environmental values, the Wallpolla Island Floodplain Complex is recognised for its many social and cultural values.

Cultural and historical values

Prior to European settlement, Aboriginal people occupied all aspects of the Victorian landscape, governed by a distinct system of land ownership. Aboriginal occupation dates back thousands of years and on Wallpolla Island was sustained by the rich productivity of the floodplain and woodland systems. Many cultural heritage sites exist within the vicinity of the island, including many registered sites, containing shell middens, hearths, culturally scarred trees and other items of cultural significance (Bell, 2013).

Wallpolla Island originally formed part of the Kulnine or Hawdon's Upper Run, gazetted in December 1848 (Bell, 2013). In 1857 it was subdivided into Kulnine Upper and Kulnine Lower and was grazed by cattle and sheep. Timber cutting, paddleboats and river trade also had an impact on the forests.

The majority of Wallpolla Island is Crown Land and up until recently, land tenure has been State Forest. The Land Conservation Council report, Mallee Area Review (1987) identified public land use for Wallpolla Island as hardwood production.

Social and recreational values

Being close to Mildura, recreational use of the site is quite high and includes fishing, camping, boating, canoeing, bird and wildlife watching, photography, horse riding, motor biking and four-wheel driving. Wallpolla Island attracts campers especially in spring and autumn.

5. Ecological objectives and targets (Section 4.3)

Ecological objectives have been developed for the Wallpolla Island site, drawing on a range of approaches and recommended lines of enquiry including, but not limited to:

- the overarching objective in Schedule 7 of the Basin Plan
- the Basin-wide Environmental Watering Strategy (MDBA, 2014)
- a review of relevant literature including monitoring data from the TLM initiative (Bayes et al., 2010; Henderson et al., 2012; Henderson et al., 2013; Henderson et al., 2014)
- desktop and field based flora and fauna surveys (Ogyris, 2013; Biosis, 2013)
- site visits, and
- a workshop with an expert panel comprised of aquatic, wildlife and restoration ecologists and key project stakeholders from DEPI, Parks Victoria and the Mallee CMA (Ecological Associates, 2014a).

The ecological objectives for the *Wallpolla Island Floodplain Management Project* were developed with a view to enhance the conservation values of the site with the proposed works, inform the detailed design and operation of the works and guide monitoring and evaluation.

5.1. Overarching Ecological Objective

The overarching objective of water management at Wallpolla Island is:

*"to **protect and restore** the key species, habitat components and functions of the Wallpolla Island ecosystem by providing the hydrological environments required by indigenous plant and animal species and communities"* (Ecological Associates, 2014).

The proposed works will provide:

- a mosaic of hydrological regimes and habitat types across Wallpolla Island
- enhanced connectivity between floodplain elements, the floodplain and the river, and
- continuity of stream-flow and condition through Wallpolla Creek and associated watercourses and to the wider lower Murray floodplain including Chowilla Floodplain (SA), Lindsay Island (Vic), Mulcra Island (Vic) and the Carrs, Capitts and Bunberoo Creek system (NSW) (Figure 5-1).

Regent parrots at Wallpolla Island (2013)

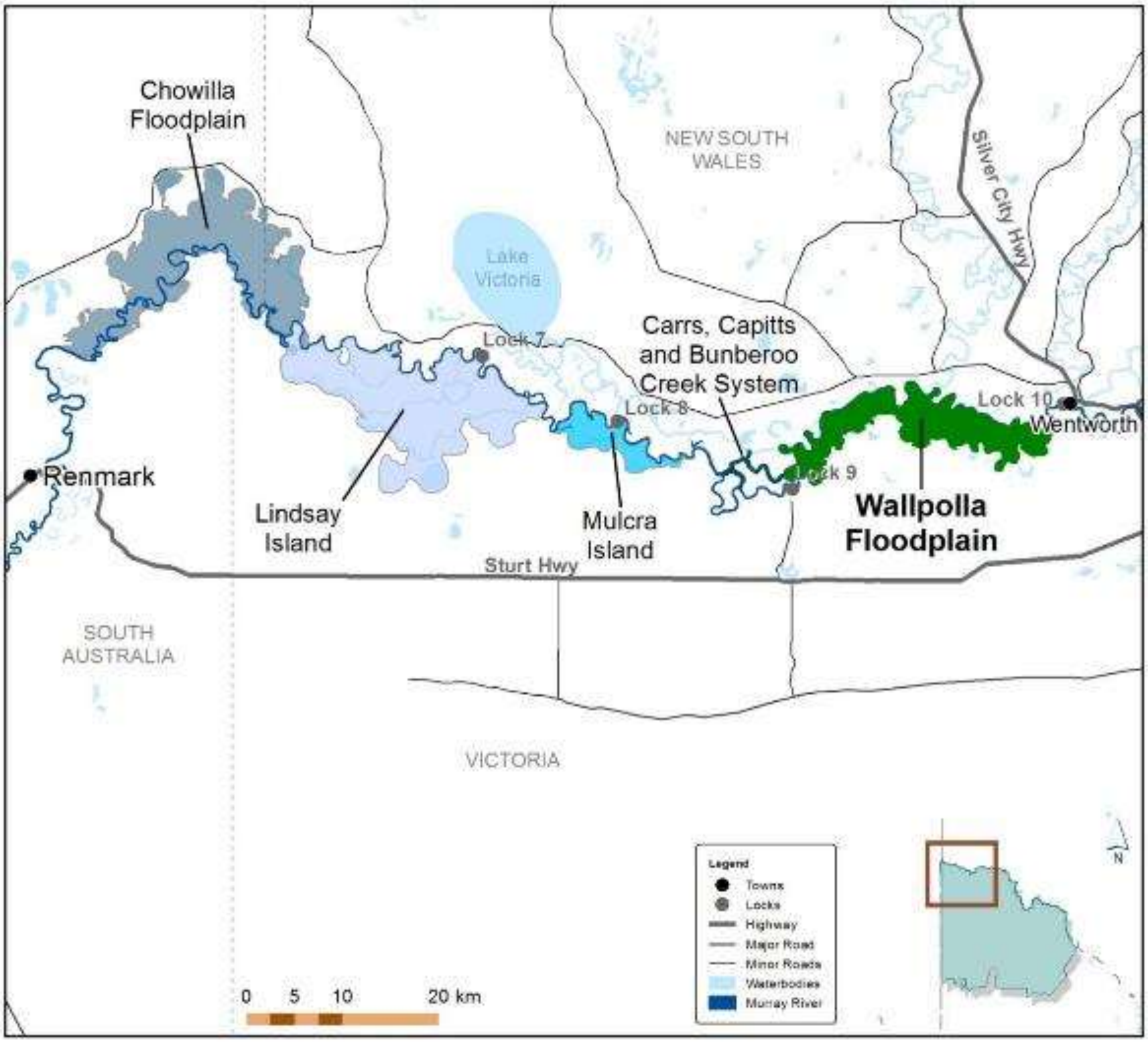


Figure 5-1. The proximity of Wallpolla Island to other high-value floodplain systems in Vic, NSW and SA

Achieving the overarching objective will be supported by the land management regime. In 2008, recommendations from a Victorian Environmental Assessment Council (VEAC) investigation resulted in the expansion of the area of public land managed as National Park. The *Wallpolla Island Floodplain Management Project* will provide the improved hydrological regime needed to restore values within the landscape achieving the recommendations established for the Murray-Sunset National Park (VEAC, 2008). The works have been designed to operate in conjunction with Basin Plan flows but will also allow use of temporary pumps under low River Murray flows and will therefore protect this wetland system through droughts.

5.2. Specific objectives and targets

Specific ecological objectives have been developed for the proposed supply measure, based on the key water dependent values of Wallpolla Island. The objectives are consistent with those of the *Lindsay-Wallpolla Icon Site Environmental Water Management Plan* (MDBA, 2012) and will contribute to achieving the environmental objectives set by the Basin Plan. The Basin Plan objectives have been summarised as follows:

1. *to protect and restore a subset of all water-dependent ecosystems in the Murray-Darling Basin ensuring that:*
   (a) declared Ramsar wetlands that depend on Basin water resources maintain their ecological character: and
   (b) water-dependent ecosystems that depend on Basin water resources and support the lifecycles of species listed under the Bonn Convention, CAMBA, JAMBA or ROKAMBA continue to support those species: and
   (c) water-dependent ecosystems are able to support episodically high ecological productivity and its ecological dispersal.
2. *to protect and restore biodiversity that is dependent on Basin water resources, including by ensuring that: are protected and, if necessary, restored so that they continue to support those life cycles*
   (a) water-dependent ecosystems that support the lifecycles of a listed threatened species or ecological community, or species treated as threatened or endangered in State law, are protected and, if necessary, restored so that they continue to support those lifecycles; and
   (b) representative populations and communities of native biota are protected and if necessary restored.
3. *that the water quality of Basin water resources does not adversely affect water-dependent ecosystems and is consistent with the water quality and salinity management plan.*
4. *to protect and restore connectivity within and between water-dependent ecosystems including by ensuring that:*
   (a) the diversity and dynamics of geomorphic structures, habitats, species and genes are protected and restored; and
   (b) ecological processes depend on hydrologic connectivity longitudinally along rivers, and laterally, between rivers and their floodplains (and associated wetlands) are protected and restored: and
   (c) the Murray Mouth remains open at frequencies, for durations and with passing flows, sufficient to enable the conveyance of salt, nutrients and sediment from the Murray-Darling Basin to the ocean: and
   (d) the Murray Mouth remains open at frequencies, and for durations, sufficient to ensure that the tidal exchanges maintain the Coorong's water quality within the tolerance of the Coorong ecosystems' resilience and
   (e) barriers to the passage of biological resources (including biota, carbon and nutrients) through the Murray Darling Basin are overcome or minimised.
5. *that natural processes that shape landforms (for example, the formation and maintenance of soils) are protected and restored.*
6. *to provide habitat diversity for biota at a range of scales (including, for example, the Murray–Darling Basin, riverine landscape, river reach and asset class).*
7. *to protect and restore food webs that sustain water-dependent ecosystems, including by ensuring that energy, carbon and nutrient dynamics (including primary production and respiration) are protected and restored.*
8. *to protect and restore ecosystem functions of water-dependent ecosystems that maintain populations (for example recruitment, regeneration, dispersal, immigration and emigration) including by ensuring that;*
   (a) flow sequences, and inundation and recession events, meet ecological requirements (for example, cues for migration, germination and breeding); and
   (b) habitat diversity that supports the life cycles of biota of water dependent ecosystems (for example habitats that protect juveniles from predation) is maintained
9. *to protect and restore ecological community structure and species interactions.*
10. *that water-dependent ecosystems are resilient to climate change, climate variability and disturbances (for example, drought and fire)*
11. *to protect refugia in order to support the long-term survival and resilience of water-dependent populations of native flora and fauna, including during drought to allow for subsequent re-colonisation beyond the refugia.*
12. *to provide wetting and drying cycles and inundation intervals that do not exceed the tolerance of ecosystem resilience or the threshold of irreversible changes.*
13. *to mitigate human-induced threats (for example, the impact of alien species, water management activities and degraded water quality).*
14. *to minimise habitat fragmentation.*

Ecological targets have also been developed to measure progress towards the specific ecological objectives. It is anticipated that these targets will be tested and refined once the proposed supply measure is operational. The targets describe an ecological outcome or process and are:

- quantitative and measurable
- time-bound, and
- justified by existing site data or scientific knowledge.

The ecological targets compare the current state of the ecosystem (i.e. using 2015 as a baseline) with a future state after the recommended water regimes have been applied, assuming that the proposed works are commissioned in 2020. It will take some time to realise ecological outcomes due to the time required for vegetation to adapt to the new inundation conditions, for floodplain productivity to increase (e.g. for additional energy and nutrients to be distributed through the food web) and for fauna populations to respond. Targets based on relatively stable variables will be evaluated in 2030. Targets based on the frequency of an event occurring will be evaluated over the period from 2025 to 2035.

The specific ecological objectives and targets, and the contribution of each objective to the Basin Plan objectives, are shown in Table 5-1.

Table 5-1. Specific ecological objectives and targets for Wallpolla Island (Ecological Associates, 2014), relevant water regime classes and the contribution of each objective to the Basin Plan objectives

Specific Objective	Ecological Targets	Water Regime Classes	Associated Basin Plan Objectives
Increase resident populations of frogs, waterbirds and small fish in wetlands.	At least four native fish species are present in at least three wetland sites throughout the period from 2025 to 2035. At least three frog species are present in at least three wetland sites throughout the period from 2025 to 2035.	Semi-permanent Wetlands Temporary Wetlands Watercourses	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14
Provide reliable breeding habitat for waterbirds, including colonial nesting species	Any species of waterfowl, crake, rail, waterhen or coot to breed every year in at least four wetland sites in the period between 2025 and 2035. Platform-building waterbirds breed in lignum shrublands on at least three occasions between 2025 and 2035. Cormorants and / or nankeen night heron breed at Wallpolla Island on at least three occasions between 2025 and 2035.	Semi-permanent Wetlands Temporary Wetlands Red Gum Forest and Woodland Lignum Shrubland and Woodland Alluvial Plain	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14
Enhance local populations of channel-specialist fish by augmenting anabranch habitat and improving the productivity of connected riparian zones and wetlands	The population of adult Murray cod in Wallpolla Island watercourses increases by 25% from 2015 levels by 2030. The population of adult golden perch in Wallpolla Island watercourses increases by 25% from 2015 levels by 2030. The average lateral extent of aquatic macrophyte vegetation on the banks of permanent floodplain watercourse reaches increases by 100% from 2015 levels by 2030. The average December projected cover of aquatic macrophytes exceeds 50% in at least 100 ha in wetland habitat in the period between 2025 and 2030.	Semi-permanent Wetlands Temporary Wetlands Watercourses	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14
Frequently provide habitat for thousands of waterbirds	Total summer waterbird abundance at Wallpolla Island exceeds 2,000 in at least three seasons between 2025 and 2035.	Lignum Shrubland and Woodland Alluvial Plain	1, 2, 3, 4 , 6, 7, 8, 9, 10, 11, 12, 13, 14
Protect and restore floodplain productivity to maintain resident populations of vertebrate fauna including carpet python, insectivorous bats and Giles' planigale	Total bat abundance increases by 25% from 2014 levels by 2030.	Red Gum Forest and Woodland Lignum Shrubland and Woodland Black Box Woodland	1, 2, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14
Contributing to the carbon requirements of the River Murray channel ecosystem	The average annual carbon load (dissolved and particulate) to the River Murray from Wallpolla Island for the period 2025 to 2035 is double 2015 to 2020 levels.	Red Gum Forest and Woodland Lignum Shrubland and Woodland Black Box Woodland	1, 2, 3, 4, 6, 7, 8, 9, 10, 11, 12, 13, 14

5.3. Environmental water requirements

The proposed works will provide flexibility to deliver a wide range of environmental watering events to meet the ecological objectives described in Section 5-2.

The hydrological regime experienced by each water regime class has varied from natural due to river regulation and diversions. The environmental water requirements for each water regime class are described in detail in Section 9. Detailed ecological justification and the water requirements of each water regime class are provided in Appendix B.

Table 5-2 provides a comparison of the water regime that can be provided by the proposed measure with the following water regimes:

- Natural
- Baseline Condition (Current Condition)
- Basin Plan (2750) without the measure

Basin Plan flows will contribute toward achieving the environmental water requirement of Wallpolla Island compared to baseline conditions. The proposed measure is required to bridge the gap between Basin Plan flows and the environmental water requirements of Wallpolla Island.

A detailed analysis of the frequency, extent and duration provided by the proposed measures, in comparison to the natural flow regime, baseline conditions and under Basin Plan 2750 without measure, are provided in Section 8.

Table 5-2. Comparison of water regimes provided by natural, baseline, Basin Plan and the Wallpolla Island measure (Gippel, 2014); 'with measure' figures based upon interpretation of the preliminary operations plan adapted from (Ecological Associates, 2014a)

Threshold (ML/d)	WRC	Scenario	Frequency Mean (/100 yrs)	Interval Median (days)	Duration Median (days)	Event start date Median (day of year, 1 Jan = 1)	Prevalence yrs with event %
40,000	Semi-permanent Wetlands	With measure	50	270	120	214	50
		Natural	87.7	237	141	214	89
		Baseline	44.7	339	89	230	52
		Basin Plan flow without measure	56.1	326	94	215	54
60,000	Temporary Wetlands	With measure	60	270	90	240	60
		Natural	64	319	95	240	68
		Baseline	25.4	634	41	271	32
		Basin Plan flow without measure	33.3	630	48	258	36
30,000	Watercourses	With measure	95	200	150	193	95
		Natural	95.6	168	167	193	95
		Baseline	55.3	314	98	207	54

Threshold (ML/d)	WRC	Scenario	Frequency Mean (/100 yrs)	Interval Median (days)	Duration Median (days)	Event start date Median (day of year, 1 Jan = 1)	Prevalence yrs with event %
		Basin Plan flow without measure	75.4	274	108	202	74
80,000	Red Gum Forest and Woodland	With measure	35	700	50	266	35
		Natural	38.5	627	51	266	39
		Baseline	13.2	2081	49	262	30
		Basin Plan flow without measure	14	1214	44	269	31
80,000	Lignum Shrubland and Woodland	With measure	35	700	50	266	35
		Natural	38.5	627	51	266	39
		Baseline	13.2	2081	49	262	30
		Basin Plan flow without measure	14	1214	44	269	31
100,000	Black Box Woodland	With measure	25	830	42	182	25
		Natural	26.3	735	32	276	30
		Baseline	6.1	5699	73	248	5
		Basin Plan flow without measure	6.1	1109	77	248	5
120,000	Alluvial Plain	With measure	15	2500	30	182	15
		Natural	15.8	1738	30	279	15
		Baseline	6.1	6467	23	281	4
		Basin Plan flow without measure	6.1	4986	34	279	5

6. Anticipated ecological benefits (Section 4.4.1)

The creeks, temporary anabranches, wetland and floodplain systems of Wallpolla Island support a variety of aquatic and terrestrial ecological communities, including woodlands and grasslands (Section 4). The condition of ecological values of Wallpolla Island and past management activities and actions are outlined in Sections 4.3 and 4.4 respectively.

6.1. Ecological benefits of inundation events

Inundation maintains the productivity of floodplain habitats and is necessary for the regeneration and successful recruitment of major canopy species such as red gum and black box. Dense understorey vegetation maintained by inundation regimes provides the prey species and structural habitat on which carpet python and lace monitor depend. High levels of insect productivity, derived from both wetland and woodland inundation, contribute to Wallpolla Island's diverse bat fauna, which comprises 16 species (Biosis, 2013). Organic matter generated on the floodplain is conveyed to the river channel by receding flood water and contributes to the energy requirements of the river ecosystem (Ecological Associates, 2014).

Flora and fauna surveys completed in 2009 and 2010 (Bayes et al., 2010), conclude that the 2009 environmental watering made a significant contribution to increasing the resilience and therefore long-term viability of the plant communities and populations of threatened species at Wallpolla Island. In comparison to un-watered sites, watered wetlands supported a more diverse and abundant wetland flora, which often included rare and threatened species. The unwatered wetlands were in a stressed condition, with few to no flood-dependant understory species present, and with many trees either dead or dying. Inundation-dependent threatened species were missing from some areas suggesting that more frequent inundation would significantly enhance species diversity (Bayes et al. 2010).

The environmental watering was beneficial to frog populations. One of the three frog species recorded as present during the survey was recorded breeding (Bayes et al., 2010). Frog presence is important as their eggs and tadpoles represent a food resource for other wetland dependant fauna (Bayes et al., 2010).

A trend of improving ecological condition has been recorded since the end of the millennium drought period (Henderson et al., 2014). These results provide a high level of confidence that the implementation of the proposed supply measure and its associated watering regime will provide the expected benefits.

This project presents a unique opportunity to restore and protect ecosystem functions and processes due to the ability to connect, via watering events, large areas of the floodplain, including flowing aquatic habitat, wetlands and areas of river red gum, black box, lignum and alluvial floodplains.

Photo point monitoring at Wallpolla Island showing the improvement in vegetation condition after environmental watering (above: water just reaching the tree line, January 2013; below: water receding, May 2013)

6.2. Proposed ecological benefits

The proposed supply measure will restore flooding and productivity to extensive areas of river red gum woodland, black box woodland and lignum shrubland. It will contribute significantly to the feeding and breeding requirements of platform-building waterbirds that nest in lignum, including colonial nesting species. Frequent flooding of wetlands will maintain wetland habitat for sedgelands and rushlands and support populations of small-bodied fish and cryptic waterbirds such as bitterns, crakes and rails.

The anticipated ecological benefits for each water regime class are described in Table 6-1.

Wallpolla Island (2010)

Table 6-1. Water regime class, strategy and ecological benefits (Ecological Associates, 2014)

Water Regime Class	Strategy	Ecological benefits, including site ecological targets
Semi-permanent Wetlands	Protect and restore semi-permanent inundation to deep, low-lying wetlands and restore hydraulic connections to riverine habitats	Stimulation of seed bank resulting in greater diversity and abundance of wetland flora. This will in turn provide foraging and breeding habitats for wetland birds, fish and frogs. Riparian shrubs; will potentially demonstrate increased vigour in species such as lignum, and possibly also exhibit an increase in abundance and diversity. Adjacent trees; will likely demonstrate increased vigour and recruitment, therefore leading to an overall improvement in wetland health, maintenance of wetland buffers and maintenance of fauna habitats.
Temporary Wetlands	Protect and restore intermittent inundation of floodplain wetlands	Stimulation of seed bank resulting in greater diversity and abundance of wetland flora. This will in turn provide foraging and breeding habitats for wetland birds, fish and frogs. Riparian shrubs; will potentially demonstrate increased vigour in species such as lignum, and possibly also exhibit an increase in abundance and diversity. Adjacent trees; will likely demonstrate increased vigour and recruitment, therefore leading to an overall improvement in wetland health, maintenance of wetland buffers and maintenance of fauna habitats.
Water Courses	Introduce seasonal variation in anabranch water levels	In-channel macrophytes; flows convey seeds and propagules into the wetland resulting in an increase in diversity and abundance species. Water quality may also improve. Improve native fish diversity and abundance through improved habitat. Bank and channel edge macrophytes; flows convey seeds and propagules . Riparian shrubs; will potentially demonstrate increased vigour in species such as lignum, and possibly also exhibit an increase in abundance and diversity. Adjacent trees; increased vigour and recruitment, maintenance of wetland buffers and fauna habitats; an increase in diversity and abundance of emergent species. Water quality may improve, wetland banks stabilised.
River Red Gum Forest and Woodland	Protect and restore the inundation of River Red Gum forest and woodland	Maintain and enhance adult river red gums for hollow-dependent threatened species occurring within the area such as regent parrots, carpet python and lace monitor. A long-term net benefit through the maintenance and enhancement in condition of river red gum communities. The availability of resources in these ecosystems depends on regular inundation events, which promote aquatic and grassy woodland vegetation, woody debris, submerged aquatic vegetation and other prey habitats (Ecological Associates, 2007). Quality and extent of habitat for a wide range of native species, including threatened species, would be expected to result from improved flow regimes. In particular, colonial nesting waterbirds relying on productive inundated river red gum woodlands and shallow wetlands to forage during breeding and would be expected to benefit (GHD, 2012).
Lignum Shrubland and Woodland	Protect and restore inundation to lignum shrublands	The maintenance and enhancement in condition of lignum shrubland within the study area. When inundated, lignum shrubland can provide an extension of habitat for frog, reptile and fish species (MDBC, 2005b), as well as shallow-water feeding waterbirds utilising macrophytes developed in the inter-shrub area for habitat (SKM & Roberts, 2003). Waterbirds that breed over water, such as ibis and spoonbill may nest over inundated lignum shrubland and regular breeding habitat for waterbirds dependant on lignum, such as freckled duck and colonial nesting waterbirds could be provided if 50% of inundation events last three months (Ecological Associates, 2007; GHD, 2012).

Water Regime Class	Strategy	Ecological benefits, including site ecological targets
Black Box Woodland	Protect and restore inundation to black box woodland	Provide a long-term net benefit through the maintenance and enhancement in condition of floodplain Black Box woodland communities. In addition, the increased inundation regime would provide the appropriate conditions for recruitment within the area, maintaining a diverse age structure, including maturation and development of hollows, maintaining habitat in the long-term for native fauna species (GHD, 2012).
Alluvial Plains	Protect and restore inundation to alluvial plains	Inundation provides opportunistic habitat for floodplain fauna, including feeding habitat for wading birds. Inundation of the alluvial plain will contribute to the success of waterbird breeding events by increasing the availability of food. Extensive inundation may also attract birds to the site and trigger breeding behaviour (Ecological Associates, 2014) Alluvial plains should be inundated to complement waterbird breeding objectives in wetland, lignum and woodland habitats (Ecological Associates, 2014) Provide important foraging and refuge habitat for floodplain fauna species e.g. chenopod shrublands providing foraging habitat for regent parrots, cracking soils providing refuge habitat for small mammals and reptiles (GHD, 2012). Alluvial plains are also likely to represent refuge for terrestrial fauna species during periods of inundation.

6.3. Monitoring and Evaluation Plans (Section 4.4.1)

The effectiveness of the proposed supply measure and its operation will primarily be monitored and reported on through well-established monitoring, evaluation and reporting (MER) strategies and protocols. These strategies and protocols will build upon experience and lessons learned through the ongoing, long-term Living Murray ecological monitoring programs, which include condition and intervention monitoring across several sites in the Mallee. The Mallee CMA has been implementing and coordinating the local Living Murray annual MER process since 2006.

