

Environmental Water Management Plan



Photo: Pshyce Creek Canoe Launch,
Kings Billabong

Kings Billabong

Version Number	Description	Issued To	Issue Date
1.	Report structure updated following internal discussion	Beth Ashworth, Julia Reed, Michael Jensz, Tori Perrin	13/10/2010
2.	Report structure updated following comments from EWR team	EWaMP working group across CMAs and DSE	19/10/2010
3.	Draft Butlers Creek EWMP for project team review	M. Cooling	17/03/2016
4.	Draft 1 Butlers Creek EWMP for CMA review	E. Healy	30/03/2016
5.	Draft 2 Butlers Creek EWMP for CMA review	E. Healy	18/04/2016
6.	Final Draft Butlers Creek EWMP	E. Healy	27/04/2016
7.	Updated ecological objectives - Water's Edge Consulting (Kings Billabong EWMP & Butlers Creek EWMP)	D. Wood (Mallee CMA)	16/12/2020
8.	Whole Kings Billabong EWMP review and update according to latest guidelines	G. Cranston	01/12/2021
9.	Whole Butlers Creek EWMP review and update according to latest guidelines	G Cranston	08/12/2021
10.	Whole EWMP review and update according to latest guidelines and data. Re-incorporate Butlers Creek into Kings Billabong EWMP	T. Muster	17/03/2022
11.	1 st Draft for Mallee CMA review April 2022 guidelines– Pinion Advisory	A. Nunn	16/06/2022
12.	1 st Draft from Pinion Advisory reviewed – MCMA	G. Cranston	20/06/2022
13.	Final incorporating MCMA comments – Pinion Advisory	G. Cranston & A. Nunn	22/06/2022
14.	Update to incorporate 2023 Community Consultation – Alluvium Consulting	E Johnstone	25/07/2023

Citation

Please cite this document as:

Mallee CMA (2021) Environmental Water Management Plan Kings Billabong, Mallee Catchment Management Authority, Mildura, Victoria.

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Cover image: Canoe Launch, Psyche Creek, Kings Billabong

Acknowledgement of Country

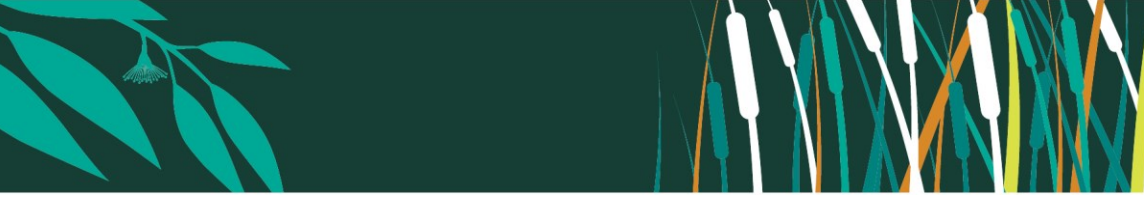
Mallee Catchment Management Authority (CMA) acknowledges and respects Traditional Owners, Aboriginal communities and organisations. We recognise the diversity of their cultures and the deep connections they have with Victoria's lands and waters.

We value partnerships with them for the health of people and country.

Mallee CMA Board, management and staff pay their respects to Elders past and present, and recognise the primacy of Traditional Owners' obligations, rights and responsibilities to use and care for their traditional lands and waters.

Abbreviations and acronyms

CAMBA	China-Australia Migratory Bird Agreement
CMAs	Catchment Management Authorities
DEH	Department of Environment and Heritage
DSE	Department of Sustainability and Environment
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plan
EWH	Environmental Water Holder
FSL	Full Supply Level
G-MW	Goulburn-Murray Water
JAMBA	Japan-Australia Migratory Bird Agreement
MDBA	Murray-Darling Basin Authority (formally Murray-Darling Basin Commission, MDBC)
Ramsar	Global treaty adopted in the Iranian city of Ramsar in 1971 that focuses on the conservation of internationally important wetlands
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RRG	River Red Gum
TLM	The Living Murray Initiative
TSL	Targeted Supply Level



Executive Summary

Environmental Water Management Plans (EWMPs) have been developed for key sites in the Mallee region by the Mallee Catchment Management Authority in partnership with the Victorian Department of Environment, Land, Water and Planning (DELWP). The Mallee Waterway Strategy 2014-22 (Mallee CMA, 2014) identified 23 Waterway Management Units (WMU) from 216 targeted waterways in the Mallee. The interconnectedness and commonality of threats impacting on the waterway values were used to group the WMUs into planning units. This EWMP has been developed for the Kings Billabong WMU sub-unit which is part of the Nichols Point WMU. The EWMP will help to guide future environmental watering activities for this area.

The Kings Billabong EWMP was developed in 2010. In 2016 the Butlers Creek component of this EWMP was incorporated into a separate Butlers Creek EWMP. Due to their shared ecological values, connectedness, and geographic proximity the Mallee CMA has chosen to re-incorporate Butlers Creek into the Kings Billabong EWMP.

Kings Billabong is located in the Robinvale Plains Bioregion 10 km south east of Mildura. The area contains a number of depleted and vulnerable ecological vegetation classes and regionally important wetlands. The site provides habitat for species listed under state, national and international treaties, conventions, Acts and initiatives such as the endangered freshwater Catfish (*Tandanus tandanus*) and vulnerable Growling Grass Frog (*Litoria raniformis*). The site also provides habitat for large wading birds, which could be supported in the flooded Lignum vegetation communities within Ducksfoot Lagoon, and large numbers of piscivorous water birds will be supported by high levels of aquatic productivity and the abundant fish community.

Kings Billabong is a high-profile site for environmental watering with high numbers of visitors to the Kings Billabong Park and the close proximity to Mildura. It is in a popular area for recreational activities including walking, bird watching and fishing. The area also has significant Indigenous and European cultural heritage values. Kings Billabong is also used for storage and transfer of irrigation water.

This EWMP was developed in collaboration with key stakeholders namely Parks Victoria, DELWP, and local interest groups. This plan also outlines planned consultation with Traditional Owners to review and provide input into the plan.

A number of risks associated with environmental water delivery have been identified and management measures have been put in place in an attempt to decrease and/or mitigate these risks.

The management goals for Kings Billabong/Butlers Creek are:

- To provide a watering regime that supports a mosaic of aquatic and semi emergent wetland vegetation communities to provide key habitat and food sources for a diverse range of fauna.
- For the Butlers Creek complex to be permanent wetlands with seasonal variation in water levels that will support the populations of Growling Grass Frog and support key habitat requirements of piscivorous and large wading birds

To achieve the management goals, ecological and hydrological objectives have been defined to provide an appropriate environmental watering regime. The environmental objectives for Kings Billabong and Butlers Creek were updated in 2020. These updated objectives are:



KB1: By 2030, improve vital habitat at the King's Billabong asset by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.

KB4a: By 2030 increase breeding of frogs at the Kings Billabong asset.

KB4b: By 2030, improve biodiversity at the Kings Billabong asset by supporting the life cycle of EPBC listed Growling Grass Frog (*Litoria raniformis*).

KB5: By 2030, protect and restore biodiversity by maintaining representative populations of native small-bodied fish at the Kings Billabong asset, including Australian Smelt (*Retropinna semoni*), Carp gudgeon (*Hypseleotris spp.*), Flat-headed Gudgeon (*Philypnodon grandiceps*), Murray-Darling Rainbowfish (*Melanotaenia fluviatilis*), Un-specked Hardyhead (*Craterocephalus stercusmuscarum fulvus*).

KB6: By 2030, improve the population of Freshwater catfish (*Tandanus tandanus*) at the Kings Billabong asset.

KB7: By 2030, maintain representative populations of the shallow-water and deep feeding guilds of waterbirds, including shorebirds (F2 and F3, after Jaensch 2002) at the Kings Billabong asset, by maintaining a mixture of foraging habitats.

KB8: By 2030, maintain vital habitat to provide a refugium for listed species of waterbirds at the Kings Billabong asset.

KB 9 (BTC4): By 2030, maintain representative populations of piscivores (guild D4, after Jaensch 2002) at the Butlers Creek asset.

KB 10 (BTC5): Protect and restore ecosystem functions of water-dependent ecosystems that support successful breeding of large waders at Ducksfoot Lagoon by providing conditions for breeding and fledging at least 3 times every 10 years

The intended water regime to meet the environmental objectives for each of the wetlands is provided below.

The Butlers Creek complex (Butlers Creek, Baggs Lagoon and Ducksfoot Lagoon) is to be managed as a permanently inundated water area with seasonal variations in water level. Fill wetlands to 34.4m AHD every spring/summer by opening regulator gates at Baggs and Jennings bridges. Close regulator gates in autumn allowing natural drawdown of the water level during autumn/winter. Maintain permanent open water habitat by ensuring that water levels do not fall below 33.9m AHD by opening the regulator gates as required. Fill wetland up to 34.9m AHD (using temporary pumps) only as required, if not achievable using natural flows, and maintain this level for seven months to facilitate waterbird breeding and flushing of sediment. Top up as required. A drying phase is to be introduced only as a Carp management tool. This should be enacted when there is evidence of abundant large Carp, or obvious decline in submergent macrophyte communities as a result of Carp.

Kings Billabong Wetland is to be managed as a permanently inundated water area. The Kings Billabong regulator enables the wetland to be isolated from Psyche Creek and water levels in the wetland to be managed for environmental outcomes. In such an event the regulator can be closed and water levels within the wetland area reduced by up to 1 m during autumn and winter. Water levels can then be allowed to return to normal operating levels during the peak irrigation period in summer by opening the regulator. This is currently not a priority for the Mallee CMA and there are no current plans to regularly utilise regulator for environmental purposes.

Table of Contents

Executive Summary	0
1 Introduction	1
2 Consultation	1
2.1 Target audience	1
2.2 Developing / updating the EWMP	3
2.2.1 Verifying asset values	4
2.2.2 Informing proposed management objectives, targets and approaches	4
2.2.3 Promoting adaptive management	4
2.3 Community	4
2.4 Traditional Owners	6
3 Asset Overview	6
3.1 Catchment Setting.....	7
3.2 Land Status and Managagement.....	7
3.3 Asset Characteristics	9
3.4 Environmental Water Sources	11
4 Current/Historical Hydrological Regime and System Operations	12
4.1 Groundwater and salinity interactions.....	14
4.2 Environmental watering.....	15
5 Water Dependant Values	16
5.1 Environmental Values	17
5.1.1 Ecosystem type	17
5.1.2 Flora and Fauna Values	19
5.1 Shared Benefits.....	29
5.2 Traditional Owner Cultural Values	29
5.3 Recreational Values	30
5.4 Current Condition	30
5.5 Trajectory of change	32
6 Managing Water Related Threats	32
7 Management Goals, Objectives and Targets	34
7.1 Management Goal.....	34



7.2	Environmental Objectives and Targets	34
7.3	Regional Significance.....	38
7.4	Alignment to Basin Plan	38
7.5	Documenting EWMP Updates and Mapping to Basin Plan and Other Policy Documents	38
8	Environmental Water Requirements and Intended Water Regime	39
8.1	Watering Requirements and Intended Watering Regimes	39
8.2	Expected Watering Effects	40
8.3	Seasonally Adaptive Approach	43
9	Environmental Water Delivery Infrastructure	45
9.1	Water Delivery Infrastructure	45
9.2	Constraints	45
10	Demonstrating Outcomes	46
11	Knowledge gaps and recommendations.....	48
12	References.....	49



1 Introduction

This Environmental Water Management Plan (EWMP) has been prepared by the Mallee Catchment Management Authority (CMA) to establish the long-term management goals of Kings Billabong. Kings Billabong is located on the Murray River floodplain 10 km south east of Mildura

The key purposes of the EWMP are to:

- identify long-term objectives and water requirements for the wetlands, identified as a high priority by the Mallee CMA;
- provide a vehicle for community consultation, including for the long-term objectives and water requirements of the wetlands;
- inform the development of seasonal watering proposals and seasonal watering plans; and
- inform the long-term watering plans to be developed under the Basin Plan requirements.

The Kings Billabong EWMP was developed in 2010. In 2016 the Butlers Creek component of this EWMP was incorporated into a separate Butlers Creek EWMP. The environmental objectives were reviewed and updated in 2020 for both Kings Billabong and Butlers Creek. Due to their shared ecological values, connectedness, and geographic proximity, the Mallee CMA has chosen to re-incorporate Butlers Creek into the Kings Billabong EWMP. The latest version of the Kings Billabong EWMP (2022) has been updated to incorporate new information and align with the Department of Environment, Land, Water and Planning (DELWP) Draft EWMP Guidelines (Version 6 – April 2022).

2 Consultation

2.1 TARGET AUDIENCE


This section identifies the target audience and modes of consultation necessary to manage environmental water delivery, report against stated objectives and targets, and promote adaptive management over the life of the EWMP.

Engagement with different stakeholder groups is based on the International Association of Public Participation (IAP2) spectrum. The spectrum allows for a tailored approach based on stakeholder groups and their needs.

IAP2 Spectrum of Public Participation



IAP2's Spectrum of Public Participation was designed to assist with the selection of the level of participation that defines the public's role in any public participation process. The Spectrum is used internationally, and it is found in public participation plans around the world.

INCREASING IMPACT ON THE DECISION 					
	INFORM	CONSULT	INVOLVE	COLLABORATE	EMPOWER
PUBLIC PARTICIPATION GOAL	To provide the public with balanced and objective information to assist them in understanding the problem, alternatives, opportunities and/or solutions.	To obtain public feedback on analysis, alternatives and/or decisions.	To work directly with the public throughout the process to ensure that public concerns and aspirations are consistently understood and considered.	To partner with the public in each aspect of the decision including the development of alternatives and the identification of the preferred solution.	To place final decision making in the hands of the public.
PROMISE TO THE PUBLIC	We will keep you informed.	We will keep you informed, listen to and acknowledge concerns and aspirations, and provide feedback on how public input influenced the decision.	We will work with you to ensure that your concerns and aspirations are directly reflected in the alternatives developed and provide feedback on how public input influenced the decision.	We will look to you for advice and innovation in formulating solutions and incorporate your advice and recommendations into the decisions to the maximum extent possible.	We will implement what you decide.

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Figure 1 IAP2 Spectrum (source: (c) *International Association for Public Participation* www.iap2.org)

Table 1 lists the main stakeholder groups with an interest in environmental water based on their needs and interests and level of engagement required. To read more about the role of specific stakeholders in overseeing environmental water at Kings Billabong, refer to Section 3.2.

Mallee CMA develops a communication and engagement plan each year that covers environmental watering events for the entire Mallee CMA region, including Kings Billabong. This ensures that all stakeholders and community members are aware of the Kings Billabong environmental watering operations.

Table 1. Stakeholder Consultation for Kings Billabong EWMP

Stakeholder groups	Stakeholders	Needs and interest	IAP2 level	Consultation modes
Traditional Owners and Interested Parties	See Section 2.4: Traditional Owners	Ongoing connection to Country and protection of cultural heritage and values. Environmental impacts and benefits. environmental watering regimes and how these may be timed to support/promote cultural values.	Collaborate	Via Mallee CMA's Traditional Owner engagement team. Consultation is largely undertaken in-person and, where possible, on Country.
Victorian water holders	VEWH	Make decisions about annual environmental water usage.	Collaborate	Via formal meetings.

