VICTORIAN MURRAY FLOODPLAIN RESTORATION PROJECT

HEALTHY LANDSCAPES, STRONG COMMUNITIES

Draft Operating Plan

Burra Environmental Works and Measure Program

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List of abbreviations	
Abbreviation	**Full description**
AHD	Above Height Datum
ARI	Arthur Rylah institute
AWOC	After SDL works operation commencement
BSMS	Basin Salinity Management Strategy
BWS	Basin-wide Environmental Watering Strategy
CAMBA	China-Australia Migratory Bird Agreement
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary industry
DTF	Department of Treasury and Finance
EMF	Environmental Management Framework
EPBC	Environmental Protection and Biodiversity Conservation
EWMP	Environmental Water Management Plans
FFG	Flora and Fauna guarantee
GHD	Guttridge Haskins & Davey
GL	Gigalitre
GMW	Goulburn Murray Water
JAMBA	Japan-Australian Migratory Bird Agreement
LMW	Lower Murray Water
LTWP	Long-Term Watering Plans
MCMA	Mallee Catchment Management Authority
MDBA	Murray Darling Basin Authority
MDFRC	Murray-Darling Freshwater Research Centre
MER	Monitoring, evaluation and reporting
ML	Megalitre
PEA	Priority Environmental Assets
PEF	Priority Ecosystem Functions
PWOC	Prior to SDL works operation commencement
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SCBWEC	Southern Connected Basin Environmental Watering Committee
SDL	Sustainable Diversion Limit
SKM	Sinclair Knight Merz [consultant]
SWP	Seasonal Watering Proposal
TLM	The Living Murray
VEAC	Victorian Environmental Assessment Council
VEWH	Victorian Environmental Water Holder
VMFRP	The Victorian Murray Floodplain Restoration project
WRP	Water Resource Plan

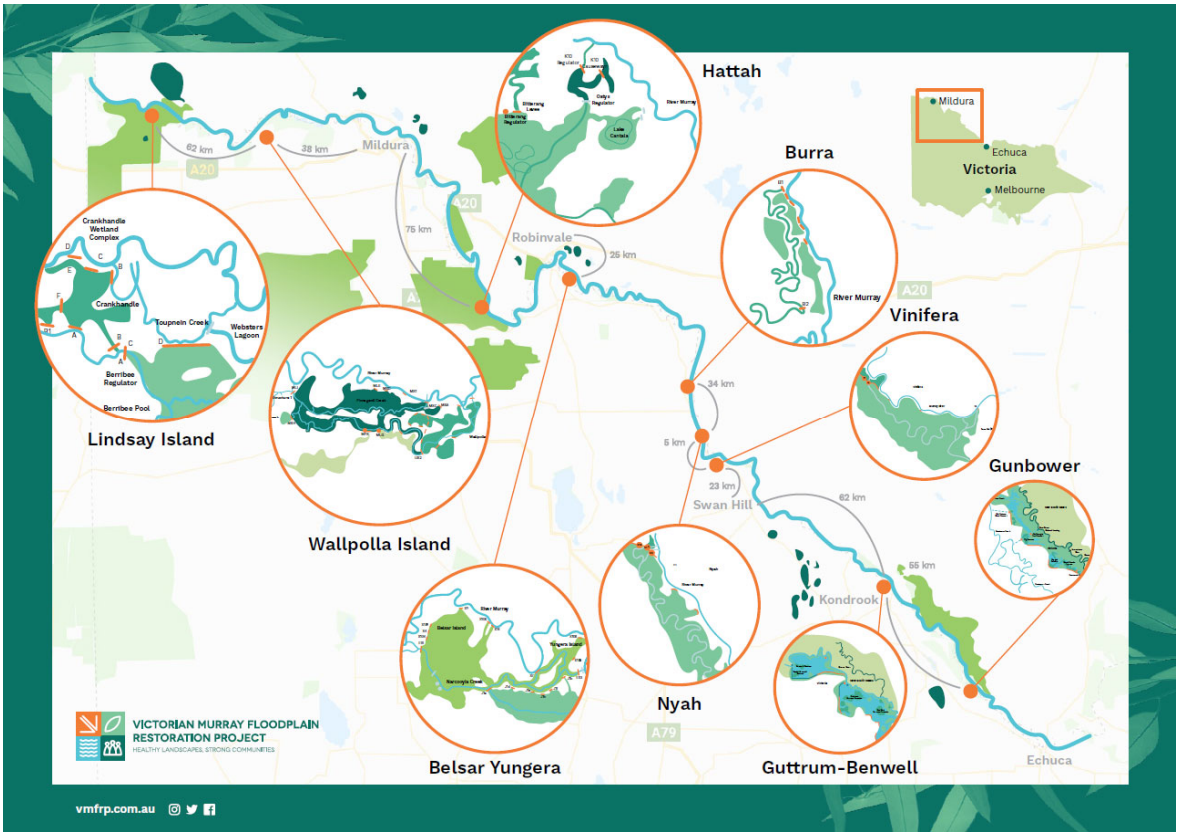
Introduction

The Victorian Murray Floodplain Restoration Project (VMFRP) is being implemented as part of Victoria's obligations under the Murray Darling Basin Plan in partnership with Lower Murray Water, Goulburn Murray Water, Mallee CMA, North Central CMA, Parks Victoria and the Department of Environment, Land Water and Planning (DELWP). The VMFRP Project is funded by the Australian Government's Department of Agriculture.

The project consists of nine discrete environmental works projects that aim to return an enhanced natural inundation regime across more than 14,000 ha of high ecological value Murray River floodplain in Victoria through the construction of new infrastructure and in coordination with existing infrastructure operating regimes (refer to Figure 1).

The proposed works will allow environmental water to be diverted from the Murray River to high value wetlands and floodplains. This will mimic the impact of natural flood events and improve the condition of vegetation communities and provide habitat for native fish, birds, frogs and reptiles.

Figure 1: VMFRP Project Locations



Burra Creek is located between the rural localities of Piangil and Kenley. The Burra Creek site is an anabranch of the River Murray, extending 54 km just upstream of the junctions of the Murrumbidgee and Wakool rivers.

The land between the creek and the River Murray forms Macreadie Island, which consists of floodplain with areas of cropping and grazing land and floodplain vegetation. For approximately 17 km of its northern length, Burra Creek flows through River Murray Reserve. A narrow strip of River Red Gum lines the bank of the Creek. Floodplain vegetation further afield, generally consists of Black Box and Lignum communities.

The area in the north of Macreadie Island, Burra North, is largely unmodified and comprises wetland, forest and woodland. The southern part of the island is mainly freehold land and has been developed for agriculture.

The Burra Creek site provides significant habitat for a suite of plant and animal species of conservation significance, both at a Victorian and national level.

The Burra Creek works aim to complement Basin flows in returning a more natural inundation regime to 404 ha of the Burra Creek floodplain. In the absence of sufficient flows in the River Murray to provide sufficient inflows to the site, the works will also enable watering of the floodplain through the use of temporary pumping.

Environmental watering goals, ecological objectives and watering regimes are detailed in the Burra Environmental Water Management Plan Addendum (VMFRP Project Team, 2020).

This Operating Plan provides the framework for the operation of the VMFRP infrastructure at Burra to meet these goals and objectives.