The MER strategies and protocols are linked to overarching State and Victorian Environmental Water Holder frameworks to provide a routine process to:

- Establish a robust program logic to define the correlation between works and other inputs and identified outputs and ecosystem outcomes. This provides the basis for a suite of quantifiable ecological targets that are relevant to the specific sit.
- Monitor progress against those targets on a regular basis.
- Evaluate the implications of the results for the operational parameters of the scheme.
- Amend and adjust the operational arrangements to optimise performance and outcomes.

Monitoring data is required to plan watering events, to optimise water delivery, to manage risks and to refine ecological objectives. The evaluation process involves analysing collected data and improving operations.

A detailed monitoring and evaluation plan has been prepared for the Wallpolla Island site by Ecological Associates, (2014b). Monitoring and evaluation will focus on the effects of local watering actions and include:

- evaluating water use
- measuring ecological outcomes against ecological targets
- refining conceptual models and improving knowledge, and
- managing risk.

The Wallpolla Island monitoring and evaluation plan identifies the agencies responsible for commissioning, reviewing and acting on monitoring data. The linkages back to decision-making are described in the detailed plan Ecological Associates, (2014b).

Initial monitoring will provide a baseline of the existing status of the ecological objectives and outcome monitoring will measure progress towards these objectives. This information will inform the ongoing operations at the site. Over time the results of the outcome monitoring will test assumptions and monitoring data will assist with refining conceptual models and ecological objectives. Param for monitoring each ecological objective of the supply measure for Wallpolla Island are detailed in
Appendix C (Ecological Associates 2014b).

The environmental risks from implementing the proposed water regime are detailed in Section 11. Monitoring data will identify emerging hazards and enable operational decisions to minimise risk.

This MER approach will be formalised once funding for the supply measure has been confirmed.

The final MER approach for this supply measure will be informed by broader intergovernmental arrangements for Basin-wide monitoring and evaluation under the Basin Plan. This measure is expected to contribute to the achievement of outcomes under two key Chapters of the Plan, namely: (i) the delivery of ecological outcomes under Chapter 8; and (ii) under Chapter 10, meeting the relevant sustainable diversion limit/s (SDLs), which must be complied with under the state's relevant water resource plan/s (WRPs) from 1 July 2019.

Both Chapter 8 and Chapter 10 of the Basin Plan are captured under the Murray-Darling Basin Authority's (MDBA) own monitoring and evaluation framework. Once specific Basin Plan Chapters commence within a state, the state must report to the MDBA on relevant matters. This will include 5 yearly reporting on the achievement of environmental outcomes at an asset scale in relation to Chapter 8, and annually reporting on WRP compliance in relation to Chapter 10.

The proponent is satisfied that its participation in the MDBA's reporting and evaluation framework will effectively allow for progress in relation to this supply measure to be monitored, and for success in meeting associated ecological objectives and targets to be assessed.

This approach closely aligns with agreed arrangements under the Basin Plan Implementation Agreement, where implementation tasks are to be as streamlined and as cost-efficient as possible.

Wallpolla Island prior to environmental watering (2005, above) and after (2007, below)

7. Potential adverse ecological impacts (Section 4.4.2)

This business case has taken into consideration potential adverse ecological impacts of this proposal. It is acknowledged that works that alter floodplain hydraulics and hydrology may threaten the ecological values of the Wallpolla Island site, and potentially those of surrounding areas. In order to identify and assess these risks during project development, a comprehensive and rigorous risk assessment was completed (Lloyd Environmental, 2014). This involved identifying potential undesirable outcomes, determining their root causes, assessing likely consequences and significance; and developing relevant mitigation measures to reduce any residual risk to an acceptable level (very low to moderate). Experience gained from previous works and measures, and environmental watering projects of similar scale and complexity, including TLM, informed this process.

The methodology described in Section 7.2 was applied to assess the threats to successful project development, delivery and operation, and the potential adverse ecological impacts of the proposed supply measure. It is therefore also relevant to Sections 11 and 17.

The comprehensive approach undertaken to assess potential adverse ecological impacts of the *Wallpolla Island Floodplain Management Project* ensures risk management strategies can be implemented to ensure management and mitigation of:

- adverse salinity impacts or water quality outcomes at the site
- the potential to increase pest species
- the potential to favour certain species to the detriment of others or to adversely affect certain species, and
- adverse impacts on ecological function and connectivity.

The nature of any downstream salinity and/or water quality impacts, and any potential cumulative impacts with other measures, cannot be formally ascertained at this time. This is because such impacts will be influenced by other measures that may be operating upstream of this site, including other supply/efficiency/constraints measures under the SDL adjustment mechanism, and the associated total volume of water that is recovered for the environment.

It is expected that likely or potential downstream/cumulative impacts will become better understood as the full package of adjustment measures is modelled by the MDBA and a final package is agreed to by Basin governments.

7.1. Risk assessment methodology

A risk assessment was completed in line with the requirements of AS/NZS ISO 31000:2009 (Lloyd Environmental 2014). This assessed both the likelihood of an event occurring and the severity of the outcome if that event occurred. The assessment generated a risk matrix in line with the ISO standards and prioritised mitigation strategies and measures. Table 7-1 and Table 7-2 show, respectively, the definitions used for assigning levels of the consequences of threats, and definitions used for assigning levels of the likelihood of threats. Tables 7-3 and 7-4 show, respectively, the risk matrix and definitions used in this risk assessment.

A thorough review of existing literature and a cross-disciplinary expert workshop with the Mallee CMA and key stakeholders was undertaken to complete the risk assessment for the project site (Lloyd Environmental, 2014). In summary, the process included:

- identification of values, threats to those values and the significance of these threats
- assessment of the likelihood and consequences of potential impacts for each threat
- identification of mitigation options, and
- assessment of the residual risk after mitigation options were identified.

Further work to consolidate the risk assessment was undertaken as the project developed and incorporated into Table 7-5.

Table 7-1. Definitions used for assigning levels of the consequences of threats

	Level	Description
Consequence	Minor (1)	The effects are limited in extent or duration and do not significantly impact on the site values
	Moderate (2)	The effects are moderate in extent or duration and are in conflict with site values or will have minor impacts on offsite values
	Severe (3)	The event significantly undermines site values or moderately impacts on offsite values
	Catastrophic (4)	The event is in significant conflict with the site values or severely impacts offsite values and will result in a serious deterioration of the system

Table 7-2. Definitions used for assigning levels of the likelihood of threats

	Level	Description
Likelihood	Remote (1)	An event which is not expected to occur but may occur under rare, exceptional circumstances
	Unlikely (2)	An event which is not expected to occur as a result of normal activities but may occur
	Possible (3)	An event which is possible and will occasionally occur as a result of normal activities
	Likely (4)	An event which is expected to occur as part of normal activities
	Certain (5)	An event which is expected to occur as a result of the action

Table 7-3. ISO Risk Matrix

	Consequence			
Likelihood	Minor	Moderate	Severe	Catastrophic
Remote	1	2	3	4
Unlikely	2	4	6	8
Possible	3	6	9	12
Likely	4	8	12	16
Certain	5	10	15	20

Table 7-4. Definitions of the levels of risk

	Scores	Risk	Definitions
Risk	1-2	Very Low	There is no reasonable prospect the project objectives will be affected by the event
	3-4	Low	The event is a low priority for management but risk management measures should be considered
	5-8	Moderate	The risk is a moderate priority for management. Risk management measures should be undertaken.
	9-12	High	The risk is a high priority for management. There is a reasonable likelihood it will occur and will have harmful consequences. Risk management is essential.
	15-20	Very High	The risk is a very high priority for management. It is likely to occur and will have very harmful consequences. Risk management is essential.

7.2. Risk assessment outcomes

A summary of the risk assessment and subsequent work undertaken are presented in Table 7-5, including the mitigation measures developed and an assessment of the residual risk after these are applied. Where a residual risk is given a range of ratings, the highest risk category is listed. It is important to note that the majority of the risks identified in this table exist in both an “existing conditions” or “Basin Plan without works” scenario, but are included because the proposed works provide mitigation opportunities.

Table 7-5. Risk assessment - potential adverse ecological impacts without mitigation and residual risk rating with mitigation, adapted from Lloyd Environmental (2014)

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual risk
Adverse salinity impacts or water quality outcomes						
Low dissolved oxygen (DO) levels	Low dissolved oxygen (DO) concentrations can occur through a variety of processes, including blackwater events, algal and cyanobacterial blooms, high organic matter loadings and stratification. Low DO can cause the death of aquatic fauna and have negative impacts on the health of wetland communities in general. More frequent inundation (i.e. through managed watering events) will reduce the accumulation of organic matter on the floodplain between inundation events.	Likely	Severe	High	Planning phase: • Monitor antecedent floodplain conditions (i.e. organic matter loads) to assess risk of a hypoxic event occurring. • Consider seasonal conditions (e.g. temperature, algae) prior to watering Operations phase: • Commence watering as early as possible to move organic matter off the floodplain while temperatures are low • Maintain through-flow where possible in other areas to maximise exchange rates and movement of organic material. • Monitor DO and water temperature to identify hypoxic areas to inform consequence management (see below). Managing consequences: • Ensure dilution of low DO water by managing outflow rates and river flows • Delay outflows if river flows are too low. • Dispose of hypoxic water by pumping to higher wetlands where possible. • Agitate water using infrastructure to increase aeration.	Moderate
Poor water quality	Water manipulations may lead to suspension of sediments and/or organic matter causing elevated nutrients, high turbidity and/or low dissolved oxygen (DO) levels. This may impact reduce food	Possible	Moderate	Moderate	As above.	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual risk
	sources and possibly toxic algal blooms upon wetland community health, threatened species, fish and other aquatic fauna communities, and waterbird communities (via impacts). The risk assessment for low DO water is presented above.					
Inability to discharge poor quality water	Inability to discharge water of poor water quality during a managed flow event, due to downstream impacts (e.g. increases in instream salinity), could result in impacts on floodplain vegetation (due to extended inundation) or formation of blackwater/algal blooms.	Likely	Severe	High	Schedule watering events to make use of dilution flows where possible. Maintain good relationships with other water managers. Integrate water management with other sites in seasonal water planning process. Where possible and useful, water can be disposed within the site (pump to higher wetlands). Continue to undertake water quality monitoring before, during and after watering events to inform adaptive management strategies and real-time operational decision making.	Low
Development of saline mounds under wetlands and displacement of saline groundwater	An increase in groundwater levels may occur in response to project inundation events. Shallow saline groundwater can impact on the health of floodplain vegetation and wetland communities, both at Wallpolla Island and downstream. Further details on the salinity impact assessment and mitigation strategies for this proposed supply measure is provided in Section 11.4.	Likely	Severe	High	Avoid watering salinity hot spots identified through the use of AEM datasets (Munday et al. 2008), instream NanoTEM (Telfer et al. 2005a and 2005b, 2007) and other salinity investigations. Monitor the salinity of ground and surface water salinity before, during and after watering events to inform management and ensure sufficient volumes are available for mitigation such as: • Diluting saline groundwater discharge with sufficient river flows. • Diluting saline water on the floodplain by delivering more fresh water to these areas. Reduce the frequency and/or extent of planned	Moderate

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual risk
					watering events if sufficient volumes not available.	
The potential to increase pest species						
Increased carp populations	Carp will breed in response to both natural and managed floods. High numbers of carp can threaten the health and diversity of wetland vegetation, affecting native fish and other aquatic fauna. This has potential impacts both within the project site and at the reach scale.	Certain	Severe	Very High	Tailor watering regimes to provide a competitive advantage for native fish over carp. Dry wetlands that contain large numbers of carp. Manage the drawdown phase to provide triggers for native fish to move off the floodplain and, where possible, strand carp.	Moderate
Proliferation of pest plants	Pest plants may be promoted under certain water regimes, potentially impacting the health of all wetland and floodplain vegetation communities. This, in turn, will impact on dependent fauna, including threatened species.	Certain	Severe	Very High	Time water manipulations to drown seedlings, minimise growth, germination and seed set. Time water manipulations to promote native species. Control current populations and eradicate/control new infestations via existing management strategies (e.g. Parks Victoria pest management action plans/strategies). Support partner agencies to seek further funding for targeted weed control programs if necessary.	Low
Increase in pest animals	The reinstatement of more frequent flooding regimes is likely to provide and maintain more favourable conditions for many terrestrial animal pests. In particular, pigs are swamp dwellers and their impacts on watered areas may be more severe than other species.	Likely	Severe	High	Control pest animal populations via existing management strategies (e.g. Parks Victoria pest management action plans/strategies). Support partner agencies to seek further funding for targeted control programs if necessary.	Moderate

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual risk
Transport or proliferation of invasive weeds due to construction activity	Proliferation of weeds will have impacts on the health of all wetland and floodplain vegetation communities. This, in turn, will impact on dependent fauna, including threatened species.	Likely	Moderate	Moderate	Develop and adhere to an Environmental Management Plan (EMP) that includes hygiene protocols, enforcement and contractor management.	Low
The potential to favour certain species to the detriment of others or to adversely affect certain species						
Permanent habitat removal or disturbance during construction	Construction of the proposed works will cause disturbance to the floodplain and require the permanent removal of some vegetation/habitat.	Certain	Moderate to Severe	High to Very High	Utilise existing access tracks wherever possible. Design and locate infrastructure/works to avoid and minimise the extent of clearing and disturbance. Ensure clear on-site delineation of construction zones and adequate supervision during works to avoid unauthorized clearance/disturbance.	Moderate
Temporary habitat removal or disturbance during construction	Construction of the proposed works will cause disturbance to the floodplain and require the temporary removal of some vegetation/habitat.	Certain	Moderate	Moderate to Very High	As above. Remediate/revegetate the site once construction activities are complete.	Moderate
Invasion of river red gum in watercourses and open wetlands	Germination of dense thickets of river red gum within watercourses and wetlands, and at the edge of the Mid-Wallpolla Regulator pool may block flow through the system. Obstruction of flows can diminish the effectiveness of future watering events. Prolific germination of seedlings within wetlands will change the habitat structure and the suite of dependent biota.	Certain	Moderate	High	Use of operational strategies to control unwanted germination and establishment, including: • Drowning seedlings. • Timing the recession to avoid optimal conditions for germination in targeted areas (if feasible). Targeted removal of seedling/saplings to remove flow obstructions, if necessary.	Low
Adverse impacts on ecological function and connectivity						

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual risk
Episodic reduction in hydrodynamic diversity	Installation of regulators within waterways will affect flows and create lentic zones in regulator pools when in operation. This may reduce the extent and variety of aquatic habitat, and change the structure and diversity of wetland and floodplain vegetation communities. In particular, regulator operation is likely to reduce or eliminate fast-flowing habitat that is particularly important for some fish species, including Murray cod.	Likely	Severe	High	Design structures to minimize waterway obstruction and provide through-flow during operations. Develop operational protocols to maintain hydraulic diversity. Assess the response of species of concern during and after managed watering events and adjust operational arrangements if required.	Moderate
Increase in fire frequency, extent and intensity	The reinstatement of more frequent flooding regimes threat will increase the biomass of floodplain vegetation, increasing the fuel load for bushfires. An increase in the frequency, extent and duration of bushfire could have impacts on ecosystem form and function.	Possible	Moderate	Moderate	No specific mitigating actions have been identified. If a bushfire occurs on Wallpolla Island, Parks Victoria and DEPI will respond as usual in such situations.	Moderate
Managed inundation regimes do not match flow requirements for key species	The delivery of an inappropriate water regime may occur through inadequate knowledge of biotic requirements or conflicting requirements of particular species with broader ecological communities. This may lead to adverse ecological outcomes, e.g. failure of waterbird breeding events, lack of spawning response in fish, spawning response but no recruitment.	Possible	Moderate	Moderate	Consider the various requirements of key species/communities when developing operating strategies and planning for watering events. Assess the response of species of concern during and after managed watering events and adjust operational arrangements if required. Update operating strategies to capture new information on the water requirements/ response of key species/communities. Target different taxa at different times (e.g. target vegetation one year and fish the next).	Low
Mismatch between vegetation requirements and internal regulator	Vegetation in the deepest part of the Mid-Wallpolla Weir pool may receive excessive inundation (duration and depth) if the inundation requirements of vegetation at the perimeter of the	Possible	Moderate	Moderate	Ensure through-flow when operating structures (including consideration of raising the upstream head via Lock 9) to more closely replicate a more natural hydraulic gradient.	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual risk
pool operation	pool are met. This is likely to cause localised impacts on vegetation health and possible death of less tolerant species.				Incorporate information on operations, potential impacts and tolerance of inundation regimes and the role of natural floods in ecosystem function into operational plans to minimise the impact.	
Inadequate water regime delivered	An inadequate water regime could be delivered through: • Design and construction issues • Invalid modelling assumptions and/or flow measurement • Inadequate or incorrect information regarding water requirements and/or system condition; • Errors in planning and calculation of the volumes required, or • An inadequate volume allocated to the event. This could result in adverse ecological impacts such as drought-stress of vegetation, loss of habitat and limited breeding opportunities for fauna.	Unlikely	Severe	Moderate	Confirm the validity of modelling assumptions during operations to inform future planning and refine the operating arrangements. Design structures for maximum operational flexibility. Ensure adequate measures are in place to measure inflows/outflows. Assess ecosystem response during and after managed watering events and adjust operational arrangements if required. Maintain strong working relationships with river operators, partner agencies and water holders to facilitate timely issue resolution (e.g. allocation of additional water if required).	Low
Stranding and isolation of fish on floodplains	Stranding can occur through sudden changes in water levels and/or new barriers preventing native fish from escaping drying areas during flood recessions. This may result in the death of a portion of the native fish population.	Possible	Moderate	Moderate	Develop a 'Fish Exit Strategy' to inform regulator operation during the drawdown phase to maintain fish passage for as long as possible and to provide cues for fish to move off the floodplain. Monitor fish movement and adapt operations as required. Continue to build on knowledge and understanding through current studies relating to fish movement in response to environmental watering and cues.	Low
Barriers to fish and other aquatic fauna movement	Installation of regulators in waterways and wetlands creates barriers to the movement of fish and other aquatic fauna. This can reduce access to feeding and breeding habitat, and limit migration	Possible	Moderate	Moderate	Determine fish passage requirements and incorporate into regulator design (as in Hames, 2014). Continue to build on knowledge and understanding through current studies relating to	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual risk
	or spawning opportunities.				fish movement in response to environmental watering and cues.	

7.3. Consideration of significant, threatened or listed species

Throughout project development, significant consideration has been given to the potential impact on significant, threatened or listed species that occur at Wallpolla Island (see Section 4). Overall, the project is expected to benefit these species by increasing the frequency, duration and extent of floods of various sizes (see Section 6). However, construction activities will involve physical disturbance to the floodplain and some vegetation clearance is unavoidable. This will result in temporary and permanent vegetation removal and habitat disturbance (see Table 7-5).

In order to minimise the potential impacts on threatened species, detailed vegetation assessments and further assessment of the impacts on all threatened species will be carried out during the detailed design process, to inform final construction footprints and the development of mitigation measures, where necessary. To date, preliminary locations for infrastructure and works have been chosen to minimise vegetation loss. New access tracks and upgrades of existing tracks will be designed to minimise clearance of large trees and understorey vegetation.

Any losses of native vegetation will be offset in line with current state policy. A program-level approach to offsetting is currently being developed, where the primary offsetting mechanism will be the gains in vegetation condition within the areas watered by the various Victorian works-based supply measures. An assessment of vegetation offset requirements based on preliminary construction footprints indicates that the offsets for this proposed supply measure can be met using this approach.

If funded for construction, this proposed supply measure will be referred under the EPBC Act and Victorian EE Act. Measures to avoid and minimise impacts to threatened species will be a key component of the referrals. Such measures will be consolidated in relevant management plans such as a Construction Environment Management Plan (CEMP) and a Threatened Species Management Plan (TSMP).

Operation of the proposed supply measure could also have adverse impacts on threatened species. The waterways and wetlands of Wallpolla island support significant native fish populations. The protection and, where possible, the enhancement of these populations has been a primary consideration during the development of designs and operational scenarios for the proposed works.

Designs have allowed for passive fish passage through minor structures and have also included provision of a dedicated vertical slot fishway at the Structure 1 regulator which itself was located upstream of Dedmans Creek which provides permanent flow into the lower reaches of Wallpolla Creek to minimise disruption to fish passage. These design considerations will allow passage for both small and large bodied fish, for a range of operational scenarios. Additionally, all structures have been designed to present no impediment to fish passage in waterways when not in use.

The hydraulic model developed during preparation of the business case will be used to further inform operational plans by ensuring that hydraulic conditions appropriate for fish are maintained during each phase of operation of the works. This approach will mirror that already in place for the recently commissioned Chowilla Floodplain Living Murray works, where fish ecologists have worked in conjunction with hydraulic modellers to develop appropriate operational scenarios.

Monitoring of the response of threatened species to operation (e.g. population abundance, structure and distribution) and the effectiveness of mitigating actions will be critical to inform the planning and management of watering events.

7.4. Risk mitigation and controls

The risk assessment confirms that all identified risks are reduced to acceptable levels (very low to moderate) once well-established risk mitigation controls are implemented. While there are several potential threats could generate high risks to ecological functionality (Table 7-3), these are considered manageable because they:

- are well known and are unlikely to involve new or unknown challenges
- can be mitigated through well-established management controls
- have been successfully managed by the Mallee CMA and project partners (including construction authorities) in previous projects, and
- result in very low or moderate residual risks after standard mitigation measures are implemented.

As noted in Lloyd Environmental (2014), characterisation of the residual risk must be read within the context of the works creating a substantial improvement in the ecological condition of the site. The improvement will have a very significant role in mitigating many of the impacts. However, these improvements will take time to be realised and therefore the impacts may seem more significant in the short term.

Eight threats retained a residual risk of moderate after implementation of the recommended mitigation strategies (Table 7-6). Further consideration of these threats may assist in further understanding the potential impacts and, in some cases, identifying additional mitigation measures to reduce the residual risk.

7.5. Risk management strategy

A comprehensive risk management strategy will be developed for the proposed supply measure, building on the work completed for this business case. The strategy will cover ecological and socio-economic aspects to provide a structured and coherent approach to risk management for the life of this project (i.e. construction and operation). The strategy will include review processes and timetables for risk assessments, based on new developments or actions taken, and will assign responsible owner/s to individual risks. This will be an important input into the development of operating arrangements for the site.

The risk management strategy will include mitigating measures to address the following potential ecological impacts, as described in Table 7-5:

- adverse salinity impacts or water quality outcomes either at the site or downstream
- the potential to increase pest species
- the potential to favour certain species to the detriment of others or to adversely affect certain species, and
- adverse impacts on ecological function and connectivity.

Risk assessment and management is not a static process. Regular monitoring and review of the risk management process is essential to ensure that:

- mitigation measures are effective and efficient in both design and operation
- further information is obtained to improve the risk assessment
- lessons are learnt from events (including near-misses), changes, trends, successes and failures
- risk treatments and priorities are revised in light of changes in the external and internal context, including changes to risk criteria and the risk itself, and
- emerging risks are identified.

The risk assessment process will continue throughout the development and implementation of this project. It is anticipated that additional threats will be identified and evaluated as the project progresses, and any new risks incorporated into the risk management strategy.