Stakeholder groups	Stakeholders	Needs and interest	IAP2 level	Consultation modes
State government	DEECA	Consultation regarding monitoring and assessment Ongoing consultation during planning and preparation of annual environmental water documents and agreements	Collaborate	Via formal meetings.
River operators	Lower Murray Water	Manage water storage.	Collaborate	Via formal meetings.
Public land managers	Parks Victoria,	Managing impacts from watering such as access.	Collaborate	Via formal meetings.
Community (interest groups)	Friends of Kings Billabong	Watering benefits and impacts on local communities such as access to parks and river during watering events.	Inform	Via existing groups such as the Mallee CMA Land and Water Committee. Via Mallee CMA social media and news.

Consultation with relevant organisations and consultancies who have undertaken monitoring or research at Kings Billabong has been undertaken. This consultation will continue to ensure that up-to-date scientific information is used to inform management objectives, targets and approaches in subsequent versions of this EWMP.

Consultation with the Department of Environment, Land, Water and Planning (DELWP) and the Victorian Environmental Water Holder (VEWH) will be required regarding the recommended monitoring and assessment arrangements in Section 10. DELWP will use this information in aligning with monitoring programs and planning for Victoria's reporting obligations against Matter 8 of the Murray Darling Basin Plan.

2.2 DEVELOPING / UPDATING THE EWMP

Mallee CMA carried out community consultation through the following channels:

- Mallee CMA Land and Water Advisory Committee
- surveys at community events such as farmers' markets
- workshops and on-country visits with Traditional Owners (see Section 3)
- campaign emails
- meeting with landholders
- social media channels.

Relevant government agencies were invited to participate in the consultation process via a formal letter. They have also been engaged through existing channels, with discussions and presentations.

The key outcomes from this engagement were:



- ensuring that Traditional Owner values were represented in the ecological outcomes
- building more frequent initial watering into the proposed watering regime to help the landscape recover and monitoring outcomes to determine future water needs, in response to Traditional Owner feedback.

2.2.1 Verifying asset values

Asset values at Kings Billabong have been established through environmental assessments and the development of previous versions of this EWMP. Consultation has been a key part of these processes with Traditional Owners, community members and technical specialists. Mallee CMA has continued to engage on asset values throughout the development of the EWMP, particularly with Traditional Owners and private and public landholders.

2.2.2 Informing proposed management objectives, targets and approaches

Mallee CMA has long worked with those who have an extensive knowledge of Kings Billabong and floodplain ecosystems. This work has been central to providing a basis for local knowledge and expertise.

Combined with the Seasonal Watering Proposal, the data and knowledge from the will guide future watering events, as part of the adaptive management.

2.2.3 Promoting adaptive management

Mallee CMA and other partners will take an adaptive management approach taking into account both varying seasonal conditions and lessons learned from previous event.

After the annual adaptive management checkpoint, Mallee CMA will adapt the EWMP if needed, which would then go through consultation, giving stakeholders the opportunity to see any updates.

2.3 COMMUNITY

Community stakeholders were engaged via an online survey, which was hosted on the Mallee CMA website in January-February 2023. The survey was designed to enable landholders, recreational users, Landcare groups, environmental groups and other interested parties to provide input to the plans. Twenty respondents to the online survey identified King Billabong as the most important site (of all eight wetland sites for which EWMP were updated) and provided information on site use and values. Of these respondents, 94% visited Kings Billabong, and approximately 50% visited each of Butlers Creek and Ducksfoot Lagoon. The results of the ranking are shown in Tables 2, 3 and 4. For further detail about the outcomes of the 2023 community engagement, refer to appendix 6.

The survey supplements earlier community engagement about the Kings Billabong EWMP, and annual community engagement that informs the Seasonal Watering Proposal (SWP). Community consultation occurs at the IAP2 level of CONSULT.

Table 2 - Community Values Rankings – Kings Billabong. Twelve completed surveys

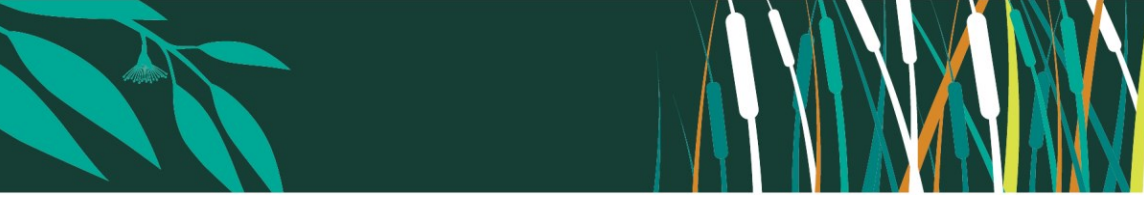
<i>Community Value</i>	<i>Value Ranking</i>
Unique landscape features and natural beauty	Unique landscape features and natural beauty were of extremely high importance to over half (7/12) of survey respondents (weighed score 4.42/5).
Recreational opportunities (e.g. birdwatching, fishing)	Recreational opportunities were of extremely high importance to over half (7/12) of survey respondents (weighed score 4.42/5).
Exercise (trails for walking, running, cycling)	Eleven of twelve respondents considered the exercise values of Kings Billabong to be of high to extremely high importance (score 4.25/5)
Work or Education opportunities	The ranking of work or education opportunities ranged from extremely important to not important at all, with an average score of 3.67/5. Five respondents considered such opportunities to be extremely important. Four respondents considered work or education opportunities as of moderate importance.
Commercial or business opportunities	Commercial or business opportunities were of low importance to respondents (score 2/5), and ranged from moderate importance, to not important at all.

Table 3 - Community Values ranking – Butlers Creek. Four completed surveys

<i>Community Value</i>	<i>Value Ranking</i>
Unique landscape features and natural beauty	Unique landscape features and natural beauty were of extremely high importance to all respondents (score 5/5)
Recreational opportunities (e.g. birdwatching, fishing)	Recreational opportunities were of very high importance to the respondents (score 4.75/5)
Exercise (trails for walking, running, cycling)	Exercise values were of moderate to extremely high importance to respondents (score 4/5)
Work or Education opportunities	Work or education opportunities ranged from extremely important to not important at all, with an average score of 3/5.
Commercial or business opportunities	Commercial or business opportunities were of low importance to respondents (score 2/5), and ranged from moderate importance, to not important at all.

Table 4 - Community Values ranking – Ducksfoot Lagoon. Two completed surveys

<i>Community Value</i>	<i>Value Ranking</i>
Unique landscape features and natural beauty	This value was of very high importance to respondents (score 4.5/5)
Recreational opportunities (e.g. birdwatching, fishing)	Recreational opportunities were of very high importance to the respondents (score 4.5/5).
Exercise (trails for walking, running, cycling)	The respondents considered exercise values to be of high importance (score 4/5).
Work or Education opportunities	The respondents considered work or education opportunities to be of high importance (score 4/5)
Commercial or business opportunities	Commercial or business opportunities were of very low importance to respondents (score 1.5/5)



2.4 TRADITIONAL OWNERS

Kings Billabong is located within the formally recognised Country of the First People of the Millewa-Mallee Aboriginal Corporation (FPMMAC). FPMMAC has indicated in DEECA's EWMP guidelines how they would like to be consulted about environmental watering. Consultation with FPMMAC, in-line with the EWMP guidelines, is ongoing. Engagement with Traditional Owners is conducted on a one-on-one basis at the COLLABORATE level of the IAP2 framework, with the level of interest and involvement self-determined. Annual consultation will also be undertaken during the development of Seasonal Water Proposals (SWPs) for Kings Billabong.

FPMMAC were engaged in March 2023 to collaborate on the EWMP update process. This involved a presentation to a group of TO's from FPMMAC about the sites included in the update.

An on Country visit to Kings Billabong was also undertaken, to assist in site based values discussions.

Discussions included ecological, social and cultural outcomes and watering regimes to support these. Engagement and discussions about these topics will be on going and essential to future watering programs.

3 Asset Overview

The Mallee CMA region is situated in the north-west of Victoria. The area of responsibility is close to 39,000 km² (3.9 million ha) and has a regional population estimated to be 65,000. Population centres include Mildura, Birchip, Sea Lake, Ouyen, Robinvale, Red Cliffs and Merbein. The boundaries of the Mallee CMA region cover almost one fifth of Victoria, making it the largest area managed by a CMA in the state.

Approximately 40% of the land area within the Mallee CMA boundary is public land, consisting mainly of national parks, reserves, wilderness, and large areas of riverine and dryland forests. The other 60% is predominantly dryland crops, but there is also a significant investment in irrigated horticulture including grapes, citrus, almonds, olives and vegetables along the Murray River corridor. Irrigated crops contribute over 40% of the value of agricultural production for the region.

In 2006, the Mallee CMA engaged consultants (Ecological Associates, 2006) to investigate water management options for the Murray River floodplain from Robinvale to Wallpolla Island. One of the major outcomes of these investigations was the development of a system of Floodplain Management Units (FMUs). These divide the floodplain into management units in which water regimes can be managed independently, but which are relatively consistent in their ecological values and land uses. The Mallee CMA has based its environmental water management plans on these FMUs to support effective management of hydrologically connected systems. In addition to this, the Mallee CMA has also used individual FMUs or groupings of FMUs to form Waterway Management Units (WMUs) for planning within its Mallee Waterway Strategy.

The site for this plan is the Kings Billabong WMU sub-unit, hereafter referred to as Kings Billabong in this document. Kings Billabong is located 10 km south east of Mildura on the Murray River floodplain (**Figure 2**).

A regional context document (North, 2014) has been prepared to compliment the Mallee CMA EWMPs and should be read in conjunction with this document.

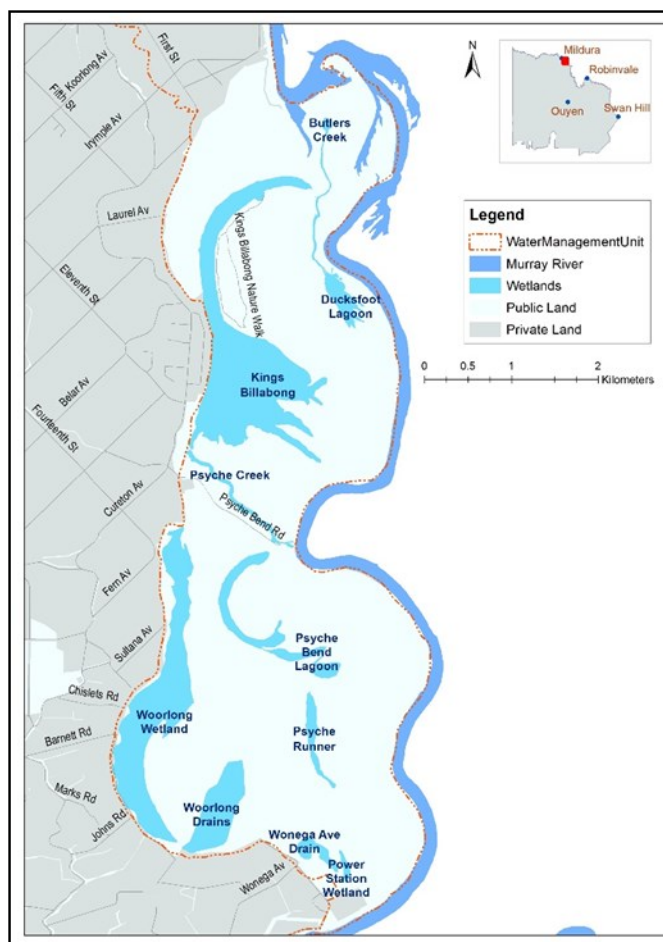


Figure 2. Kings Billabong and surrounding area.

3.1 CATCHMENT SETTING

Kings Billabong is a floodplain wetland complex located within the Robinvale Plains bioregion within the Mallee CMA region. The Robinvale Plains bioregion is characterised by a narrow gorge confined by the cliffs along the Murray River, which is entrenched within older up-faulted Cainozoic sedimentary rocks. Alluvium deposits from the Cainozoic period gave rise to the red brown earths, cracking clays and texture contrast soils (Dermosols, Vertosols, Chromosols and Sodosols) this supports Riverine Grassy Forest and Riverine Grassy Chenopod Woodland ecosystems. (DEPI, 2015).

3.2 LAND STATUS AND MANAGEMENT

Kings Billabong was a Wildlife Reserve until it was declared the Kings Billabong Park in the Victorian Environmental Assessment Council River Red Gum Forests Investigation (VEAC, 2008b). The change in land status does not affect the land management as Parks Victoria continues to manage the area. Lower Murray Water manages the irrigation water resources and infrastructure (along with the Mallee CMA) within the park. Stakeholders involved in managing the land and water within Kings Billabong are listed in Table 5. Land management boundaries are shown in Figure 3.

Table 5. Stakeholders for the Kings Billabong EWMP

Group	Role
Parks Victoria	Land Manager
Mallee CMA	Regional waterway and environmental management
Department of Environment, Land, Water and Planning (DELWP)	State level environmental management planning, land manager, threatened species manager
Victorian Environmental Water Holder	Manager of Victoria's environmental water entitlements
First People of the Millewa-Mallee Aboriginal Corporation	Indigenous representation
Friends of Kings Billabong	Assistance in planning and implementation of programs

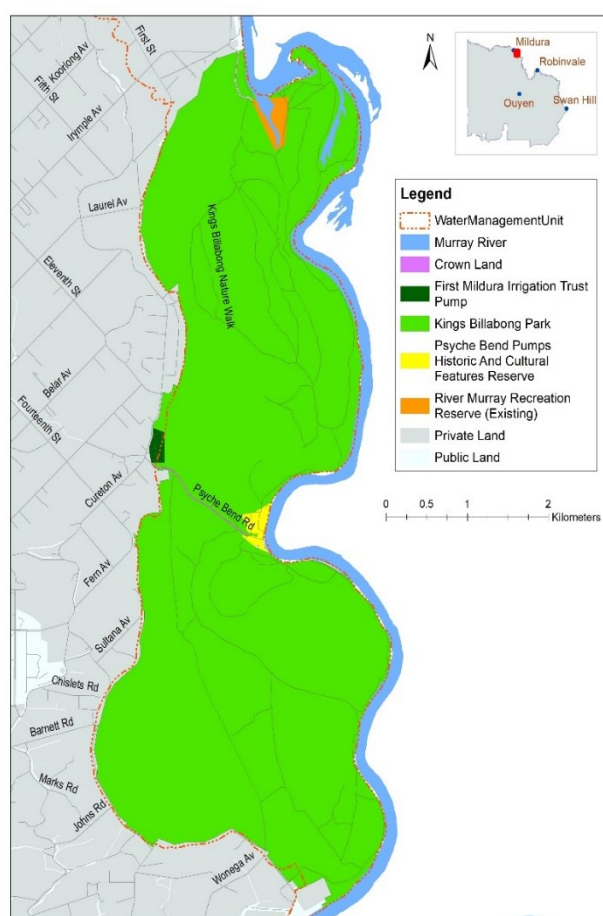


Figure 3. Land management boundaries around Kings Billabong.

3.3 ASSET CHARACTERISTICS

Kings Billabong is situated on the Murray River floodplain, 10 km south east of Mildura at Nichols Point. Kings Billabong consists of two distinct areas, the main billabong, herein referred to as the Kings Billabong Wetland, and the Butlers Creek complex which is separated from the Kings Billabong Wetland by an earthen block bank located at the northern end of the wetland.