1. Purpose of the Operating Plan

This Operating Plan provides the framework for the operation of the Burra water management structures to meet key ecological objectives within the broader context of VMFRP legislative requirements and governance. The purpose of this Operating Plan is to:

- Summarise the governance arrangements for managed inundation activities at the site;
- Summarise the roles and responsibilities of partner agencies;
- Aid in decision making and planning prior to, during, and after watering events;
- Summarise operational risks and mitigations strategies;
- Outline water measurement arrangements;
- Outline communication and consultation requirements; and
- Provide links to document containing further detail.

The Operating Plan also defines the obligation of the various parties to manage and operate the structure as required under the Murray-Darling Basin Agreement (S 52-54; *Water Act* (Commonwealth of Australia, 2007)).

The Operating Plan is not intended to prescribe particular watering events. The audience for the Operating Plan is summarised in Table 1.

This document is a 'living document' that will be further refined and updated over time by the Mallee CMA and relevant project partners if legislation changes, operations in the major river systems require it.

It is expected that knowledge and information in relation to adjusting and optimising structure operations will improve with each event. As asset owners, Lower Murray Water/ Goulburn Murray Water will adopt their own Operating Plan on completion of construction.

Table 1: Intended Audience for the Operating Plan

Audience	Key Requirements	Primary Interest		
		Ecological	Operation	Risk
Event Managers (Lower Murray Water, Goulburn Murray Water,)	Adaptive Management	✓	✓	✓
Land Manager (Parks Victoria)	Adaptive Management	✓	✓	✓
Other Environmental Managers (DELWP)	Adaptive Management	✓		✓
Operators (Lower Murray Water, Goulburn Murray Water,)	Operation of structures Accounting		✓	✓
Water holder/funder (TLM-MDBA, CEWH, VEWH)	Accountability	✓	✓	✓
MDBA (BSMS)	Meet legal requirements			✓
Asset Manager (Lower Murray Water, Goulburn Murray Water,)	Meet legal requirements		✓	✓

Additional Documents

This addendum is one of six supporting documents to the Burra Environmental Water Management Plan (EWMP)(Sunraysia Environmental, 2015). Each schedule focuses on a specific area of operations for Burra Table 2.

Table 2: Additional documents supporting water management at the Burra Project Area.

Document	Purpose
Burra Environmental Water Management Plan (Sunraysia Environmental, 2015)	Environmental Water Management Plan
Burra Environmental Water Management Plan Addendum (VMFRP Project Team, 2020)	Update to the Burra Environmental Water Management Plan 2015 to include information relevant to the VMFRP project
Hydrodynamic modelling report (Jacobs, 2016)	Report on the Hydrodynamic modelling of the Burra project
Burra Detailed Design Report (R8, In prep)	Report on the detailed design for Burra including detailed design drawings
Groundwater salinity monitoring bore specifications for SDL projects (Jacobs, Groundwater salinity monitoring bore specification for SDL projects, 2019)	Report on groundwater salinity monitoring of the proposed inundated areas
Monitoring and Evaluation Reporting Plan (MER plan) (Arthur Rylah Institute, Preliminary Draft VMFRP Ecological Monitoring Evaluation & Reporting Plan, 2020)	Framework for reporting on monitoring and evaluations, in preparation by the Arthur Rylah institute. Anticipated completion by March 2020.

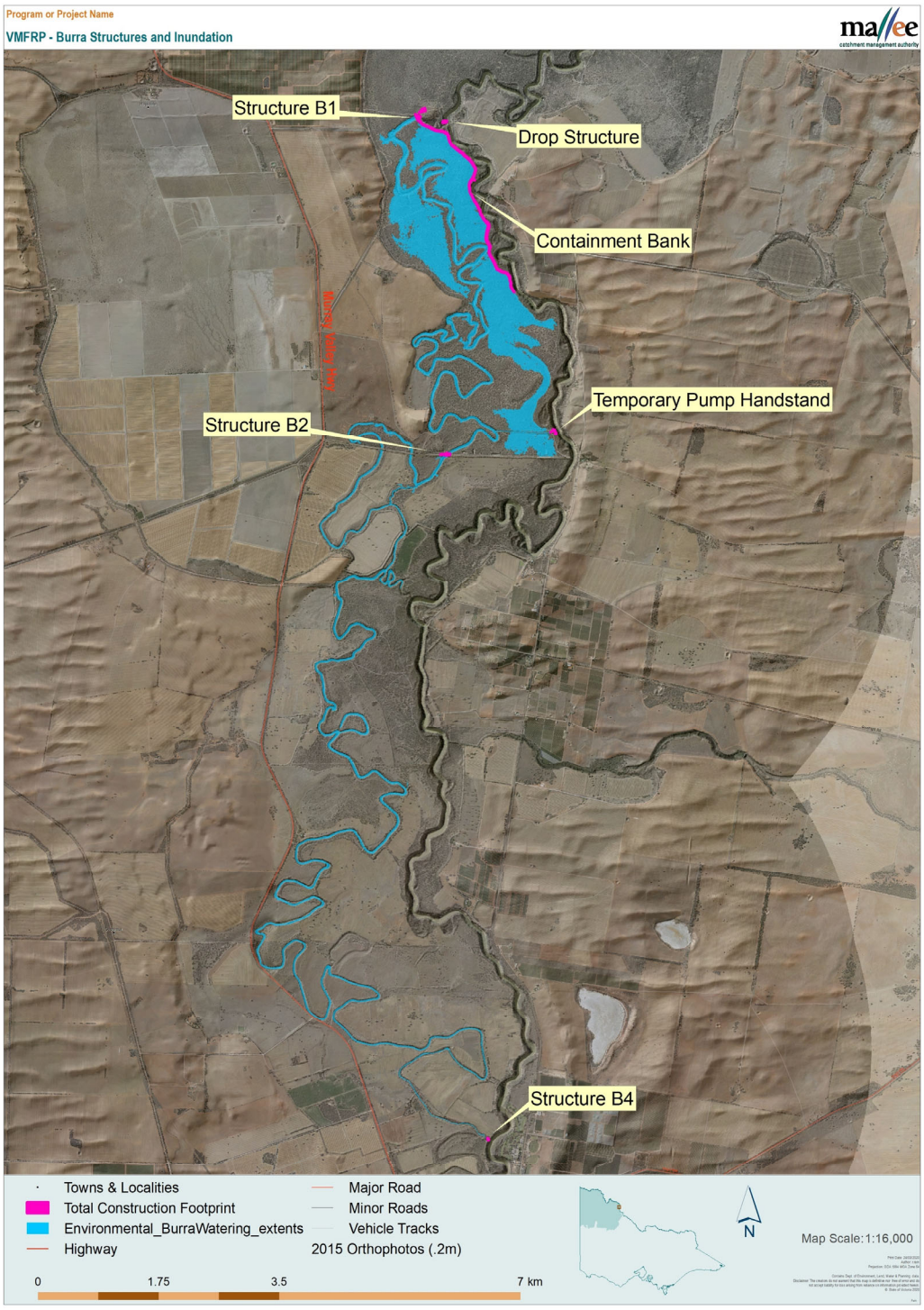
2. Proposed VMFRP Structures and Inundation Extent

Burra Creek is situated 185 river kilometres upstream of Lock 15 (MDBA, Weirs and locks, 2017) and is outside the influence of its weir pool. The flows at Burra are also influences by the Goulburn River and all upstream River Murray tributaries (MCMA, 2014).

The infrastructure works to be delivered for the Burra project include:

- A six-bay regulator (B1) located at the downstream end of Burra Creek
- A twin pipe culvert regulator (B2) at the upstream end of Burra Creek
- A pipe culvert regulator (B4) at the upstream end of Burra Creek
- Raised track and overflow sills at low points around the area to be flooded
- A drop structure downstream of regulator B1.