Table 7-6. High priority risks, mitigation and residual risk

Threat	Risk without mitigation	Residual Risk Rating	Additional considerations (Lloyd Environmental, 2014)	Guiding documents[2]
Enhancing carp recruitment conditions	Very High	Moderate	Additional targeted carp fishdowns, water level manipulations to disrupt the survival of juveniles and the installation of carp cages may all help reduce carp numbers. In addition, future research on carp control may identify new control measures.	*Wallpolla Island Floodplain Management Project* Operating Plan (Preliminary) *Fish exit strategy*
Permanent habitat removal or disturbance during construction	High to Very High	Moderate	The risk assessment for these threats will be revised once construction footprints are finalised and detailed vegetation assessments are carried out. If significant species or EVCs are found to be at or close to the site and could be impacted, further actions to reduce the residual risk would include targeted management actions and/or vegetation offsets for the relevant biota.	Basin Plan Environmental Works Program: Regulatory Approvals Strategy (GHD, 2014) Statutory Approval Requirements (Golsworthy, 2014). *Environmental Management Framework* *Construction Environmental Management Plan* *Offset Strategy* *Threatened Species Management Plan*
Temporary habitat removal or disturbance during construction	Moderate to Very High	Moderate		
Hypoxic blackwater events resulting from watering actions	High	Moderate	The risk assessment has assumed that more frequent inundation will result in more frequent blackwater events than occur currently, and that these events will be of similar magnitude. It is, however, possible that more frequent events may be less intense as tannins and organic material are thought to reduce in subsequent watering events. This is a knowledge gap that could be addressed through ongoing studies.	Assessing the Risk of Hypoxic Blackwater Generation at Proposed SDL Offset Project Sites on the Lower River Murray Floodplain (Ning et al., 2014) *Wallpolla Island Floodplain Management Project* Operating Plan (Preliminary)
Development of saline mounds under wetlands and displacement of saline groundwater.	High	Moderate	Implementation of comprehensive monitoring, including additional groundwater monitoring bores, will inform a more detailed analysis of local and downstream salinity impacts. This information should feed into a larger scale investigation covering river operations and environmental watering activities taking place between Lock 9 and Lock 5.	Salinity impact assessment (Preliminary) *Wallpolla Island Floodplain Management Project* Operating Plan (Preliminary)

[2] Documents in italics are yet to be developed

Threat	Risk without mitigation	Residual Risk Rating	Additional considerations (Lloyd Environmental, 2014)	Guiding documents[2]
Increase in pest animals	High	Moderate	More intensive culling programs may be needed. Further research into alternative control measures may provide additional control options.	*Wallpolla Island Floodplain Management Project* Operating Plan (Preliminary)
Episodic reduction in hydrodynamic diversity	High	Moderate	There remains a knowledge gap in terms of the flora and fauna that may be affected by this threat and this is reflected in the moderate residual risk. Eliminating this knowledge gap may reduce the risk to low or very low. Work is continuing to address this knowledge gap across Lindsay and Wallpolla Islands, particular in relation to the impacts on Murray cod and other native fish. Learnings taken from the operation of the Chowilla Floodplain infrastructure and weir pool manipulations undertaken at Locks 8 and 9 will inform operational arrangements. Targeted management plans and/or offsets may also reduce the level of risk.	*Wallpolla Island Floodplain Management Project* Operating Plan (Preliminary) Modelling management scenarios for Murray Cod populations in the Mullaroo Creek (Todd et al., 2007) Observations of the movement of Murray Cod under varying flow conditions within Mullaroo Creek (Saddlier et al., 2009) Fish requirements for the proposed Upper Lindsay Watercourse Enhancement Project (Mallen-Cooper et al., 2010) Lindsay Island Fish Requirements (Lloyd Environmental, 2012)
Increase in fire frequency, extent and intensity	Moderate	Moderate	Unavoidable risk that accompanies a project designed to promote growth of native vegetation in the region.	Mallee Fire Operations Plan (DEPI, 2013)

8. Current hydrology and proposed changes (Section 4.5.1)

8.1. Pre-regulation river hydrology

Wallpolla Island is located approximately 3km downstream of the Darling River confluence with the River Murray. The River Murray flows are influenced by the Murray, Murrumbidgee, Wakool and Goulburn tributaries and are typically highest from late winter to early summer. The Darling River, which drains the northern basin, is often influenced by sub-tropical weather systems that generate large flows in summer. Wallpolla Island experiences its largest inundation events when both the Darling and Murray systems are in flood (Ecological Associates, 2014).

The network of waterways, wetlands and floodplain on Wallpolla Island support a hydraulically diverse landscape that would have experienced inundation to varying degrees in almost every year. Wallpolla Island predominantly received inflows in spring and autumn associated with peak flow in the River Murray and Darling River.

Prior to regulation River Murray flow events of 80,000 ML/d were a regular occurrence at Wallpolla Island, with a median frequency of 4.4 events in 10 years. The period between successive 80,000 ML/d flow events was also frequent, with a mean interval of 1.7 years (Gippel, 2014).

For comparative purposes throughout Section 8 the mean frequency and median interval for an 80,000 ML/d flow event will be discussed for a range of scenarios.

8.2. Current floodplain hydrology

Wallpolla Island is located within an intensely regulated reach of the River Murray, situated between Lock 9 and Lock 10 and adjacent to the Lake Victoria inlet (Frenchman's Creek). These regulation structures strongly influence the current hydrology of Wallpolla Island.

The downstream end of Wallpolla Creek, approximately 25 km upstream of Lock 9, is significantly influenced by the Lock 9 weir pool, with the effect that water ponds in the channels in the west of the island, particularly affecting the western parts of Wallpolla Creek and a number of waterways and wetlands (Ecological Associates, 2014a).

Lake Victoria is a major balancing storage and lies on the New South Wales (NSW) side of the River Murray. The lake stores water diverted from the River Murray above Lock 9 and releases water to the river just downstream of Lock 7.

The upstream connections of watercourses in the east of the island start to become active at River Murray flows exceeding 3,000 ML/d, but significant anabranch flow requires higher levels. Finnigans Creek becomes active at flows exceeding 8,000 ML/d and Sandy Creek flows when river discharge exceeds 33,000 ML/d. The upstream connection of Wallpolla Creek becomes active when river discharge exceeds 70,000 ML/d (Ecology Associates, 2014). Floodwater is largely confined within the wetlands and deeply incised channels until river flows exceed 70,000 ML/d at which point water spills into black box woodlands and lignum shrublands. Widespread floodplain inundation occurs at flows exceeding 90,000 ML/d (Ecology Associates, 2014).

The River Murray flow at Wallpolla Island has been altered significantly by storages, regulation and diversions on both the Murray and Darling Rivers (Ecological Associates, 2014a). These practices have reduced the occurrence of high flows and created extended periods of low flows, delayed the onset of inundation and reduced the frequency and duration of inundation (Ecological Associates, 2007). Further, it has resulted in a significant change to winter and spring flows as these flows are now captured in upstream storages and gradually released over summer, resulting in a relative continuous flow year round. This is illustrated in Figure 8.1.

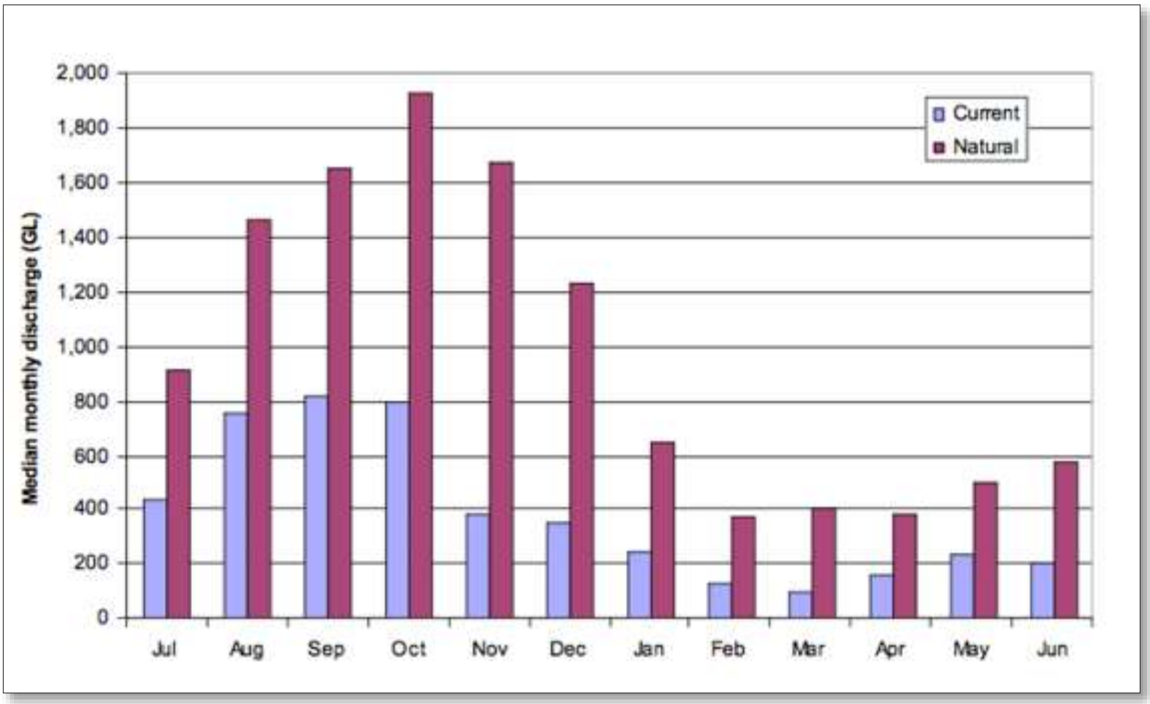


Figure 8-1. Comparison of the natural (unregulated) and current median monthly discharge at Lock 10 (Ecological Associates, 2007)

Regulation has significantly altered the frequency and recurrence interval of 80,000 ML/d flow events at Wallpolla Island. The mean frequency of these flows has declined to as much as 31% of natural, (to 1.4 events in 10 years). This has caused a 150% increase in the interval between these flow events, resulting in a median recurrence interval of 4.2 years (Gippel, 2014).

Spells analysis of river modelling outputs (Figure 8-2) shows that, compared to natural conditions:

- The River Murray now experiences more time at very low flows, less than 10,000 ML/d.
- Events that inundate low-lying wetlands, between 40,000 and 60,000 ML/d, now occur at approximately half the frequency of natural conditions. The duration of these events, when they do occur, has also been reduced by approximately 50%.
- The frequency of events that inundate black box areas has declined to 20% of natural.
- The spell timing (represented by start day) was shifted forward by around one month for spells with threshold lower than 70,000 ML/d.

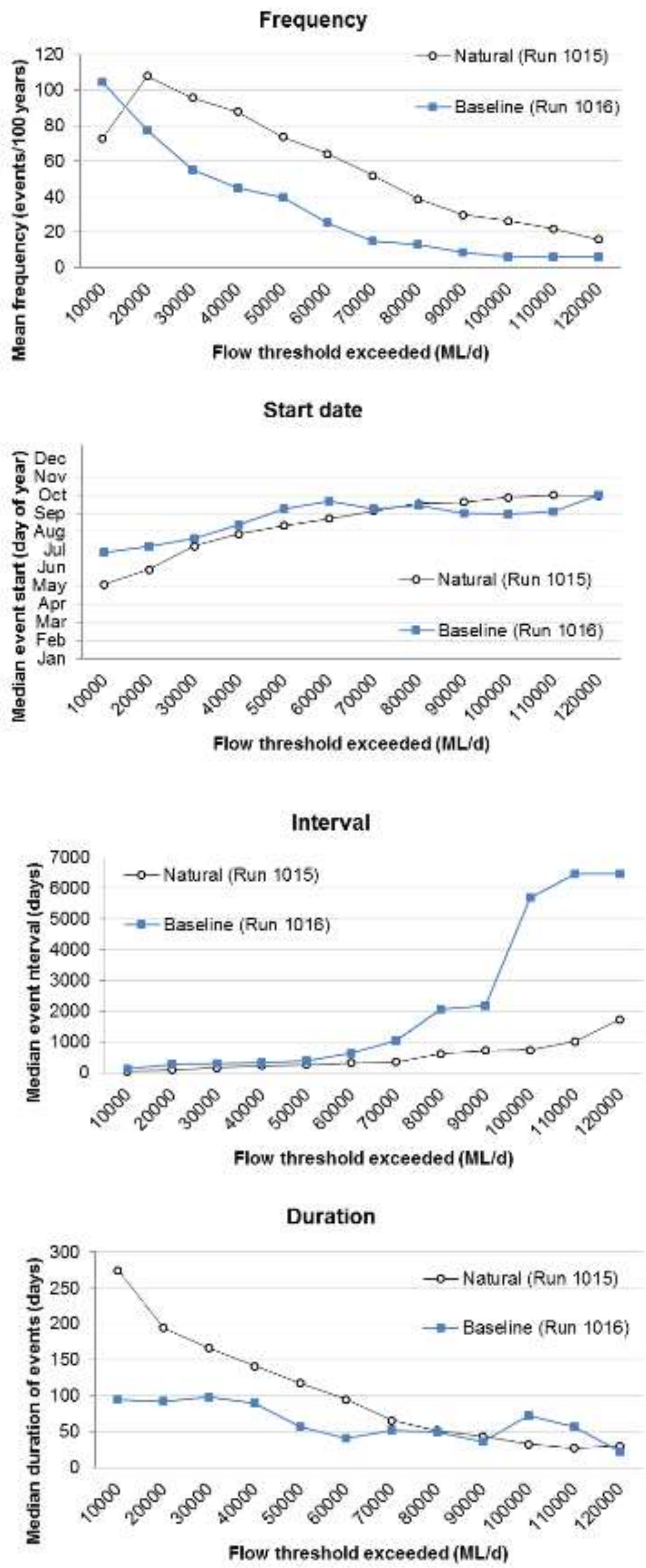
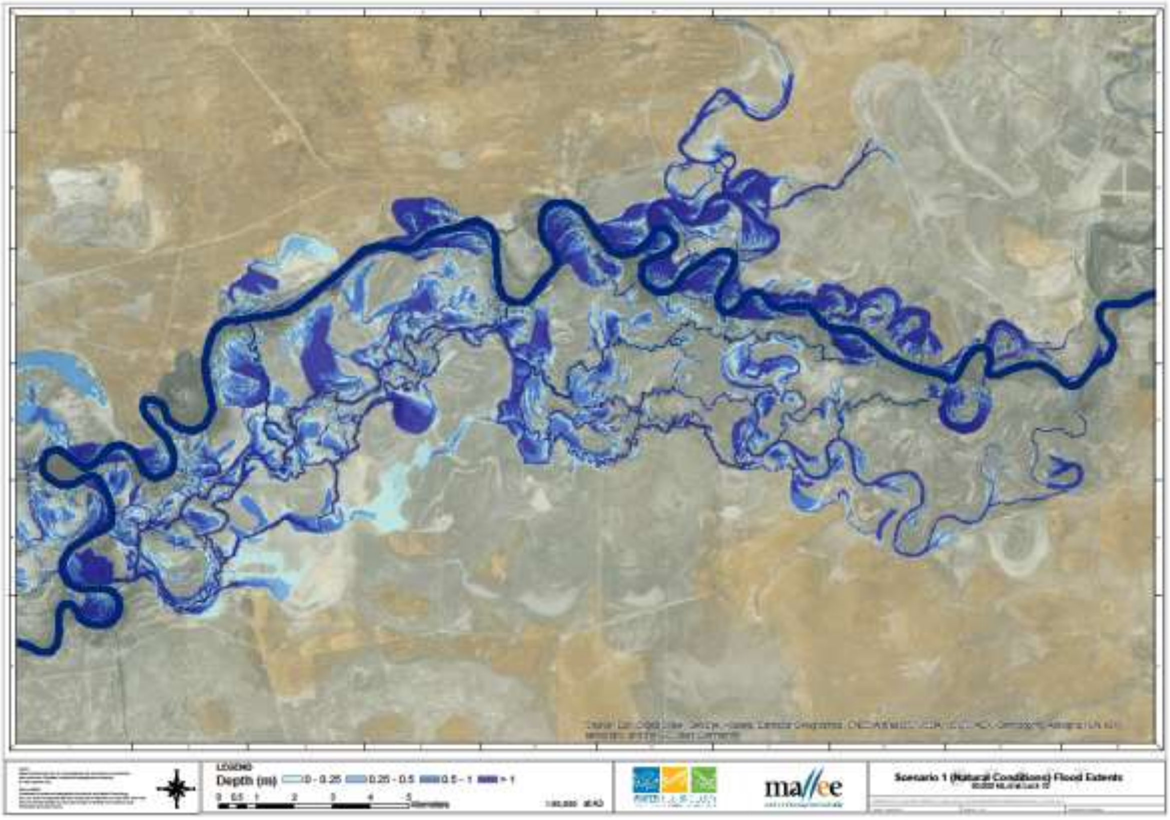


Figure 8-2. Comparison of statistical properties of events at Lock 9 upstream under Natural and Baseline modelled flow scenarios, over a 114 year modelled period (Gippel, 2014)

A complex of waterway, wetland and floodplain environments are connected to the River Murray at a variety of river flows. Hydraulic modelling of Wallpolla Island under current condition shows that there is connection of the waterways at 60,000 ML/d, with the floodplain engaging at 90,000 ML/d, with more widespread floodplain inundation at 110,000 ML/d (Figure 8-2). These hydraulic modelling outputs were derived from steady state conditions, which may not reflect operational River Murray hydrographs and, as such, may result in lower inundation areas.

Figure 8-2a. Wallpolla Island floodplain inundation at flows of 60,000 ML/d (Water Technology, 2014)



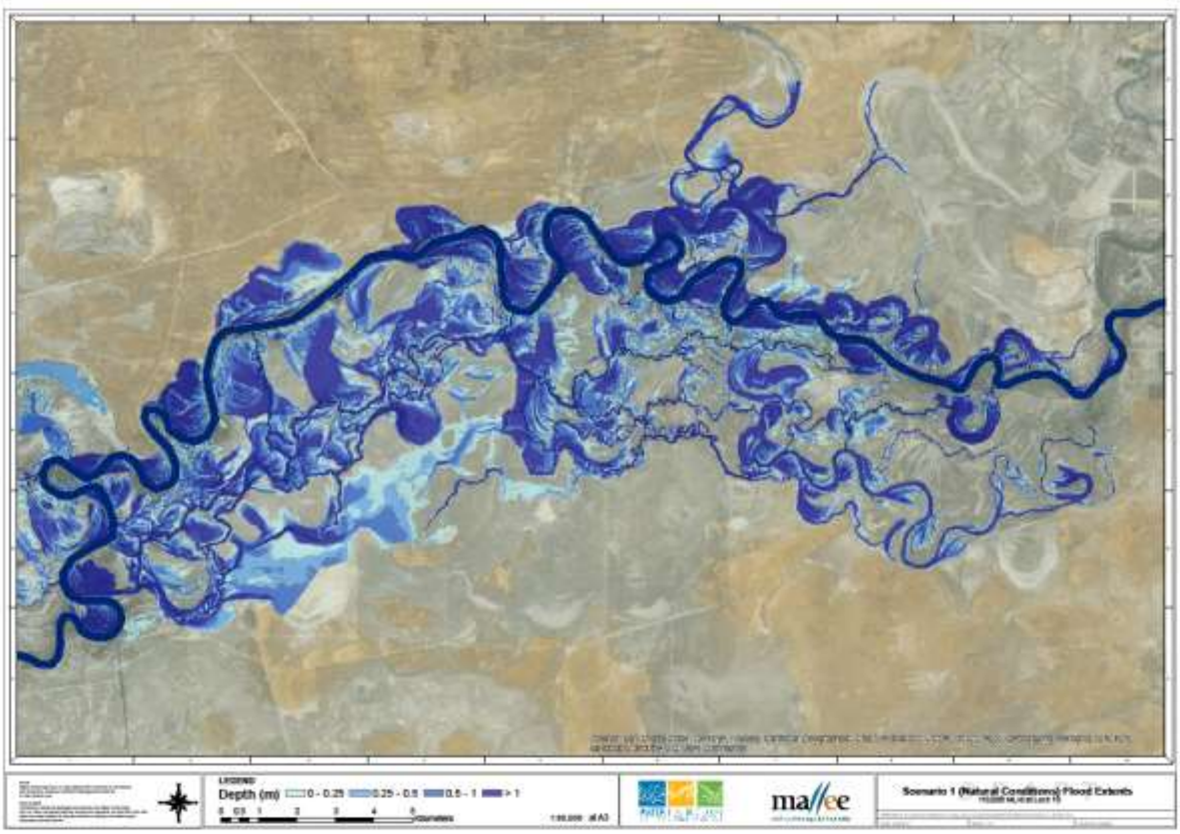


Figure 8-2b. Wallpolla Island floodplain inundation at flows of 90,000 and 110,000 ML/d (Water Technology, 2014)

8.3. Proposed Changes

Basin Plan flow will contribute toward bridging the gap between natural and baseline conditions as shown in the spells analysis (Figure 8-4) and Table 8-1. Note: Basin Plan 2750 model run number 983 has been used as the basis of this analysis.

The Basin Plan will primarily affect flows less than that required for floodplain watering at Wallpolla Island (Table 8-1). For example flows of 40 000 ML/d will occur 4.5 times in 10 years under baseline, 5.6 times under Basin Plan and 8.7 naturally. By comparison flows of 80 000 ML/d will occur 1.3 times in 10 years under baseline, 1.3 times under Basin Plan and 3.9 naturally..

The proposed measure may be used to provide equivalent inundation on Wallpolla Island to that of an 80,000 ML/d flow event. Targeted operation of the works in junction with Basin Plan flows will enable mean frequency of inundation equivalent to an 80,000 ML/d flow event to be restored. The mean frequency of inundation will increase from 1.3 to 3.5 events in 10 years. This will improve the interval between flow events, by reducing the median interval period from 5.7 to 1.9 years (Table 8-1).

In order to further demonstrate the differences in the scenarios described in Table 8-1, hydrographs of the flow regimes are illustrated in Figure 8-5. The flow regimes represent a wetter than average sequence of years (1990s) and an extremely dry sequence of years (2000s).

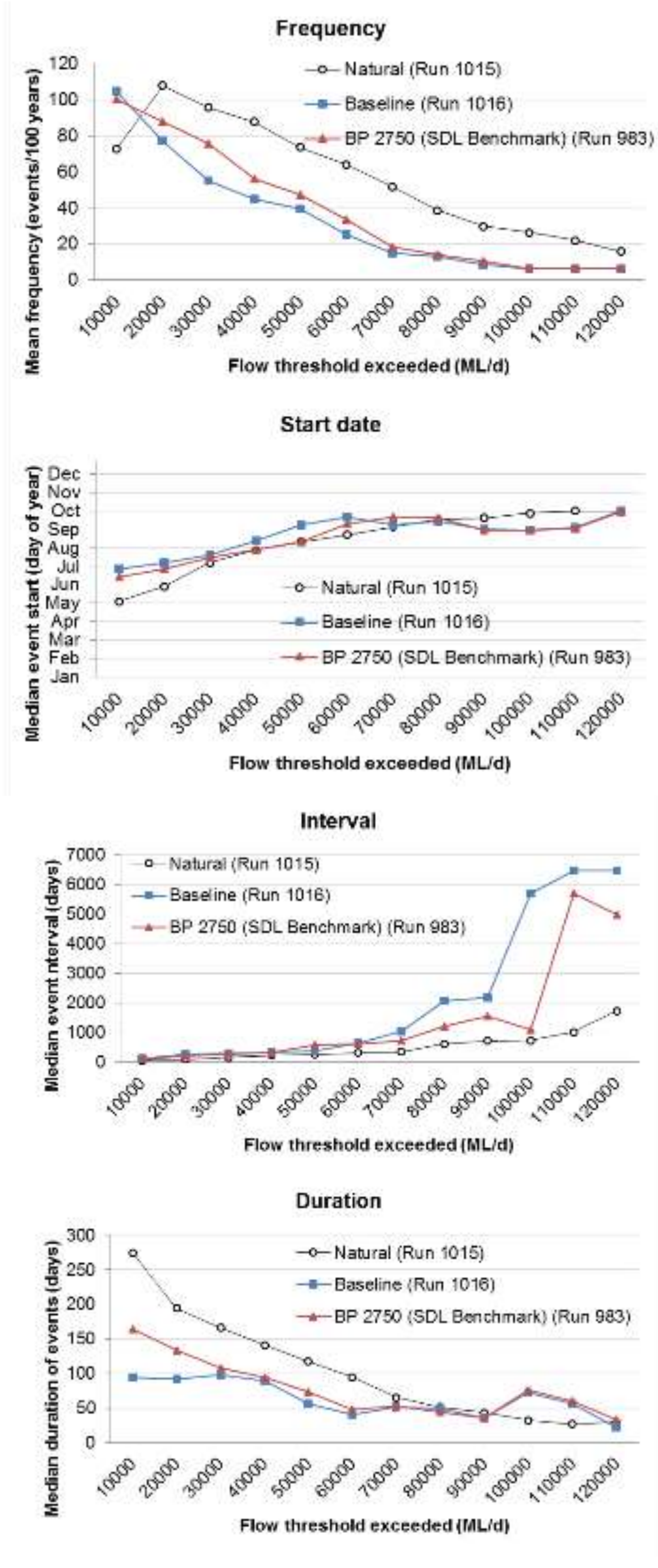


Figure 8-4. Comparison of statistical properties of events at Lock 9 upstream under the Natural, Baseline and BP 2750 modelled flow scenarios, over a 114 year modelled period.