The Kings Billabong Wetland consists of a permanently inundated wetland area which covers most of the mapped Kings Billabong Wetland (#11360). This area is managed for the storage and transfer of irrigation water and is generally maintained at an operating level of 37 m AHD, which is 2.6 m above the operating level of the Lock 11 weir on the Murray River at Mildura (34.4 m AHD). The Lower Murray Water pumps on the Murray River at Psyche Bend maintain the water level within the wetland by pumping water into Psyche Creek which is connected to the southern end of the wetland. Water is retained within the wetland by a block bank at the northern end of the wetland and a regulator to the south east on Psyche Creek at the connection with the Murray River. A recently constructed (2011) regulator at the connection between the wetland and Psyche Creek enables water levels within the wetland to be managed for environmental outcomes without impacting on water levels at the nearby Lower Murray Water pump station on Pysche Creek.

The Butlers Creek complex consists of the north eastern tip of the Kings Billabong Wetland (#11360), Butlers Creek (no wetland #), Ducksfoot Lagoon (#11371 and #11373), and Baggs Lagoon (#11367). These wetlands have historically been permanently inundated by two unregulated connections with the Murray River (Baggs Bridge and Jennings Bridge), which is maintained at a normal operating level of 34.4 m AHD by the Lock 11 Weir at Mildura. Regulators constructed in 2010 at these two connections enable water levels within the Butlers Creek complex to be managed for environmental outcomes.

Kings Billabong is located within the Kings Billabong Park and is popular for activities including walking, bird watching and fishing. Kings Billabong has significant Indigenous and European cultural heritage values. The wetlands in the park provide a range of wetland habitats including River Red Gum forest, Black Box-chenopod woodland and reed beds.

A brief overview of the main characteristics of the wetlands at Kings Billabong is provided in **Table 6**. Wetland types found with the Kings Billabong are shown in **Figure 4**.

Table 6. Wetland Characteristics at Kings Billabong

Characteristics	Description
Name	Kings Billabong
Mapping ID (Wetland Current layer)	King Billabong: 11360 (171.18 ha) Ducksfoot Lagoon: 11371 (12.5 ha), 11373 (2.08 ha) Baggs Lagoon: 11367 (1.21 ha) Butlers Creek (no ID) Unnamed wetland: 11364 (3.85 ha - outside target area)

	<p>Unnamed wetland: 11374 (6.18 ha - outside target area)</p> <p>Unnamed wetland: 11355 (20.35 ha - outside target area)</p>
Area of wetlands in target area	186.97 ha
Bioregion	Robinvale Plains
Conservation status	<p>The Kings Billabong Wetlands (which includes all of the target area) is listed as a nationally important wetland in the Directory of Important Wetlands in Australia (DIWA)</p> <p>Bioregion conservation status: areas of EVCs listed as Vulnerable, Depleted and Least Concern</p>
Land status	Kings Billabong Park
Land manager	Parks Victoria
Surrounding land use	Irrigated horticulture, rural townships
Water supply	Natural inflows and environmental water from the Murray River, pumped inflows from the Murray River, and local catchment runoff
Wetland category (Wetland Current layer)	<p>King Billabong (11360): 5 – Permanent open freshwater</p> <p>Ducksfoot Lagoon (11371 & 11373): 5 – Permanent open freshwater</p> <p>Baggs Lagoon (11367): 5 – Permanent open freshwater</p> <p>Butlers Creek: N/A</p> <p>Unnamed wetland 11364: 5 – Permanent open freshwater</p> <p>Unnamed wetland: 11374: 5 – Permanent open freshwater</p> <p>Unnamed wetland: 11355: 2- Freshwater meadow</p>
Wetland depth at capacity	<p>Butlers Creek area: Greater than 2 metres at deepest point</p> <p>Kings Billabong Wetland: 2-5 metres</p>

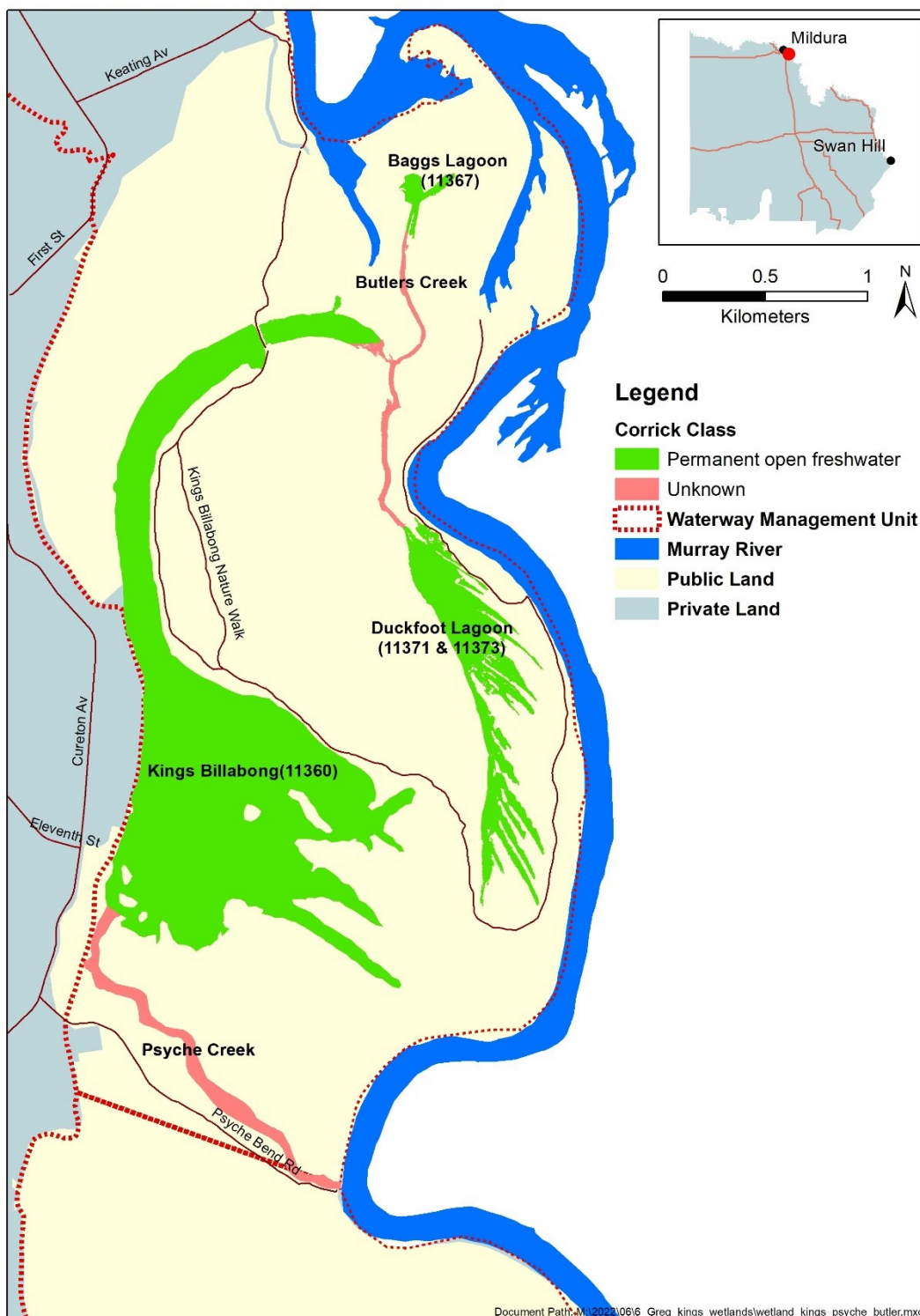


Figure 4. Kings Billabong wetland category.

3.4 ENVIRONMENTAL WATER SOURCES

The Environmental Water Reserve (EWR) is the legally recognised amount of water set aside to meet environmental needs. The Reserve can include minimum river flows, unregulated flows and specific environmental entitlements. Environmental entitlements can be called out of storage when needed and delivered to wetlands or streams to protect their environmental values and health.

The Victorian Minister for Environment, Climate Change and Water appointed Commissioners to Victoria's first independent body for holding and managing environmental water on 1 July 2011 – The Victorian Environmental Water Holder (VEWH) is responsible for holding and managing Victoria's environmental water entitlements and making decisions on their use.

Environmental water for the target area may be sourced from the water entitlements through the Seasonal Water Proposal (SWP) process and their responsible agencies listed in **Table 7** and further explained in the Regional Context Document (North, 2014). Previous environmental watering at Kings Billabong is outlined in the Environmental Watering section of this EWMP.

Table 7. Summary of Environmental Water Sources available to Kings Billabong

Water entitlement	Responsible agency
Murray River unregulated flows	Murray-Darling Basin Authority
Murray River surplus flows	
Victorian Murray River Flora and Fauna Bulk Entitlement	Victorian Environmental Water Holder
Commonwealth water	Commonwealth Environmental Water Holder
Donated water	Victorian Environmental Water Holder

4 Current/Historical Hydrological Regime and System Operations

Wetland hydrology is the most important determinant in the establishment and maintenance of wetland types and processes. It affects the chemical and physical aspects of the wetland which in turn affects the type of flora and fauna that the wetland supports. A wetland's hydrology is determined by the physical form of the wetland, surface and groundwater inflows and outflows in addition to precipitation and evapotranspiration. Duration, frequency and seasonality (timing) are the main components of the hydrological regime for wetlands and rivers.

Murray River hydrology has been altered significantly by regulation and diversion upstream. Storages in Victoria and New South Wales are managed to capture water in winter and spring and to deliver this water at manageable flow rates to consumers (primarily irrigators) during the summer. The impact on river hydrology has been a reduction in large winter and spring flow peaks and enhancement of low summer flows. Locks and weirs have further altered floodplain water regimes by stabilising river levels.

The ecologically significant effects of these hydrological and hydraulic changes have been to:

- largely eliminate flowing water habitat under normal regulated flows;
- permanently inundate wetlands, the river channel and low-lying floodplain areas in the vicinity of the weir pools; and

- reduce the frequency and duration of floods that reach higher-level wetlands and floodplain areas.

Since there are no major tributaries or losses from the Murray River between Robinvale to Wallpolla Island, Ecological Associates (2007b) suggest that the hydrology at Kings Billabong is best described using gauge #414203 (Murray River @ downstream of Euston Weir). The hydrology of the river at Kings Billabong has been characterised by analysing the MSM_Bigmod daily flow series for Natural and Current (Baseline scenarios, using data from 1891 to 2009 (Figure 5).

Prior to river regulation in this reach of the Murray River, the floodplain experienced inundation more frequently and for longer periods. The regulation and diversion of the Murray River has reduced the frequency and duration of peaks in river flow which activate anabranches, fill wetlands and inundate floodplain areas.

The river now spends more time fluctuating at very low flows, less than 10,000 ML/d, than under natural conditions as indicated by higher than natural spell frequency but much shorter spell duration. Events that inundate low-lying wetlands, between 30,000 and 60,000 ML/d, now occur at almost half the frequency of natural conditions. The duration of these events, when they do occur, has also been reduced by almost 60%. The impact on floodplain inundation is also significant. While the duration of spells exceeding 70,000 ML/d under current conditions is similar to natural, the frequency of these events has declined to as much as 50% of natural. This has resulted in a major increase in the interval between spells for very high flows.

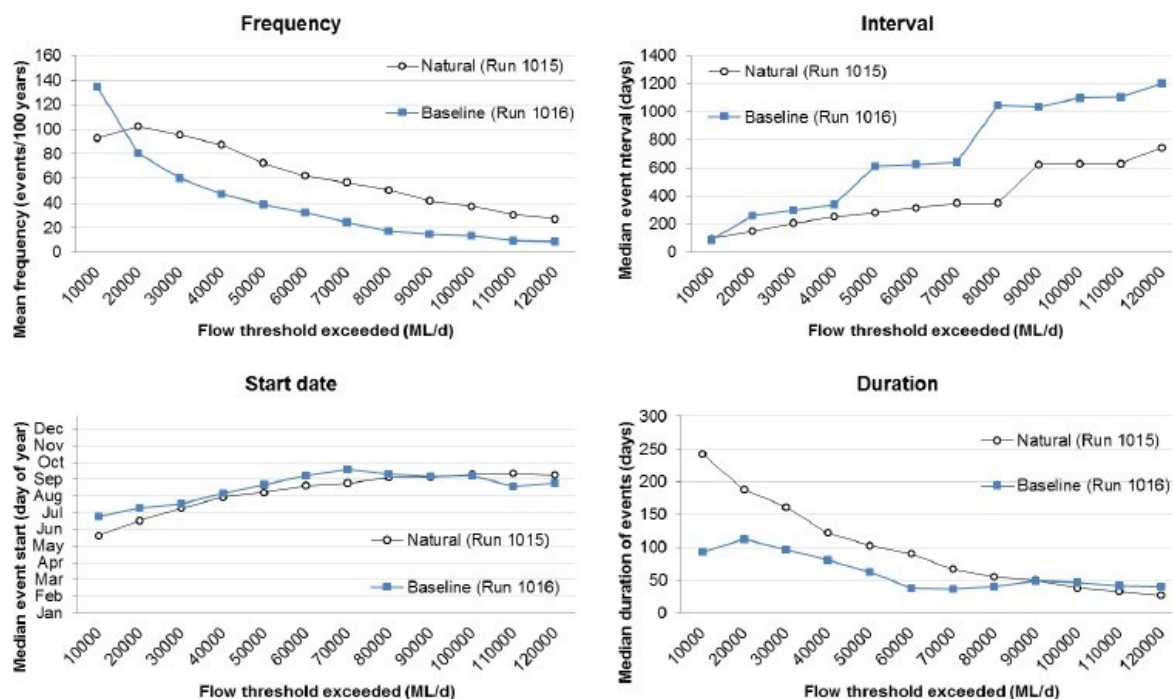


Figure 5. Spells analysis for River Murray flows upstream of Lock 11 (using data from Euston DS) for Natural and Baseline scenarios over a 114 year modelled period (Fluvial Systems 2014).

Mean annual flows at Euston have been reduced by 49 per cent from natural levels, although seasonality of mean monthly flows is largely unaltered (Maheshwari, Walker and McMahon, 1993; Ecological Associates, 2006) as shown in Figure 6.

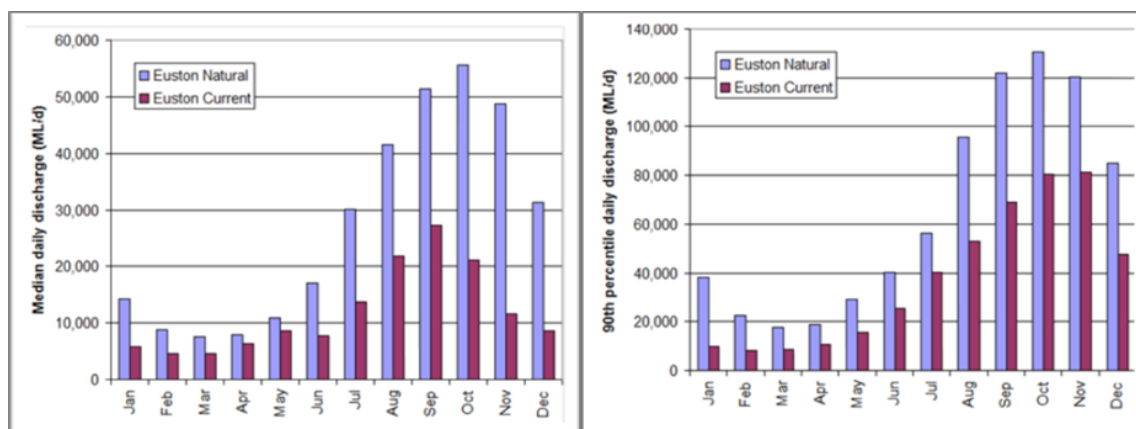


Figure 6. Distribution of median flows and 90th per centile flows for each month in the Murray River through Euston Weir for pre-regulated and regulated (current) conditions (Ecological Associates, 2006).