Figure 2: VMFRP Structures and inundation extent



The project will provide inundation of up to 404 ha of inundation dependent habitat with a water level of 58.7 m AHD in Burra North floodplain and 59.9 m AHD in Burra Creek South (), requiring a volume of 1,474 ML and 1276 ML of water; total of 2750 ML (MCMA, 2014).

The project works will rely on natural high River Murray flow events and temporary pumps to deliver water to the Burra area (Ecological Associates, SDL Floodplain Watering Projects: Operating Plan, Report AL048-1-B, 2015). Table 4 describes the infrastructure that will be used. Section 6 Details of Structures details the infrastructure that will be used in different operating scenarios.

3. Governance

3.1 Governance Arrangement for Operating the Burra Structures

Structures will be owned and operated under an agreement between Lower Murray Water and Goulburn Murray Water. The Mallee CMA and environmental water holders will plan and select the areas of inundation as per their published Seasonal Watering Proposals.

Arrangements will be put in place to ensure appropriate senior oversight of project operations to allow for the successful operation of the works.

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 project management.

The project management structure and team will be overseen by the project owner. In line with the governance arrangements that have underpinned the Business Case preparation for this proposed supply measure, the project owner will be supported by a Project Control Board (PCB), comprised of senior executives representing the project owner, the relevant Victorian CMAs, the relevant constructing authorities (e.g. GMW; LMW), Parks Victoria and the Commonwealth.

3.2 Burra Operations Group

An Operations Group will be established to assist and advise on the commissioning and operation of the Burra works. 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 Burra site, the Operations Group membership will consist of partners and stakeholders, including the Murray Darling Basin Authority, Department of Environment, Land, Water and Planning, the Victorian Department of Environment and Primary Industries, Goulburn Murray 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. See Table 3 for Organisational roles and responsibilities supporting Burra environmental watering.

Table 3: Organisational roles and responsibilities supporting Burra environmental watering

Organisation	Main Roles	Tasks/Responsibilities		
		Event Planning	Event Management	Event Reporting
Planning & monitoring- Mallee CMA	Communications Monitoring	▪ Ensure planning process is to annual schedule ▪ Review and Revise Operating Plan and Risk Management Plan with other BOG input ▪ Prepare Annual Watering Plan with BOG input	▪ Coordinate event monitoring (ecology/environment/water use) ▪ Coordinate Community Communications and Consultation	▪ Prepare Annual Watering Report with other stakeholder input ▪ Compile/Collate Monitoring Results ▪ Update event record and incorporate lessons learnt into operating plan
Site Manager - LMW	Event Coordination Communications Monitoring	▪ Convene Burra Operations Group (BOG)	▪ Convene BOG and coordinate weekly (or as required) meetings/teleconferences. ▪ Coordinate Community Communications and Consultation ▪ Coordinate event monitoring (water use)	
MDBA - River Operations and Modellers	Modelling	▪ Provide advice on basin wide river operations and any implications for Burra ▪ Provide advice to assist in planning	▪ Provide advice on basin wide river operations and any implications ▪ Re-calibrate the water use model during the event	▪ Assist LMW/GMW with water measuring ▪ Provide advice on any water delivery implications encountered and future considerations ▪ Model calibration confidence
LMW/GMW	Structure Operation & Maintenance, Water Accounting	▪ Provide advice on structural or maintenance issues and any implications ▪ Conduct maintenance ▪ Provide advice on water accounting planning and preparedness and any implications for an event	▪ Operate Structures to meet requests ▪ Provide advice on structural or maintenance issues and any implications ▪ Data collection and provision of data to MDBA during events including flow, level and water quality monitoring ▪ Watering accounting – calculate weekly diversion volumes	▪ Provide details on performance of structures and any issues or future considerations ▪ Provide details of issues associated with operational costs ▪ Watering accounting against Victorian entitlements – provide the VEWH with volumes used and inform BOG ▪ Report on water use.
Parks Victoria	Land Manager	▪ Provide advice on expected ecological response to proposed watering ▪ Advise the group regarding site ecological values or threats and any	▪ Manage public access during and after event ▪ Advise of any threats to site ecological values	▪ Provide details of site ecological responses and any future implications

		implications ▪ Approve watering on public land		
VEWH	Water Availability (If VEWH water used) Approvals	▪ Approve Victorian statewide watering priorities ▪ Approve Annual Watering Plan – Victorian priorities ▪ Co-ordinates water use with other environmental water holders, including advising on water availability for the site from all environmental water holders.	▪ Authorises all watering activities through Seasonal Watering Statements ▪ Provides indication on water availability for watering activities ▪ Seek further water if required ▪ Water accounting verification of volumes, use and coordinate return flows	▪ Assist with report compilation and review ▪ Review volumes of environmental water used
MDBA Environmental Water Coordination	Water Availability (If TLM water used)	▪ Advise on TLM watering objectives ▪ Advise on TLM water availability ▪ Coordinating activities across TLM Icon Sites	OBSERVER ROLE ONLY if contributing environmental water	Assist with report compilation and review
CEWH	Water Availability (If Commonwealth water used)	▪ Advise on Commonwealth watering objectives ▪ Advise on Commonwealth water availability ▪ Coordinating other CEWH activities	Decision making role in planning, delivery, monitoring and reporting in collaboration with CMA's and Water Authorities.	Assist with report compilation and review
DEWLP	Environmental Water Policy	▪ Provide advice on statewide environmental water policy ▪ Ensure integration of activities with the Basin Plan and related state initiatives	OBSERVER ROLE ONLY	OBSERVER ROLE ONLY
Scientific consultants	Event Monitoring	▪ Provide advice on achieving ecological objectives	Undertake monitoring activities as directed by the Mallee CMA or other contracting agency	Report monitoring results
Scientific Advisors	Specialist Advice	Assist setting ecological objectives	Provide specialist advice when required	NO ROLE EXPECTED

SCBEWC (includes TLM partner governments)	Allocation of TLM water (if TLM water used) Coordination of the delivery environmental water in the Southern Connected Murray-Darling Basin	- Decision making on the use of TLM portfolio, River Murray unregulated flows and River Murray increased flows - Input into the development of large-scale multi-site environmental watering events	NO ROLE –unless site or in river conditions lead to substantial change from planned event	Reporting included in annual SCBEWC report to the Basin Officials Committee and reporting on annual TLM watering activities

3.3 Stakeholder Roles and Responsibilities

Mallee Catchment Management Authority (CMA) – Site Manager

Catchment Management Authorities are the caretakers of river health and responsible for the management of environmental water in Victoria, as specified in the Water Act 1989. The Mallee CMA works closely with its partner agencies, Lower Murray Water, Goulburn-Murray Water, Parks Victoria and DELWP and is supported by a number of site-specific committees.

Lower Murray Water (LMW) – Site Manager

The site manager for the Vinifera project is the Managing Director of LMW, working closely with its partner agencies, Mallee CMA, Goulburn-Murray Water, Parks Victoria and DELWP and is supported by a number of site-specific committees.

Murray-Darling Basin Authority – River Management (Operations, Modelling and Data Management)

MDBA River Operations attends and contributes to the Vinifera Operations Group meetings.

Operational data is collected at structures throughout watering events. The data is stored on the MDBA data system and is available for all to use upon request. Modellers provide advice to Mallee CMA during events – from the water bid proposal to the end of the event. The modellers also re-calibrate the model as the event takes place.