Figure 8-1: Comparison of water regimes provided by natural, baseline, Basin Plan and the Wallpolla Island measure; Natural, Baseline and Basin Plan flows from Gippel, 2014

Threshold (ML/d)	Water Regime Class	Scenario[3]	Prevalence (yrs with event, %)	Median duration (days)	Timing	Proposed operations to meet gap	
						Frequency (event/ 100 years)	Duration
40,000	Semi-permanent Wetlands	With measure	50	120	Early to mid-winter	4	4 months
		Basin Plan flow without measure	54	94	Early to mid-winter	May be operated in additional years to extend the duration of BP inflows	
60,000	Temporary Wetlands	With measure	60	90	Late winter-early spring	24	3 months
		Basin Plan flow without measure	36	48	Late winter-early spring	36	1 – 2 months
30,000	Watercourses	With measure	95	150	Late winter	20	5 months
		Basin Plan flow without measure	74	108	Late winter	Operated in additional years to extend the duration of BP inflows	
80,000	Red Gum Forest and Woodland	With measure	35	50	Late winter-early spring	Flow requirements largely met by BP flows. Some events to extend the duration of flows may be implemented.	
		Basin Plan flow without measure	31	44	Late winter-early spring		
80,000	Lignum Shrubland and Woodland	With measure	35	50	Late winter-early spring	Flow requirements largely met by BP flows. Some events to extend the duration of flows may be implemented.	
		Basin Plan flow without measure	31	44	Early spring		
100,000	Black Box Woodland	With measure	25	42	Mid to late winter	20	6 weeks
		Basin Plan flow without measure	5	77	Late winter to early spring	May be operated in additional years to extend the duration of BP inflows	
120,000	Alluvial Plain	With measure	15	30	Late winter to early spring	10	4 – 5 weeks
		Basin Plan flow without measure	5	34	Early spring		

[3] 'with measure' figures based upon interpretation of the preliminary operations plan adapted from (Ecological Associates, 2014a)

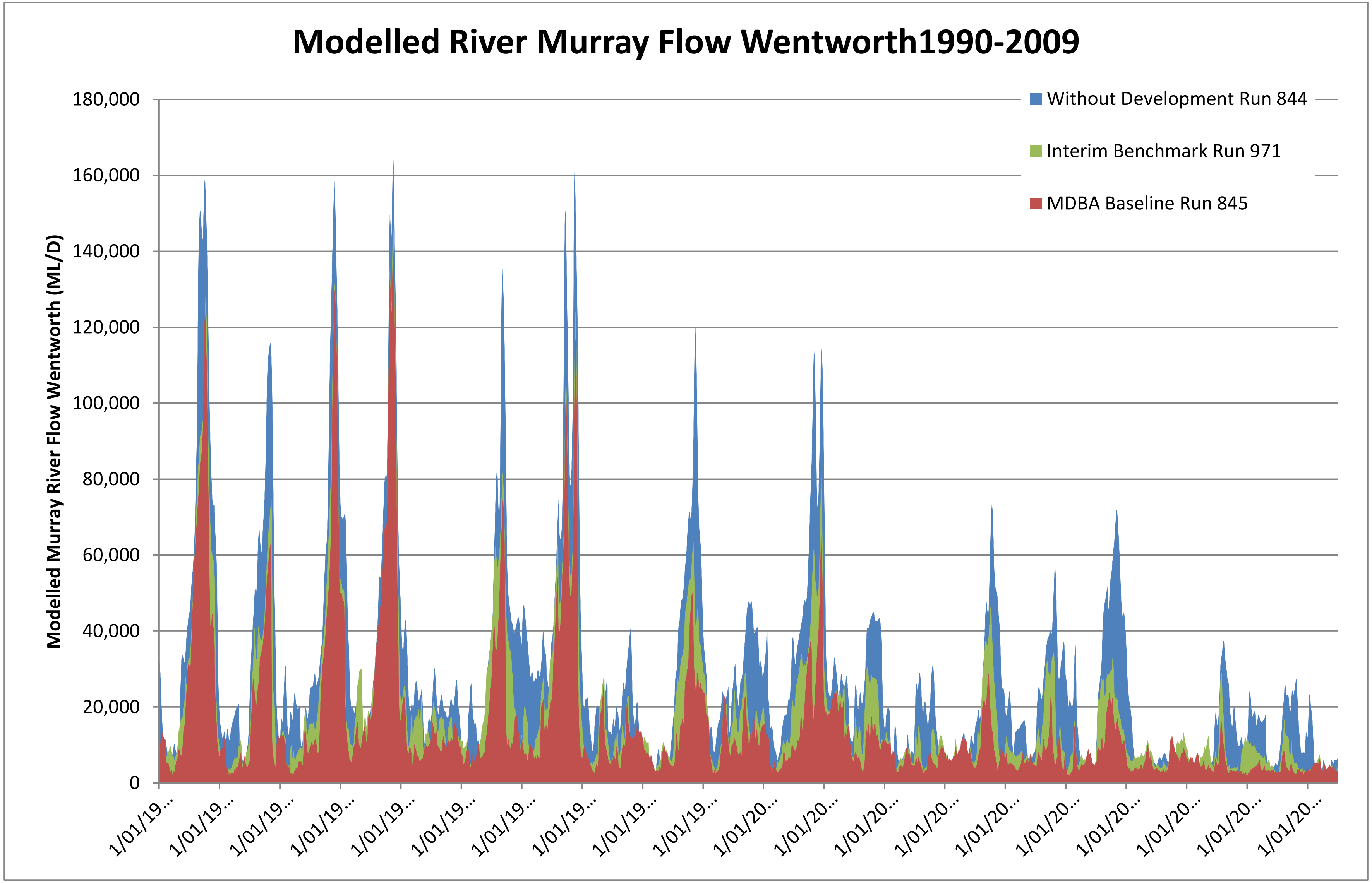


Figure 8-3. Daily Peak Flow by year for different flow regimes at Lock 10 (Data supplied Mallee CMA, 2014)

9. Environmental water requirements (Section 4.5.2)

The environmental water requirements of the *Wallpolla Island Floodplain Management Project* have been identified and contribute to the achievement of ecological objectives and targets for this site (Ecological Associates, 2014a).

The process for identifying the environmental water requirements for this site built on the work undertaken in establishing ecological objectives. Detailed hydrographic information, spatial data and scientific literature relating to the site was analysed and compared against ecological objectives, which was then combined to generate site-specific environmental water requirements (Ecological Associates, 2014a).

A key environmental outcome of this project is to maintain productivity and structure of black box woodlands, which require inundation three years in ten for two to six weeks, with a maximum period between events of seven years. Inundation of this extent requires passing flows of approximately 100,000 ML/d, for an extended period, to reach black box areas, which occurs less-often under the current hydrologic regime.

Environmental benefits for black box can be achieved using the proposed environmental works, as they are able to deliver water to these areas, at times when high river flows are not available.

Ecological objectives and targets, and their corresponding environmental water requirements, are outlined in Table 9-1.

Mechanisms to deliver these environmental water requirements are detailed in Section 10.

Table 9-1. Environmental water requirements and ecological objectives (Ecological Associates, 2014a)

Water Regime Class	Flow threshold	Ecological objective	Frequency	Duration	Timing
Semi-permanent Wetlands	40,000	Protect and restore semi-permanent inundation to deep, low-lying wetlands Restore hydraulic connections to riverine habitats	>8 years in 10	Variable (depending upon depth of filling)	Early to mid-winter
Temporary Wetlands	60,000	Protect and restore intermittent inundation of floodplain wetlands	Variable; 3-9 years in 10	Variable (depending upon depth of filling)	Late winter-early spring
Watercourses	30,000	Introduce seasonal variation in anabranch water levels	Watercourses to receive water in 95% of years.	2 – 6 months	June - November
Red Gum Forest and Woodland	80,000	Protect and restore the inundation of River Red Gum forest and woodland	>70,000 ML/d: 6 years in 10	4 -10 weeks	Commence between September and December
			> 85,000 ML/d, 5 years in 10	3 - 6 weeks	
Lignum Shrubland and Woodland	80,000	Protect and restore inundation to lignum shrublands	70,000 ML/d, 6 years in 10:	4 – 10 weeks	Late winter – early spring
			85,000 ML/d, 5 years in 10	3 - 6 weeks	
Black Box Woodland	100,000	Protect and restore inundation to black box woodland	3 years in 10 Maximum period between events is 7 years	2 - 6 weeks	Late winter – early spring
Alluvial Plain	120,000	Protect and restore inundation to alluvial plains. Highest priority years are during major waterbird breeding events.	1 year in 10 No more than 3 years in 10	3 weeks	Summer

10. Operating regime (Section 4.6)

10.1. Role of the structures

The Wallpolla Island Floodplain works consist of two main regulators and a range of supporting structures. These structures will be operated in conjunction with Basin Plan flow or temporary pumping to deliver water to Wallpolla Island.

These works and the existing infrastructure are described in Table 10-1. The volumes in Table 10-1 were derived from scenario modelling to determine the extent of flooding, and depth/area relationships with stage height for each of the regulators. The volumes therefore refer to void space and assumes no losses or return flows. This information, together with the proposed operating regime, will enable the MDBA to model return flows for the full range of operational scenarios during the assessment process.

Table 10-2. Summary of existing and proposed environmental watering infrastructure for Wallpolla Island and its role in the project

Infrastructure	Existing or proposed	Role	Inundation Area (ha)	Volume (GL)
Mid Wallpolla area (Structure 1 and supporting structures)	Proposed	Provides inundation of Mid Wallpolla area in conjunction with Basin Plan flows or temporary pumps	864	7.7
Upper Wallpolla (Structure 4 and supporting structures)	Proposed	Provides inundation of Upper Wallpolla area in conjunction with Basin Plan flows or temporary pumps	1072	17.3
Wallpolla South	Proposed	To allow temporary pumping to inundate private land south of Wallpolla Island	715	0.9
Horseshoe Lagoon	Existing	To allow management of water regime of Horseshoe Lagoon	25	0.3

10.2. Operating scenarios

The *Wallpolla Island Floodplain Management Project* works have been designed to provide maximum operational flexibility and be used to complement Basin Plan flows to deliver the environmental benefits. Six scenarios have been developed in order to summarise the range of scenarios possible. These include:

- Default
- Seasonal Fresh
- Mid Wallpolla Maximum
- Mid and Upper Wallpolla Maximum
- Mid and Upper Wallpolla Maximum and pumping
- Natural Inundation

Each of the scenarios align with the water regime classes for Wallpolla Island, as illustrated in

Table 10-2. This table shows that a seasonal fresh meets the water requirements of the Watercourses WRC, while the Mid Wallpolla Maximum scenario would meet the requirements of Watercourses, Semi-permanent Wetlands and Temporary Wetlands. The Upper Wallpolla Maximum scenario meets the water requirements of Red Gum Swamp Forest and Lignum Shrubland. Temporary pumping can be used to target Black Box Woodland and, occasionally, Alluvial Plain.

Table 10-2: Links between the operating scenarios and water regime classes at Wallpolla Island

Scenario	Equivalent flow threshold and water regime class			
	Up to 40,000 ML/d	60,000 ML/d	Up to 80,000 ML/d	>100,000 ML/d
Seasonal fresh				
Mid Wallpolla Maximum				
Mid and Upper Wallpolla Maximum				
Mid and Upper Wallpolla Maximum, and pumping				

An overview of each of the operational scenarios is provided below.

Default

This scenario is the default configuration for Wallpolla Island water management structures, in normal regulated flows when environmental watering is not required.

All structures are open in this scenario.

Seasonal Fresh

The seasonal fresh scenario targets in-channel flows and is achieved via opening all structures to allow water to flow through Finnigans and Wallpolla Creek during Basin Plan flows.

Mid Wallpolla Maximum

The Structure 1 (Dedmans Creek regulator) and associated support structures will be operated to their maximum operational height to enable broad scale inundation of Mid Wallpolla. Where appropriate passing flow downstream of Structure 1 would be provided, in addition to flows passing through the fishway.

Delivery to this site will take advantage of high river flows and potentially be augmented through use of temporary pumps when necessary.

The floodplain downstream of Long Levee Regulator 1 would be watered on drawdown.

Mid and Upper Wallpolla Maximum

The Structure 1 and 4 regulators and their associated support structures will be operated to their maximum operational height to enable broad scale inundation of Mid and Upper Wallpolla. Where appropriate passing flow downstream of Structure 1 and 4 would be provided, in addition to flows passing through Structure 1 fishway.

Delivery to this site will take advantage of high river flows and potentially be augmented through use of temporary pumps when necessary.

The floodplain downstream of Long Levee Regulator 1 would be watered on drawdown.

Mid and Upper Wallpolla Maximum and Pumping

This scenario is a variation of the Mid and Upper Wallpolla maximum operation. In addition, water would be delivered to Wallpolla South with temporary pumps.

Natural Inundation

In order to minimise the impact of the infrastructure on natural inundation patterns it is proposed that all regulating structures will be open allowing full connectivity between the River Murray, Wallpolla Creek, Finnigans Creek and the floodplain.

10.3. Transition between operating scenarios

For a range of reasons it may be necessary to change between operation scenario during the course of a watering event.

Factors that may influence a decision to transition between scenarios may include:

- inflows causing increase in environmental water allocations
- inflows generating natural flooding
- response to ecological opportunities or to mitigate risks
- response to operational opportunities or to mitigate risks, and
- response to water quality risk mitigation requirements.

An operation matrix (Table 10-2) has been developed which summarises how each structure would be operated to change from one scenario to another.

For example, to move from No Operation conditions to Mid Wallpolla maximum, structure 1 and its supporting regulators would need to be raised to their maximum safe operating level and structures, V, Y and Z are fully opened. Stop logs would be progressively placed in Structure 1 to raise water levels in the Mid-Wallpolla area while maintaining appropriate passing flows both over the structure and through the fishway located at structure 1.

The ‘Condition during scenario’ sections of the matrix show the status of the structures once each scenario has been established and is in operation. This matrix shows a selection of available operational configurations for the purposes of illustrating the flexibility of the works package.

During transition to all structure open under flood conditions, stop logs at the regulators are progressively removed until tailwater and headwater levels are matched. The structures may then be completely stripped to allow unimpeded passage of natural flows.

Table 10.3. Operational matrix

	Scenario	To Default	To Seasonal Fresh	To Mid Wallpolla Maximum	To Mid and Upper Wallpolla Maximum	To Mid and Upper Wallpolla Maximum and pump	To Natural inundation
From	**Default**	Condition During Scenario All structures open	No change	Structure 1 and associated supporting structures set to height required to maximum operating height (30 m AHD) with through flow maintained.	Structure 1, 4 and associated supporting structures set to height required to maximum operating height (30 and 32 m AHD respectively) with through flow maintained.	Structure 1, 4 and associated supporting structures set to height required to maximum operating height (30 and 32 m AHD respectively) with through flow maintained. Temporary pumps in operation to inundate Wallpolla South.	No change
	Seasonal Fresh	No change	Condition During Scenario All structures open	Structure 1 and associated supporting structures set to height required to maximum operating height (30 m AHD) with through flow maintained.	Structure 1, 4 and associated supporting structures set to height required to maximum operating height (30 and 32 m AHD respectively) with through flow maintained.	Structure 1, 4 and associated supporting structures set to height required to maximum operating height (30 and 32 m AHD respectively) with through flow maintained. Temporary pumps in operation to inundate Wallpolla South.	No change
	Mid Wallpolla Maximum	All structures open	All structures open	Condition During Scenario Structure 1 and associated supporting structures set to height required to maximum operating height (30 m AHD) with through flow maintained.	Structure 4 and associated supporting structures set to height required to maximum operating height (32 m AHD respectively) with through flow maintained.	Structure 4 and associated supporting structures set to height required to maximum operating height (32 m AHD respectively) with through flow maintained. Temporary pumps in operation to inundate Wallpolla South.	All structures open
From	**Mid and Upper Wallpolla Maximum**	All structures open	All structures open	Structure 4 and associated supporting structures set to open	Condition During Scenario Structure 1, 4 and associated supporting structures set to height required to maximum operating height (30 and 32 m AHD respectively) with through flow maintained.	Temporary pumps in operation to inundate Wallpolla South.	All structures open
	Mid and Upper Wallpolla	All structures set to open	All structures open	Structure 4 and associated supporting structures set to open	Pump switched off	Condition During Scenario Structure 1, 4 and associated supporting structures set to	All structures open

Scenario	To Default	To Seasonal Fresh	To Mid Wallpolla Maximum	To Mid and Upper Wallpolla Maximum	To Mid and Upper Wallpolla Maximum and pump	To Natural inundation
Maximum and pump			Pump switched off		height required to maximum operating height (30 and 31 m AHD respectively) with through flow maintained. Temporary pumps in operation to inundate Wallpolla South.	
Natural flows	No change	No change	All structures open Structure 1 and associated supporting structures set to height required to maximum operating height (30 m AHD) with through flow maintained	All structures open Structure 1, 4 and associated supporting structures set to height required to maximum operating height (30 and 32 m AHD respectively) with through flow maintained.	All structures open Structure 1, 4 and associated supporting structures set to height required to maximum operating height (30 and 31 m AHD respectively) with through flow maintained. Temporary pumps in operation to inundate Wallpolla South.	Condition During Scenario All structures open

10.4. Timing of Operations and Risk Management

The proposed works provide a high degree of operational flexibility. Ecological Associates (2014c) provides a selection of possible operating scenarios. The decision to initiate an environmental watering event will be based on:

- water availability
- the floodplain water requirements consistent with the watering regime, ecological objectives and targets
- operational risks, and
- the regional context (i.e. survival watering, recruitment watering, maintenance watering) and other river operations that may occur within the river reach.

Timing will be in response to late winter/spring flow cues and the inundation will be managed according to the flow rate in the River Murray.

The structures will be operated to manage adverse impacts as per the risk mitigation covered in Section 11.

11. Assessment of risks and impacts of the operation of the measure (Section 4.7)

A comprehensive risk assessment of the potential operational impacts of the proposed supply measure has been carried out during development of this business case. It is acknowledged that operation may have a range of impacts, including adverse impacts on cultural heritage, socio-economic values and impacts from operation of structures. This risk assessment process was informed by experience with operating environmental watering projects of similar scale and complexity, including TLM.

11.1. Risk assessment methodology

The risk assessment for the *Wallpolla Island Floodplain Management Project* was completed in line with the requirements of AS/NZS ISO 31000:2009 (Lloyd Environmental, 2014). This assessed both the likelihood of an event occurring and the severity of the outcome if that event occurred. The assessment generated a risk matrix in line with the ISO standards and prioritised mitigation strategies and measures.

Refer to Section 7, Tables 7-1 to 7-4 to view the risk matrix and definitions used in this risk assessment, and further details on the methodology.

The risk assessment was consolidated as the project developed and additional information incorporated into Table 11-1.

11.2. Risk assessment outcomes

Table 11-1 presents a summary of the assessment and subsequent work undertaken, including mitigation measures developed and an assessment of residual risks after these are applied. It should be noted that where a residual risk is given a range of ratings, the highest risk category is listed.

Table 11-1. Risk assessment – threats and impacts of operation of the measure without mitigation and residual risk rating after mitigation, adapted from Lloyd Environmental (2014)

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
Adverse impacts on cultural heritage						
Loss of artefacts via erosion; loss of artefacts via inundation	Wallpolla Island is considered an area of high cultural heritage sensitivity. Fluvial processes during watering events could damage cultural sites and places, resulting in the loss of artefacts in-situ on the floodplain. This may damage relationships with Indigenous stakeholders and subsequently affect future operation of the works.	Possible	Moderate	Moderate	Preliminary cultural heritage assessment work has been undertaken through the Wallpolla Island Floodplain Due Diligence Assessment (Bell, 2013). A Cultural Heritage Management Plan will be required prior to construction activities and will be developed in partnership with Indigenous stakeholders. This will provide for any further remedial works during/after operations. Implement measures during operations to minimise damage to cultural sites. Proactive engagement with Indigenous stakeholders during operation, which may involve inspection of cultural sites pre and post watering events to monitor and undertake protection works, relocation of artefacts as required, and rehabilitation works.	Low
Damage to relationships with Indigenous stakeholders	This threat could occur through unforeseen impacts on cultural sites during operation, which may damage relationships with Indigenous stakeholders. This could affect the future operation of works and subsequently impact on the site's water-dependent ecological values.	Possible	Moderate	Moderate	As above.	Low
Adverse impacts on socio-economic values						
Restricted access to public land during watering events	Watering events may inundate roads and bridges, limiting or prohibiting public access. This may reduce opportunities for active and passive recreation, and possibly tourism.	Certain	Minor	Moderate	Improved planning and modelling to predict access limitations during operation. Issue public notifications of access changes/limitations prior to watering events. Close consultation with tourism industry to ensure timely communication around planned events. Upgrade roads to improve access where practical. Provide boat access as an alternative, where	Moderate

Threat	**Description**	**Likelihood**	**Consequence**	**Risk without mitigation**	**Mitigation**	Residual Risk
					relevant.	
Disturbance of beekeeping and other commercial operations (kayaking, camping, tours etc.)	In addition to restricting access, watering events could inundate vegetation with pollination potential and beehive sites. Watering events could also restrict other commercial operations such as camping and kayaking tours.	Possible	Moderate	Moderate	Engage with the relevant stakeholders (apiarists, licensed tourism operators etc.) to ensure they are aware of the extent of upcoming watering events and can plan accordingly. This will be incorporated into the project stakeholder management strategy.	Low
Rise in river salinity	A key driver to salinity on Wallpolla River is discharge of saline groundwater along gaining reaches during a flow recession. Increases in salinity (measured as EC units at Morgan) may breach Basin Salinity Management Strategy requirements and also exceed Basin Plan salinity targets. This may result in poor water quality for downstream users.	Likely	Moderate	High	Avoid watering salinity hot spots identified through the use of AEM datasets (Munday et al. 2008), instream nanoTEM (Telfer et al., 2005a and 2005b, 2007) and other salinity investigations. Provision of dilution flows in the River Murray during and following drawdown. Not operating during high-risk periods. Use regulators to: • Control the level and area of floodplain inundated and control of recession to manage the volume of saline water to be returned to the river. • Enable hold periods to be shortened or lengthened to mitigate impact of release of stored water. • Restrict release from impounded areas to allow evaporation and seepage. • Manage rates of rise within the Mid-Wallpolla Weir Pool to maximise through-flow and dilution. • Manage rates of fall within the Mid-Wallpolla Weir Pool to reduce peak impact and minimise hydraulic gradient between groundwater and surface water. Ongoing monitoring of groundwater and surface water levels and salinity to inform adaptive management and update of Operational Plans.	Moderate
Increased mosquito	Ponding water on the floodplain has the potential to localised increases in mosquito	Possible	Moderate	Moderate	Active community engagement to improve awareness and encourage people to take	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
populations	populations. This could lead to human discomfort, disease exposure and eventually to negative perceptions about the project.				precautions. This would be carried out as part of wider communication and engagement activities.	
Adverse impacts resulting from operating structures						
Structural failure of new works during operation	Structures can be vulnerable to inundation flows during operation via processes and attributes such as: inadequate elevation; insufficient protection from scour; insufficient rock armour; flood preparation including strip boards and handrails.	Possible	Severe	High	Provide adequate protection from erosion during and after operation. Ongoing inspection and maintenance of structures for early identification of potential problems during operation. Flood preparation actions written into O&M documents including removing structural parts likely to be barriers to flow or large debris.	Low
Unforseen incompatibility with existing infrastructure (e.g. Lock 7)	Interactions with other River Murray management structures including Lake Victoria and Lock 9 will need to be planned and approved. If these requirements cannot be achieved this would cause operational changes or project delays, affecting the ability to operate effectively and achieve the ecological objectives.	Possible	Moderate	Moderate	Identify system constraints and operate within these (or address constraints, where possible), informed by the Constraints Management Strategy (MDBA, 2013). Maintain strong working relationships with river operators, partner agencies (including agencies in NSW, SA and Victoria), through regular operation group meetings to manage all aspects of watering events. Events informed by hydraulic modelling (Water Technology, 2014). Develop a detailed Operational Plan and review regularly to implement an adaptive management approach that can respond as necessary.	Low
Poor design of structures	This could occur through inadequate technical rigour during design or maintenance, causing maintenance issues or reduced effectiveness in operations.	Possible	Moderate	Moderate	Peer review of structure designs. Develop and implement appropriate maintenance programs.	Low
Unsafe operation of built infrastructure	Unsafe operation, such as breaches of OH&S procedures, could threaten human safety.	Unlikely	Catastrophic	Moderate	Ensure appropriate design that incorporates best-practice OH&S provisions. Operate infrastructure in compliance with OH&S requirements.	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
					Develop and implement a suitable maintenance program, in conjunction with Operation and Maintenance Plans. Provide safe access provisions and public safety provisions. Provide appropriate induction and training for staff operating infrastructure and equipment. Provide appropriate personal protective equipment (PPE) and equipment for operations.	
Adverse impacts on operation, maintenance and management. *Please note: These threats impact operations, but are not caused by the operating regime.*						
Lack of clear understanding of roles and responsibilities of ownership and operation	Lack of clear understanding of roles and responsibilities of ownership and operation could prevent the effective operation of the infrastructure.	Possible	Moderate	Moderate	Establish a MoU between all relevant agencies outlining roles and responsibilities during operation. Facilitate shared knowledge of project objectives among asset owners and operators. Develop all documentation with relevant agencies prior to construction, including production of Operation and Maintenance manuals. Ensure emergency response arrangements are in place. Ensure ongoing maintenance of structures and insurance arrangements. Maintain strong working relationships with river operators, partner agencies (including agencies in NSW, SA and Victoria), and Commonwealth and Victorian water holders through regular operations group meetings. Maintain clear lines of communication during operation and reporting of water accounts/flows (i.e. reporting and accounting arrangements).	Low
Lack of funding for ongoing operation, maintenance and	Insufficient funding for maintenance activities result in deterioration of structures, increasing the risk of failure. Inability to coordinate/direct operations	Possible	Severe	High	Maintain strong relationships with investors/funding bodies to secure long term operational funding. Suspend operations if insufficient resources	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
management	due to insufficient agency resources.				available to support relevant agencies.	
Operational outcomes do not reflect hydrological modelling outputs	On-ground outcomes during operation do not meet expectations due to incorrect assumptions, input data, interpretation or inaccurate models.	Possible	Severe	Moderate	Models developed using best available information. Undertake sensitivity modelling to confirm minor discrepancies in model accuracy do not result in dramatic changes to operational outcomes. Models independently peer-reviewed and determined to be fit for purpose.	Moderate
Community/ stakeholder resistance, backlash or poor perception	Poor communication with project stakeholders and the community can result in misunderstanding of the project's works and ongoing operations. This may limit on the capacity to operate the site as required.	Possible	Moderate	Moderate	Ongoing stakeholder liaison (early and often) guided by a stakeholder engagement plan. Targeted engagement to address identified concerns of key stakeholders.	Low
Inundation of private land without prior agreement	The proposed works enable 76 ha of private land to be inundated, if landholder agreements are in place. If ownership changes and agreements aren't registered on title, it is possible that the new owners will not permit flooding.	Possible	Moderate	Moderate	Ongoing engagement with landholders regarding planned watering events and outcomes. Negotiate conservation covenants and/or flood/access easements to be registered on title if ownership changes. Build in design-based mechanisms to prevent flooding of private land.	Low

11.3. Risk mitigation and controls

The risk assessment confirms that all the risks identified in the risk assessment are reduced to acceptable levels (very low to moderate) once well-established risk mitigation controls are implemented.