Prior to river regulation the ephemeral wetlands of the floodplain experienced inundation during high flow periods punctuated with drying phases on a regular basis. The inundation allowed for recruitment and preservation of the floodplain species.

The Kings Billabong Wetland has been used to store and transfer irrigation water for more than 100 years. The wetland is maintained at a relatively constant level (37 m AHD) to facilitate the supply of irrigation water. The water level is managed through the use of regulators, a levee bank and the pumping of water from the River Murray. (SKM 2002). The levee bank is located at the northern end of the wetland and separates it from the Butlers Creek complex. In 2011 a regulator was installed at the southern end of the wetland at the connection with Psyche Creek. This regulator is located immediately north of the Mildura Central Pump Station (Lower Murray Water) and enables water levels within the Kings Billabong Wetland to be managed for environmental outcomes without impacting on water levels at the pump station.

The Butlers Creek complex, including Ducksfoot Lagoon and Baggs Lagoon, was previously permanently inundated by the influence of the Lock 11 weir pool. In 2010 Mallee CMA worked in conjunction with Parks Victoria to install two regulators to allow the lagoons and Butler's Creek system to be disconnected from the river to allow water levels to be managed independently and enable a more natural wetting and drying cycle.

4.1 GROUNDWATER AND SALINITY INTERACTIONS

As previously described the Kings Billabong Wetland has been modified to be used to store and transfer irrigation water. These modifications have isolated the wetland from the Murray River with direct connection limited to periodic flood events. The wetland is permanently inundated and maintained at a constant level via ongoing pumping by Lower Murray Water from the Murray River. As a result, the water stored in the wetland is low in salinity, equivalent to Murray River salinity. The wetland is relatively healthy, supporting diverse flora and fauna populations. The quality of the vegetation communities has been aided by regular inflows of freshwater limiting the effects of salinity. The low salt concentration of the freshwater storage and its freshening influence also reduces the influence of any saline groundwater intrusion within the Kings Billabong target area (MCMA 2022).

The impacts of saline groundwater intrusion and irrigation drainage water disposal are evident in the Psyche Bend Lagoon/Woorlong Wetlands which are immediately south of the Kings Billabong target area.

4.2 ENVIRONMENTAL WATERING

A summary of environmental watering events at Kings Billabong is provided in Table 8. Environmental watering events commenced in the Butlers Creek complex following the installation of regulators at the at Baggs Bridge and Jennings Bridge in 2010. This enabled the Butlers Creek system to be disconnected from the Lock 11 weir pool and water levels to be managed for environmental outcomes. In 2011 the Kings Billabong regulator was installed on Psyche Creek where it connects to the southern end of the Kings Billabong wetland. This enabled the wetland to be cut off from Psyche Creek and water levels within the wetland to be managed for environmental purposes, if required.

Following the installation of the regulators within the Butlers Creek complex, a drying cycle regime was attempted on two occasions, however high Murray River flows resulted in the drying being abandoned. The third attempt in 2012/2013 was successful with an extensive area of the wetland drying. The wetland was refilled by drawing water from the weir pool.

A watering event with the Butlers Creek complex in 2013/2014 targeted River Red Gum forest, Black Box-chenopod woodland and reed beds. A 2015/2016 environmental watering event targeted River Red Gum communities, native fish and aquatic vegetation, the inundation extent of this watering event is shown in Figure 7. During these watering events the two regulators were closed to isolate the Butlers Creek complex from the Murray River, and a temporary pump located at Baggs Bridge (Figure 7) was utilised to raise water levels above weir pool height.

Since 2015/2016 no environmental water has been pumped into the Butlers Creek complex. However, water levels have been managed for environmental purposes, utilising the Lock 11 weir pool and the regulators at Baggs Bridge and Jennings Bridge to partially dry the area during autumn/winter (down to 33.9 m AHD) and increase water levels to weir pool height (34.4 m AHD) during spring/summer.

Table 8. A Summary of environmental watering at Kings Billabong

Water year	Time of inflow	Environmental Water Source	Source volume (ML)	Total volume (ML)	Area (ha) inundated
2013/2014	November to January	VEWH	600 ML	600 ML	60 ha (Butlers Creek)
2015/2016	September		250 ML	102.8 ML	38.3 ha (Butlers Creek)

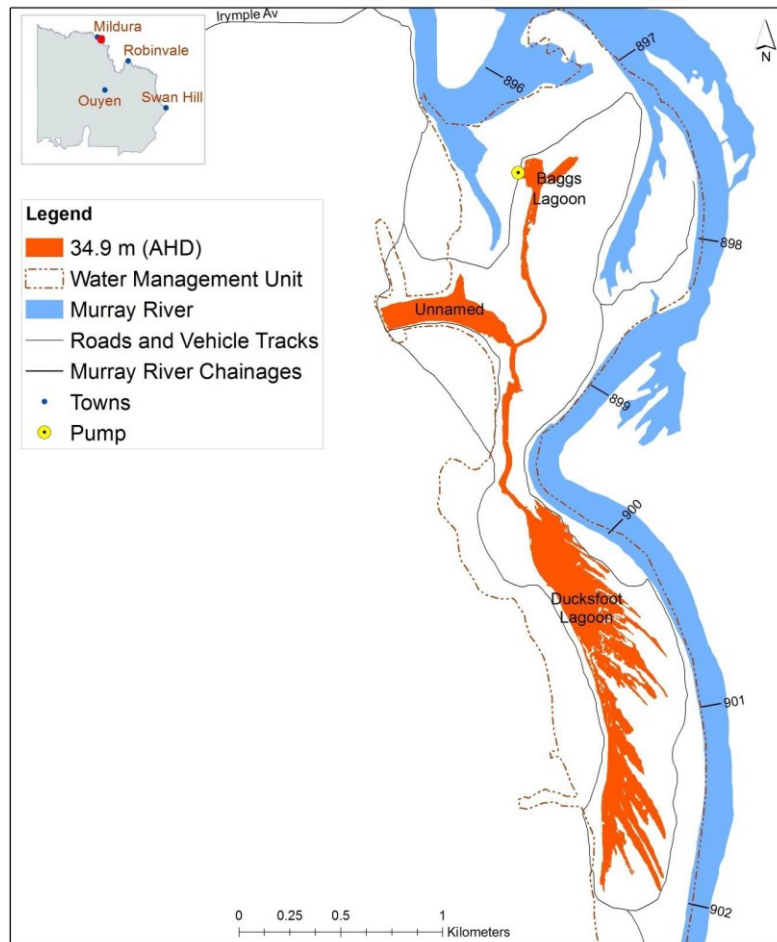


Figure 7. Inundation extent of 2015/2016 environmental watering in the Butlers Creek system (covering the entire target area).

5 Water Dependant Values

Wetlands and waterways on the floodplain are a vital component of the landscape and support flora and fauna which vary with the type of wetland/waterway system. The habitat provided by vegetation communities around wetlands is essential for maintaining populations of water dependent fauna species. Other ecological functions provided by floodplain complexes include water filtration, slowing surface water flow to reduce soil erosion, flood mitigation and reducing nutrient input into waterways. Protecting the ecological functioning of wetlands ensures these vital services are maintained.

Kings Billabong provides a range of shelter and food resources for indigenous fauna, flora and vegetation communities. The types of habitat provided, and consequently the species that utilise the site, change as water fills the wetlands, creek and floodplain and recedes again.

Kings Billabong consists of floodplain flats, floodplain creeks and wetlands which contain significant flora and fauna communities listed in various legislation, agreements, or conventions.

Kings Billabong is located within the Kings Billabong Park and is recognised as a significant conservation area. The list of species recorded at Kings Billabong

includes 5 species of frogs including the EPBC listed Growling Grass Frog (*Litoria raniformis*).

The availability of flora and fauna data for the site is limited. Data from the Victorian Biodiversity Atlas (DELWP, 2016b, and 2022) and previous site investigations (Ellis, Huntley, Lampard and Wood, 2015) (Ecological Associates, 2007b) have been referenced.

5.1 ENVIRONMENTAL VALUES

5.1.1 Ecosystem type

The conservation significance of Victorian wetland types has been determined by comparing the estimated extent prior to European settlement (Victorian Wetland Inventory - Pre-European) with the current extent (Victorian Wetland Inventory - Current).

All three wetlands within the target area addressed in this EWMP are classified as Permanent Open Freshwater wetlands (Corrick Category 5). The overall decline of this wetland type in Victoria is 6%. In the Mallee CMA this wetland type has actually increased by 5% due to the creation of permanent aquatic habitats through the construction of weirs and irrigation infrastructure. The Robinvale Plains bioregion has seen a decline of 1% (**Table 9**). A review of wetland mapping data for the three wetlands on MapshareVic (DELWP 2022) indicates a decline of approximately 20% in wetland area for the Kings Billabong Wetland and Ducksfoot Lagoon and no change for Baggs Lagoon (**Table 9**).

Table 9. Changes in area of the wetlands in the target area by Corrick classification
Source: DELWP MapshareVic, Mallee Wetland Strategy.

Corrick category (Current and Pre-European)	Wetland name	Total area (ha)		Percentage change in wetland area at Kings Billabong (Pre-European – Current)	Percentage change in wetland area from 1788 to 1994 (State & Regional)		
		Current	Pre-European		Vic	Mallee CMA	Robinvale Plains bioregion
Permanent Open Freshwater	Ducksfoot Lagoon (11371 & 11373)	14.58	18.48	-21%			
	Baggs Lagoon (11367)	1.21	1.21	0%	-6%	+5%	-1%
	Kings Billabong (11360)	171.18	219.62	-22%			

Ecosystem functions

Kings Billabong is a floodplain wetland complex. Floodplain wetlands perform important functions necessary to maintain the hydrological, physical and ecological health of river systems. These ecosystem functions include:

- enhancing water quality through filtering sediments and re-using nutrients;
- absorbing and releasing floodwaters;
- providing organic material to rivers to maintain riverine food chains; and



- providing feeding, breeding and drought refuge sites for an array of flora and fauna, especially waterbirds and fish.

Wetland ecosystems support distinctive communities of plants and animals and support numerous ecosystem functions. Floodplain wetlands perform important functions necessary to maintain the hydrological, physical and ecological health of river systems.

Four key broad ecosystem functions have been identified for the Kings Billabong EWMP. Each function is interlinked and must be supported in order for the ecosystem to flourish. The functions are briefly described below.

Creation and maintenance of vital habitats and populations

Inundation of the wetland-woodland mosaic provide a diversity of feeding, breeding and nursery sites for native water-dependent biota.

The slow-flowing waters, in-stream woody habitat and variable water levels will support Freshwater Catfish. The permanent waterways will act as refugia for frogs, native fish and waterbirds during periods of extended drought in an arid landscape.

Seasonal inundation of littoral and riparian areas will encourage a diversity of emergent, submerged and floating macrophytes and fringing vegetation, providing shelter, feeding and spawning areas for the Growling Grass Frog (Clemann and Gillespie, 2012).

Areas of deeper, permanent water with quality in-stream habitat will support a range of fish species and provide a reliable food source for piscivorous waterbirds.

Connections across floodplains, adjacent wetlands and billabongs (lateral)

Water levels that engage flood channels, wetlands and floodplain surfaces promote nutrient and carbon cycling and return organic material to the river where it contributes to the riverine food web (Robertston, Bacon and Heagney, 2001a).

The waterbird groups also access a variety of habitat types such as mud flats and shallow aquatic vegetation which only become available following inundation.

Diversity of habitat for feeding, breeding and nursery

Seasonal fluctuations in water levels in the wetlands increase the availability of specific habitat niches for feeding, breeding and nursery areas. Permanent and semi-permanent water bodies provide a source of food, refuge from predators and nesting sites and materials (Kingsford and Norman, 2002).

Wetland filling and water recession increases the extent of the band of sedges, rushes and semiaquatic forbs surrounding wetlands. Areas of deeper, permanent water support submerged aquatic macrophytes. This will promote high levels of aquatic productivity and physical habitat for frogs, fish, and waterbirds. Flooded Lignum Shrubland areas around Ducksfoot Lagoon will provide nesting areas for large waders to reproduce.

Transportation and dilution of nutrients and organic matter and increase in macroinvertebrate productivity and biofilm diversity

Drying of wetlands, particularly during summer and autumn, exposes sediments and facilitates decomposition and processing of organic matter. The microbial decay of plant material is an important route for energy and nutrients to enter the riverine food chain (Young, 2001). During dry periods, organic matter such as leaf litter is slowly decomposed by bacteria, releasing carbon and nutrients which accumulate in the soil.

Wetland inundation transports nutrients and carbon into the water column, which then becomes available for consumption by bacteria, algae and macroinvertebrates. On re-wetting, decomposition accelerates and becomes more efficient. Carbon and nutrients are released from the soil and enter the water and are available for aquatic plants and animals. The release of energy and nutrients results in increased productivity, with an increase in bacteria and invertebrates (Ecological Associates, 2013). This results in abundant food for fish, birds and other animals.

Fluctuations in water levels allows exposure of substrates such as large wood and plant stems through a drying cycle, which increases the diversity of the biofilms grazed by macroinvertebrates and fish.

5.1.2 Flora and Fauna Values

Ecological Vegetation Classes

Kings Billabong is positioned at the north-west end of the Robinvale Plains bioregion which contains the floodplains of the Murray River, close to the boundary with the Murray Mallee bioregion which stretches inland.

Six Ecological Vegetation Classes (EVCs) are modelled as present within the target area. Table 10 provides a list of these EVCs, along with their bioregional conservation status, Figure 8 displays the spatial arrangement of the EVCs, and Appendix 2 provides detailed descriptions of the EVCs.

Table 10. Ecological Vegetation Classes modelled as present within the Kings Billabong target area.