Lower-Murray Water (LMW) – Asset operations and maintenance

Lower-Murray Water (LMW) is responsible for day to day river operations.

LMW is also responsible for the operation and maintenance of all water delivery structures within Vinifera, as well as the weir operations that support environmental watering

LMW is also responsible for collecting data during the event and providing it to MDBA River Management to assist with real-time management and modelling.

Goulburn-Murray Water (GMW) – Water accounting

GMW is the delegated Resource Manager for the Victorian River Murray system under the Water Act 1989 (Victoria) and coordinates the accounting of resources associated with operations in this reach. In this role, GMW liaises closely with the River Murray Operations team of the MDBA to ensure bulk and retail water accounts are correctly credited and debited.

Parks Victoria – Public Land Manager

Parks Victoria is the public land manager responsible for management of the Vinifera Park. Under the Parks Victoria Act 2018, Parks Victoria is responsible for providing services to the state and its agencies for the management of parks, reserves and other public land and is responsible for all areas reserved under the National Parks Act 1975.

Victorian Environmental Water Holder (VEWH)

The VEWH is responsible for holding and managing Victoria's environmental water entitlements and allocations and coordinating the delivery of Victorian environmental water allocations with other environmental entitlement holders to maximise benefits to the environment.

The VEWH works closely with catchment management authorities and Melbourne Water to ensure that environmental water entitlements are used to maximise ecological outcomes for the water available. In terms of Vinifera, the VEWH will consider environmental watering proposals along with all others in the state to determine environmental watering priorities from a state perspective.

If Vinifera is determined to be an environmental priority for the year and water is made available to the site, the VEWH then authorises the use of water by the Mallee CMA through a Seasonal Watering Statement.

Murray-Darling Basin Authority – Environmental Water Coordination

The MDBA – Environmental Water Coordination team coordinates the planning and delivery of TLM environmental water to TLM Icon Sites. This undertaken as part of Southern Connected Basin Environmental Watering Committee (SCBEWC) environmental delivery coordination. SCBEWC is chaired by the MDBA and includes representative from the TLM government partners and the Commonwealth Environmental Water Office.

Commonwealth Environmental Water Office (CEWH)

As a component of Murray-Darling Basin reforms, the Australian Government has acquired a number of water entitlements with the objective to return more water to the environment. These entitlements have become a part of the Commonwealth environmental water holdings and are managed by CEWO. The volume of environmental water held by CEWO is significant and may constitute an important source of environmental water for the Vinifera Floodplains.

Victorian Department of Environment, Land, Water and Planning (DELWP)

In Victoria, the overall Environmental program is delivered by DELWP, which provides high level policy input and coordinates the delivery across all Victorian Sites. One of the key roles for DELWP is to provide statutory and strategic guidance to the planning of Victoria. DELWP is also the site owner for most Crown land in Victoria and may delegate the management of Crown land to others on its behalf, as is the case with Parks Victoria.

Southern Connected Basin Environmental Watering Committee (SCBWEC)

The Southern Connected Basin Environmental Watering Committee (SCBEWC) coordinates the delivery of environmental water to maximise environmental outcomes in the Southern Connected Murray-Darling Basin. Members include Basin state and Australian Government environmental water holders, water managers and key river operators. In addition to the coordination function, SCBEWC also makes decisions on the use of jointly held environmental water portfolios -The Living Murray portfolio, River Murray Unregulated Flows and River Murray Increased Flows. The MDBA chairs the Committee and provides secretariat support for SCBEWC activities.

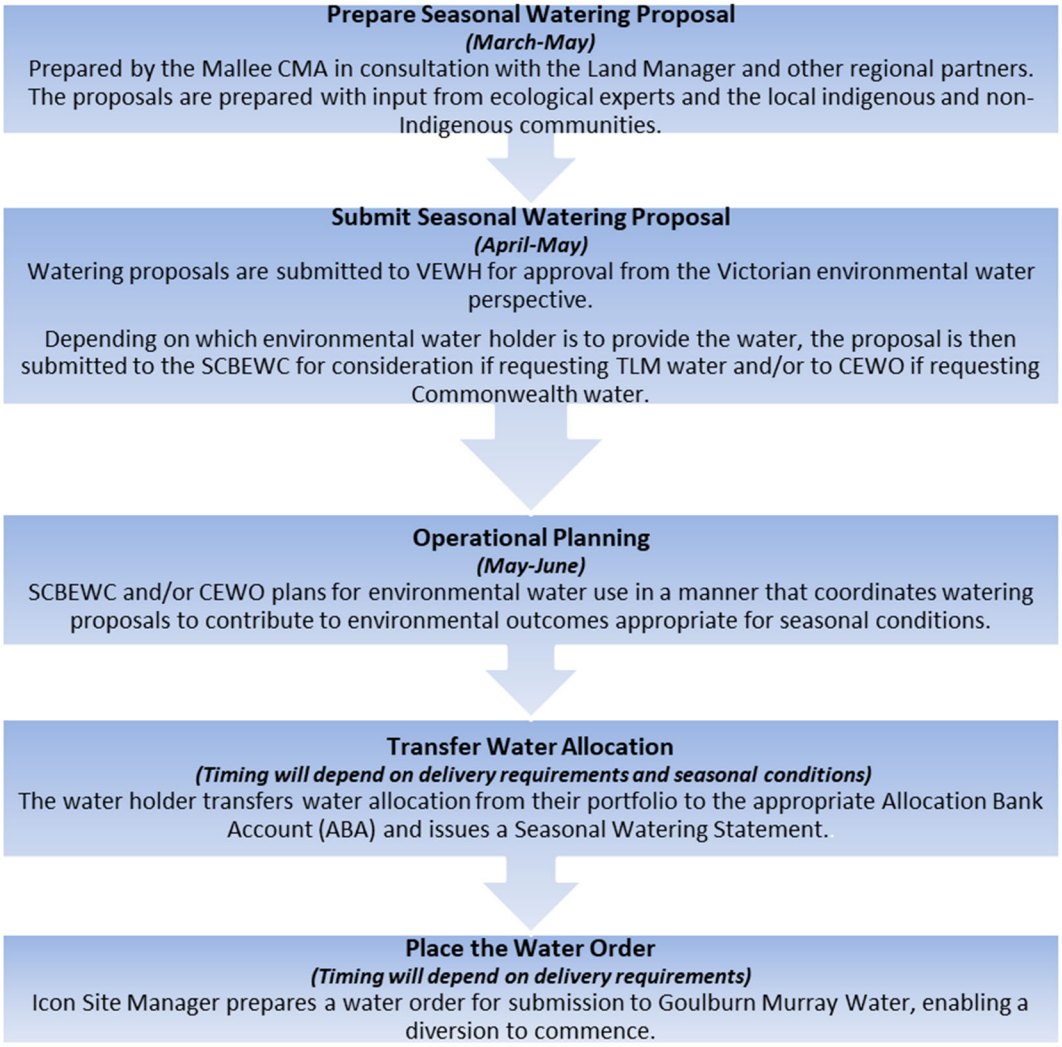
3.4 Sourcing Water for Managed Inundation Events

Environmental watering at the site will be undertaken in accordance with the VEWH's annual seasonal watering plan and in partnership between Lower Murray Water, Goulburn Murray Water, the Mallee CMA and Parks Victoria.