While the risk assessment identifies several potential threats that could generate high risks to the operation of the structures (Table 11-1), these risks are considered manageable because they:

- are well known and are unlikely to involve new or unknown challenges
- can be mitigated through well-established management controls
- have been successfully managed by the Mallee CMA and project partners (including construction authorities) in previous projects, and
- result in very low or moderate residual risks after standard mitigation measures are implemented.

Three risks retained a residual risk of moderate after implementation of the recommended mitigation strategies (Table 11-2). Further consideration of these threats may assist in further understanding the potential impacts and, in some cases, identifying additional mitigation measures to reduce the residual risk.

While downstream and cumulative salinity impacts cannot be formally ascertained at this time (see Section 7), particular consideration has been given to the potential salinity impacts of the project, as described in Section 11.5.

Table 11-2. High priority risks, mitigation and residual risk

Threat	Risk without mitigation	Residual risk rating	Additional considerations (Lloyd Environmental, 2014)
Restricted access to public land during watering events	Moderate	Moderate	Alternative recreational sites could be promoted as a form of 'offset' during watering events. New infrastructure could be provided to enhance the most common recreational pursuits (e.g. walking tracks and bird hides, campgrounds for campers)
Rise in river salinity from salt wash off from floodplain soils, mobilisation in stream salt store or via mobilisation of saline groundwater to watercourses	High	Moderate	Implementation of comprehensive monitoring including the installation of additional groundwater monitoring bores during early operations and the use of information obtained will inform a more detailed analysis of local and downstream salinity impacts and adaptive management of the site. This local scale investigation should form part of a larger scale investigation covering river operations and environmental watering activities taking place between Lock 9 and Lock 5.
Operational outcomes do not reflect hydrological modelling outputs	Moderate	Moderate	Opportunities for improvement of models identified for action as more information becomes available. Further refinement of models undertaken as project develops and contextual information is provided regarding Basin Plan flows, detailed designs and initial operations

11.4. Risk management strategy

As noted in Section 7.3, a comprehensive risk management strategy will be developed for the proposed supply measure, building on the work completed for this business case. The strategy will cover ecological and socio-economic aspects to provide a structured and coherent approach to risk management for the life of this project (i.e. construction and operation).

With regard to potential operational impacts, the risk management strategy will focus on the following issues, as described in Table 11-1:

- potential impacts on socio-economic values, including salinity impacts
- operation of structures, and

- maintenance and ongoing management.

Risk assessment and management is not a static process. Regular monitoring and review of the risk management process is essential to ensure that:

- mitigation measures are effective and efficient in both design and operation
- further information is obtained to improve the risk assessment
- lessons are learnt from events (including near-misses), changes, trends, successes and failures
- risk treatments and priorities are revised in light of changes in the external and internal context, including changes to risk criteria and the risk itself, and
- emerging risks are identified.

The risk assessment process will continue throughout the development and implementation of this project. It is anticipated that additional threats will be identified and evaluated as the project progresses, and any new risks incorporated into the risk management strategy.

11.5. Salinity Impact Assessment and Mitigation Strategies

A preliminary salinity impact assessment of the *Wallpolla Island Floodplain Management Project* has been completed which includes analysis of both Basin Salinity Management Strategy (BSMS) considerations (as measured in EC units at Morgan) and real time salinity impacts. The parameters applied in this assessment are based on historically observed surface and groundwater responses. While the salt mobilisation responses can be identified and estimated, the operating regime of the River Murray under the Basin Plan is largely unknown at this point in time and may affect the observed salinity response. The preliminary salinity impact assessment must be considered in this context.

The Victorian Salt Disposal Working Group provides advice to DEPI about Victoria's compliance and implementation of the BSMS, including the assessment of salinity impacts. The Group comprises representatives from DEPI, Goulburn Broken, Mallee and North Central CMAs, G-MW and Lower Murray Water. The Group has reviewed the preliminary salinity impact assessment for the *Wallpolla Island Floodplain Management Project* and considered the findings of the expert peer review (see Appendix L). The Group endorses the assessment methodology as consistent with the BSMS and fit for purpose to support this business case.

Preliminary Salinity Assessment Approach

The study estimated salt loads to the river system using a combination of approaches (semi-quantitative and qualitative) based on an initial desktop assessment of hydrogeological and salinity information and methods including mass balance, flow nets and groundwater mound calculations. Associated salinity impacts at Morgan were derived using the Ready Reckoner developed specifically for environmental watering projects (Fuller and Telfer 2007).

There is some uncertainty related to assumptions made in the analysis. Where uncertainty was identified for a given parameter, a conservative value was assumed or upper bound used. This approach is likely to overestimate the salt load magnitude.

The information provided by these assessments can be used to inform analysis of cumulative impacts of the final suite of Supply, Demand and Constraint Management Measures implemented under the Basin Plan. For detailed information please refer to the Preliminary Impact Assessment for Mallee Environmental Watering Projects – Other Sites (SKM, 2014; Appendix D).

Preliminary salt estimate

The preliminary salinity impact is approximately 4.39 EC at Morgan for all Wallpolla Island watering options at the nominated frequency and duration of inundation. This initial estimate does not account for implementation of mitigation strategies.

Only the Mid Wallpolla Mid option has been modelled (over the 25 year benchmark period) to exceed the salinity targets at Morgan (830 µS/cm) for less than a week. It should be noted that the background River Murray salinities also exceeded the salinity operation target at Morgan for over 200 days during the benchmark period. The time series results are found to be heavily reliant on the timing of fill and release from the floodplain with respect to the River Murray flow and salinity. The exceedance of operational salinity targets modelled through the time series analysis must be considered in context with the precursory river salinity that they are already very close to the target.

Without mitigation, the real-time salinity impact immediately downstream of Wallpolla Island is likely to result in a minor increase in salinity.

Key salt mobilisation processes at play

The key driver of the salinity response across Wallpolla Island is the displacement of saline groundwater stored in the soil and river bank when the floodwater recedes. This is mostly generated from within the Mid Wallpolla area. The AEM data indicates that there are large areas of highly saline groundwater (average salinity of 30,000 EC) and mobilisation has been assumed to occur in a similar way as observed at Lindsay Island. However the historic record under much wetter conditions has not shown large salt loads within the Lock 9 to Lock 10 reach. This assumption may overestimate salinity impacts. In order to better understand the salt mobilisation mechanisms in this area an adaptive management approach where a modest area is watered to provide the data required to increase the certainty of this estimate. Currently the available data in this area is sparse and therefore creates significant uncertainty in determining the salinity estimates.

Mitigating measures and their feasibility

A balanced approach is required to maximise environmental benefits while at the same time minimising salinity impacts. The level of impact is highly dependent on the magnitude of river flow and the baseline salt load in the river system, which in turn is dependent on whole-of–river operations and priority order for each individual watering project.

The availability of dilution flows and their relative volume, duration and timing of release will be important considerations however, without further detail on the whole-of–river operations, it is not feasible to undertake the myriad of possible modelling scenarios required to determine the most appropriate mitigation strategy (SKM 2014).

Mitigation strategies are therefore described below in general terms. More detailed analysis of the potential salinity impacts and risk mitigation strategies is recommended upon approval of this business case, potentially using a daily river operations model. This will most useful when there is greater certainty about the structure specifications and proposed operating regimes of the River Murray. A range of management responses are available and may be appropriate to consider in minimising each salinity process triggered. These include:

- Creation of an operations protocol that explicitly connects projected salinity impacts, salinity thresholds for operation and contingency planning; and
- Implementing a monitoring regime that informs both the operation of the structures within the nominated thresholds as well as the overall estimation of salinity impacts downstream.

Should larger impacts occur with time, these could be offset by the less frequent operation and shorter duration of watering events as required.

Significant opportunities exist to manage the way that salt is generated and to mitigate the overall impacts including:

- Optimising the timing of diversion. Generally the rising limb of the flow hydrography in the lower Murray is associated with increasing salinity. Smaller wetlands could be watered earlier, before any significant increase in river salinity caused by flooding upstream. Bringing fresher water into the wetlands will minimise the impact of the salt on release.
- Optimising the timing of releases. Release of water into a falling river will have a more significant impact when flows are low. Releasing into higher flows will minimise local impacts but not necessarily affect the overall salt loads from a BSMS perspective.
- Optimising the rate of release. If water must be released into a very low river, local effects can be mitigated by slowing the rate of release. In some cases, this may be used in conjunction with the above measures.

Monitoring requirements and further analysis

The level of complexity of Wallpolla Island and limited groundwater data limit the ability to refine the quantum of salinity impact. SKM (2014) recommended the implementation of comprehensive monitoring during early operations and the use of information obtained to inform a more detailed analysis of local and downstream salinity impacts and inform adaptive management of the site. This local scale investigation should form part of a larger scale investigation covering river operations and environmental watering activities taking place along the River Murray System.

Priority monitoring relies on measurements of salinity, water level from observation wells and fixed surface water monitoring sites. These include:

- Five new bore sites to be drilled to channel sands aquifer to assist with measuring a change at Wallpolla Mid, Wallpolla Lower and Wallpolla South.
- Nine data logger sites have been suggested to capture continuous salinity and water level data – additional sites may be required where inundation activities present access issues.
- Twenty-four existing bores sites monitored for water level and salinity before, during and immediately after watering events, and every three months between events.
- Additional surface water data (flow, level and salinity) to be collected along Wallpolla Creek in particular associated with proposed regulator sites.
- Upgrade of an existing surface water monitoring station at Dedmans Creek is required to capture flow and water height (in additional to salinity data).

12.Technical feasibility and fitness for purpose (Section 4.8)

12.1. Development of designs

Design principles

The options selected for the *Wallpolla Island Floodplain Management Project* have been developed to complement the delivery of basin plan flows. They offer opportunities to provide environmental water to sites during times of water shortage and by allowing delivery of water to higher parts of the floodplain beyond the reach of regulated releases to meet target inundation frequency, extent and duration param. In developing options for the project consultants were asked to consider the following:

- Maximising environmental benefit from operation of the proposed works by:
  - targeting areas that are difficult to reach with run of river murray flows
  - considering lifting water from areas flooded by works to higher elevations with temporary pumps
  - providing the ability to deliver water to high value target areas without requiring large storage releases to generate overbank flow and without relying on removal of system constraints
  - ensuring that works can be used to magnify the effects of natural flows or regulated releases with minimal additional water use, and
  - designing infrastructure which will be flexible in its use to allow implementation of operational strategies developed through adaptive management of the site.
- Maximising cost effectiveness, environmental benefits and water efficiency returns for investors through:
  - analysis of environmental works in the region and incorporating lessons learned from the construction and operation of these projects
  - pragmatic analysis of available infrastructure options, and
  - striking a balance between capital investment and ongoing operating costs to deliver a cost effective solution.
- Ensuring practical and economic constructability of the project by:
  - siting structures on existing access tracks and provision of construction access plans
  - utilisation of locally obtainable construction materials where practical
  - use of advantageous geological features within the landscape where possible, and
  - incorporating information and experience obtained during the construction and operation of nearby works regarding seepage, structure settlement and stability, construction dewatering and downstream erosion control.
- Ensuring compatibility with nearby existing infrastructure and operational practice by
  - use of common design features with nearby infrastructure
  - taking into account operational capabilities of existing infrastructure which is integral to the operation of the proposed works
  - development of operational access plans, and
  - working with SA Water during options selection and development of concept designs.
- Minimising negative impacts on the environment and other river users by:
  - striving to maintain natural flow paths and capacities on the floodplain to minimise impact on natural floods
  - using existing disturbed footprints where possible
  - minimising site disturbance and the size of the footprint of any new infrastructure that is required, and

- considering the use of multiple cascading structures to mimic hydraulic gradient and avoid extensive networks of tall levees.

12.2. Design criteria used

In addition to the broad considerations above, specific design criteria have been developed to inform the development of concept designs. These criteria have been developed through reference to current literature and best practice guidelines and through targeted workshops. Detailed descriptions of design rational and criteria are provided in the Appendix E concept design report. A summary of key design criteria is provided below.

Capacity and Flow Conveyance

The general philosophy for sizing the regulators is to consider cost efficiency and maintain a reasonable proportion of the existing waterway area where possible, with consideration of the following

- conveyance of a volume of flow into a given area downstream, over an defined period of time
- velocity of flows through the structure and at entry and exits points
- minimising allowances for freeboard to reduce the (inundation) height range over which the structure may potential obstruct natural flows, and
- operability - to provide controlled release of flows and drawdown rates to ensure fish passage and erosion control criteria are being optimised.

Fish Passage

A fish passage workshop was held on the 16th of July 2014 involving key fish ecologists, representatives from design consultancies and constructing authorities. All seven of the proposed supply measures within the Mallee CMA region were presented to the workshop and then discussed in detail.

Specific outcomes from the workshop relevant to design of the Wallpolla Island works included the following:

- a single vertical slot fishway at Structure 1 on Wallpolla Creek.
- works need to incorporate deep plunge pools where overshot flow is expected.
- works need to consider fish passage for all scenarios of watering events, and
- the velocity through regulators should be minimized where practical.

From this it was determined that, engineering designs, where cost effective, will incorporate appropriate and practical mechanisms to ensure fish passage can occur to and from the River Murray through regulating structures.

The general design philosophy has been to provide explicit fish passage on any structure on a main watercourse (Wallpolla Creek) which requires a continuous passing flow. This has been applied to the Structure 1 regulator.

Passive fish passage is to be provided on all minor structures to limit the placement of barriers or encumbrances to fish. For example, on a minor regulator this would mean the use of overshot gates, ensuring optimal natural lighting conditions, etc.

Gate Design

A gate assessment workshop was held at Berri on 22 August 2014 and included representatives from SA Water operations and major projects as well as from Aurecon and Mallee CMA. The object of this workshop was to determine appropriate design criteria for each of the regulating structures within the project.

During this workshop the adoption of the concrete stop log system in use at the Chowilla Environmental Regulator and on weirs managed by SA Water in the region was confirmed for the Structure 1 Regulator on Wallpolla Creek. This system requires the purchase of a rubber tired excavator equipped with retractable rail wheels and a specially adapted boom for the positioning of stop logs. The design, construction and operation of these structures are well understood by SA Water and adopting this system allows efficiencies in terms of maintenance and commonality of spare parts as well as ensuring that reserve equipment is available in the event of a breakdown.

Design of smaller regulators at the site was standardized to use manually placed 1200 mm or 1800 long aluminium stop logs installed on the upstream face of box culvert structures.

Freeboard

The design crest level for each of the structures has been set based upon the design water level (taken as the Top, or Maximum Water Level), and a freeboard allowance.

The freeboard adopted for design of the Structure 1 regulator was 1500 mm above the maximum operating level. This includes provision for a possible increase in operating levels at the site if private land inundation issues are resolved.

In setting the levee crest level, a design freeboard allowance of 300 mm above the top of impermeable cone, has been adopted for small structures and levees:

Defined spillways have been incorporated in structures to direct flow to appropriately protected areas during overtopping events.

Design Life of works

The design life of the concrete and embankment structures within the project is between 80 and 100 years when appropriately maintained. Mechanical components will have a design life of 30 years.

12.3. Concept design drawings

Concept designs have been prepared for structures associated with the Mid Wallpolla and Upper Wallpolla described in Tables 12-1 and 12.2. Concept design drawings for each structure are provided within the design report (Appendix E). Figure 12-1 shows the plan view of the proposed Structure 1 Regulator.

Table 12-1. Mid Wallpolla Area works components (Aurecon 2014a)

Mid Wallpolla Component Works	
Name	**Description - Size of structure, function**
Structure 1 Regulator and vertical slot fishway	Structure 1 is located at the downstream end of the Mid Wallpolla area on Wallpolla Creek. Its function is to retain the water during a watering event initially to 30.0 m AHD. Closure of the structure is achieved through the installation 6 m long x 300 mm high concrete stop logs installed by a purpose modified excavator running on rails over the structure (the same equipment currently used at Chowilla Regulator). The structure will also include a single lane bridge to provide public access to Wallpolla Island. The structure has 10 number 6 m wide bays with 1.2 m wide piers supporting the bridge and rails for the excavator. On both abutments there are earth fill levees. A vertical slot fishway is provided on the right abutment
Structure V	Structure V is located on a minor channel with connection to the River Murray and the Mid Wallpolla area. Its function is to allow water into the Mid Wallpolla area if the River Murray is at flow rates above ~10,000 ML/d (nominally 27.7 m AHD) or is closed off to allow portable pumps to supply the water to the Mid Wallpolla area. The structure includes provision for installation 2 m long, 300 mm high aluminium stop logs installed by a truck mounted crane (Hiab or similar) located on the bridge. The structure has 8 number 2 m wide bays with 650 mm wide stop logs piers between the central bridge pier and the abutments.
LL1	Regulator and Crossing. This structure contains flood inundation to public land. The structure comprises 1 No. 1200 mm wide x 300 mm high; 55 m long minor regulator/crossing structure to be located on an existing track.
LL2	This minor levee structure contains flood water within the Mid Wallpolla. The levee has a maximum height of 0.7 m, is approximately 52 m in length and will be located within an existing flood runner.
PL1	This structure prevents a breakout of water to the south of the Mid Wallpolla and into private land. The structure comprises 2 No. 1200 mm wide x 900 mm high; 40 m long minor regulator/crossing structure to be located on a new access track.
PL2	This minor levee structure prevents a breakout of water to the south of the Mid Wallpolla and into private land. The levee has a maximum height of 1.4 m, is approximately 30 m in length and will be located within an existing flood runner.
T	This structure prevents a breakout of water to the north returning to the River Murray. The structure comprises 1 No. 1200 mm wide x 600 mm high; 14 long minor regulator/crossing structure to be located on an existing track.
Y	This minor levee structure prevents a breakout of water to the north and returning to the River Murray. The levee has a maximum height of 0.3 m, is approximately 6 m in length and will be located within an existing flood runner.
Z	Controls the breakout of water to the north and into the Lily Pond area. The structure comprises 2 No. 1200 mm wide x 1200 mm high; 20 m long minor regulator

Mid Wallpolla Component Works	
Name	**Description - Size of structure, function**
	structure to be located on an existing channel. The approximate structure height is 2.4 m. The structure has been located so that it is close the existing track to minimise disturbance of construction of new access track.
3	Regulator and Crossing. This structure provides access over Finnigans Creek. The structure comprises 3 No. 1200 mm wide x 600 mm high; 20 m long minor regulator/crossing structure to be located on an existing track. The approximate structure height is 0.8 m with localised mounding of track to enable higher culvert opening.

Table 12-2. Upper Wallpolla Area works components (GHD 2014)

Upper Wallpolla Area COMPONENT WORKS	
Name	**Description - Size of structure, function**
Structure 4	Structure 4 is located on the downstream end of the Upper Wallpolla area on Wallpolla Creek. Its function is to retain the water during a watering event to 32 m AHD. The structure will be equipped with 2 m long 300 mm high aluminium stop logs installed by a truck mounted crane (Hiab or similar) located on the bridge. The structure will also include a single lane bridge to provide public access to Wallpolla Island. The structure has 16 number 2 m wide. On both abutments there are earth fill levees.
Structure S	Structure S is located on a minor channel with connection to the River Murray and the Upper Wallpolla area. Its function is to allow water into the Upper Wallpolla area if the River Murray is at flow rates above ~55,000 ML/d (nominally 30.3 m AHD) or is closed off to allow use of temporary pumps. During all other conditions (normal and flood operations) the structure will remain completely open (i.e. stop logs removed) to allow free passage of water and fish. The structure will be equipped with 2 m long, 300 mm high aluminium stop logs installed by a truck mounted crane (Hiab or similar) located on the bridge. The structure has 5 number 2 m wide bays. The bridge deck will span across the structure abutments. On both abutments there are short earth fill levees.
B	This minor levee structure prevents a breakout of water to the west of the Dedmans Track. The levee has a maximum height of 0.15 m, is approximately 15 m in length and will be located along Dedmans Track.
C	Levee along Track. This minor levee structure prevents a breakout of water to the west of the Dedmans Track. The levee has a maximum height of 0.2 m, is approximately 90 m in length and will be located along Dedmans Track.
D	This minor levee structure prevents a breakout of water to the west of the Dedmans Track. The levee has a maximum height of 0.95 m, is approximately 425 m in length and will be located along Dedmans Track.
DR	This minor levee structure allows connectivity during a planned water event between areas on either side of Dedmans Track. The levee has a maximum height of 0.4 m, is approximately 480 m in length and will be located along Dedmans Track. Culverts will be installed to minimise impediments to flow.
E	This structure prevents a breakout of water to the south of the Upper Wallpolla and into the Mid Wallpolla. The structure comprises 2 No. 1200 mm wide x 1200 mm high; 65 m long minor regulator located on an existing flood runner. The approximate structure height is 1.8 m. This structure is not located near an existing track and access for construction and

Upper Wallpolla Area COMPONENT WORKS	
Name	**Description - Size of structure, function**
	operation will need to be provided. The exact location of the structure and access will need to be informed by detailed cultural heritage and ecological field studies.
G	This structure prevents a breakout of water to the south of the Upper Wallpolla and into the Mid Wallpolla. The structure comprises 2 No. 1200 mm wide x 600 mm high; 175 long minor regulator/crossing structure to be located on an existing track. The approximate structure height is 0.6 m.
H	This minor levee structure prevents a breakout of water to the south of the Upper Wallpolla and into the Mid Wallpolla. The levee has a maximum height of 0.3 m, is approximately 6 m in length and will be located within an existing flood runner.
I	Controls the breakout of water to the north. The structure comprises 1 No. 1200 mm wide x 900 mm high; 80 m long minor regulator structure to be located on an existing flood runner. The approximate structure height is 1.0 m.
J	This structure prevents a breakout of water to the north. The structure comprises 2 No. 1200 mm wide x 600 mm high; 90 m long minor regulator/crossing structure to be located on an existing track. The approximate structure height is 0.8 m.
K	This structure prevents a breakout of water to the north. The structure comprises 2 No. 1200 mm wide x 300 mm high; 140 m long minor regulator/crossing structure to be located on an existing track. The approximate structure height is 0.3 m.
M	This structure prevents a breakout of water to the north. Located on existing track. The structure is a 75 m long minor regulator/crossing. The structure height is to be confirmed.
N	This structure prevents a breakout of water to the north. The structure is a 75 m long minor regulator/crossing. The structure height is to be confirmed.
P	This structure prevents movement of water north and into the River Murray. It is located along an existing track. The structure comprises 2 No. 1200 mm wide x 300 mm high; 15 m long minor regulator/crossing structure to be located on an existing track.
R	This prevents movement of water north and inundation of private land during a planned water event. The structure comprises 2 No. 1200 mm wide x 300 mm high; 35 m long minor regulator/crossing structure to be located on an existing track. The approximate structure height is 0.6 m.

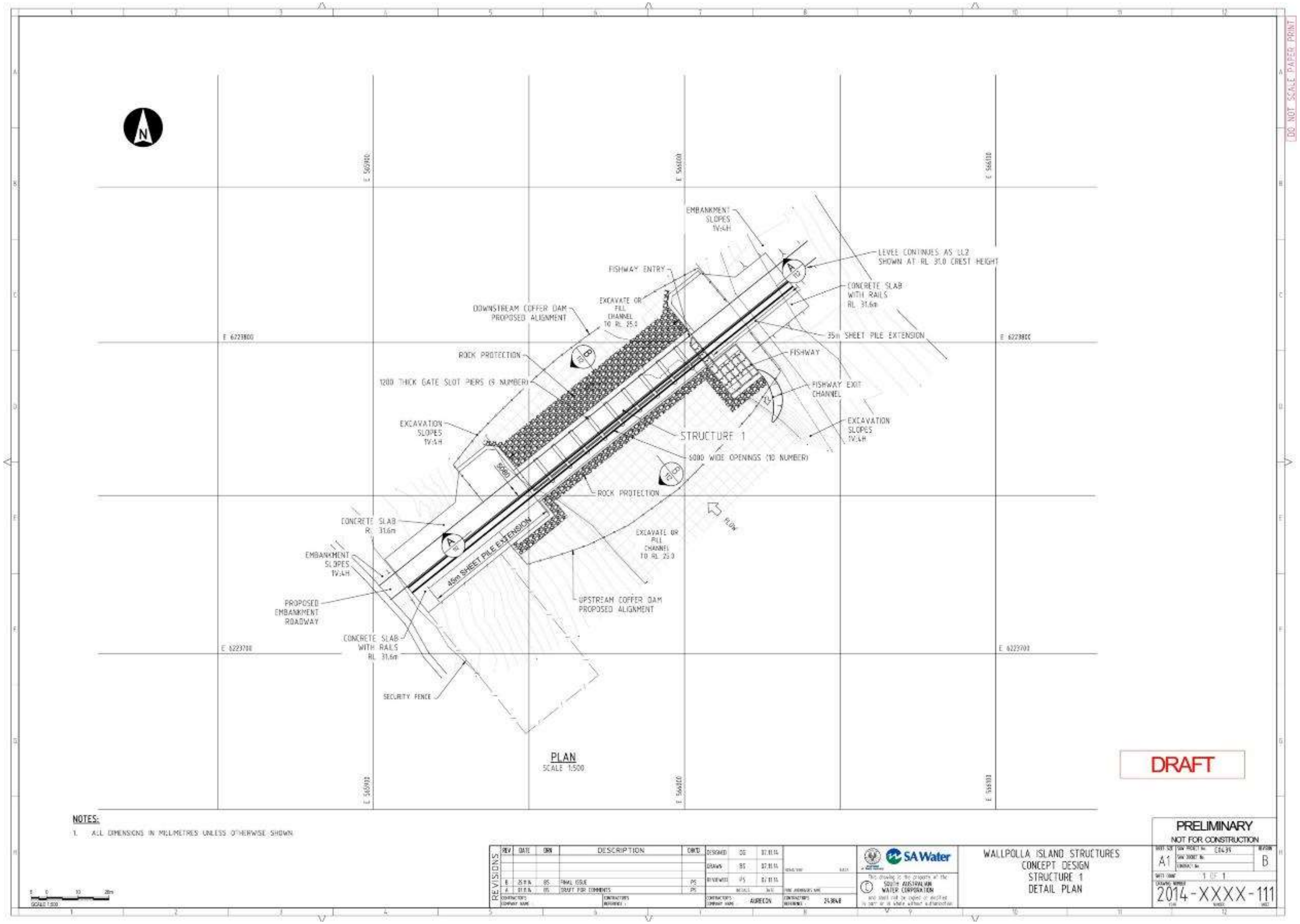


Figure 12-1. Concept design of Structure 1 (Aurecon 2014a)

12.4. Location of activities to be undertaken, access routes, footprint area

The location of each structure has been selected to maximize the efficiency of the works whilst minimizing impacts on cultural heritage, native vegetation and the visual or recreational amenity of the park and adjacent landholders. Figure 12.2 shows the location of the works and their associated access tracks. Care has been taken to ensure that access for operational use is provided to allow access from the Mail Route during operation. Comprehensive mapping of these access arrangements is provided in Aurecon 2014a.