EVC no.	EVC name	Area modelled as present within target area (ha)	Bioregional conservation status
103	Riverine Chenopod Woodland	2.10	Depleted
106	Grassy Riverine Forest	0.10	Depleted
808	Lignum Shrubland	10.12	Least concern
813	Intermittent Swampy Woodland	16.66	Depleted
821	Tall Marsh	8.71	Depleted
823	Lignum Swampy Woodland	0.24	Depleted

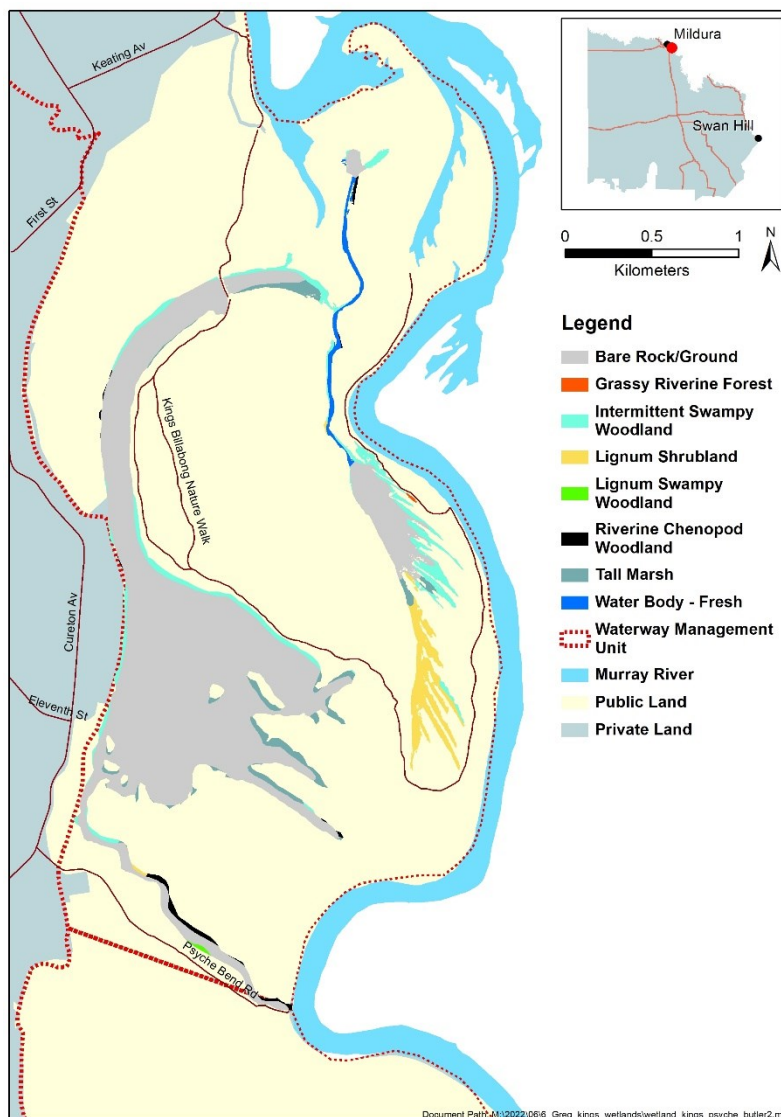


Figure 8. Ecological Vegetation Classes present in the Kings Billabong target area.

Baggs Lagoon is almost permanently inundated and supports submerged and emergent aquatic macrophytes. The surrounding EVCs for Baggs Lagoon, Ducksfoot Lagoon and Butlers Creek include Riverine Chenopod Woodland and Intermittent Swampy Woodland (Figure 9, Figure 10 and Figure 11).

Riverine Chenopod Woodland has a diverse shrubby and grassy understorey and is subject to only infrequent shallow flooding during major events. Intermittent Swampy Woodland has an overstorey of River Red Gums and or Black Box and an understorey of sedges and shrubs, including Lignum.



Figure 9. Baggs Lagoon is surrounded by Intermittent Swampy Woodland and Riverine Chenopod Woodland.

Healthy River Red Gums provide extensive habitat for a range of fauna, and waterbirds can use these trees for nesting. River Red Gums also deposit organic woody debris to wetlands which provide structural habitat features for wetland fauna such as perching sites for waterbirds and snags for fish (Roberts and Marston, 2011). Ideal flooding for River Red Gum recruitment is late spring to early summer (Johns et al., 2009), while ideal flood timing for River Red Gum maintenance and survival is winter to spring following the natural flooding pattern (Dalton, 1990).

Black Box provides essential habitat and foraging opportunities for a range of species including mammals and reptiles and supports a high proportion of ground foraging and hollow-nesting birds. Black Box can tolerate long periods without inundation (Roberts and Marston, 2011), however recruitment and establishment is linked to the elevated and continued soil moisture associated with flood events. Under extended periods of dry conditions Black Box is likely to decline and eventually die (Ecological Associates, 2007a).



Figure 10. Butlers Creek is fringed by Riverine Chenopod Woodland and Intermittent Swampy Woodland.

Lignum Shrublands are located in floodplain depressions that retain water following flood events. Lignum Shrubland is dominated by Lignum and chenopod shrubs with a ground layer of grasses and herbs that are tolerant of, or able to survive, both



periods of inundation and dry. Lignum Shrubland EVC is present in Ducksfoot lagoon.

When flooded, areas of Lignum can provide nesting habitat for platform building birds as well as productive fish habitat (Ecological Associates, 2006b). Tangled Lignum (*Duma florulenta*) has particular ecological value as waterbird breeding habitat making it especially significant. Wetland birds that breed over water, use flooded Lignum Shrubland (Ecological Associates, 2007a) for nesting and other waterbirds use Lignum for nesting (Rogers and Ralph, 2011).



Figure 11. Intermittent Swampy Woodland is present between Ducksfoot Lagoon and the Murray River.

Tall marsh is a wetland EVC dominated by tall emergent rushes, sedges and or reeds. It often has low plant diversity. It is dominated by a few highly competitive species that are tolerant of prolonged inundation to depths less than 1.5 m, but not sustained total immersion. It is present at the shallow ends of Ducksfoot Lagoon (Figure 12).



Figure 12. Ducksfoot Lagoon with extensive areas of reed beds.

Water-dependant fauna

One hundred and eighty nine fauna species have been recorded at Kings Billabong (Appendix 1), 8 of which are introduced. Of special interest and management responsibility are the 23 water dependent fauna species listed in legislation, agreements or conventions.

Kings Billabong supports species listed under the international agreements CAMBA, JAMBA, ROKAMBA and the Bonn Convention; the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Victoria's *Flora and Fauna Guarantee Act 1988* (FFG Act) (**Table 11**).

Table 11. Listed water-dependant fauna at Kings Billabong.

Common name	Scientific name	Type	International agreements	EPBC threatened status	Victorian Status - FFG
Plumed Egret	<i>Ardea intermedia plumifera</i>	B	-		CE
Eastern Great Egret	<i>Ardea alba modesta</i>	B	JAMBA CAMBA		VU
Hardhead	<i>Aythya australis</i>	B	-		VU
Silver Perch	<i>Bidyanus bidyanus</i>	F	-	CE	EN
Musk Duck	<i>Biziura lobata</i>	B			Vu
Curlew Sandpiper	<i>Calidris ferruginea</i>	B	Bonn, CAMBA, JAMBA, ROKAMBA	CE	CE
Broad-shelled Turtle	<i>Chelodina expansa</i>	R			EN
Little Egret	<i>Egretta garzetta nigripes</i>	B			EN
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	B		-	EN
Caspian Tern	<i>Hydroprogne caspia</i>	B	JAMBA		VU
Australian Little Bittern	<i>Ixobrychus dubius</i>	B			EN
Growling Grass Frog	<i>Litoria raniformis</i>	A		VU	VU
Murray River Rainbowfish	<i>Melanotaenia fluviatilis</i>	F			EN
Carpet Python*	<i>Morelia spilota metcalfei</i>	R			EN
Blue-billed Duck	<i>Oxyura australis</i>	B			VU
Glossy Ibis	<i>Plegadis falcinellus</i>	B	Bonn		NL
Regent Parrot*	<i>Polytelis anthopeplus monarchoides</i>	B		VU	VU
Australasian Shoveler	<i>Spatula rhynchotis</i>	B			VU
Freckled Duck	<i>Stictonetta naevosa</i>	B	-		EN

Common name	Scientific name	Type	International agreements	EPBC threatened status	Victorian Status - FFG
Freshwater Catfish	<i>Tandanus tandanus</i>	F	-		EN
Common Greenshank	<i>Tringa nebularia</i>	B	Bonn, CAMBA, JAMBA, ROKAMBA		EN
Marsh Sandpiper	<i>Tringa stagnatilis</i>	B	Bonn, CAMBA, JAMBA, ROKAMBA		EN
Legend: Lifeform type: Amphibian (A), Bird (B), Fish (F), Reptile (R) International Agreements: China-Australia Migratory Bird Agreement (CAMBA); Japan-Australia Migratory Bird Agreement (JAMBA); Republic of Korea Australia Migratory Bird Agreement (ROKAMBA); Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) EPBC threatened status/Victorian Status - FFG: VU = Vulnerable, EN = Endangered, CE = Critically Endangered, NL = Not Listed					

*indirectly water dependent

Of the 23 listed water dependant species at the site, the Carpet Python (*Morelia spilota metcalfei*) and the Regent Parrot (*Polytelis anthopeplus monarchoides*) are considered indirectly water dependent as they require riparian trees for shelter and nesting. The remaining species are directly dependent on water due to food, shelter or breeding requirements.

Waterbirds

Waterbird diversity and abundance are influenced by wetland habitat diversity, with different species and feeding guilds using different habitats for breeding and foraging (Haig, Mehlman and Oring, 1998). Water depth in particular influences waterbird diversity due to the specific feeding behaviours of different species (Bancroft, Gawlick and Rutchey, 2002). Managing wetlands to provide diverse habitats such as variable water depth, mud flats, inundated vegetation and areas of deep water increases the likelihood of increased waterbird diversity (Taft, Colwell, Isola and Safran, 2002).

Recommendations within this EWMP will be directed toward providing habitat through a watering regime appropriate to providing key habitat needs of the waterbird guilds listed in Table 12. This is based on the habitat types available at the site.

Table 12. Waterbird functional feeding groups (Roshier, Robertson and Kingsford, 2002) and their resource use..

Waterbird Group	Food Resource	Habitat Use	Waterbird Group
Dabbling and Diving Ducks (e.g. Chestnut teal, Pink-eared duck, Freckled duck)	Generalists; plankton, small invertebrates, plant material	Shallow Water (Dabblers)	Solitary
Grazing Waterfowl (e.g. Shelduck, Wood Duck)	Plant material, seeds, invertebrates	Shallow Water, littoral zone	Colonial or solitary

Fish Eaters (e.g. Pelican, Cormorants, Grebes, Darter, Egret, Heron, Tern)	Fish	Open and deep water	Colonial
Small Waders (e.g. Stilt, Plovers, Dotterels)	Small invertebrates, seeds	Littoral zone, mudflats	Solitary
Large Waders (e.g. Ibis)	Macroinvertebrates, fish, amphibians	Littoral zone	Colonial or solitary
Shoreline Foragers (e.g. Lapwings, Hens)	Plant material, seeds, invertebrates,	Littoral zone, mudflats	Solitary or small groups

Providing appropriate water requirements to support vegetation communities will support habitat for birds that have adapted to the required flooding and drying cycle (Scott, 1997). With an appropriate water regime, waterbirds will utilise areas of shallow water, mudflats and the littoral zone in floodplain channels and wetlands found in the Kings Billabong target area (Figure 13).



Figure 13. Ducksfoot Lagoon provides habitat for piscivorous waterbirds.

Fish

Kings Billabong provides habitat for a range of listed threatened species, including Silver Perch (*Bidyanus bidyanus*), Murray River Rainbowfish (*Melanotaenia fluviatilis*) and Freshwater Catfish (*Tandanus tandanus*), which have been recorded in the target area. As well as the listed species, a range of other fish species have been recorded including Western Carp Gudgeon (*Hypseleotris klunzingeri*), Flathead Gudgeon (*Philypnodon grandiceps*), Bony Herring (*Nematalosa erebi*), Australian Smelt (*Retropinna semoni*), and Dwarf Flathead Gudgeon (*Philypnodon macrostomus*) (Ellis et al., 2015). The introduced species Goldfish (*Carassius auratus*), European Carp (*Cyprinus carpio*), Oriental Weatherloach (*Misgurnus anguillicaudatus*), and Eastern Gambusia (*Gambusia holbrooki*) have also been found within the target area.



Figure 14. Butlers Creek supports a wide range of fish species.

Amphibians

The Growling Grass Frog (*Litoria ranformis*) is listed under the EPBC Act as Vulnerable and the FFG Act as Threatened. The Growling Grass Frog is usually found in among vegetation within or at the edges of permanent or ephemeral wetlands or slow flowing rivers and streams. In disturbed areas it can be found in farm dams and irrigation channels (Pyke, 2002). Preferred sites generally have a large proportion of vegetation that is emergent, submerged and floating (Clemann and Gillespie, 2012). During the winter months individuals may shelter under cover close to the water such as rocks, logs and vegetation (Pyke, 2002). It is a generalist carnivore, prey species include invertebrates and tadpoles. Breeding is triggered by flooding of wetlands and floodplains during spring and summer (Clemann and Gillespie, 2012).

Flora

Three hundred and fifty-seven species of flora have been recorded at Kings Billabong (a full list of flora can be found in Appendix 3). Of these, 60 are listed under the FFG Act (Table 13), and 40 of these are considered inundation dependent as they are found around lakes, waterways or on floodplains and/or propagate more readily with inundation. Eighty-two introduced flora species have also been recorded at the site.

Table 13. Listed Flora recorded at Kings Billabong.

Common name	Scientific name	Inundation dependent	FFG status	EPBC threatened status
Umbrella Wattle	<i>Acacia oswaldii</i>	no	CE	NL
Jerry-jerry	<i>Ammannia multiflora</i>	yes	EN	NL
Wimmera Woodruff	<i>Asperula wimmerana</i>	yes	EN	NL
Spreading Saltbush	<i>Atriplex limbata</i>	yes	EN	NL
Dwarf Old-man Saltbush	<i>Atriplex nummularia subsp. omissa</i>	yes	EN	NL
Coral Saltbush	<i>Atriplex papillata</i>	no	VU	NL
Silver Saltbush	<i>Atriplex rhagodioides</i>	yes	EN	NL
Spiny-fruit Saltbush	<i>Atriplex spinibractea</i>	yes	EN	NL
Jerry Water-fire	<i>Bergia ammannioides</i>	yes	EN	NL
Small Water-fire	<i>Bergia trimera</i>	yes	EN	NL
Billabong Daisy	<i>Brachyscome gracilis subsp. robusta</i>	yes	CE	NL
Blue Burr-daisy	<i>Calotis cuneifolia</i>	unknown	EN	NL
Yellow Burr-daisy	<i>Calotis lappulacea</i>	no	VU	NL
Riverina Bitter-cress	<i>Cardamine moirensis</i>	yes	EN	NL
Native Scurf-pea	<i>Cullen australasicum</i>	unknown	CE	NL
Hoary Scurf-pea	<i>Cullen cinereum</i>	yes	EN	NL
Grey Scurf-pea	<i>Cullen discolor</i>	no	EN	NL
Woolly Scurf-pea	<i>Cullen pallidum</i>	no	EN	NL
Spreading Scurf-pea	<i>Cullen patens</i>	no	EN	NL
Tough Scurf-pea	<i>Cullen tenax</i>	unknown	EN	NL
Lax Flat-sedge	<i>Cyperus flaccidus</i>	yes	EN	NL
Button Rush	<i>Cyperus leptocarpus</i>	yes	EN	NL
Curly Flat-sedge	<i>Cyperus rigidellus</i>	yes	TH	NL
Riverine Flax-lily	<i>Dianella porracea</i>	yes	CE	NL
Silky Umbrella-grass	<i>Digitaria ammophila</i>	yes	EN	NL
Brown Beetle-grass	<i>Diplachne fusca subsp. fusca</i>	yes	EN	NL
Twin-flower Saltbush	<i>Dissocarpus biflorus var. biflorus</i>	yes	CE	NL
Small Elachanth	<i>Elachanthus pusillus</i>	unknown	EN	NL