Before a watering action can commence, a Seasonal Watering Proposal must be prepared by The Mallee CMA and approved by the VEWH; see Figure 3 . Submissions for environmental water allocations are presented by the VEWH to the relevant water holders who subsequently prioritise the watering proposals against all other watering proposals.

Once a watering action is approved, the VEWH ensures sufficient water is in the appropriate allocation bank account (ABA). This may require a transfer of water from one ABA to another. The VEWH will then issue a Seasonal Watering Statement to the Mallee CMA allowing access to an allocation of water in the ABA. Once the Seasonal Watering Statement is approved, a water order can be placed by MCMA with GMW, enabling a diversion to commence.

Figure 3: Sourcing Environmental Water for a watering event at Burra



The VMFRP works will leverage natural high River Murray flow events to deliver water to the Burra floodplain.

4. Site Characteristics Guiding Managed Inundation

The proposed Burra Creek supply measure addresses deficiencies in the water regime of the northern section of Burra Creek and adjacent lignum and black box floodplain vegetation. When flooded the creek would provide seasonal aquatic habitat for frogs and small fish. Flooding of the adjacent floodplain will improve vegetation health and productivity and connection with the River Murray will enable biota and nutrient exchange (MCMA, 2014).

4.1 Waterflow

Burra Creek diverges from the River Murray downstream of Piangil at 1,320 river km and re-joins the river at 1,296 river km. The area between the creek and the River Murray forms Macreadie Island (Ecological Associates, SDL Floodplain Watering Projects: Operating Plan, Report AL048-1-B, 2015).

The southern part of the island is largely freehold land and has been developed for agriculture. The creek is Crown Land (River Murray Reserve) but has been modified at several locations. Banks are used to provide road crossings and to store water for irrigation.

The road culverts generally have a high sill, a small capacity and impeded the flow of water. Containment banks at some locations confine water in the creek and reduce floodplain inundation (Ecological Associates, 2015).

In the Burra North the floodplain is protected in the River Murray Reserve and is largely unmodified. However, blockages are present in Burra Creek.

Water first enters Burra Creek at the downstream river connection when River Murray discharge exceeds about 17,000 ML/d. But the movement of water along the creek is impeded by blockages (MCMA, 2014).

An effluent at 1308 river kilometres introduces water to the mid-section of Burra Creek when river discharge exceeds about 20,000 ML/d. Water spreads up and down the Burra Creek from this point but its movement is impeded by banks and narrow culverts (MCMA, 2014).

Under natural conditions the creek would be completely connected by flows of approximately 20,000 ML/d, but now this does not occur until river flow reaches 30,000 ML/d.

Floodplain inundation commences in the central part of the island at flows exceeding 27,500 ML/d.

The floodplain in the Burra North area is completely inundated when water breaks out of Burra Creek at flows exceeding 30,000 ML/d.

5. Operating Thresholds

This section provides guidance on the operational thresholds that inform the Burra Operational Group during planning and adaptive management of events.

5.1 Natural Inundation Events

Natural flows into Burra Creek can occur at two locations:

- Burra Creek North (east of Regulator B1) – the main site of inflows from the River Murray as the river discharge exceeds 17,500 ML/d.
- Burra Creek South (east of Regulator B4) – inflows commence at this upstream end of Burra Creek when the River Murray discharge exceeds 22,500 ML/d.

The arrangement of structures, containment banks and overflow sills are designed to minimise the potential for erosion over the whole range of flow conditions.

- Pass low and medium flows through hard structures (regulators)
- Pass higher flows through purpose designed overflow sills, with rock protection, located on natural flow paths.
- Overtop the earthen banks only after the water levels are near equalised on either side

Outflows from Burra Creek to the River Murray occurs via the Northern creek end.

5.2 Managed Events

Two distinct phases of the flood capture event have been conceived:

- The initial phase in which gates would be open. The point at which the gates are closed would depend on the predominant direction of inflow and would vary depending on the specifics of the event. The design flows for through flow for this phase are similar to natural events.
- Capture phase in which the gates are operated to retain water in the forest. The critical design cases are the flow and water levels resulting from the gate operation.

The direction of inflow during a flood capture event could be either backflow through regulator B1 or through flow. The volume of Burra North floodplain at EL58.7 is 1474 ML and Burra Creek South at EL 59.9 is 1276 (MCMA, 2014).

Managed events will also utilise minor works in the form of sills and containment banks required at drainages along the riverbank to prevent the escape of water. In total the works will inundate up to 404 ha of the floodplain.

5.3 Managed Events – Managed Drawdown

The infrastructure will have the capacity to control the drawdown following a managed event. The drawdown criteria are as follows:

- Empty the floodplain in a period of 7 to 10 days (maximum 20 days) for the purpose of drying the access tracks and reopening the park to the public; and limiting the period of operation.
- Managed drawdown to be coincident with a low water level in the River Murray, typically one month after a flood capture event.
- Limiting the frequency of operator visits during the drawdown period. This would be no more than once per day, and preferably less frequent depending on the duration of the drawdown period.
- Minimise the potential for erosion at the regulator and the confluence of the River Murray.
- Provide downstream fish passage for fish to exit the forest.
- Prevent stranding of fish due to excessive rate of drawdown.

6. Details of Structures

The proposed works consist of environmental regulators and supporting structures.

The works, in conjunction with Basin plan flows, will be the primary means of delivering water to Burra Creek and achieving ecological objectives for the site. The proposed works are described in Table 4.

Two barriers in Burra Creek will also be removed to allow the Burra North section of the channels to completely fill with water when River Murray flows exceed 20,000 ML/d (Ecological Associates, SDL Floodplain Watering Projects: Operating Plan, Report AL048-1-B, 2015).

Temporary pumping may also be used to deliver water onto the floodplain when required.

Table 4: Proposed Burra VMFRP structures (MCMA, 2014)

Infrastructure	Description	Role	Associated Area
Regulator B1	An environmental regulator on the downstream end of Burra Creek consisting of an 1800 mm x 3000 mm box culvert with split leaf gates.	Retain water during a managed event as well as controlling flows between Burra Creek and the River Murray.	Whole of project
Containment banks	Earthen containment bank on existing track alignment, with three spillways.	Contain the water within the floodplain as well as passing natural flows.	
Drop Structure	Situated downstream of Regulator B1. Consists of Sheet piles and rock beaching.	The drop structure is necessary to protect banks against erosion upon release of impounded water from regulator B1. The structure will establish a tailwater at the regulator sufficient to prevent sweep out of the hydraulic jump and provide a plunge pool for downstream fish passage.	

Regulator B2	A twin pipe culvert regulator structure located at the upstream end of Burra Creek that will contain flow during a managed inundation event in Burra Creek North.	To contain flow in the system during a managed inundation event and prevent it flowing upstream into the Burra South forest.	
Regulator B4	An environmental regulator on the upstream end of Burra Creek consisting of 1500 mm diameter RC pipe with matching actuated pen stock gate.	Retain water during a managed event as well as controlling flows between Burra Creek and the River Murray.	

Examples of the proposed types of works to be delivered to the Burra project are shown in Figure 4 and Figure 5

Figure 4: A regulating structure at Mullaroo inlet (Lindsay Island) similar to the proposed B1 regulator

Figure 5: A containment bank constructed under The Living Murray at the Hattah Lakes, similar to those proposed for Burra

7. Operations

The Burra Creek works have been designed to provide maximum operational flexibility and can be used to complement Basin Plan flows or to deliver environmental benefits. The project will enable the replication of key components of the natural hydrology of the system to those areas.