Where possible, infrastructure has been located on existing tracks or other disturbed areas. The use of existing disturbed areas minimizes the loss of vegetation and damage to cultural heritage values.

It is proposed to construct the Structure 1 Regulator in a single stage as there is no requirement to maintain fish passage and flow through this part of the Wallpolla Creek during construction as it is not presently flowing habitat. There will be a requirement to ensure that water levels are maintained on the upstream side of the works area via temporary pumps or siphons as the watercourse acts as a boundary between parks and private land upstream of the proposed works.

Passing bays and construction footprints have not yet been defined for the project. Construction of previous environmental works has shown that the selection of these smaller set down areas and construction footprints is best done as a collaborative exercise between cultural heritage advisors, ecologists and construction engineers during the development of detailed designs and approvals.

For the purposes of preparing an estimate of vegetation impacts a nominal footprint at each of the proposed regulator sites was used along with nominal widths for access tracks and levees. These estimates were conservative and provide a correspondingly conservative (high) estimate of vegetation impacts.

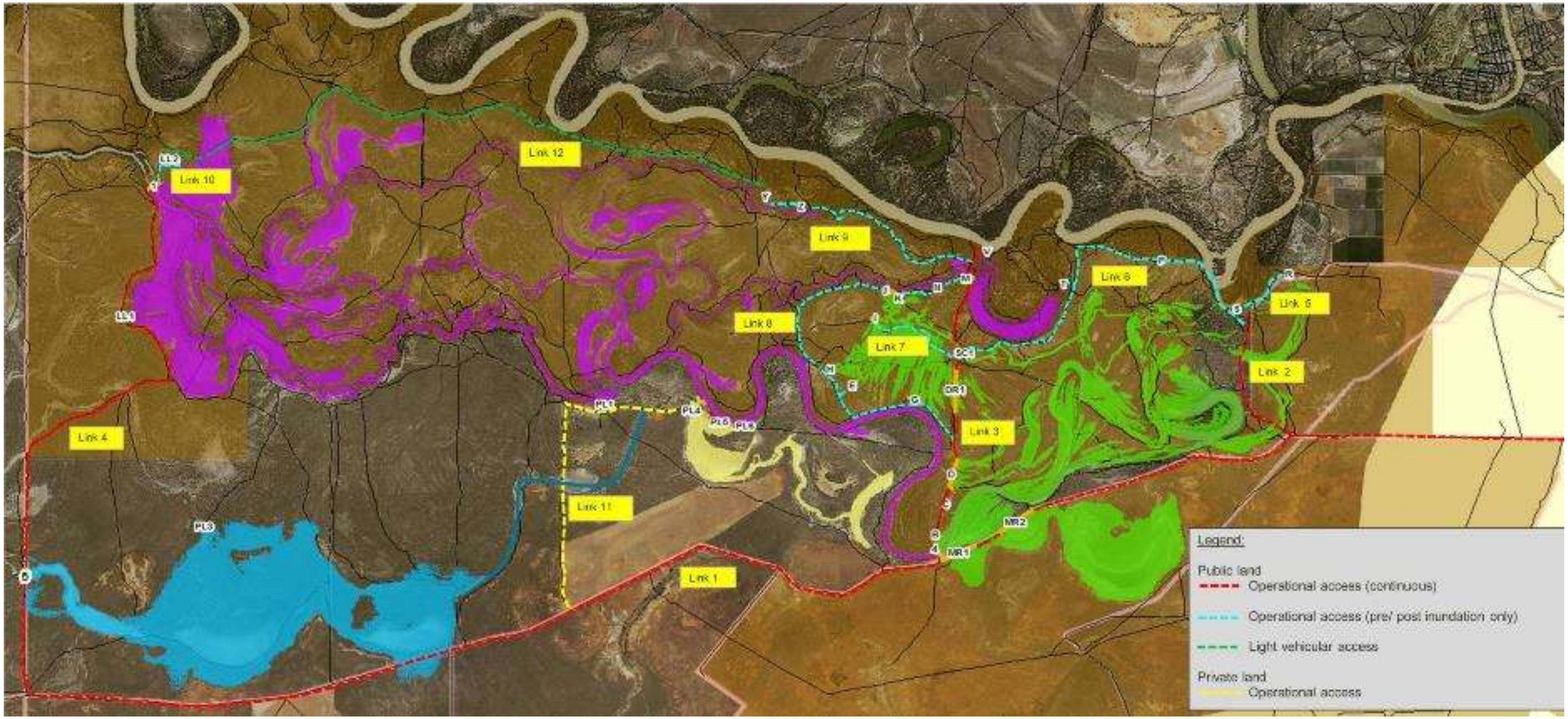


Figure 12-2. Location of structures and access tracks (Aurecon, 2014a)

12.5. Geotechnical investigation results

Geotechnical investigations undertaken by Aurecon (2014) showed:

- The general soil profile can be simplified for the entire *Wallpolla Island Floodplain Management Project* site as comprising three geological units. The upper unit is the Coonambidgal Formation clays. The middle unit is the Monoman Formation sands. The lower unit is the Blanchetown Clay. The Parilla Sand was not encountered in any of the boreholes. The results of the boreholes drilled by Aurecon are consistent with the published geological data, and also show good agreement with the results of the earlier boreholes drilled by GTS, although the SPT blow counts for the GTS boreholes generally tended to be a little higher than the SPT blow counts for the Aurecon boreholes.
- For the Long Levee 1 and Structure P boreholes, only a thin layer of surficial clayey silt was present before the Monoman Formation sands were encountered. A number of the shallow (4 m depth or less) boreholes were terminated in the Coonambidgal Formation clays without having encountered the top of the Monoman Formation sands. Only the three deepest boreholes (Structure 1 North, Structure 1 South and Structure V) intersected the top of the Blanchetown Clay, and all of these boreholes terminated within the Blanchetown Clay. Thus, the total thickness of Blanchetown Clay, and the depth to the top of the Parilla Sand, were not proven.

The field investigations undertaken as part of this project have not identified any major technical constraints, which would prevent construction of the proposed works however further geotechnical investigations are required to inform the development of detailed designs.

12.6. Alternative designs and specifications

Over the last decade there have been a number of investigations to identify the most effective designs to water Wallpolla Island. Each study has resulted in the refinement of preferred options to create this business case.

Major options, which were investigated (Ecological Associates, 2007) include:

- Lock 9 raising and lowering – such options were seen to provide little wide-scale benefit to Wallpolla Island as they had limited effect on floodplain inundation (Ecological Associates, 2007). This option has been pursued in conjunction with other floodplain watering options
- Lock 9 Bypass – This was seen to provide medium value for the cost.
- Relocate Cullulleraine Pumps to draw water from Wallpolla Creek to create a flowing environment (Ecological Associates, 2007). This was seen to provide poor value in terms of ecological benefits versus the cost.

As the preferred options became clearer more detailed analysis (Wallpolla water management options – Concept Design Report Alluvium, 2013) was carried out.

Wallpolla Island was divided into four water management areas to identify the most suitable options, these were:

- Upper Wallpolla
- Mid Wallpolla
- South Wallpolla
- Lower Wallpolla

The location of these water management areas are shown in Figure 12-3.

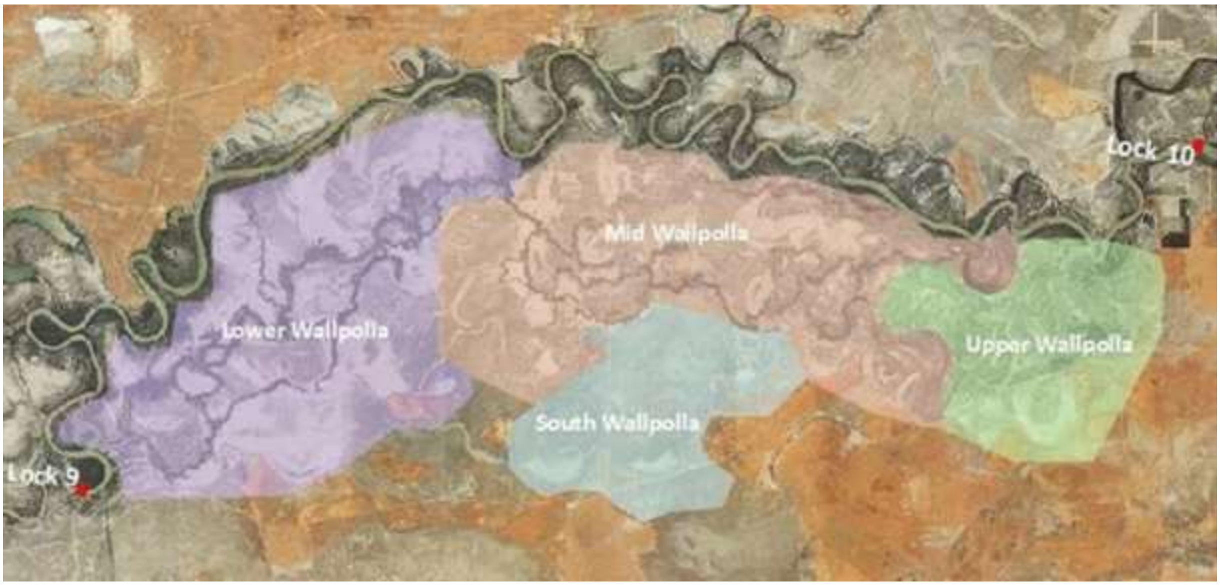


Figure 12-3. Wallpolla Water Management Areas

Water management options assessed for the Wallpolla area included:

- Alternate inundation elevations and levee heights
- Alternate levee alignments and regulator locations
- Alternate options to supply water to the Wallpolla Island including:
- Through regulators
- Pumping from the River Murray and
- Via a channel from the Lock 10 weir pool.

A set of more preferred water management options were selected in consultation with the Mallee CMA and stakeholders that best met the agreed water management objectives for the Wallpolla area. These are summarised in Table 12-1.

Table 12-1. Interim options selected for concept design (Alluvium, 2013)

Water management area and option summary	Activities and works	Outcome	Costs
1. Mid Wallpolla Water management area. Inundation to 31.0 m AHD	A large regulating structure (Structure 1) on Wallpolla Creek A regulating structure across Finnigans Creek at the diffluence with River Murray 10 new minor regulating structures within Wallpolla floodplain 10 km of levee across the Wallpolla floodplain.	Inundates a total of 3,292 ha of the Mid (and Upper) Wallpolla Creek Inundates 2,622 ha that is not inundated with 70 GL/d flow 1,271 ha of Black Box Woodlands inundated (1,206 ha of which would not be inundated by a 70 GL/d flow) Requires 29.9 GL of water.	$25.9M $9,880 per hectare of additional inundated area $21,500 per hectare of additional Black Box Woodlands inundated (above 70 GL/d flow)
2. Upper Wallpolla Water management area. Inundation to 32.0 m AHD	Temporary pump installations if and as required (once every 10 years) on bank of River Murray Construction of regulator (Structure 4) on Wallpolla Creek Construction of additional regulating structures and levees.	Inundates 804 ha of the Upper Wallpolla Creek (612 ha of area that is not inundated by a 70 GL/d flow) 477 ha of Black Box Woodlands inundated (344 ha of which would not be inundated by either Option 1 or 70 GL/d in the Murray) Requires 6.4 GL.	$8.1M $13,200 per hectare of additional inundated area (above 70 GL/d flow) $23,500 per hectare of additional Black Box Woodland inundated

12.7. Ongoing operational monitoring and record keeping arrangements

Operational monitoring and record keeping

The operational monitoring regime will form a key component of the operating plan developed for the site and will assign roles and responsibilities for agencies tasked with undertaking this monitoring. Critical areas of operational monitoring include those associated with water accounting and water quality which will be assigned to SA Water.

The project team has many years of experience in river and asset management and maintenance on the River Murray floodplain including the construction and operation of works at Chowilla and Mulcra Island. Along with this experience comes the necessary organisational capacity including data management and asset management systems required to maintain and operate large works including those subject to ANCOLD regulation. The team also has systems in place to manage data generated by operations including water accounting and water quality monitoring data.

Surface water flow and water quality monitoring will be implemented to ensure the water volume used and the water quality impacts of the project are recorded to appropriate standards and that this informs management and operations.

Groundwater monitoring will also be implemented to ensure salinity risks are appropriately managed.

An Operations Plan will describe how the infrastructure is to be operated for maximum environmental benefit while carefully managing risks. It will describe procedures for the works and interactions with River Murray operations and floods.

12.8. Peer review of concept designs

Prior to the commencement of the Advanced Concept Designs a workshop was held including representatives from GHD, SA Water, G-MW and an independent expert reviewer engaged by DEPI to provide advice regarding specific areas to be addressed during further design work. The outcomes of this review were provided to GHD as input into the Advanced Concept Design.

Aurecon have undertaken their own internal reviews of material during development of designs as well as incorporating feedback provided by G-MW and the Mallee CMA on draft reports

During the development of concept designs, draft material including geotechnical investigation specifications and design documentation have also been provided to independent experts engaged by DEPI. The experts engaged for the engineering review were Phillip Cummins and Shane McGrath.

For further information on the expert review outcomes, please see Appendix L.

13.Complementary actions and interdependencies (Section 4.9)

The proposed *Wallpolla Island Floodplain Management Project* supply measure will affect the Victorian Murray (SS2) surface water SDL water resource unit. This SDL resource unit is anticipated to be affected by this supply measure through an adjustment to the SDL, pending confirmation of a final off-set amount by the Murray-Darling Basin Authority (MDBA).

Any potential inter-dependencies for this supply measure and its associated SDL resource unit, in terms of other measures, cannot be formally ascertained at this time. This is because such inter-dependencies will be influenced by other factors that may be operating in connection with this site, including other supply/efficiency/constraints measures under the SDL adjustment mechanism and the total volume of water that is recovered for the environment.

It is expected that all likely linkages and inter-dependencies for this measure and its associated SDL resource unit, particularly with any constraints measures, will be better understood as the full adjustment package is modelled by the MDBA and a final package is agreed to by Basin governments.

Similarly, a fully comprehensive assessment of the likely risks for this supply measure and its SDL resource unit cannot be completed until the full package of adjustment measures has been modelled by the MDBA, and a final package has been agreed between Basin governments.

The operation of the proposed works is not dependent on any additional infrastructure.

Under current arrangements, the operation of the existing TLM infrastructure on Wallpolla Island is undertaken by SA Water at the request of MDBA River operators, following advice from the Lindsay, Mulcra and Wallpolla Operating Group, which is chaired by the Mallee CMA. This arrangement ensures local requests for the operation of the TLM works are integrated into broader river operations and provides a proven model for the operational governance of the proposed works.

Complementary actions beyond water management will include pest plant and animal control programs and other Natural Resource Management activities funded by state and federal programs delivered by local agencies as per current arrangements.

13.1. Cumulative impacts of operation of existing and proposed works

The operation of the proposed works in conjunction with Basin Plan flows, constraints management measures, operating rule changes and other proposed or existing environmental works will have both positive and negative cumulative impacts on the system and river users.

The benefits of integrating the operation of works along the River Murray and the delivery of Basin Plan flows and natural cues will include water efficiencies and the provision of appropriate ecological cues across multiple river reaches. Potential negative impacts may include cumulative salinity and other water quality impacts.

River scale benefits will include provision of nursery habitat for fish larvae and juvenile fish spawned upstream during elevated flows or operation of environmental works. These fish will return to the river as the water is drawn down from the floodplain contributing to the fish stocks of the River Murray.

On a local scale, the cumulative impacts of the proposed Lindsay and *Wallpolla Island Floodplain Management Project*s and the existing Mulcra Island and Chowilla Floodplain Management Projects on downstream salinity and dissolved oxygen levels for river users and operation of downstream environmental works such as Pike and Katarapco Creeks will need to be managed carefully through use of appropriate dilution flows. The effectiveness of this dilution approach has been demonstrated during the recent successful operation of the Chowilla works. It is expected that basin plan flows will more than meet dilution flow requirements proposed and existing works as well as delivering environmental and water quality benefits along the full length of the river.

The operation of the proposed Lindsay and *Wallpolla Island Floodplain Management Project*s in conjunction with the Mulcra Island and Chowilla Floodplain infrastructure, weir pool manipulation and other nearby environmental watering events, will dramatically increase and improve available floodplain habitat for valued flood-dependent fauna beyond that provided by the operation of any individual project, or Basin Plan flows, in isolation.

Holistic planning across the Basin will be required to mitigate potential negative impacts and maximise the social and ecological contribution of the *Wallpolla Island Floodplain Management Project* to the outcomes of the Basin Plan.

14.Costs, benefits and funding arrangements (Section 4.10)

14.1. Introduction

Consistent with the guidance given on page 26 of the Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases, a formal cost benefit analysis has not been undertaken as yet for this project because the main benefit of the project (in this case, the SDL adjustment) cannot be reliably estimated in time to inform this business case.

However from a qualitative perspective, Victoria considers that, on balance, the benefits of this project will significantly outweigh its costs. The rationale for this assertion is that a broad range of enduring social, economic and environmental benefits can be pre-emptively assumed to arise from this project.

These include:

- The social and economic benefits that will accrue for local and regional communities and businesses associated with its construction and operation
- The increased social and environmental amenity at this site arising from improved environmental health, increasing its attraction for tourism and recreational activities, and
- The broader regional economic benefit of taking less water out of productive use as a consequence of undertaking this project and being credited with an SDL Offset.

It must also be recognised that these immediate benefits can be assumed to have a range of positive secondary and tertiary benefits through the 'multiplier effect'. For example, the investment committed to construction of the project will benefit local businesses and families through jobs, materials purchase and normal everyday expenditure.

A similar positive impact can be anticipated as a consequence of the increase in tourism and recreation generated by the project and its environmental amenity dividend over its lifetime.

There is evidence that the quantum of visitor numbers to sites such as this, are closely related to inundation, with tourists more attracted to visit when water is present. As an illustrative example of this effect, whilst formal visitor statistics are not available, anecdotal evidence from Parks Victoria staff indicate that visitor numbers at the Hattah Lakes site have increased significantly (up to 50%) since environmental water was first pumped into the lakes (B Rodgers, 2009, pers. comm.).

It is accepted that there will be some disbenefits to account for; but these will be minor and transient. Construction will involve unavoidable physical disturbance which has the potential to impact on native vegetation, wildlife, and cultural heritage sites and places. These impacts will be avoided where possible by careful planning and adherence to relevant state and Commonwealth legislation, regulations and guidelines.

Any unavoidable impacts will be minimised through the implementation of a rigorous environmental management framework during construction.

It is also acknowledged that access will be compromised to some extent during the construction phase; but this is temporary. Access will also be limited during managed inundation events; however this would also occur during natural inundation.

In addition, given the relative remoteness of the site from populated areas, there is also unlikely to be any significant loss of social amenity to surrounding communities due to the noise and nuisance that will be encountered during construction.

Drawing an overall conclusion from the matters described above, it can be assumed that more than any other factor over the long term, the local and regional communities located close to this site will significantly benefit from the environmental amenity dividend generated by this project over its lifetime.

By contrast, it is difficult to envisage any significant social, economic and environmental disbenefit arising from direct operation of this asset in the manner described in this business case.

The Phase 2 Assessment Guidelines for Supply and Constraint Measure Business Cases require that business cases identify benefits and costs that support a compelling case for investment, including a detailed estimate of financial cost and advice on proposed funding arrangements.

This chapter provides this information on the following:

- Capital cost estimates
- Operating and maintenance costs
- Funding sought and co-contributions
- Ownership of assets, and
- Project benefits.

These costs and benefits are outlined both in undiscounted terms in the year in which they occur, and in ‘present value’ terms, discounted to 2014 dollars by a central real discount rate of 7%. This discount rate is suggested by the Victorian Department of Treasury and Finance (DTF) for projects of this kind, and is also consistent with the Commonwealth Office of Best Practice Regulation (OPBR) advice on the choice of discount rate. A project timeframe of 30 years is used for the analysis, as per Victorian DTF guidelines for Economic Evaluation for Business Cases. Year 1 of this time period is 2016 when design costs are incurred.

14.2. Capital cost estimates

This business case presents the cost to fully deliver the project (i.e. until all infrastructure is constructed, commissioned and operational), including contingencies. Cost estimates for all components in this proposal are based on current costs, with no calculation of cost escalation either accounting for the taken from estimating the cost to the time for construction to commence or for escalation during execution of the project. To ensure sufficient funding will be available to deliver the project in the event that it is approved by the MDB Ministerial Council for inclusion in its approved SDL Adjustment Package to be submitted to the MDBA by 30 June 2016, cost escalations will be determined in an agreed manner between the proponent and the investor as part of negotiating an investment agreement for this project.

Total capital costs (including contingencies but excluding design costs), in Present Value 2014 dollars are $49,427,395. The cost of individual structures, overall design costs and contingencies are provided in Table 14-1.

Capital cost estimates for this project have been developed by engineering consultancies responsible for project designs, using real-world costs from recently constructed environmental infrastructure projects in the area (e.g. Hattah Lakes, Mulcra Island, Upper Lindsay River Watercourse Enhancement Project, Chowilla Floodplain), in conjunction with agencies involved in these and other projects. These cost estimates have been peer reviewed by the Expert Review Panel, comprised of recognised experts (as described in Section 17 and see Appendix L).

Contingencies form 30 % of the total capital costs. In additional to these contingency specifically costed risks including, inundation from flooding, wet weather delays and delays due to approvals during construction have been included. This reflects the current level of development of designs and incorporates, but is not limited to, contingencies associated with geotechnical uncertainty.

Total project implementation costs, through to commissioning of the structures, in Present Value 2014 dollars are $59,523,808.

Project implementation costs that are in scope for Commonwealth Supply or Constraint Measure Funding are summarised by project stage in Table 14-2. Only forward looking costs have been included (that is, costs already incurred are not included in the table). Note that Table 14-2 does not include funding to coordinate the delivery of the final package of works-based supply measures; this will be determined as part of negotiating an investment agreement for this project.

Costs incurred for monitoring related to verifying the performance and integrity of newly constructed infrastructure have been included as commissioning costs.

Costs expressed in this document are present day values and investors will need to consider indexation and cost variations as appropriate.

The costs presented here relate to the implementation of this project in isolation. With the exception of capital, contingency and commissioning costs, opportunities exist for considerable efficiencies if multiple sites are implemented in parallel.

[redacted]

[redacted]

14.3. Operating and maintenance costs

A full estimate of ongoing costs can only be developed after this proposal is built into Basin-scale modelling of post-SDL adjustment operations and the likely frequency of operation estimated. In order to provide a conservative estimate of ongoing costs, it has been assumed the proposed works will be operated according to appropriate scenarios (as detailed in Section 10) in 50 % of years.

Operating and maintenance costs for the project are summarised in Table 14-3. As only a preliminary operating strategy has been developed to date, the operating costs in Table 14-3 are presented as average and maximum annual costs to provide an indication of the costs associated with temporary pumping.

Operation and maintenance costs (supplied by SA Water) are based on a 30 year timeframe and do not include asset renewal.

[redacted]

14.4. Projects seeking Commonwealth Supply or Constraint Measure Funding (funding sought and co-contributions)

Victoria will be seeking 100 % of project funding for this supply measure proposal from the Commonwealth. The funding requested will ensure the proposed supply measure is construction ready, built in accordance with all regulatory approval requirements and conditions, and fully commissioned once construction is completed.

Co-contributions

No co-contributions are provided for project capital costs, however all operating and maintenance expenses will be incurred by other parties.

14.5. Ownership of assets

To inform an eventual decision on proposed financial responsibility for ongoing asset ownership costs, and the preferred agency to undertake this role, the DEPI convened a workshop with the key delivery partners for Victoria's proposed supply measures. Attendees at the workshop included representatives from:

- Mallee CMA
- North Central CMA
- DEPI
- Parks Victoria
- G-MW.