Common name	Scientific name	Inundation dependent	FFG status	EPBC threatened status
Cane Grass	<i>Eragrostis australasica</i>	yes	CE	NL
Purple Love-grass	<i>Eragrostis lacunaria</i>	yes	EN	NL
Bristly Love-grass	<i>Eragrostis setifolia</i>	yes	EN	NL
Spreading Emu-bush	<i>Eremophila divaricata</i> subsp. <i>divaricata</i>	yes	VU	NL
Spotted Emu-bush	<i>Eremophila maculata</i> subsp. <i>maculata</i>	yes	CE	NL
Tall Nut-heads	<i>Ethuliopsis cunninghamii</i>	yes	EN	NL
Veiled Fringe-sedge	<i>Fimbristylis velata</i>	yes	EN	NL
Small-flower Mud-mat	<i>Glossostigma cleistanthum</i>	yes	EN	NL
Spoon-leaf Mud-mat	<i>Glossostigma diandrum</i>	yes	EN	NL
Hydrilla	<i>Hydrilla verticillata</i>	yes	VU	NL
Veined Peppercross	<i>Lepidium phlebopetalum</i>	yes	EN	NL
Goat Head	<i>Malacocera tricornis</i>	yes	VU	NL
Bush Minuria	<i>Minuria cunninghamii</i>	yes	VU	NL
Smooth Minuria	<i>Minuria integerrima</i>	yes	VU	NL
Water Nymph	<i>Najas tenuifolia</i>	yes	EN	NL
Sandhill Spurge	<i>Phyllanthus lacunellus</i>	yes	EN	NL
Yellow Tails	<i>Ptilotus nobilis</i> var. <i>nobilis</i>	yes	EN	NL
Long Tails	<i>Ptilotus polystachyus</i> var. <i>polystachyus</i>	yes	EN	NL
Scrambling Twin-leaf	<i>Roepera angustifolia</i>	no	EN	NL
Glistening Dock	<i>Rumex crystallinus</i> s.s.	yes	EN	NL
Sarcozona	<i>Sarcozona praecox</i>	no	EN	NL
Spear-fruit Copperburr	<i>Sclerolaena patentiscuspis</i>	no	VU	NL
Fleshy Groundsel	<i>Senecio gregorii</i>	no	EN	NL
Riverina Groundsel	<i>Senecio productus</i> subsp. <i>productus</i>	yes	EN	NL
Pin Sida	<i>Sida fibulifera</i>	yes	EN	NL
Twiggy Sida	<i>Sida intricata</i>	yes	EN	NL
Velvet Thread-petal	<i>Stenopetalum velutinum</i>	unknown	CE	NL
Small-leaf Swainsonpea	<i>Swainsona microphylla</i>	no	EN	NL

Common name	Scientific name	Inundation dependent	FFG status	EPBC threatened status
Dwarf Swainson-pea	<i>Swainsona phacoides</i>	no	EN	NL
Silky Swainson-pea	<i>Swainsona sericea</i>	no	EN	NL
Needle Grass	<i>Triraphis mollis</i>	no	EN	NL
Mallee Annual-bluebell	<i>Wahlenbergia tumidifructa</i>	no	EN	NL
Legend: EPBC threatened status/Victorian Status - FFG: VU = Vulnerable, EN = Endangered, CE = Critically Endangered, TH = Threatened, NL = Not Listed				

5.1 SHARED BENEFITS

As well as supporting environmental objectives environmental water provides benefits to a variety of community related activities and values. Kings Billabong is located close to the township of Mildura and is popular for many community activities including bushwalking, camping, four-wheel driving, bird watching, canoeing, and fishing. Kings Billabong also has significant Indigenous and European cultural heritage values. These values are closely linked with the ecological values that are protected and enhanced by environmental watering.

5.2 TRADITIONAL OWNER CULTURAL VALUES

The Mallee region has been occupied by hundreds of generations of Indigenous people with human activity dated as far back as 23,400 years ago. The region's rich and diverse Indigenous heritage has been formed through the historical and spiritual significance of sites associated with this habitation; together with the strong and enduring connection Traditional Owners have with the Mallee's natural landscapes.

In Indigenous culture, water is inseparable from the land, air, plants and animals. Caring for, and healing, Country is an inherited cultural obligation that is reliant upon having water in the landscape in the right place, at the right time of year. Water creates and sustains life, and is a living and cultural entity that connects Traditional Owners to Ancestors, Country, cultural practice and identity. Indeed, a respondent in a 2023 community survey of Kings Billabong water-dependent values stated they visit Kings Billabong for connection to Country.

Within the Mallee CMA region, the Murray River and its associated waterways continue to be culturally significant habitation areas for many Aboriginal groups. The high number of Indigenous cultural heritage sites throughout the Murray floodplain is unique in Victoria because of their concentration and diversity. It is typical to find high densities of identified Indigenous cultural heritage sites located around, or close to, freshwater sources. The Aboriginal Heritage Regulations 2018 define "areas of cultural heritage sensitivity" which include land within 200 m of named waterways and land within 50 m of registered Aboriginal cultural heritage places. A review of the Aboriginal Cultural Heritage Register and Information System (ACHRIS) confirms that the entire Kings Billabong Park is defined as an area of cultural heritage sensitivity.

The current Registered Aboriginal Party (RAP) for the area is the First People of the Millewa-Mallee Aboriginal Corporation (FPMMAC). Their Action Plan and Country and Water Plan "seek to repair the natural environment and our people's place in the environment" (Mallee CMA, 2022). The Mallee CMA have engaged with the FPMMAC



about this EWMP, and are committed to working with FPMAC to ensure that tangible and intangible Aboriginal culture and heritage is protected, and that Traditional Owner led practices are imbedded in the management and healing of Country (Mallee CMA, 2022).

5.3 RECREATIONAL VALUES

Kings Billabong is close to Mildura and its easy accessibility, permanent water, diversity of scenery and access to the Murray River helps to make it popular for walking (a range of walking trails are provided), picnicking (several designated picnic areas, fire places and tables are provided), birdwatching, fishing and four-wheel driving. An all-abilities canoe launching ramp at Psyche Pumps provides access to Psyche Creek and Kings Billabong (Parks Victoria, 2018). The Park is also popular for wildlife and bird watching, with a bird hide overlooking Kings Billabong.

Local community has been participating in citizen science projects at Butlers Creek and Ducksfoot Lagoon surveying for native fauna in the park. These projects have included bat, bird and frog monitoring and have recorded an additional five bat species, five frog species and 12 bird species that were not previously included in the EWMP. These records have been included in the fauna list (Appendix 1)

A local recreational fishing group, Sunraysia Ozfish, has been undertaking works at Butlers Creek to improve the habitat for native fish. Works undertaken in 2019 include vegetation monitoring along the banks of the creek, habitat mapping in the creek bed, revegetation, and the addition of in-stream habitat via installation of logs and 'fish hotels' (Figure 15).



Figure 15. -Environmental improvement works undertaken at Butlers Creek by Sunraysia Ozfish. Revegetation along Butlers Creek (left) and 'fish hotels' in Butlers Creek (right).

5.4 CURRENT CONDITION

The condition of the wetlands within Kings Billabong was assessed in 2009/2010 (Table 14) using the Index of Wetland Condition (IWC). The IWC defines wetland condition as the state of the biological, physical, and chemical components of the wetland ecosystem and their interactions. The IWC has five sub- indices based on the catchment of the wetland and its fundamental characteristics: physical form, hydrology, water properties, soils and biota. Each sub-index is given a score between 0 and 20 based on the assessment of a number of measures. The overall IWC score is not a simple summation of the sub index scores. A formula is used that weights each sub index according to the contribution it makes to the overall condition of the wetland. The wetland hydrology sub index for example contributes

more to the overall score than the soils sub index. Further information on the IWC scoring is provided in Appendix 5.

Table 14. IWC sub-index and overall scores for wetlands within the Kings Billabong target area (2009/2010).

Wetland Name	Kings Billabong		Butlers Creek Lagoon		Baggs Lagoon		Ducksfoot Lagoon		Ducksfoot Lagoon extension	
Wetland No.	11360		11360 (east of levee bank)		11367		11371		11373	
IWC sub index	Score (/20)	Category	Score (/20)	Category	Score (/20)	Category	Score (/20)	Category	Score (/20)	Category
Wetland catchment	20	Excellent	16	Good	12.5	Good	20	Excellent	20	Excellent
Physical form	20	Excellent	20	Excellent	20	Excellent	20	Excellent	20	Excellent
Hydrology	0	Poor	0	Poor	0	Poor	0	Poor	0	Poor
Water properties	17	Excellent	15	Good	17	Excellent	10.33	Moderate	10.33	Moderate
Soils	19.9	Excellent	19.65	Excellent	18.58	Excellent	18.85	Excellent	15.75	Good
Biota	15.38	Moderate	13.75	Moderate	16.62	Good	15.98	Moderate	5.07	Very Poor
Overall IWC Score	7	Good	6	Moderate	7	Good	6	Moderate	4	Poor

The overall IWC score for the wetlands assessed in 2009/2010 varied from very poor to good (Table 14). Hydrology was considered to be very poor in all of the wetlands due to the significant impact the regulation of the Murray River and irrigation water management has on the natural wetting and drying cycle of wetlands of the floodplain. This has in turn significantly modified wetland vegetation within the target area with vegetation adapted to prolonged flooding dominating. However, the water management regime proposed in this EWMP aims to increase the abundance, distribution, and diversity of native wetland species in the study area.

Butlers Creek was assessed in 2010 using the Index of Stream Condition (ISC). The Index of Stream Condition (ISC) is a composite indicator of river condition (similar to the IWC) that assesses 23 indicators across 5 major sub-indexes: hydrology, physical form, streamside zone, water quality and aquatic life. Butlers Creek was assessed using the ISC in 2010 and was found to be in a very poor condition.

Only three of the five sub-indices were measured, hydrology (1/10), physical form where it scored well on bank condition but poorly on the presence of artificial barriers and in-stream large wood (5/10) and streamside zone (6/10).



Figure 16. - Ducksfoot Lagoon provides areas of macrophyte beds, structural woody habitat and open water.

5.5 TRAJECTORY OF CHANGE

The installation of regulators within the Butlers Creek complex and the implementation of a drying phase to control carp numbers, followed by appropriate environmental watering has significantly improved the condition within these wetlands. Implementing an appropriate seasonal watering regime will continue to improve condition.

Ecological monitoring at Kings Billabong will be undertaken in 2022. This monitoring will assist in determining the current condition as well as measuring the trajectory of change into the future.

Without continuing environmental watering programs and works, the condition of these wetlands would decline on a number of levels, which would impact their ability to support the important ecological values described in Section 5.

6 Managing Water Related Threats

The Aquatic Value Identification and Risk Assessment (AVIRA) database is an on-line tool used by Victorian waterway managers to store data about the values, threats and risks to waterway health in their region. The database evaluates threats for a range of sub-indices including water regime, invasive fauna and acid sulphate soils (Peters, 2009). Below are listed the main threats to Kings Billabong, as assessed by AVIRA and a risk rating for each of these threats (**Table 15**).

Changed water regime

Kings Billabong Wetland, Baggs Lagoon, Ducksfoot Lagoon and Butlers Creek all scored poorly on the hydrology sub-index of the IWC and ISC. The hydrology sub-index of the IWC takes into account the impacts of regulation of the primary water source of the wetland (Murray River), other activities which may impact the

wetlands water regime, impacts to seasonality, duration and frequency of the water regime and the severity of the effects of these activities. The ISC hydrology sub-index for Butlers Creek was assessed using a flow stress ranking procedure, a numerical modelling process using water flow gauge information from across Victoria. It was calculated from information on high flow, low flow, zero flow, seasonality and variability (DEPI, 2014c). The installation of the regulators within the target area means that these threats can be reduced by managing water levels for environmental outcomes.

Invasive fauna (aquatic)

European Carp have been found to contribute to the loss of aquatic vegetation and increased turbidity, resulting in loss of habitat for waterfowl (Purdey and Loyn, 2008) and native fish species. This species also competes with the native fish for habitat and food (Mallee CMA, 2003). Carp degrade Freshwater Catfish habitat by disturbing nests on the wetland bed and increasing turbidity (Lake, 1967). The installation of the regulators within the Butlers Creek complex enables a drying phase to be introduced for Carp management purposes, such as the drying event implemented in 2012/2013. The introduction of a similar drying phase within the Kings Billabong Wetland is not possible given its current use for irrigation water storage/transfer.

Table 15. Risk Rating of Water Related Threats.

Cause	Threat	Likelihood	Consequence	Risk	Management measure (risk treatment)	Residual Risk
Maintenance of static water levels in the Lock 11 Weir Pool due to regulation of the Murray River	Altered water regime to off channel wetlands in the Butlers Creek complex that impacts aquatic and riparian vegetation structure and composition	Possible	Moderate	Medium	Introduce appropriate water regime using regulating structures	Low
Maintenance of static water levels in the Kings Billabong Wetland due to its operation for irrigation water storage/transfer	Altered water regime that impacts aquatic and riparian vegetation structure and composition	Possible	Moderate	Medium	Introduce partial drying phase if required using regulating structure	Low
High populations of invasive fish (European Carp) in Butlers Creek complex	Loss of aquatic vegetation, increased turbidity, predation, and competition with native fish	Likely	Moderate	High	Introduce drying phase to remove European Carp if high numbers of adults present	Moderate
High populations of invasive fish (European Carp) in Kings Billabong Wetland	Loss of aquatic vegetation, increased turbidity, predation, and competition with native fish	Likely	Moderate	High	Management options limited by current use for irrigation water storage/transfer. Unable to introduce drying	High

Cause	Threat	Likelihood	Consequence	Risk	Management measure (risk treatment)	Residual Risk
					phase if high numbers of adult European Carp are present	

7 Management Goals, Objectives and Targets

7.1 MANAGEMENT GOAL

The management goals for the Kings Billabong EWMP are:

- To provide a watering regime that supports a mosaic of aquatic and semi emergent wetland vegetation communities to provide key habitat and food sources for a diverse range of fauna.
- For the Butlers Creek complex to be permanent wetlands with seasonal variation in water levels that will support the populations of Growling Grass Frog and support key habitat requirements of piscivorous and large wading birds

They are strongly linked to the goals of the Mallee Waterway Strategy 2014-22 (Mallee CMA 2014)

- To maintain or improve habitat within waterways and on surrounding riparian land;
- To manage all land tenures for water quality benefits and respond appropriately to threatening events (both natural and pollution based);
- To restore appropriate water regimes and improve connectivity;
- To protect the extent and condition of Cultural Heritage (Indigenous and non-Indigenous) sites associated with waterways; and
- To increase community capacity for, awareness of and participation in waterway management.

7.2 ENVIRONMENTAL OBJECTIVES AND TARGETS

Environmental objectives represent the desired environmental outcomes of the site based on the management goal, above, as well as the key values outlined in the Water Dependent Values section. It is intended that EWMP objectives will be described in terms of the primary environmental outcomes, in most cases ecological attributes. The focus of the objectives should be on the final ecological outcomes and not the drivers *per se*.

During 2020, the environmental objectives (formally ecological objectives) undertook a refinement process with the intent of improving the specificity and measurability of the objectives through the development of targets, and to improve line of sight to the Basin Plan. While the process attempted to maintain the intent and integrity of the original objectives, it provided an opportunity to reassess the suitability of these objectives for the asset. The rationalisation, assessment of SMARTness, mapping to Basin Plan and update of each objective for Kings Billabong can be found in Section 5.17.1 of Butcher et al. (2020).