The infrastructure has been designed to be operated in several possible flow regimes consistent with the requirements set out in the business case described by the operating scenarios shown in Table 6 and *Table 7*.

Transitioning between scenarios is possible and provides a high level of operational flexibility when delivering planned watering events or responding to natural inflows. An Operational Matrix is outlined in Table 8.

The structures will be operated to achieve environmental watering targets under three scenarios:

- Under normal flow conditions (when no environmental watering is occurring) the upstream and downstream regulators on Burra Creek will be open.
- When a flow peak is anticipated, the regulators will remain open to promote flowing habitat in Burra Creek. As river levels fall, the regulators will be closed to store floodwater. The level at which water is stored will depend on the ecological objectives of the event. When the hydrological targets of the watering activity are met, water will be released at the downstream regulator.
- If peaks in river flow are too infrequent to meet managed inundation targets, parts or all of the system may be flooded by temporary pumps installed on the river bank (MCMA, 2014).

7.1 Watering Regimes

The watering regime has been derived from the ecological and hydrological objectives. To allow for adaptive and integrated management, the watering regime is framed using the seasonally adaptive approach. This means that a watering regime is identified for optimal conditions, as well as the maximum and minimum tolerable watering scenarios.

The minimum watering regime is likely to be provided in drought or dry years, the optimum watering regime in average conditions and the maximum watering regime in wet or flooded years.

The optimum, minimum and maximum watering regimes are described in Table 5

Table 5: Target water regime in response to climatic condition (Sunraysia Environmental, 2015)

Site	Dry/Drought	Median	Wet
Burra	Seasonal Anabranch	Seasonal Anabranch Lignum Shrubland and Woodland Black Box and Red Gum Woodland	Seasonal Anabranch Lignum Shrubland and Woodland Black Box and Red Gum Woodland

7.2 Operational Scenarios

The Burra works have been deigned to replicate key components of the natural hydrology of the system. The infrastructure has been designed to be operated in several possible flow regimes consistent with the requirements set out in the Business Case (MCMA, 2014). Transitioning between scenarios is possible and provides a high level of operational flexibility when delivering planned watering events or responding to natural inflows.

Water will be delivered to the Burra floodplain area using gravity and occasional temporary pumping when required (Scenario 4), this is further described in Table 6 and *Table 7* respectively. The works will provide for the inundation of up to 404 ha of floodplain.

Table 6: Burra North operating scenario (Ecological Associates, SDL Floodplain Watering Projects: Operating Plan, Report AL048-1-B, 2015; Jacobs, 2016; Sunraysia Environmental, 2015)

Scenario	Pre-conditions (Murray Flow required ML/d) (Jacobs, 2017)	Structure Operation	Maximum design inundation level (m AHD) (Jacobs, 2017)	Preferred Frequency (Sunraysia Environmental, 2015)	Threshold (depth, level or discharge) (Jacobs, 2017)	Holding Duration (Sunraysia Environmental, 2015)	Preferred Timing (Ecological Associates, 2014)	Maximum Interval Between Events (Sunraysia Environmental, 2015)	Water Regime Class Targeted
Capture Low Flood Peaks in Burra Creek (Scenario 1)	Capture can occur when discharge at Swan Hill exceeds 20,000 ML/d. Peaks up to 22,500 ML/d represent a low flood peak.	Regulator is closed when the flood peak starts to recede Regulator is opened when the flood duration target is met.	57.7	9 years in 10	Levels equivalent to 22,500 ML/d	3 months	June to November	3 years	Seasonal Anabranch
Capture Large Flood Peaks in Burra Creek	Capture can occur when discharge at Swan Hill exceeds 20,000 ML/d.	Regulator is closed when the flood peak starts to recede. Regulator is opened to	58.2	3 years in 10	Levels equivalent to 25,000 ML/d	3 months	June to November	7 years	Seasonal Anabranch Lignum Shrubland and Woodland

(Scenario 2)	Peaks up to 25,000 ML/d represent a very large flood peak.	release water when the flood duration target is met.							
Pump to High Floodplain Areas (Jacobs, 2016) (Scenario 4)	Pumping can commence when discharge at Swan Hill equals or exceeds 20,000 ML/d.	Upstream and downstream regulators are closed. Water is pumped into storage area. Regulator is opened to release water when the flood duration target is met.	58.70	0.9 years in 10 (Jacobs, 2016)	Levels equivalent to 30,000 ML/d	1 month	June to November	10 years	Seasonal Anabranch Lignum Shrubland and Woodland Black Box and Red Gum Woodland
Capture Very Large Flood Peaks in Burra Creek (Scenario 3)	Capture can occur when discharge at Swan Hill exceeds 20,000 ML/d. Peaks up to 30,000 ML/d represent a very large flood peak.	Regulator is closed when the flood peak starts to recede. Regulator is opened to release water when the flood duration target is met.	58.70	0.9 years in 10 (Jacobs, 2016)	Levels equivalent to 30,000 ML/d	15 days	June to November	10 years	Seasonal Anabranch Lignum Shrubland and Woodland Black Box and Red Gum Woodland

Table 7: Burra South operating scenario ((Ecological Associates, 2015; Sunraysia Environmental, 2015)

Scenario	Pre-conditions (Murray Flow required ML/d)	Structure Operation	Maximum inundation level (m AHD)	Preferred Frequency (Sunraysia Environmental, 2015)	Threshold (depth, level or discharge) (Sunraysia Environmental, 2015)	Holding Duration (Sunraysia Environmental, 2015)	Preferred Timing (Ecological Associates, 2015)	Maximum Interval Between Events (Sunraysia Environmental, 2015)	Water Regime Class Targeted (Ecological Associates, 2015)
Capture Large Flood Peaks in Burra Creek (Scenario 2)	Capture can occur when discharge at Swan Hill exceeds 22,500 ML/d. (Jacobs, 2017) Peaks up to 25,000 ML/d represent a large flood peak. (Jacobs, 2017)	Regulator is closed when the flood peak starts to recede. Regulator is opened to release water when the flood duration target is met.	Water to be maintained within creek line. Maximum water level to be below creek top bank level.	9 years in 10	Levels equivalent to 25,000 ML/d	3 months	June to November	3 years	Seasonal Anabranch
Pump to Large Flood level in Burra Creek (Authority, 2019) (Scenario 4)	Pumping can commence when discharge at Swan Hill equals or exceeds 6,000 ML/d. (Authority, 2019) (MDBA, 2019) Note, pumping can commence at a lower flow if approved by VEWH and if river depth at pumping location is suitable for efficient pump operation (pumping contractor approval).	Upstream and downstream regulators are closed. Water is pumped into storage area. Regulator is opened to release water when the flood duration target is met.	Water to be maintained within creek line. Maximum water level to be below creek top bank level.	9 years in 10	Levels equivalent to 25,000 ML/d	3 months	June to November	3 years	Seasonal Anabranch

Table 8: Operational Matrix. Transitions between the VMFRP Operating Scenarios at Burra (MCMA, 2014)

Scenario	To Default	To Seasonal Fresh	To Burra Intermediate	To Burra Maximum	To Natural Flows
From Default	Condition During Scenario: All structures open	No change	B1, B2, B4 – set to maintain target level	B1, B2, B4 – set maximum level 58.7 m AHD	No change
From Seasonal Fresh	All structures open	Condition During Scenario: All structures open	B1, B2, B4 – set to maintain target level	B1, B2, B4 – set maximum level 58.7 m AHD	No change
From Burra Intermediate	All structures open	All structures open	Condition During Scenario: B1, B2, B4 – set to maintain target level	B1, B2, B4 – set maximum level 58.7 m AHD	All structures open
From Burra Maximum	All structures open	All structures open	B1, B2, B4 – set to maintain target level	Condition During Scenario: B1, B2, B4 – set maximum level 58.7 m AHD	All structures open
From Natural Flows	No change	No change	B1, B2, B4 – set to maintain target level	B1, B2, B4 – set maximum level 58.7 m AHD	All structures open