The workshop was convened as a theoretical scoping exercise to draw on pre-existing expertise to evaluate the set of criteria that an agency would need to possess in order to effectively own, operate and maintain an asset like this proposed supply measure. Key criteria evaluated included:

- Access to capability to perform the required functions, either directly or under contract
- Access to suitable resources which can be deployed in a timely, efficient manner
- Sufficient powers conferred under legislation to enable services to be provided
- Demonstrable benefit or linkage to primary business mission or activities
- Ability to collaborate and co-ordinate effectively with multiple parties
- Risks are allocated to those best placed to manage them.

Participants at the workshop were collectively of the view that while a number of Victorian agencies possessed many of the key criteria needed to perform this role, more information was needed before a conclusive decision could be made on which agency was overall the best fit. This included a more determinative sense of the full suite of adjustment measures that were likely to be agreed to across the Basin, and their spatial distribution, so that opportunities to capitalise on economies of scale could be more fully investigated.

On this basis, DEPI advises that the delegation of asset ownership and operation, including any associated proposed financial responsibility, cannot be formally ascertained at this time. Such decisions are generally whole-of-Victorian government, and sufficient information is not currently available to enable a formal position on this matter to be clarified.

In line with good financial practice, any long-term arrangements for asset ownership, operation and maintenance should maximise cost-efficiencies where they can be found. This includes options to 'package up' ongoing ownership, operation and maintenance where this is deemed the most cost-effective approach.

DEPI will be in a position to provide more formal advice on the state's preferred long-term arrangements for this supply measure once the full suite of Victorian proposals under the SDL adjustment mechanism has been more definitely scoped. This is anticipated to occur during the course of 2015, pending receipt of advice from the MDBA on likely adjustment outcomes.

14.6. Project benefits

The main benefit of this project (SDL adjustment) will be calculated after submission of this business case, and cannot be included in this document. However, the project will also produce additional significant environmental, social and economic benefits to the region, driven by the environmental improvement generated by the project. A study was commissioned into the quantifiable benefits of the project other than water savings (provided in Appendix F), which drew on a Total Economic Value (TEV) framework and involved the 'benefit transfer' method of transferring unit values from original studies in a similar context.

The quantified economic values produced by the project reflect the broader Victorian community's willingness to pay (WTP) for specific types of environmental improvement, as well as an estimate of the consumer surplus associated with increased recreation produced by this environmental improvement. Specific benefits include (Aither, 2014):

- Improved healthy native vegetation: studies have shown that the Victorian community values improvements to the health of native vegetation, specifically River Murray red gum forests[4]. Values were applied to 1,029 ha of the project area
- Improved native fish populations: the same studies reveal a community WTP for improvement in native fish populations, calculated at an estimated 2% increase in native fish populations in the river produced by the project[5]
- Increased frequency of colonial water bird breeding: previous analysis reveals a community WTP for an increase in the frequency of water bird breeding in the River Murray ($12 per year per household)[6]. Under the assumption that site represents 1.5% of this River Murray value, a value for increased water bird breeding to the Victorian community was developed
- Increased recreation: Mallee CMA staff estimated that the Wallpolla project was estimated to increase the net annual tourist visitor days to the site by 10,000 days[7]. Using previous studies that estimated the economic value of a visitor day ($134 per visitor day[8]), the economic value of an increase of 10,000 visitor days was estimated.

The economic value of these four[9] quantified economic benefits is presented in Table 14-1. The 'present value' estimates assume benefits start accruing in the year of commissioning (shown as 2021 on the proposed project schedule in Table 3-3) and continue annually for the remaining years of the analysis timeframe (30 years). They are discounted to 2014 using a 7% discount rate.

[4] Bennett et al (2007) found that annual household willingness to pay for improvement to the health of 1000 hectares of river red gum forests was $3.90 for Bairnsdale households and $1.20 for Melbourne residents (local residents identified no willingness to pay for this improvement. We adjust these values with CPI from 2007 to 2014

[5] Bennett et al (2007) found that annual household value for this change was estimated at $0.97 per Melbourne household, $1.43 per 'rest of Victoria' household, and $1.00 per 'local region' household. We adjust these values with CPI from 2007 to 2014.

[6] We adjust this source value for CPI from 2011 to 2014. Please note that this was not undertaken in the Aither report.

[7] Some minor negative impacts in visitor numbers were expected during inundation events, but these were expected to be offset by significant increases in visitor numbers over time.

[8] We again account for CPI from the source study in 2007 to 2014.

[9] Please note that the value for changes to healthy native vegetation, native fish population and frequency of colonial water-bird breeding may constitute a 'double-count' of environmental value, depending upon how the CSIRO SDL Adjustment Ecological Elements Method is employed. How this method will be employed is unknown at the time of this business case submission.

Table 14-1. Economic benefits produced by the project ($2014) (Aither, 2014)[10]

	Annual value ($M)	Present value ($M)11
Healthy native vegetation	$2	$18.2
Native fish population	$0.24	$2.2
Frequency of colonial water-bird breeding	$0.55	$5
Recreation	$1.6	$14.8
Total	$4.4 million	$40.2 million

A number of unquantified benefits are also identified for the project, namely:

- Cultural heritage: numerous cultural heritage sites exist within the vicinity of Wallpolla Island, including burial sites scarred trees, artefact scatters, shell middens, hearth features and human remains. The scarred trees may benefit from improved environmental conditions, while other cultural sites (e.g. hearths) may benefit from increased protection works undertaken through the Cultural Heritage Management Plan developed for this project.
- Apiarists: the beehives that currently exist at Wallpolla Island depend on seasonal flowering of river red gum forests, which will increase in regularity and reliability due to the project. This should increase the number of hives at each site, and the number of active sites. This value is not quantified.

In terms of impacts on the local community of the project, Compelling Economics developed a REMPLAN input-output model of the Mildura-Wentworth region. Using this model, the impact of the proposed works at Wallpolla Island can be estimated in terms of employment, output, wages and salary, and industry value added.

During the two year construction phase of the proposed works, the additional expenditure will result in $29.6 million per year of gross output and 71 jobs. After this construction phase, tourism expenditure and annual operations and maintenance expenditure will result in output of $3.8 million per annum and 9 additional jobs.

These numbers illustrate the regional benefits of the project but are not proposed to be included in the cost-benefit analysis.

[10] Please note that all data in this table is adjusted for CPI from the source year (2007). This was not undertaken in the Aither analysis.

[11] $2014, discount rate of 7% over 30 years. Please note that the 'present value' estimates in the Aither document differ from numbers reported here, as Aither estimated 30 years of benefit whereas in this project benefits commence in the 4th year of the 30 year analysis period, producing only 26 years of benefit.

15.Stakeholder management strategy (Section 4.11.1)

The Mallee CMA has worked with key stakeholders and interested community groups to develop the concept for the *Wallpolla Island Floodplain Management Project* from 2012 to 2014. Communication and engagement activities conducted throughout the Business Case phase have included:

- More than 110 face-to-face briefing sessions, meetings, presentations and on-site visits, engaging more than 334 people, which is reflective of the wide range of project stakeholders;
- Fact sheets, media releases, electronic communication (website, emails, newsletters), brochures and correspondence.

This direct approach to engagement has helped ensure the views and local knowledge of key stakeholders and community members have been directly integrated into the project, resulting in broad community support for the proposed works at Wallpolla Island, as evidenced by the receipt of letters of support from:

- Materially-affected land managers such as Parks Victoria
- Aboriginal stakeholders
- Adjacent private landholders
- Regional Development Australia and Regional Development Victoria – Loddon Mallee
- Local government (Mildura Rural City Council)
- Industry groups
- Tourism operators, and
- Community groups such as the Yelta Landcare Group and Sunraysia Riverwatch.

A full list of the letters of support received for this project is listed in Appendix G.

Broad community support for this proposed project is further evidenced by the sustained interest in the proposal as illustrated by on-going requests from key stakeholders to provide briefings, presentations and updates.

15.1. Communication and engagement strategy

A detailed Communication and Engagement Strategy has been developed for this project and key stakeholders identified. This strategy has helped to ensure those who are materially affected by the project and the broader community have been consulted and their views adequately considered and responded to (RMCG, 2014).

This strategy reflects the intent of the *Principles to be applied in environmental watering* outlined in the Basin Plan (MDBA, 2012a), aligns with the directions of the Victorian Government's Environmental Partnerships policy (Victorian Government, 2012) and is consistent with the principles of the Community Engagement and Partnerships Framework for Victoria's Catchment Management Authorities (Community Engagement and Partnership Working Group 2012) (RMCG, 2014).

The Communication and Engagement Strategy includes:

- Identification of key stakeholders of the *Wallpolla Island Floodplain Management Project*
- Detailed analysis of the stakeholders, which have been divided into three groups according to their level of interest in and influence on the project
- Analysis of stakeholders' issues and sensitivities
- Clearly articulated objectives and engagement approaches designed to meet the needs of different stakeholder groups, and
- Communication and engagement activities for both the Business Case and implementation phases of the project.

An overview of the Wallpolla Island Communications and Engagement Strategy and the outcomes from the Business Case phase are provided in the following sections. The full strategy is provided in Appendix H.

15.2. Key stakeholders

Stakeholders have been characterised into three groups relating to their interest and influence on the project outcomes. Relative to each other, Stakeholder Group 1 has a higher level of interest in and influence on the project outcomes, Stakeholder Group 2 has a moderate level of interest in and influence on the project outcomes and Stakeholder Group 3 has a lower level of interest in and influence on the project outcomes (RMCG, 2014).

Stakeholder Group 1 has been further defined into two key types; project partners and project stakeholders. Project partners are differentiated from project stakeholders for the purposes of defining appropriate communication and engagement approaches as they have a direct role in the design and development of the project (i.e. as investors, land managers, construction or operational managers) (RMCG, 2014).

The engagement approach for Stakeholder Group 1 can be described as high intensity, targeted and tailored to the needs of each individual stakeholder. On the iap2 public participation spectrum, the aim of the engagement approach for project partners is to COLLABORATE in the planning, construction and operation phases of the *Wallpolla Island Floodplain Management Project*. For project stakeholders, the aim is to INVOLVE stakeholders in all phases of the *Wallpolla Island Floodplain Management Project* (RMCG, 2014).

The engagement approach for Stakeholder Group 2 is of moderate intensity, targeted and more generic in nature in comparison to Stakeholder Group 1. On the iap2 public participation spectrum, the aim of the engagement approach for Stakeholder Group 2 is to CONSULT stakeholders on the planning, construction and operation phases of the *Wallpolla Island Floodplain Management Project* (RMCG, 2014).

The engagement approach for Stakeholder Group 3 is of lower intensity, publicly accessible and generic in nature. On the iap2 public participation spectrum, the aim of the engagement approach for Stakeholder Group 3 is to INFORM stakeholders on the planning, construction and operation phases of the *Wallpolla Island Floodplain Management Project*.

Table 15-1 provides a list of stakeholders in each of the three Stakeholder Groups. A more detailed analysis of issues and sensitivities by stakeholder is provided in the Wallpolla Island Communication and Engagement Strategy (Appendix H: Section 2, pp. 4-8) (RMCG, 2014).

Table 15-1. Stakeholders of the *Wallpolla Island Floodplain Management Project*

Stakeholder group	Stakeholder	Summary of issues and sensitivities
Group 1a: Project partners	Department of Environment and Primary Industries (DEPI) Parks Victoria Trust for Nature Murray-Darling Basin Authority (MDBA) Goulburn-Murray Water (G-MW) SA Water	Land inundation Restoring the natural ecology Consistency with Basin Plan Environmental water responsibilities Managing impacts of works on visitors and recreation Responsibility for construction/operations Impacts of water volume on river flow Appropriate infrastructure to maximise the impact of environmental watering Ensuring projects are delivered in a way that both benefits the environment and respects Indigenous culture
Group 1b: Project stakeholders	**Indigenous community:** Ngintait, Latji Latji Mumthelang Aboriginal Corporation, Nyeri Nyeri Lindsay Point Irrigators Adjacent freehold landholders **Local community**: townships of Lake Cullulleraine, Werrimull and Mildura **Mallee CMA Community Committees:** Land and Water Advisory Committee (LWAC), Aboriginal Reference Group (ARG), The Living Murray Community Reference Group (CRG) (Hattah Lakes and Lindsay-Wallpolla Icon Sites) **Local Government:** Mildura Rural City Council Commonwealth Environmental Water Holder (CEWH) Victorian Environmental Water Holders (VEWH)	Impact to cultural heritage and indigenous values Future environmental health of country Land inundation Restoring the natural ecology Continuity and quality of irrigation water supply Local knowledge, history and a sense of ownership of the areas involved Impact to local amenity, recreation, economy and environment Impacts of water volume on river flow Appropriate infrastructure to maximise the impact of environmental watering Ensuring projects are delivered in a way that both benefits the environment and respects Indigenous culture Ensuring that proposed activities and outcomes are acceptable to the wider community Consistency with planning scheme
Group 2	**Other environmental organisations:** Murray-Darling Freshwater Research Centre, Murray-Darling Association, Environment Victoria, Australian Conservation Foundation, Lower Murray Water **Community-based environment groups:** Yelta Landcare Group, Millewa-Carwarp Landcare Group, Birdlife Australia (Mildura Branch), River Watch, Sunraysia Field Naturalists Club, Sporting Shooters Association of Australia (Nhill), Murray-Darling Wetlands Working Group, Victorian National Parks Association	Impact to local amenity, recreation, economy and environment Ensuring projects are delivered in a way that both benefits the environment and respects Indigenous culture

	Indigenous organisations/groups: North West Native Title Claimants, Murray Lower Darling Rivers Indigenous Nations (MLDRIN) **Other community groups/businesses:** Regional Development Australia and Regional Development Victoria – Loddon Mallee, 4WD clubs, angling clubs, tourism businesses, license holders (firewood, bee keeping, fishing), Rotary, Probus, Progress associations, CWA, Lions **Park users/visitors:** Murray-Sunset National Park	
Group 3	**Wider community:** Mallee region, Victoria, Murray-Darling Basin	As above

15.3. Communication and engagement approaches and outcomes from the Business Case phase

The overall response to engagement activities undertaken to date has been positive. Engagement activities were tailored to the stakeholder's interest in the project and provided the opportunity to identify issues/sensitivities and reach agreed outcomes.

For all communication and engagement activities completed through the Business Case phase, Mallee CMA has kept a detailed record of:

- Who has been consulted and the outcomes
- How consultation outcomes have been considered and responded to, and
- The extent of stakeholder and community support for the project.

The outcomes of consultation undertaken during the business case phase will directly inform the communication and engagement strategy for the implementation phase of this project.

An overview of the communication and engagement approaches and main outcomes from the consultation by stakeholder group is provided in Table 15-2.

A more detailed analysis of the approaches, including key constraints is provided in the Wallpolla Island Communication and Engagement Strategy (Appendix H: Section 3-4, pp. 9-25).

Table 15-2. Summary of consultation outcomes from the Business Case phase

Stakeholder group	Communication/engagement approach	Focus of consultation	Summary of consultation outcomes (Mallee CMA response)	Evidence of support for the project
Group 1: Project partners	Intensive engagement through: Sustainable Diversion Limits Offset Projects Steering Committee: Lindsay-Wallpolla Islands meetings (monthly) Design team meetings Negotiations regarding roles and responsibilities One-on-one discussions as required	Siting of proposed infrastructure Design param of proposed infrastructure Downstream water quality impacts Adjustments/clarifications to technical information and/or presentation of information in business case Monitoring and management of salinity and turbidity during operation of proposed infrastructure	Adjusted structure location to reflect stakeholder advice Designs developed in accordance with stakeholder preferences/requirements Operational scenarios for proposed infrastructure investigated to minimise water quality impacts Business case adjusted in accordance with feedback received Salinity investigations undertaken, monitoring and management strategies considered Planned ongoing engagement with project partners	Provisional endorsement of business cases by Steering Committee Letters of support for the project from partner agencies such as Parks Victoria Sustained, consistent high-level involvement in project development throughout business case phase
Group 1: Project stakeholders	Small group (face-to-face) briefing sessions with Mallee CMA, including on-site visits Face-to-face engagement and on-site visits with Aboriginal stakeholders Presentations conducted by Mallee CMA	Inundation of private land Minimisation of harm to sites of cultural heritage, in line with legislative requirements Monitoring and management of salinity and turbidity during operation of proposed infrastructure	Specific control mechanisms included in project proposal to include/exclude private land inundation in line with stakeholder preference Works proposed for existing tracks/disturbed areas where possible to minimise harm to sites of cultural heritage Preliminary cultural heritage assessment completed to inform project development Salinity investigations undertaken, monitoring and management strategies considered Planned ongoing engagement with project stakeholders	Letters of support from Aboriginal stakeholders, adjacent freehold landholders (including NSW landholders), Mallee CMA community committees and local government (Mildura Rural City Council) On-going discussions/preliminary approval processes completed with Mildura Rural City Council, resulting in a strong working relationship. Sustained interest in the project as illustrated by on-going requests from key stakeholders to provide briefings, presentations and updates.

Group 2	Teleconference briefing sessions with Mallee CMA staff Presentations conducted by Mallee CMA staff	Social (e.g. public access) and economic (e.g. financial investment in region) challenges/opportunities Impact on apiary operations.	Operational scenarios for proposed infrastructure investigated to minimise restrictions to public access. Clear and accessible information provided regarding proposed project Consideration of apiary requirements in planning operation of infrastructure Planned ongoing engagement with project stakeholders	Letters of support from tourism operators, as well as key organisations and community groups such as Regional Development Australia and Regional Development Victoria – Loddon Mallee, Yelta Landcare Group, Mildura West Inc, Sunraysia Branch Victorian Apiarists Association Sustained interest in the project as illustrated by on-going requests from key stakeholders to provide briefings, presentations and updates.
Group 3	Information accessed through the Mallee CMA website	Impacts on public access and/or water quality during operation of proposed infrastructure.	Operational scenarios for proposed infrastructure investigated to minimise water quality impacts and/or restrictions to public access Planned ongoing engagement with project stakeholders	Letters of support Sustained interest in the project as illustrated by on-going requests from key stakeholders to provide briefings, presentations and updates.
All stakeholders	Information package accessed on the Mallee CMA website (fact sheets, case studies, photos, contact information) Project up-dates	As above	As above	Letters of support Sustained interest in the project as illustrated by on-going requests from key stakeholders to provide briefings, presentations and updates.

15.4. Proposed consultation approaches for the implementation phase

A proposed communication and engagement strategy has been prepared for each Stakeholder Group for the implementation phase of the *Wallpolla Island Floodplain Management Project*. This strategy was directly informed by the outcomes of the consultation activities undertaken during the business case phase of the project.

An overview of the planned communication and engagement approaches is provided in Table 15-3. A more detailed analysis of the approaches is provided in the Wallpolla Island Communication and Engagement Strategy [Appendix H, Section 3-4, pp. 9-25].

A large effort has been invested in the communication and engagement activities in order to develop broad community support for the *Wallpolla Island Floodplain Management Project*. The project has high visibility among materially affected and adjacent landholders/managers, along with Aboriginal stakeholders and other interested parties. It is critical to the success of project that the advice and concerns of those involved have been considered and responded to accordingly. This strong commitment to working directly with project partners and the community will be ongoing throughout the construction and implementation phases of the project, further engaging community support and ensuring success for the *Wallpolla Island Floodplain Management Project*.

Table 15-3. Communication and engagement strategy for the implementation phase

Stakeholder group	Engagement approach	iap2 level of engagement	Number / timing
Group 1: Project partners	Intensive engagement throughout project planning and development including design and construction meetings, on-site visits and other engagement methods as relevant	Collaborate	Ongoing
Group 1: Project stakeholders	Tailored events (e.g. site tours, funding announcement, commencement of construction)	Involve	Funding announcement/commencement of construction Site tours as required
Group 2	Teleconference briefing sessions with Mallee CMA staff Presentations conducted by Mallee CMA staff	Consult	Ongoing as required Throughout implementation phase
Group 3	Videos accessed through the Mallee CMA website Information package accessed on the Mallee CMA website (fact sheets, case studies, photos, contact information)	Inform	Accessible throughout implementation phase As soon as possible after funding is confirmed Updated and accessible throughout implementation phase
All stakeholders	Project up-dates accessed through the Mallee CMA website and social media channels (e.g. e-newsletter, Twitter and other social media)	Inform	Regularly throughout implementation phase
	Media communication (e.g. media releases, newspaper articles, radio interviews, television interviews)	Inform	As required throughout construction and operation One media release associated with each watering event

16.Legal and regulatory requirements (Section 4.11.2)

Obtaining statutory approvals is an essential consideration for the *Wallpolla Island Floodplain Management Project*. The process of obtaining the necessary approvals can be complex and can present risks to the timeline, budget and delivery of the project.

Early identification of statutory approvals and background investigations required to complete the approvals, interdependencies between approvals as well as timeframes associated with both the preparation and assessment/consideration of submissions have been identified as important elements critical to the timely delivery of environmental watering projects (Golsworthy, 2014).

In order to guide the approvals process, DEPI and the Mallee CMA commissioned management strategies (GHD, 2014; Golsworthy 2014). The strategies provide a clear understanding of the current relevant legislation as well as the approvals required, based on the type and location of planned works, the cultural heritage, flora and fauna values present within the works footprint, and the past experience of the Mallee CMA and partner agencies in completing approvals for large, infrastructure-based projects within National Parks.

16.1. Regulatory approvals

GHD (2014a, Appendix I) and Golsworthy (2014, Appendix J) have identified the approvals, permits and licences likely to be required prior to the commencement of construction. An assessment of relevant issues based on the proposed construction footprint at Wallpolla Island has indicated the need to obtain several approvals under local government, State and Commonwealth legislation.

***Approvals** refers to all environmental and planning consents, endorsements and agreements required from Government agencies by legislative or other statutory obligations to conduct works (GHD, 2014).*

The approvals required for Wallpolla Island are listed in Table 16-1.

Table 16-1. Regulatory approvals anticipated for Wallpolla Island (GHD, 2014)

Approvals required	Description
Commonwealth legislation	
Environmental Protection & Biodiversity Conservation Act 1999 **Referral**	A number of "matters of national environmental significance" (MNES) are potentially present at Wallpolla Island: Upstream of Banrock, Coorong and Riverland Ramsar sites Eight migratory waterbird species 19 nationally threatened species Three threatened ecological communities.
Victorian legislation	
Environmental Effects Act 1978 **Referral**	Relevant to two of the six referral criteria for individual potential effects i.e. Potential clearing of 10 ha or more of native vegetation from an area that: • Is of an Ecological Vegetation Class identified as endangered, or • Is, or is likely to be, of very high conservation significance (as defined in accordance with Appendix 3 of Victoria's Native Vegetation Management Framework), and • Is not authorised under an approved Forest Management Plan or Fire Protection Plan Potential long-term change to the ecological character of a wetland listed under the Ramsar Convention or in 'A Directory of Important Wetlands in Australia' Potential extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems, over the long term
Planning & Environment Act 1987 **Planning permit** **Public Land Managers Consent**	Applicant to request permission from public land manager to apply for a planning permit for works on public land A planning permit application is then submitted with supporting documentation: likely to include an offset strategy, and threatened species management plan Local Council refers applications and plans to appropriate authorities for advice
Aboriginal Heritage Act 2006 **Cultural Heritage Management Plan**	A CHMP is required when a listed high impact activity will cause significant ground disturbance and is in an area of cultural heritage sensitivity as defined by the Aboriginal Heritage Regulations 2007 (Part 2, Division 5) Relevant high impact activities relates to: (xxiii) a utility installation, other than a telecommunications facility, if the works are a linear project with a length exceeding 100 m (other than the construction of an overhead power line or a pipeline with a pipe diameter not exceeding 150 mm). To be prepared by an approved Cultural Heritage Advisor
Water Act 1989 **Works on waterways permit**	Application for a licence to construct and operate works on a waterway.
National Parks Act 1975 **Section 27 consent**	Approval for a public authority to carry out its functions in a national park.
Flora & Fauna Guarantee Act 1988 **Protected flora licence or permit**	Application for approval to remove protected flora within public land for non-commercial purposes. Will need to include targeted surveys for threatened/protected species considered likely to be present at the site and impacted by proposed works

The following supporting documents will be required and likely to be requested through referral decisions on planning permit conditions (GHD, 2014):

- An offset strategy for native vegetation losses

- An environmental management framework
- A threatened species management plan, and
- A cultural heritage management plan.

The application process for each approval, the responsible agency, timing of submissions and timeframe for decisions are outlined in the Regulatory Approvals Strategy (GHD, 2014). The Strategy includes an indicative program for effecting regulatory approvals that predicts a minimum 31 week period to obtain all required approvals. This timeframe assumes that an Environmental Effects Statement is not required, all applications (including supporting documentation) are already prepared and that there are no significant delays during the assessment process. The Strategy also notes that there are a number of linkages and dependencies between approvals, where for example, some approvals cannot be issued until another is approved e.g. a planning permit cannot be granted until there is an approved CHMP.

A Regulatory Governance Group (RGG) supports the delivery of business case requirements related to regulatory approvals by providing a mechanism for high-level engagement with responsible agencies at an early stage to streamline the regulatory approvals process. The RGG provides advice to the Project Control Board (PCB) regarding the regulatory approvals needed for Victorian projects, the resolution of associated issues and develops a program-level strategy to obtain approvals.

16.2. Legislative and policy amendments and inter-jurisdictional agreements

At the state level, a legislative change may be needed to address the requirement to secure native vegetation offsets prior to clearing. As the primary offsetting mechanism is expected to be the gains in vegetation condition within the areas watered by the various Victorian works-based supply measures, i.e. the outcomes of the measures once operational, this requirement cannot be met. DEPI will investigate a suite of options to address this issue during the detailed design for this measure, including the potential for a planning scheme amendment. Note that the other options to be investigated do not require legislative changes.