While every attempt has been made to make the following objectives and targets as complete as possible, there still remains gaps as critical information is not currently available. As such, baselines are not able to be set at this time. In the interests of moving forward, the objectives and targets have been written in a way (i.e. red highlighted text) that allows this information to be included at a later stage as this information becomes available.

As noted in Section 1, in 2016 a separate the Butlers Creek EWMP was developed for the Butlers Creek component of the Kings Billabong EWMP. In 2020 the environmental objectives for the Kings Billabong and Butlers Creek were reviewed and updated separately. The Mallee CMA has since decided to re-incorporate Butlers Creek into the Kings Billabong EWMP, due to their shared ecological values, connectedness, and geographic proximity. Table 16 incorporates the updated environmental objectives from Kings Billabong and Butlers Creek. One of the three objectives for Butlers Creek (BCT1) relates to Growling Grass Frog (*Litoria raniformis*) and duplicates an objective for Kings Billabong (KB4b). BCT1 has therefore been removed from the objectives in Table 16. The two remaining updated objectives for Butlers Creek have been incorporated into the objectives below and re-labelled (BCT4 to KB9 and BCT 5 to KB10).

Table 16. Updated Environmental objectives and Targets for Kings Billabong.

Environmental objective	Target
KB1: By 2030, improve vital habitat at the King's Billabong asset by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups.	<p>By 2030, increase diversity of native of macrophytes at the King's Billabong asset with ≥ 2 species from each of the following Water Regime Indicator Groups present in 80% of years:</p> <ul style="list-style-type: none"> Aquatic (obligate submerged) (Aos) (Blunt Pondweed <i>Potamogeton ochreatus</i>, Curly Pondweed <i>Potamogeton crispus</i>, Eel Grass <i>Vallisneria australis</i>, Hornwort <i>Ceratophyllum demersum</i>) Aquatic (submerged to partially emergent) (Ase) (Red Water-milfoil <i>Myriophyllum verrucosum</i>, Robust Water-milfoil <i>Myriophyllum papillosum</i>, Star Fruit <i>Damasonium minus</i>, Swamp Lily <i>Ottelia ovalifolia</i> subsp. <i>Ovalifolia</i>) Aquatic graminoids (persistent) (Agp) (Common Reed <i>Phragmites australis</i>, Narrow-leaf Cumbungi <i>Typha domingensis</i>, River Club-sedge <i>Schoenoplectus tabernaemontani</i>) Aquatic to semi-aquatic (persistent) (Asp) (Austral Pillwort <i>Pilularia novae-hollandiae</i>, Clove-strip <i>Ludwigia peploides</i> subsp. <i>Montevidensis</i>, Common Nardoo <i>Marsilea drummondii</i>, Spiny Mud-grass <i>Pseudoraphis spinescens</i>, Swamp Crassula <i>Crassula helmsii</i>) <p>By 2030, increase diversity of native of macrophytes at the King's Billabong asset with ≥ 5 species from each of the following Water Regime Indicator Groups present in 80% of years:</p> <ul style="list-style-type: none"> Seasonally immersed – low growing (Slg) (Lesser Joyweed <i>Alternanthera denticulata</i> s.s., Common Woodruff <i>Asperula conferta</i>, Marsh Club-sedge <i>Bolboschoenus medianus</i>, Tufted Burr-daisy <i>Calotis scapigera</i>, Rosinweed <i>Cressa australis</i>, Native Couch <i>Cynodon dactylon</i> var. <i>pulchellus</i>, Common Spike-

	<p>sedge <i>Eleocharis acuta</i>, Pale Spike-sedge <i>Eleocharis pallens</i>, Small Spike-sedge <i>Eleocharis pusilla</i>, Spreading Goodenia <i>Goodenia heteromera</i>, Rough Raspwort <i>Haloragis aspera</i>, Nodding Club-sedge <i>Isolepis cernua</i>, Slender Knotweed <i>Persicaria decipiens</i>, Narrow-leaf Dock <i>Rumex tenax</i>, Beaded Glasswort <i>Sarcocornia quinqueflora</i>, Rat-tail Couch <i>Sporobolus mitchellii</i>, Blue Rod <i>Stemodia florulenta</i>, River Bluebell <i>Wahlenbergia fluminalis</i>)</p> <ul style="list-style-type: none"> Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge <i>Cyperus gymnocaulos</i>, Brown Beetle-grass <i>Diplachne fusca subsp. Fusca</i>, Southern Cane-grass <i>Eragrostis infecunda</i>, Tussock Rush <i>Juncus aridicola</i>, Gold Rush <i>Juncus flavidus</i>, Warrego Summer-grass <i>Paspalidium jubiflorum</i>)
KB4a: By 2030 increase breeding of frogs at the Kings Billabong asset.	By 2030, breeding of frogs at the Kings Billabong asset occurs in 80% of years, including Barking marsh frog (<i>Limnodynastes fletcheri</i>), Plains froglet (<i>Crinia parainsignifera</i>), Southern bullfrog (<i>Limnodynastes dumerilii</i>), and Spotted marsh frog (<i>Limnodynastes tasmaniensis</i>), measured by presence of adults calling via audio recordings, and/or presence of tadpoles
KB4b: By 2030, improve biodiversity at the Kings Billabong asset by supporting the life cycle of EPBC listed Growling Grass Frog (<i>Litoria raniformis</i>).	By 2030, maintain self-sustaining population of Growling Grass Frog, <i>Litoria raniformis</i> , at the Kings Billabong asset with evidence of breeding and recruitment in 80% (presence of tadpoles) of years. Note only recorded once to date
KB5: By 2030, protect and restore biodiversity by maintaining representative populations of native small-bodied fish at the Kings Billabong asset, including Australian Smelt (<i>Retropinna semoni</i>), Carp gudgeon (<i>Hypseleotris</i> spp.), Flat-headed Gudgeon (<i>Philypnodon grandiceps</i>), Murray-Darling Rainbowfish (<i>Melanotaenia fluviatilis</i>), Un-specked Hardyhead (<i>Craterocephalus stercusmuscarum fulvus</i>).	By 2030, maintain self-sustaining populations of Australian Smelt (<i>Retropinna semoni</i>), Carp gudgeon (<i>Hypseleotris</i> spp.), Flat-headed Gudgeon (<i>Philypnodon grandiceps</i>), Murray-Darling Rainbowfish (<i>Melanotaenia fluviatilis</i>), Un-specked Hardyhead (<i>Craterocephalus stercusmuscarum fulvus</i>) at the Kings Billabong asset. Measured as: Adults or YoY for each species recorded in 8 out of 10 years
KB6: By 2030, improve the population of Freshwater catfish (<i>Tandanus tandanus</i>) at the Kings Billabong asset.	By 2030, maintain a self-sustaining population of Freshwater catfish (<i>Tandanus tandanus</i>) at the Kings Billabong asset: - YoY recorded in 8 out of 10 years - Abundance of adult fish increased by 20% from baseline of xx (year, levels, citation)
KB7: By 2030, maintain representative populations of the shallow-water and deep feeding guilds of waterbirds, including shorebirds (F2 and F3, after Jaensch 2002) at the Kings Billabong asset, by maintaining a mixture of foraging habitats.	By 2030, 80% of the following representative F2 and F3 species recorded at the Kings Billabong asset in 8 years out of any 10-year period where conditions are suitable. <ul style="list-style-type: none"> Representative F2 species include the following ducks and allies: Australasian Grebe (<i>Tachybaptus novaehollandiae</i>), Australian White Ibis (<i>Threskiornis molucca</i>), Black Swan (<i>Cygnus atratus</i>), Dusky



	<p>Moorhen (<i>Gallinula tenebrosa</i>), Eurasian Coot (<i>Fulica atra</i>) Grey Teal (<i>Anas gracilis</i>), Masked Lapwing (<i>Vanellus miles</i>), Pacific Black Duck (<i>Anas superciliosa</i>)</p> <ul style="list-style-type: none"> Representative F3 species include: Australasian Darter (<i>Anhinga novaehollandiae</i>), Little Pied Cormorant (<i>Microcarbo melanoleucos</i>), Little Black Cormorant (<i>Phalacrocorax sulcirostris</i>), Australian Pelican (<i>Pelecanus conspicillatus</i>), <p>By 2030, 50% of the following representative shorebird F2 species recorded at the Kings Billabong asset in 8 years out of 10 years over any 10 year period.</p> <ul style="list-style-type: none"> Representative F2 species include the following shorebirds: Sharp-tailed Sandpiper (<i>Calidris acuminata</i>), Red-capped Plover (<i>Charadrius ruficapillus</i>), Black-fronted Dotterel (<i>Elseya melanops</i>), Red-kneed Dotterel (<i>Erythrogonyx cinctus</i>), Black-winged Stilt (<i>Himantopus himantopus</i>), Red-necked Avocet (<i>Recurvirostra novaehollandiae</i>) <p>Feeding habitat defined as a mixture of deep feeding areas (water >1 m) and shallow feeding areas (<0.5 m depth and or drying mud) with intermittent inundation of densely vegetated shrublands.</p>
KB8: By 2030, maintain vital habitat to provide a refugium for listed species of waterbirds at the Kings Billabong asset.	<p>By 2030, maintain vital habitat to provide a refugium for listed species of waterbirds at the Kings Billabong asset, with ≥6 of the following species occurring in 7 or any 10 year period:</p> <ul style="list-style-type: none"> Australasian Shoveler (<i>Anas rhynchotis</i>), Hardhead (<i>Aythya australis</i>), Little Egret (<i>Egretta garzetta nigripes</i>), Caspian Tern (<i>Hydroprogne caspia</i>), Blue-billed Duck (<i>Oxyura australis</i>), Freckled Duck (<i>Stictonetta naevosa</i>), Common Greenshank (<i>Tringa nebularia</i>), Marsh Sandpiper (<i>Tringa stagnatilis</i>)
KB9 (BTC4): By 2030, maintain representative populations of piscivores (guild D4, after Jaensch 2002) at the Butlers Creek complex.	<p>By 2030, 80% of representative D4 (piscivores) species recorded at the Butlers Creek complex in 8 years out of any 10-year period where conditions are suitable.</p> <ul style="list-style-type: none"> Representative D4 species include: Australasian Grebe (<i>Tachybaptus novaehollandiae</i>), White-necked Heron (<i>Ardea pacifica</i>), Australian Pelican (<i>Pelecanus conspicillatus</i>), Great Cormorant (<i>Phalacrocorax carbo</i>), Little Black Cormorant (<i>Phalacrocorax sulcirostris</i>), Australian Darter (<i>Anhinga novaehollandiae</i>), Hoary-headed Grebe (<i>Poliiocephalus poliocephalus</i>).
KB 10 (BTC5): Protect and restore ecosystem functions of water-dependent ecosystems that support successful breeding of large waders at Ducksfoot Lagoon by providing conditions for breeding and fledging at least 3 times every 10 years	<p>Increased frequency in successful breeding (recruitment into adult population – i.e. fledging) of one or more of the listed colonial nesting species 3 years in 10, when conditions are favourable:</p> <ul style="list-style-type: none"> Eastern Great Egret (<i>Ardea modesta</i>), Little Egret (<i>Ardea intermedia</i>), Darter (<i>Anhinga novaehollandiae</i>), Little black cormorant (<i>Phalacrocorax sulcirostris</i>) Little pied cormorant (<i>Microcarbo melanoleucos</i>),

	<p>White-necked heron (<i>Ardea pacifica</i>), and Yellow spoonbill <i>Platalea flavipes</i>)</p> <ul style="list-style-type: none"> • Water regime to meet Eastern Great Egret as meeting watering requirements for this species will support other species listed
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7.3 REGIONAL SIGNIFICANCE

Kings Billabong supports a range of environmental values of local, regional and Basin significance as described in Section 5. These values are linked to the management goals and environmental objectives and targets described in Section 7. Details of the links between the environmental objectives and environmental outcomes at a regional/Basin scale are provided in Appendix 4.

The management goals and environmental objectives and targets are aligned with the goals of the Mallee Waterway Strategy as described in Section 7.1. The Mallee Waterway Strategy identifies the Kings Billabong Wetland as a high priority wetland, Butlers Creek as a high priority reach and Ducksfoot Lagoon as a medium priority wetland within the Nichols Point WMU.

7.4 ALIGNMENT TO BASIN PLAN

The primary environmental outcome of the Basin Plan is the protection and restoration of water-dependent ecosystems and ecosystem functions in the Murray-Darling Basin, with strengthened resilience to a changing climate. The MDBA is required to measure progress towards achieving the objectives of the Basin Plan Environmental Watering Plan (EWP) (Chapter 8 of the Basin Plan) by using the targets in Schedule 7 and having regard to the long-term average sustainable diversion limits, ecological objectives and ecological targets. These are set out in Long-Term Watering Plan's (LTWP), the Basin-wide Environmental Watering Strategy (BWS) and annual Basin environmental watering priorities. Details on the alignment of the updated Kings Billabong EWMP environmental objectives to the Basin Plan are provided in **Table 17** and Appendix 4.

7.5 DOCUMENTING EWMP UPDATES AND MAPPING TO BASIN PLAN AND OTHER POLICY DOCUMENTS

The updated objectives are aligned with the Basin Plan, Basin-wide EWS objectives and State level LTWP objectives. **Table 17** maps line of sight linkages between these objectives and each of the updated EWMP objectives. Further details of these linkages and the rationale behind the updates for each objective is provided in Appendix 4.

Table 17. Mapping updated Kings Billabong EWMP objectives to Basin Plan Environmental Watering Plan (EWP) objectives, Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) quantified environmental expected outcomes (QEEO) (MDBA 2019), and Long-term Watering Plan (LTWP) Victorian Murray objective (DELWP 2015).

EWMP objective	Basin Plan EWP objective	Relevant Basin Plan Schedule 7 target	Relevant BWS QEEO	LTWP objective
KB1	8.05,3(b) 8.06,6(b)	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	None specified	LTWPVM2
KB4a	8.06,6(a))	Condition of priority ecosystem functions - creation of vital habitat - feeding, breeding, nursery	None specified	LTWPVM20
KB4b	8.05,3(a)	Condition of priority asset - supports listed species and communities	None specified	LTWPVM20
KB5	8.05,3(b)	Condition of priority asset - prevention of decline in native biota	B4.5	LTWPVM15
KB6	8.05,3(a) 8.05,3(b)	Condition of priority asset - supports listed species and communities Condition of priority asset - prevention of decline in native biota	None specified	None specified
KB7	8.05,3(b) 8.06,6(b)	Condition of priority asset - Vital habitat - feeding, breeding, nursery	B3.1	LTWPVM12 LTWPVM13
KB8	8.07,3 8.05,3(a)	Condition of priority asset - supports listed species and communities	None specified	None specified
KB9 (BCT4)	8.05,3(a) 8.06,6(b)	Condition of priority assets – vital habitat (habitat to prevent declines)	B3.1	LTWPVM13
KB10 (BCT5)	8.06,6(a) 8.06,6(b)	Recruitment and populations of native water-dependent birds Condition of priority ecosystem functions – vital habitat (breeding)	B3.3 B3.4	LTWPVM10 LTWPVM11

8 Environmental Water Requirements and Intended Water Regime

8.1 WATERING REQUIREMENTS AND INTENDED WATERING REGIMES

The environmental water requirements have been derived from the environmental objectives and targets and following a review of pre-regulation hydrology data. The intended watering regime is anticipated to deliver the environmental water requirements for the target area with current infrastructure. Watering requirements and the intended water regime are described below and summarised in Tables 14-16. Due to the inter-annual variability of these estimates (due to climatic conditions), determination of the predicted volume requirements in any given year will need to be undertaken by the environmental water manager when watering is planned.