8. External Considerations for Operations

8.1 Upstream and Downstream Considerations

- Minimum river height to restore seasonal flow to Burra Creek with proposed works is 59.9m AHD (Murray River flows at approximately 22,500 ML/d (MCMA, 2014).
- Working through SCBEWC during strategic annual planning and the MDBA River Murray operation team during operation to facilitate the coordination and re-use of net flows from upstream and downstream to optimise timing of e-water delivery across the Southern connected Murray-Darling Basin; time environmental water events at Burra.
- Water quality of inflows into Burra Creek
- Water quality of return flows to the River Murray particularly with regard to water quality targets outlined in the Basin Plan, including targets for salinity, blackwater and cyanobacteria
- Dilution flows required in the advent of the release of water from the lakes impacted by a blackwater event.

8.2 Temporary Pumps

Provision for the installation of temporary pumps up to provide up to 40ML/day flow is required.

This is to be achieved by gate slots in the river side headwall to allow bulkheads to be fitted on this side. It would be the responsibility of the pump contractor to design and install a bulkhead consistent with the design of their pumping equipment.

The temporary pump can be installed at the designated pump hardstand area adjacent to the B4 regulator structure.

9. Water Use

9.1 Flow types

There are four general operating scenarios (plus maintenance):

- Natural inflows/outflows – Scenario 1
- Enhance natural (extend duration) – Scenario 2
- Enhance natural (extend duration and extent) – Scenario 3
- Managed event (pumped event) – Scenario 4
- Maintenance (in years with and without a watering operation to prepare for an event, or post event)

These scenarios are described in detail in Section 7.2 Operational Scenarios, Table 6 and *Table 7*.

Based on inflow types, the scenarios fit into three groups for water measurement purposes: natural inflows (includes Scenarios 1 and 2), a hybrid event (a combination of natural and pumped flows (scenario 3)), or pumped only flows (Scenario 4).

9.2 Water Requirements

Inundation provided by the VMFRP structures will create a pool extending up to 404 ha when water is stored at the maximum level of 58.7 m AHD in Burra North floodplain and 59.9 m AHD in Burra Creek South, using a total water volume of 2750 ML (MCMA, 2014).

The removal of two barriers in Burra Creek will allow the through flow of Burra Creek to commence at 17,500 ML/d (Jacobs, 2016).

Environmental water reserves are potentially available for this purpose and will best meet the requirements of Burra North floodplain and Burra Creek South if they are provided annually over 2 to 4 months, centred on the months of June to November (Ecological Associates, 2015).

9.3 Measuring Water Used in Managed Inundation Events

Water use will be measured through the temporary pumping infrastructure using an electromagnetic or ultrasonic flow meter or similar equipment/procedure to account for river extractions.

The key aspect to consider with water delivery for the Burra floodplain is that it is a storage system with controlled inflows and outflows at Burra Creek North and South.

While significant volumes of water can be stored on the floodplain during pumping and natural large events, up to 50% of flows entering the Burra floodplain could potentially return to the River Murray.

The key conditions for water delivery purposes are:

- Commencement of River Murray natural inflows requires 17,500 ML/d or greater.
- Water can be stored in the Burra floodplain and may be released to the river.
- Not all inflows can be measured i.e. overbank flows.
- Being possible to calculate the initial volume held in the floodplain by gauge boards/stations and capacity tables. This approach will be consistent with volumes held in large storages (such as Hume Dam, Dartmouth Dam, Lake Victoria and Menindee).
- Water may switch from regulated flow to unregulated flow and vice versa during an event.

9.4 Measurement Types

The measurement types and location of the Burra works are outlined in Table 9.

Table 8 provides a matrix for the operating scenarios as well as the transitional periods between operating scenarios.

Table 9: Summary of flow measurement types and location at Burra

Site	Flow Measurement	Purpose
B1 Regulator	Height and Flow	For use during managed and hybrid events
B4 Regulator	Height and Flow	For use during managed and hybrid events
B2 Regulator	Height and Flow	For use during managed events

10. Operational Risks and Mitigation Measures

10.1 Ecological, Cultural Heritage and Socio-Economic Threats

Ecological Assessments and a Cultural Heritage Management Plan are being undertaken as part of the project.

Shared operational risks associated with environmental watering are managed through an annual process that Mallee CMA participates in. This process includes discussion of risk learnings of from the previous year, risk assessment for the coming year, and improving risk management processes.

In addition to the above measures, a monitoring, evaluation, and reporting (MER) framework is being put together for the VMFRP project that includes ecological, cultural, and socio-economic outcomes of managed inundation events at the VMFRP sites.

10.2 Impact on Salinity, Water Environments, and Fish Passage

The in-river salinity impacts (at Morgan, South Australia) potentially caused by the proposed actions at Burra were assessed relative to a base case scenario by SKM (2014).

The assessment concluded that the magnitude of the salinity impacts of the proposed watering scenarios was negligible or insignificant. The largest component of the salinity impact is associated with the displacement of groundwater due to diffuse recharge following inundation, but the impact is insignificant. This calculation is considered conservative as it assumes uniform salinity and assumes a significant percentage of the recharged water is returned the Murray River (SKM, 2014).

SKM expects that multiple managed inundation events will raise groundwater levels which may increase the salt load impact on the floodplain and river system.

Based on the uncertainty of the inundation events on salinity over time, SKM have recommended a monitoring program. This would comprise of groundwater and surface water monitoring. The MCMA monitors an existing network of bores within the Burra vicinity and undertakes a long-term salinity monitoring program to assess the impact of inundation events on groundwater levels and groundwater quality.

To assist in the monitoring of salinity impacts of Burra inundation the VMFRP, with assessment and recommendations from SKM (SKM, 2014) and Jacobs (Jacobs, Groundwater salinity monitoring bore specification for SDL projects, 2019) has proposed new bores within the proposed project inundation area.

These will be integrated into the existing MCMA monitoring network and monitoring program. Monitoring and ongoing assessment of risks will occur consistent with the Basin Salinity Management Strategy (MDBA, Basin Salinity Management Strategy 2030 (BSM2030), 2015).

In addition to the regular groundwater monitoring, Mallee CMA will manage the monitoring of surface water quality within the Burra project area, during operations. These monitoring activities are critical to verify modelled salinity impacts and to provide timely advice for management of any water quality issues arising during operation of the works.

The following mitigation measures are proposed to minimise and avoid impacts on water environments, salinity, and fish passage during operation of the project:

- Continue to undertake water quality monitoring before, during and after watering events to inform adaptive management strategies and real-time operational decision making.