Matters related to other regulatory approvals necessary for the implementation of this supply measure are discussed elsewhere in this Business Case.

No other amendments to state legislation or policy are anticipated. This includes any formal amendments to state water sharing frameworks, or river operations rules or practices.

Further to this, no changes to the Murray-Darling Basin Agreement 2008 are required to implement this measure, nor do any new agreements need to be created either with other jurisdictions or water holders in the Basin.

16.3. Cultural heritage assessment

An Archaeological Due Diligence Assessment Report (Bell, 2013) has been completed for the project (Appendix K). A desktop assessment showed that within 100 m of proposed structures there was a total of three recorded Aboriginal Cultural Heritage places. Field inspections identified a total of 15 previously unrecorded Aboriginal cultural heritage places. Under the *Aboriginal Heritage Act 2006* Wallpolla Island is specified as an area of cultural heritage sensitivity in accordance with several categories and a Cultural Heritage Management Plan will be undertaken.

17. Governance and project management (Section 4.11.3)

Appropriate governance and project management arrangements have been put in place to minimise risks to investors and other parties from the proposed supply measure. The sections below describe the governance arrangements during business case development and proposed arrangements during project implementation.

17.1. Governance arrangements during business case development

A Project Control Board (PCB) was convened by DEPI to oversee the development of business cases for the nine Victorian works-based supply measures. The PCB is comprised of senior executives from DEPI, the Mallee and North Central CMAs, Goulburn Murray Water and Parks Victoria. This has ensured high level engagement of responsible agencies and has assisted in identifying and resolving program-level issues during development of business cases. The PCB's role has been to ensure that:

- All business cases meet the requirements set out in the Phase 2 Guidelines (reference)
- All business cases are of a high and consistent standard and delivered within specified timelines
- The technical basis of each business case is robust, credible and fit for purpose; and
- Appropriate consultation with stakeholder agencies, affected persons and the community was carried out during business case development.

The PCB has been supported by an Expert Review Panel and Regulatory Governance Group, and project-specific governance arrangements set up by the North Central and Mallee CMAs (see Figure 17-1).

The *Wallpolla Island Floodplain Management Project* business case has been endorsed by the PCB as part of the final package of Victorian business cases to be submitted for assessment under Phase 2 of the SDL adjustment mechanism.

Expert Review Panel

An Expert Review Panel ('the Panel') was set up to examine the critical elements of each business case at key stages and assess quality, credibility and whether the element is fit for purpose. The Panel was chaired by David Dole and comprised of experts in engineering (including geotechnical, structural, hydraulic and water system operations), hydrology and ecology. Its members include:

- Phillip Cummins (engineering)
- Shane McGrath (engineering)
- Dr Chris Gippel (hydrology),
- Andrew Telfer (salinity)
- Professor Terry Hillman (ecology).

The following evaluations were carried out during the development of this business case:

- Engineering: Review of concept engineering designs (hydraulics and structures), the scoping of geotechnical investigations to support water management structure design and construction costs
- Hydrology: Review of hydrodynamic and hydrological models, data, modelled scenarios and outputs,
- Salinity: review of assessments of potential salinity impacts of works and measures projects; and
- Ecology: Review of the descriptions of ecological values, the ecological objectives and targets, and environmental watering requirements, and the descriptions of anticipated ecological outcomes and environmental watering requirements.

The Expert Review Panel concluded that the underlying feasibility and outcome investigations have effectively provided a soundly based proposal which is fit for purpose.

Regulatory Governance Group

The Regulatory Governance Group (RGG) was established to support the delivery of business case requirements related to regulatory approvals. The RGG was comprised of relevant staff from Victorian approvals agencies, including DEPI, Parks Victoria and Aboriginal Affairs Victoria. The RGG provided advice to the PCB regarding the regulatory approvals needed for Victorian projects, the resolution of associated issues and develop a program-level strategy to obtain approvals (Appendix I).

Setting up the RGG has provided a mechanism for high-level engagement with responsible agencies at an early stage to streamline the regulatory approvals process for proposed supply measures. While the RGG ceased operation when all business cases were finalised for submission (December 2014), the Group may be reconvened by the PCB as required.

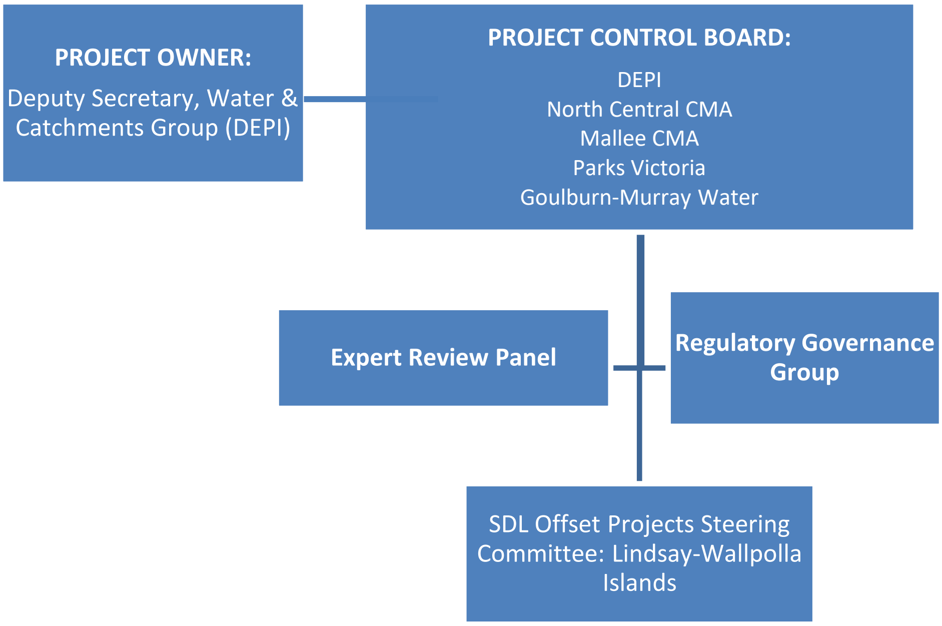


Figure 17-1. Governance arrangements during business case development.

SDL Offset Projects Steering Committee: Lindsay-Wallpolla Islands

At the project level, development of the business case for the *Wallpolla Island Floodplain Management Project* was overseen by the SDL Offset Projects Steering Committee (Lindsay-Wallpolla Islands) (Mallee CMA, 2014a). The committee's role was to ensure the business cases developed for these sites are of a high quality, consistent standard and that they meet the requirements of the Commonwealth (Mallee CMA, 2014a).

Specifically the committee was responsible for the following functions in the development and delivery of the relevant SDL project business cases (Mallee CMA, 2014a):

- Provision of advice on the development and proposed delivery of SDL projects from a technical perspective
- Ensuring projects developed and the supporting business cases produced are technically rigorous and sound
- Providing guidance to resolve project-specific issues
- Monitoring the development of business cases to ensure a consistent approach and that required information is provided, in accordance with the Phase 2 Guidelines for Supply and Constraint Measure Business Cases provided by the Commonwealth, and
- Providing advice on project procurement from a technical perspective.

The committee was comprised of the following members (Mallee CMA, 2014a):

- Chief Executive Officer, Mallee CMA
- The Living Murray Coordinator, Mallee CMA
- Manager Water, Mallee CMA
- Parks Victoria representative/s (land manager representative)
- DEPI representative/s (land manager representative and coordinator of regional environmental advice and approvals)
- G-MW representative/s
- SA Water representative/s
- MDBA representative/s.

The Steering Committee met monthly, with extraordinary meetings scheduled as necessary. The committee ceased operation when all business cases were finalised for submission (December 2014) (Mallee CMA, 2014a).

17.2 Governance arrangements during project implementation

To ensure that this proposed supply measure is delivered on time, arrangements will be put in place that ensure appropriate senior oversight of project governance and delivery. This will allow for the successful completion and operation of the measure as part of the SDL adjustment mechanism.

These arrangements will be predominantly based around those that were used to deliver the four Living Murray Environmental Works and Measures Program (EWMP) projects within Victoria, complemented by existing state government frameworks, which together will underpin a set of robust and thorough processes for procurement and project management. Key aspects of the proposed governance and project management for this supply measure will include:

Project management structure and team

The project management structure and team will be overseen by the project owner, currently anticipated to be DEPI. In line with the governance arrangements that have underpinned the Business Case preparation for this proposed supply measure, DEPI will be supported by a PCB, comprised of senior executives from DEPI, the relevant Victorian CMAs, the relevant constructing authorities (e.g. G-MW; SA Water), Parks Victoria and the Commonwealth.

It is expected that the PCB will be comprised of appropriate senior management representation from each of the participating agencies, who will have the required decision-making authority to oversee all elements of implementation. In line with the successful governance arrangements that were utilised during the Living Murray EWMP and the outcomes of the workshop regarding ongoing asset management arrangements (see Section 14.5), the relevant constructing authority would be well placed to undertake the construction of the supply measure, supported by the relevant CMA.

Procurement strategy

As the primary delivery agency, the relevant constructing authority would be expected to manage procurement during the construction of the supply measure, operating under the high-level oversight of the PCB. Supporting this, the relevant CMA will play a critical role by assisting in the development of a procurement strategy, which would be approved by the PCB. More specific details of the preferred approach for procurement will be detailed in the construction proposal.

Project Steering Committees or related governance mechanisms

In line with good governance practice, and again drawing on the experience of the Living Murray, it is expected that the PCB would meet regularly throughout the construction of this proposed supply measure to ensure that milestones and timelines are met, and to resolve any potential issues that may arise.

It is expected that PCB members would have the required decision-making authority to address any emerging risks, including the following:

- Identifying and resolving issues including those that might impact timelines/budget
- Providing guidance to resolve project-specific issues
- Ensuring appropriate consultation with key stakeholder agencies and the community
- Closely monitoring implementation to ensure timelines and budgets are met, and
- Making recommendations to DEPI on any issues that may arise during construction.

Monitoring and reporting during implementation

It is anticipated that the PCB would be the key conduit for monitoring and reporting during the implementation of this proposed supply measure. This will include:

- The relevant constructing authority providing regular implementation updates at each PCB meeting, and
- Consideration of any milestone or payment reporting that is likely to be required under all contractual funding arrangements associated with this supply measure.

Design and implementation plan with timelines

The PCB will meet regularly throughout the construction phase of this proposed supply measure to ensure milestones and timelines are met to review designs and to resolve any arising issues. The relevant CMA will play a critical supporting role by assisting the constructing authority with statutory approvals and the development of the construction proposal as well as managing discrete projects to support detailed designs and the implementation/construction of the supply measure.

A detailed work plan will document the key tasks and the agency responsible, associated resources and timelines for the implementation of the supply measure.

Refer to Table 3-3 for a proposed project delivery schedule outlining timelines for the implementation of this project.

Operations Group

An Operations Group will be established to assist and advise on the commissioning and operation of this proposed supply measure. This Group will provide a forum to involve project partners in the decision-making process to consider broader system operations (e.g. of the River Murray and other environmental watering events) during planning and operations and to inform stakeholders of operations and progress.

For the Wallpolla Island site, the Operations Group membership will consist of partners and stakeholders, including the Murray-Darling Basin Authority, the Victorian Department of Environment and Primary Industries, SA Water, NSW Office of Water, Lower Murray Water, Parks Victoria, the Commonwealth Environmental Water Holder and the Victorian Environmental Water Holder. Other agencies and organisations may be invited to participate as guests or observers.

The key responsibilities of the Operations Group will be to ensure the necessary planning, monitoring, communication and reporting arrangements are established prior to and during events and to identify and monitor any event risks or issues. This allows for safe and effective operation of the works, real time response and adaptive management when necessary.

17.3 Governance expertise of partner agencies

Implementation of the project at Wallpolla Island will be a partnership between four agencies: Mallee CMA, DEPI, Parks Victoria and SA Water.

Mallee CMA

The primary responsibility of the Mallee CMA is to ensure that natural resources in the region are managed in an integrated and ecologically sustainable way. The Mallee CMA's work is based on rigorous science and delivered through meaningful partnerships with government agencies, industry, environmental organisations, private land managers, Aboriginal stakeholders and the broader community. All delivery arrangements are formalised through a range of mechanisms including operating agreements, service level agreements and landholder incentive / tender management agreements, the application of comprehensive MERI frameworks; and the application and interpretation of complex spatial data.

The Mallee CMA have a proven track record in successfully delivering a vast range of environmental projects which have varied in complexity, monetary value (up to multi-million dollar projects) and in spatial extent (from concentrated focal points to landscape scale programs).

Operating within policies and controls approved and overseen by the Mallee CMA Board ensures transparent and accountable governance systems that embody performance and continuous improvement. These governance arrangements include a quality management approach to project management, with policies and procedures for project management, contractual arrangements, procurement and risk management.

DEPI

The primary responsibility of DEPI in regard to this project is to act as its sponsor through the project assessment process established by the Intergovernmental Agreement on Murray-Darling Basin Water Reform 2014 (IGA). As part of this process, DEPI will represent the State of Victoria in negotiations with Commonwealth Government agencies to secure funding for the project, consistent with the commitments and arrangements outlined in the above mentioned IGA.

Once a funding agreement is reached for this project, DEPI will then assume an oversight role for the rollout of the project consistent with the terms of the funding agreement. As indicated previously, this oversight will be applied through the establishment of a PCB for the purposes of this project and any others that secure Commonwealth Government funding. It is envisaged that this PCB will be chaired and operated by DEPI. Its primary focus will be to ensure that milestones and timelines are met and where necessary, to resolve any emerging issues that present a material risk to the conduct and/or completion of this project.

Over the past decade, DEPI has had considerable experience in undertaking such oversight roles to a high standard for major Commonwealth funded water infrastructure projects in Victoria. Notable examples in this regard include the Living Murray Environmental Works and Measures projects at Gunbower, Hattah Lakes, Mulcra and Lindsay Islands, the G-MW Connections Program and the Lake Mokoan project.

Parks Victoria

Parks Victoria is a statutory authority, created by the Parks Victoria Act 1998 and reporting to the Minister for Environment and Climate Change. Parks Victoria is responsible for managing an expanding and diverse estate covering more than four million ha, equating to 17 %, of Victoria.

Parks Victoria is committed to delivering works on the ground across Victoria's park network to protect and enhance park values. Parks Victoria's primary responsibility to ensure parks are healthy and resilient for current and future generations and manage parks in the context of their surrounding landscape and in partnership with Traditional Owners.

Parks Victoria works in partnership with other government and non-government organisations and community groups such as DEPI, CMAs, private land owners, friends groups, volunteers, licensed tour operators, lessees, research institutes and the broader community.

Health Parks Healthy People is at the core of everything Parks Victoria does. Parks and nature are an important part of improving and maintaining health, both for individuals and the community. Parks Victoria has a clear role to play in connecting people and communities with parks.

South Australia Water

SA Water has a history of delivering large and complex civil water retaining structures such as:

- The Chowilla Regulator on behalf of the Murray-Darling Basin Authority, ($58M)
- The South and Little Para Dam upgrades (South Australia), ($22M)
- The River Murray Locks and Weirs Upgrades, ($67M)
- Murtho Salt Interception Scheme, ($30M)
- Kangaroo Creek Dam Safety Upgrade, in delivery, ($82M)

SA Water has gathered significant experience in this field due largely to its existing capital plan in excess of $300 M per annum, which will ensure this project moves forward and delivers the outcomes for the state/national client in a consistent manner that addresses risk and opportunity throughout the life of the project.

SA Water will also deliver significant benefits to the project by leveraging existing procurement frameworks, panel relationships and senior support in the form of its Board and Senior Executive team.

This project’s outcomes will be delivered in accordance with SA Water’s Corporate Project Management Methodology. This methodology provides governance, delivery and risk management in line with the recognised national standards and is based on the Australian Business Excellence Framework and Project Management Body of Knowledge (PMBOK). The projects delivery framework will also be consistent with the Australia/New Zealand Risk Management Standard AS/NZS ISO 4360.

18. Risk assessment of project development and construction (Section 4.11.4)

A comprehensive risk assessment of the project development and construction phases has been carried out. A number of threats to successful project delivery were identified, as described in Table 18-1. The risk assessment process was informed by the past experience of the project team in the development and construction of environmental watering projects of similar scale and complexity, including TLM.

18.1 Risk assessment methodology

The risk assessment for the *Wallpolla Island Floodplain Management Project* was completed in line with the requirements of AS/NZS ISO 31000:2009 (Lloyd Environmental, 2014). This assessed both the likelihood of an event occurring and the severity of the outcome if that event occurred. The assessment generated a risk matrix in line with the ISO standards and prioritised mitigation strategies and measures.

Refer to Section 7, Tables 7-1 to 7-4 to view the risk matrix and definitions used in this risk assessment, and further details on the methodology.

The risk assessment was consolidated as the project developed and additional information incorporated into Table 18-1.

18.2 Risk assessment outcomes

Table 18-1 presents a summary of the assessment and subsequent work undertaken, including mitigation measures developed and an assessment of residual risks after these are applied. It should be noted that where a residual risk is given a range of ratings, the highest risk category is listed.

Table 18-1. Risk assessment – Potential impacts to project delivery and construction without mitigation and residual risk rating with mitigation, adapted from Lloyd Environmental (2014)

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
Unexpected delays in obtaining statutory approvals	The high environmental and cultural values of Wallpolla Island may result in a lengthy regulatory approvals process, due to requests for additional information to clarify the potential impacts and proposed mitigation measures. Numerous conditions could also be placed on permits and approvals to ensure appropriate controls are in place during construction to minimise impacts.	Certain	Moderate	High	General: • CEMP developed and implemented; monitoring during construction to ensure compliance. • Site-based approvals group convened to engage with the relevant regulatory authorities • Project delivery timelines informed by Regulatory Approvals Strategy to minimise unexpected delays. Cultural heritage: • Preliminary assessment to inform structure design and location • A CHMP will be developed in consultation with Indigenous stakeholders and implemented during construction to minimise impacts on cultural values.	Low
Delays to construction planning and completion	Time and cost overruns could occur if the time required to obtain all necessary approvals is not embedded in the project planning and delivery timeframe.	Certain	Moderate	High	As above, and: Maintain strong working relationships with partner agencies (including agencies in NSW, SA and Victoria) through regular design and construction group meetings. Incorporate potential for delays into contractual arrangements.	Low
Weather related delays	Adverse weather (such as storms, heat waves) may create short-term delays to works through limitations to site access due to poor track conditions, OH&S and fire safety considerations.	Certain	Moderate	High	Consider weather conditions and medium to long-term forecasts when sequencing site works to minimise impacts and inform program scheduling to accommodate extreme weather events. Incorporate potential for delays into contractual arrangements, including appropriate terminology and clauses to ensure the principal and client are not put at undue risk for natural events.	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
Floods	Natural floods may inundate the site and restrict access during construction, leading to cost increases and delays. These issues may be compounded by local weather conditions preventing demobilisation at the site.	Possible	Severe	High	Physically managing flows, as far as practical, through river operations. Utilise long-range weather forecasts, flow forecasts and general flow data (travel time, historical/predictive flows) to provide advance warning of floods to ensure sufficient lead time for demobilisation. Maintain strong working relationships with partner agencies (including agencies in NSW, SA and Victoria) through regular design and construction group meetings to assist timely issue resolution. Incorporate potential for delays into contractual arrangements, including appropriate terminology and clauses to ensure the principal and client are not put at undue risk for natural events. Contingency planning for inundation events. Obtain insurance covering inundation events.	Moderate
Fire	Equipment that can create sparks, such as angle grinders and welding equipment, can cause fires that threaten worker safety and require site evacuation. Bushfires (other causes) can have similar outcomes. Depending on the size and severity, fires can cause project delays and increase costs.	Unlikely	Severe	Moderate	Include safety provisions for relevant equipment in the CEMP and the site safety plan. Ensure comprehensive fire management plans are in place prior to construction that include: • Training and equipment requirements for on-ground personnel. • Site access/equipment restrictions that apply on fire danger days. • Emergency response (including evacuation) if a fire does occur. Monitor bushfire danger by liaising with DEPI, CFA, BOM and other relevant	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
					authorities. Contractual arrangements that accommodate changes resulting from fire incidents. Appropriate insurance for contractors, equipment and liability.	
Poor contractual arrangements	Ambiguous contractual arrangements may lead to confusion regarding the scope of work to be delivered and/or multiple contract variation requests. This can delay construction and have significant financial impacts.	Possible	Moderate	Moderate	Seek expert/legal advice on contractual arrangements. Ongoing supervision of contractors.	Very Low
Poor engineering design	Poor engineering design can create a number of issues, including: • Design not fit for purpose • Difficulties in operation • Increased maintenance costs • Reduced design life	Possible	Moderate	Moderate	Detailed designs and construction drawings peer reviewed before they are finalised. Early engagement of contractors and operators to provide feedback on design practicalities/constructability.	Very Low
Inadequate geotechnical information	Unforeseen geotechnical conditions encountered during construction may require significant alteration to existing designs or relocation of infrastructure causing project delays and additional expense.	Possible	Severe	High	Appropriate geotechnical investigations conducted carried out during the design phase to reduce uncertainty. Conservative design of structures to allow for variations to geotechnical conditions.	Moderate
Unclear roles and responsibilities	Unclear roles and responsibilities could hinder effective project development and construction.	Possible	Moderate	Moderate	Establish a MoU between all relevant agencies outlining roles and responsibilities during project development and construction. Ensure appropriate contractual arrangements are in place between the project owner and the agencies responsible for construction management, approvals preparation, etc. Maintain strong working relationships with river operators, partner agencies (including agencies in NSW, SA and	Low

Threat	Description	Likelihood	Consequence	Risk without mitigation	Mitigation	Residual Risk
					Victoria), and Commonwealth and Victorian water holders through regular design and construction group meetings. Maintain clear lines of communication with all partner agencies and project stakeholders during project development and delivery.	
Insufficient resourcing	Insufficient resourcing available for agency staff and equipment. This will impact on the ability to deliver the project within agreed timelines and budget.	Possible	Moderate	Moderate	Clear identification of roles, responsibilities, associated activities and resourcing requirements; funding agreements negotiated on the basis of these requirements. Maintain strong relationships with investors/funding bodies to secure adequate resources for project development and delivery.	Low

18.3 Risk mitigation and controls

While the risk assessment identifies several potential threats that could generate high risks to construction (Table 18-1), these risks are considered manageable because they:

- Are well known and are unlikely to involve new or unknown challenges
- Can be mitigated through well-established management controls
- Have been successfully managed by the project team (including construction authorities) in previous projects
- Result in very low or moderate residual risks after standard mitigation measures are implemented.

The risk assessment confirms that all risks are reduced to acceptable levels (moderate or lower) once well-established risk mitigation controls are implemented. Two threats retained a residual risk of moderate after implementation of the recommended mitigation strategies (18-2). Additional considerations may assist in further understanding, and in some cases reducing, the residual risk rating.

Threat	Risk without mitigation	Residual risk rating	Additional considerations
Inadequate geotechnical information	High	Moderate	Obtaining peer review of designs and geotechnical information prior to engagement of contractors.
Floods	High	Moderate	The risk of a flood occurring is unpredictable and mitigation options are limited. Flood risks must be adequately considered in project costs. This is reflected in the inclusion of explicit costing for flood risk in the cost estimates for this business case.

18.4 Risk management strategy

As noted in Section 7.3, a comprehensive risk management strategy will be developed for the proposed supply measure, building on the work completed for this business case. The strategy will provide a structured and coherent approach to risk management for the life of this project (i.e. construction and operation). With regard to the potential threats to project development and construction, the risk management strategy will focus on the following issues, as described in Table 18-1:

- Ability to complete construction
- Project development and delivery

Risk assessment and management is not a static process. Regular monitoring and review of the risk management process is essential to ensure that:

- Mitigation measures are effective and efficient in both design and operation
- Further information is obtained to improve the risk assessment
- Lessons are learnt from events (including near-misses), changes, trends, successes and failures
- Risk treatments and priorities are revised in light of changes in the external and internal context, including changes to risk criteria and the risk itself, and
- Emerging risks are identified.

The risk assessment process will continue throughout the development and implementation of this project. It is anticipated that additional threats will be identified and evaluated as the project progresses, and any new risks incorporated into the risk management strategy.

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19. Appendices

Appendix A:

Wallpolla proposed works and inundation extents.

Appendix B:

Ecological Associates, 2014a. SDL Floodplain Watering Projects: Rationale and Outcomes, Report AL040-1-D. Report for the Mallee CMA.

Appendix C:

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Appendix D:

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Appendix E:

Aurecon 2014a Wallpolla Island Structures – Concept Design Services, Concept Design Report. Report for SA Water.

Appendix F:

Aither 2014. Social and economic assessment- Wallpolla Water Management Works, Benefits for the Basin Plan Sustainable Diversion Limits offset program business case. Report for the Mallee CMA.

Appendix G:

Wallpolla Island letters of support.

Appendix H:

RMCG 2014. Wallpolla Sustainable Diversion Limits Offset Project, Final Communication and Engagement Strategy. Report for the Mallee CMA.

Appendix I:

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Appendix J:

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Appendix K:

Jo Bell Heritage Services (Bell) 2013. Mallee Environmental Watering Projects, Wallpolla Island Floodplain, Northwest Victoria: Due Diligence Assessment, Historical Archaeology. Report prepared for the Mallee CMA.

Appendix L:

Expert Panel Reports.

Appendix A: Proposed works