- Commence watering as early as possible to move organic matter off the floodplain while temperatures are low. Maintain a through-flow where possible in other areas to maximise exchange rates and movement of organic material. Monitor dissolved oxygen and water temperature to identify hypoxic areas to inform consequence management.
- Schedule watering events to make use of dilution flows where possible and optimise timing of releases of Burra Creek. Ensure dilution of low dissolved oxygen 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.
- Integrate water management with other sites in seasonal water planning process. Maintain good relationships with other water managers.
- Tailor watering regimes to provide competitive advantage for native fish over carp. Dry wetlands that contain carp. Manage drawdown following managed events to provide triggers for native fish to move off the floodplain, and where possible, strand carp.
- Mitigation measures would be implemented to minimise risks associated with barriers to fish passage, including:
    - Design of regulating structures to satisfy fish passage requirements including those described in the Burra Fish Management Plan (Arthur Rylah Institute, Mallee CMA SDL Fish Management Plan: Burra Creek, 2018).
    - Continuing to build on knowledge and understanding through current studies relating to fish movement in response to environmental watering and cues to further develop and refine a fish exit strategy.
- 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:
    - Developing an understanding of potential river flow requirements to dilute higher than expected salinity impacts and provision of contingency estimates in environmental water bidding process for initial operation events.
    - Diluting saline water on the floodplain by delivering more fresh water to these areas.
    - Reduce the frequency and/or extent of planned watering events if sufficient volumes not available.

10.3 Risks Associated with Pest Plants and Animals

Mitigation measures would be implemented to minimise risks associated with pest plants and animals, including:

- Timing water manipulations to drown seedlings, minimise growth, germination, and seed set. Time water manipulations to promote native species.
- Controlling 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.

10.4 Risks Associated with Structures

The owner and operator have responsibility for management of risks to the integrity of the structures themselves.

These risks are managed through operation of the structures within their design capabilities, monitoring of structural integrity and through maintenance.

Risk frameworks are being put together for the management and operation of the structures and will be confirmed during stage 2 works.

11. Operational Costs

The operations and maintenance (O&M) arrangements considers all activities to operate, maintain, monitor and report on the Burra works.

The funding arrangements for ongoing management costs (Table 10) have not formally been established at this time. Funding arrangements could involve cost sharing with the Commonwealth, or partially or in whole funding by Victoria.

There are multiple funding options currently being considered and will require further deliberation by DELWP, DTF, and the Commonwealth.

The estimated operations and maintenance costs for the project are provided in the Business Case, summarised in Table 10.

The precise operating procedures of the project will be detailed in the operations planning to be finalised as part of Stage 2 which includes the scope of works, schedule and cost estimate for the project.

Stage 2 addresses the matters listed in the most recent guidance on the content of proposals for Supply and Constraint Measures.

The operating costs in Table 10 are provided as an average annual cost and maximum annual cost to reflect the environmental water delivery via temporary pumping and will be updated as part of Stage 2 works for the Burra project.

Environmental water entitlement storage and works licencing costs are not included in this cost estimate.

Operation and maintenance are based on a 30-year timeframe and excludes asset refurbishment and replacement expenses.

Major refurbishment and replacement costs for VMFRP assets would need to be funded by government and be subject to normal funding practices.

Table 10: Burra Project Average and Annual Costs (MCMA, 2014)

Item	Average cost ($/year)	Maximum cost ($/year)	Responsible party	Notes
Capital maintenance cost and operating cost			Asset owner	Based on three per cent of capital expenditure with contingency
Pumping cost			Mallee CMA	Temporary pumping costs. Pumping only required 1 year in 10. Maximum cost assumes 2.8 GL pumped into Burra.
Ecological monitoring costs (condition and intervention)				Based on TLM condition and intervention monitoring costs
Salinity monitoring costs				Based on current monitoring and proposed monitoring framework
Compliance				Based on TLM post construction compliance monitoring
Project management costs			Project partners	Based on TLM experience
Total estimated				

12. Communications

12.1 Community Communication and Engagement Strategy

The Burra Site has a Community Communication and Engagement Strategy. A Stakeholder Engagement and Communication Plan was developed to ensure awareness amongst all stakeholders and the wider community of the Burra environmental watering operations.

The VMFRP Stakeholder Engagement & Communication Plan is attached as Appendix 1 and will be updated as appropriate as part of the Stage 2 works for the Burra project.

The Site Manager, LMW, and the Mallee CMA are committed to establishing and maintaining strong relationships within the local community during watering operations. A vital tool in the consultation process is structured engagement with the community through engagement with key stakeholders and advisory groups.

12.2 Indigenous Engagement

Indigenous stakeholders are consulted to ensure the Indigenous community has an opportunity to provide input into water management and a chance to raise and identify their cultural and spiritual links to Burra.

These stakeholders are representatives of each of the Aboriginal parties who have a vested interest in the Burra area.

Indigenous consultation is managed via the Mallee CMA Indigenous Facilitator and through the Mallee CMA Aboriginal Reference Group. This group provides a valuable single source for Indigenous engagement, advice, input and recommendation.

The reference group has Indigenous representatives who ensure that cultural heritage and values are considered and incorporated by the Site Manager and Mallee CMA.

The representatives also distribute information about Site management into the Aboriginal communities.

The development of an Indigenous engagement framework will be developed during Stage 2 works.

12.3 Communication during managed events

Mallee CMA and Lower Murray Water will coordinate communication activities for upcoming and ongoing watering events via the Burra Operations Group.

The Mallee CMA prepares a Communications Plan each year that covers environmental watering events for the entire Mallee CMA region, including Burra.

The plan is a high-level framework for communication and engagement activities, relating to that years' environmental watering. It addresses all wetlands listed in the Mallee CMA Seasonal Watering Proposals and will incorporate watering proposals for Burra under the VMFRP.

The plan does not cover government agencies as a stakeholder as the Communication Plan and Engagement occurs at an operational level, predominantly via the Burra Operations Group for the Burra site.

Parks Victoria will be responsible for communicating with its stakeholders and visitors regarding any impacts on visitor experience such as road closures, access restrictions to areas of the park and water quality issues.

During routine river operations or in the event of a broad, basin scale event such as blackwater, the MDBA, Water Authorities, and CMAs will work together to communicate with local agencies.

12.4 Complaints and Enquiries

Complaints and enquiries relating to the environmental watering process shall be directed to MCMA.

Parks Victoria will be responsible for dealing with complaints and enquiries regarding visitor access to the park and water quality concerns within the park.

13. Water Management Operations Record

A record of water management operations is maintained as part of this Operations Plan.

The purpose of the record is to document how well the infrastructure and management arrangements at Burra meet environmental watering needs and manage risk.

The record documents watering plans, actions and outcomes. An entry is made at the conclusion of each watering event and includes analysis of the strengths and weaknesses of operating arrangements.

The record is used to revise and refine the Burra Operations Plan as well as to inform annual watering actions, to ensure that water delivery is as efficient and effective as possible and that risks are managed appropriately.

The Water Management Operations Record comprises the following information:

- Event Water Year
- Watering Objective – This identifies the primary objective(s) of the watering event. Detailed rationales are provided in the Annual Watering Proposal.
- Operational Targets – The key thresholds that were set for operations, such as wetland water levels, watercourse discharge or structure settings and the dates on which they were to be achieved. This can be presented as a target hydrograph or a table. Operational targets will be required for each watercourse and wetland.
- External Factors – External factors that influenced operations are presented. These could include river flows, rain events, risk management or structure malfunction. Their influence on operations is described.
- Operational Outcomes – The actual water levels / flow rates / total water volume used/structure settings achieved and dates. This can be presented as an annotated hydrograph or table. Operational outcomes will be required for each watercourse and wetland.
- Performance – How well were the watering objectives met?
- Risk Management – How well were known risks monitored? How well were they managed?
- Considerations for future operations

14. References

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Appendix 1: VMFRP Stakeholder Engagement and Communication Plan