Butlers Creek Complex

Butlers Creek, Baggs Lagoon and Ducksfoot Lagoon are to be managed as a permanently inundated water area with seasonal variations in water level.

Fill wetlands to 34.4m AHD every spring/summer by opening regulator gates at Baggs and Jennings bridges. Close regulator gates in autumn allowing natural drawdown of the water level during autumn/winter. Maintain permanent open water habitat by ensuring that water levels do not fall below 33.9m AHD by opening the regulator gates as required. Fill wetland up to 34.9m AHD (using temporary pumps) only as required, if not achievable using natural flows, and maintain this level for seven months to facilitate waterbird breeding and flushing of sediment. Top up as required.

A drying phase is to be introduced only as a Carp management tool. This should be enacted when there is evidence of abundant large Carp, or obvious decline in submergent macrophyte communities as a result of Carp.

Table 18. Intended watering regime for Butlers Creek complex

Level (m AHD)	Zone	Timing	Frequency	Duration (months)
<33.5	Wetland bed (drying phase)	As required for Carp management purposes		
34.4	Maintain aquatic refuge and macrophyte zone	Spring/Summer	10	6
34.4 - 33.9	Maintain aquatic refuge and macrophyte zone	Autumn/Winter	10	6
34.9	Lignum wetlands, waterbird habitat surrounding wetlands (surcharge using temporary pump)	Late Winter to early Summer	As required if not achievable with natural flows	7

Kings Billabong Wetland

Kings Billabong Wetland is to be managed as a permanently inundated water area. The Kings Billabong regulator enables the wetland to be isolated from Psyche Creek and water levels in the wetland to be managed for environmental outcomes. In such an event the regulator can be closed and water levels within the wetland area reduced by up to 1 m during autumn and winter. Water levels can then be allowed to return to normal operating levels during the peak irrigation period in summer by opening the regulator. This is currently not a priority for the Mallee CMA and there are no current plans to regularly utilise this regulator for environmental purposes.

8.2 EXPECTED WATERING EFFECTS

This section aims to explicitly outline the potential watering actions and expected watering effects needed to achieve the stated environmental objective.

Table 19. Expected watering effects and potential watering action required to achieve environmental objectives

Objective Code	Environmental objective	Potential watering action	Expected watering effects
KB1	By 2030, improve vital habitat at the King's Billabong asset by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicators Groups	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> Maintain a min water level 33.9 m AHD Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer Allow water levels to recede over autumn/winter <p>Kings Billabong Wetland</p> <ul style="list-style-type: none"> Maintain at normal operating level 37 m AHD If required reduce water level over autumn/winter by up to 1 m (36 m AHD) 	Maintain suitable conditions for germination, growth and reproduction for a variety of aquatic macrophytes with seasonal variation in water levels.
KB4a	By 2030 increase breeding of frogs at the Kings Billabong asset.	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> Maintain a min water level 33.9 m AHD Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer Allow water levels to recede over autumn/winter <p>Kings Billabong Wetland</p> <ul style="list-style-type: none"> Maintain at normal operating level 37 m AHD If required reduce water level over autumn/winter by up to 1 m (36 m AHD) 	Maintain appropriate seasonal variation in water levels to provide suitable habitat and food resources for frogs.
KB4b	By 2030, improve biodiversity at the Kings Billabong asset by supporting the life cycle of EPBC listed Growling Grass Frog (<i>Litoria raniformis</i>).	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> Maintain a min water level 33.9 m AHD Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer Allow water levels to recede over autumn/winter <p>Kings Billabong Wetland</p> <ul style="list-style-type: none"> Maintain at normal operating level 37 m AHD If required reduce water level over autumn/winter by up to 1 m (36 m AHD) 	Maintain appropriate seasonal variation in water levels to provide suitable habitat and food resources for Growling Grass Frog (<i>Litoria raniformis</i>).
KB5	By 2030, protect and restore biodiversity by maintaining	Butlers Creek complex	Inundate areas of exposed sediments in spring to increase

	representative populations of native small-bodied fish at the Kings Billabong asset, including Australian Smelt (<i>Retropinna semoni</i>), Carp gudgeon (<i>Hypseleotris</i> spp.), Flat-headed Gudgeon (<i>Philypnodon grandiceps</i>), Murray-Darling Rainbowfish (<i>Melanotaenia fluviatilis</i>), Un-specked Hardyhead (<i>Craterocephalus stercusmuscarum fulvus</i>).	<ul style="list-style-type: none"> • Maintain a min water level 33.9 m AHD • Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer • Allow water levels to recede over autumn/winter <p>Kings Billabong Wetland</p> <ul style="list-style-type: none"> • Maintain at normal operating level 37 m AHD • If required reduce water level over autumn/winter by up to 1 m (36 m AHD) 	<p>zooplankton abundance and available vegetation to coincide with breeding</p> <p>Expose sediments around the fringe of the wetland in autumn/winter to allow for consolidation of sediments and germination of terrestrial plants to provide cover and spawning substrate upon re-inundation..</p>
KB6	By 2030, improve the population of Freshwater catfish (<i>Tandanus tandanus</i>) at the Kings Billabong asset.	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> • Maintain a min water level 33.9 m AHD • Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer • Allow water levels to recede over autumn/winter <p>Kings Billabong Wetland</p> <ul style="list-style-type: none"> • Maintain at normal operating level 37 m AHD <p>If required reduce water level over autumn/winter by up to 1 m (36 m AHD)</p>	Maintain appropriate seasonal variation in water levels to provide suitable habitat and food resources for large-bodied native fish.
KB7	By 2030, maintain representative populations of the shallow-water and deep feeding guilds of waterbirds, including shorebirds (F2 and F3, after Jaensch 2002) at the Kings Billabong asset, by maintaining a mixture of foraging habitats.	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> • Maintain a min water level 33.9 m AHD • Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer • Allow water levels to recede over autumn/winter <p>Kings Billabong Wetland</p> <ul style="list-style-type: none"> • Maintain at normal operating level 37 m AHD • If required reduce water level over autumn/winter by up to 1 m (36 m AHD) 	<p>Provide suitable habitat (food, refuge) in flooded wetland vegetation in spring and summer.</p> <p>Provide foraging habitat in shallow open water (<0.5m depth) and mudflats as water recedes over autumn and winter.</p>
KB8	By 2030, maintain vital habitat to provide a refugium for listed species of waterbirds at the Kings Billabong asset.	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> • Maintain a min water level 33.9 m AHD • Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer 	<p>Provide suitable habitat (food, refuge) in flooded wetland vegetation in spring and summer.</p> <p>Provide foraging habitat in shallow open water (<0.5m depth) and</p>

		<ul style="list-style-type: none"> Allow water levels to recede over autumn/winter <p>Kings Billabong Wetland</p> <ul style="list-style-type: none"> Maintain at normal operating level 37 m AHD <p>If required reduce water level over autumn/winter by up to 1 m (36 m AHD)</p>	mudflats as water recedes over autumn and winter.
KB9 (BCT4)	By 2030, maintain representative populations of piscivores (guild D4, after Jaensch 2002) at the Butlers Creek complex.	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> Maintain a min water level 33.9 m AHD Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer Allow water levels to recede over autumn/winter 	<p>Provide suitable habitat (food, refuge) in flooded wetland vegetation in spring and summer.</p> <p>Provide foraging habitat in shallow open water (<0.5m depth) and mudflats as water recedes over autumn and winter.</p>
KB10 (BCT5)	Protect and restore ecosystem functions of water-dependent ecosystems that support successful breeding of large waders at Ducksfoot Lagoon by providing conditions for breeding and fledging at least 3 times every 10 years	<p>Butlers Creek complex</p> <ul style="list-style-type: none"> Maintain a min water level 33.9 m AHD Every year in spring increase water levels to 34.4 m AHD and maintain until end of summer Allow water levels to recede over autumn/winter If required surcharge to 34.9 m AHD in late winter and maintain for 7 months 	<p>Provide suitable habitat (food, refuge, nesting sites) in flooded wetland and floodplain vegetation in spring and summer.</p>

8.3 SEASONALLY ADAPTIVE APPROACH

To allow for adaptive and integrated management, the watering requirements have been framed using an adaptive approach which identifies priorities for environmental watering under different seasonal conditions. 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 flood years. The planning scenarios under different seasonal conditions for Kings Billabong are described in **Figure 17**.

Planning Scenario	Drought	Dry	Average	Wet to very wet
Expected Conditions	Water levels in target area maintained at or above identified minimum levels	Water levels in target area maintained above identified minimum levels and increased as per intended water regime if environmental water allocations allow	Water levels in target area managed as per intended water regime	High flows or flooding in Murray River, possible overbank flooding connecting wetlands and floodplain. If no flooding, manage as per intended water regime
Management Objectives	Protect <ul style="list-style-type: none"> Avoid critical loss Maintain refuges Avoid catastrophic events 	Maintain <ul style="list-style-type: none"> Maintain wetland function with reduced reproductive capacity Maintain high priority environmental assets 	Recover <ul style="list-style-type: none"> Improve ecological health and resilience Improve recruitment opportunities for key plants and animal species 	Enhance <ul style="list-style-type: none"> Restore key floodplain wetland linkages Maximise recruitment opportunities for key animal and plant species
Watering actions to support management objectives	Provide low flows to maintain water quality to protect priority environmental assets	Provide late winter/spring flows to maintain water quality and support high priority aquatic flora and fauna Increase to maximum water levels (if possible) to support aquatic flora and fauna, riparian vegetation, and provide habitat for shallow feeding waterbirds	Provide late winter/spring flows to maximum water levels to support aquatic flora and fauna, riparian vegetation, and provide habitat for shallow feeding waterbirds	Manage regulating structures to maintain connectivity and the exchange of nutrients between the river and floodplain Top up natural flows if needed, to meet target water levels

Figure 17. Planning scenarios for Kings Billabong under a range of seasonal conditions

9 Environmental Water Delivery Infrastructure

9.1 WATER DELIVERY INFRASTRUCTURE

Existing infrastructure

Existing water delivery infrastructure at Kings Billabong is identified in **Figure 18**. This consists of regulators at both Baggs Bridge and Jennings Bridge within the Butlers Creek complex, and a regulator at the inlet to the Kings Billabong Wetland on Psyche Creek. The existing infrastructure enables the intended water regime and watering requirements to be adequately delivered.

Complimentary works

Complimentary works at Kings Billabong have been undertaken in recent years to reduce impacts on biodiversity from threatening processes, in particular recreational activities. These works include track rationalisation, canoe launching facilities and fishing platforms.

9.2 CONSTRAINTS

Full inundation of the target areas is possible with the current infrastructure. The current infrastructure and intended inundation areas are shown in **Figure 18**. To meet the intended watering regime no further infrastructure is required.

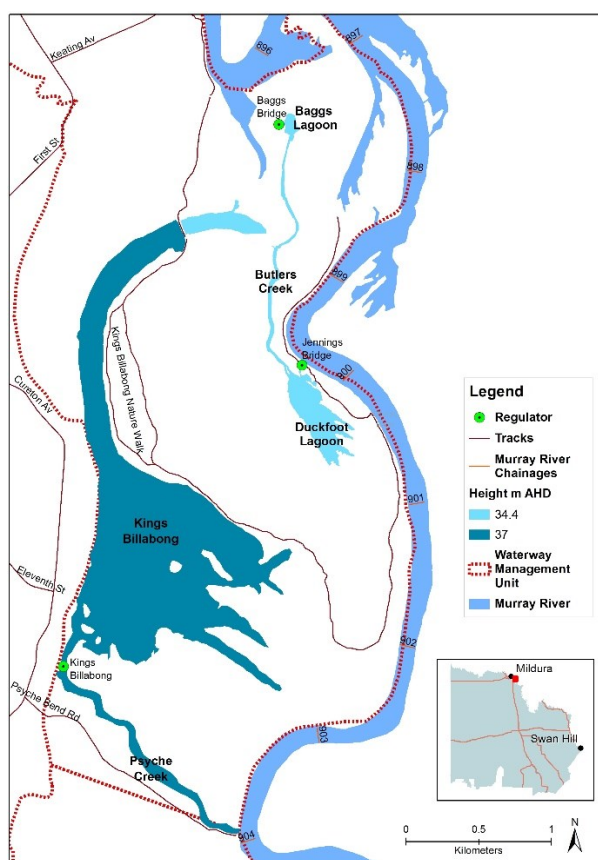


Figure 18. Area able to be inundated with existing infrastructure

10 Demonstrating Outcomes

Monitoring Priorities at Kings Billabong

The following priorities for monitoring have been identified for the Kings Billabong target area (**Table 20**). These monitoring priorities will enable environmental water managers to assess progress against targets and assist in the adaptive management of the target area to achieve the stated environmental objectives and outcomes. The link between stated objectives and monitoring priorities are described in **Table 20**.

Table 20. Links between environmental objectives, monitoring questions and monitoring priorities

Objective number	Monitoring focus	Monitoring question	Method	When
Overarching management goal				
N/A	Growling Grass Frog (<i>Litoria raniformis</i>) population	By 2030 does Kings Billabong support a self-sustaining population of Growling Grass Frog (<i>Litoria raniformis</i>)?	Refer to frog monitoring below (KB4b)	See below
	Piscivorous waterbirds and large wading birds	By 2030 does Kings Billabong support healthy populations of piscivorous waterbirds and large wading birds?	Refer to waterbird monitoring below (KB9 and KB10)	See below
	Wetland condition	Has there been an overall rehabilitation in the condition of the target area by 2030?	Undertake IWC method assessment	Every five years
Vegetation objectives				
KB1	Aquatic macrophytes at the Kings Billabong asset	By 2030 has there been an increase in diversity of aquatic macrophytes with ≥ 2 species from each of the listed Water Regime Indicator Groups present in 80% of years?	Undertake surveys of aquatic macrophytes at Kings Billabong. Compare results against benchmark of initial survey.	Every three years
Frog objectives				
KB4a	Frogs at the Kings Billabong asset	By 2030 are nominated frog species breeding in 80% of years?	Undertake frog surveys (audio recordings and/or presence of tadpoles)	Annually

Objective number	Monitoring focus	Monitoring question	Method	When
KB4b	Growling Grass Frog (<i>Litoria raniformis</i>) at the Kings Billabong asset	By 2030 is there a self-sustaining population of Growling Grass Frog (<i>Litoria raniformis</i>) with evidence of breeding and recruitment in 80 % of years?	Undertake tadpole surveys	Annually
Fish objectives				
KB5	Small-bodied native fish at the Kings Billabong asset	By 2030 are adults or YoY for nominated species recorded in 8 out of 10 years?	Undertake fish surveys targeting small-bodied native fish	Annually
KB6	Freshwater Catfish (<i>Tandanus tandanus</i>) at Kings Billabong asset	By 2030 are YoY Freshwater Catfish (<i>Tandanus tandanus</i>) recoded in 8 out of 10 years? By 2030 has the abundance of adult Freshwater Catfish (<i>Tandanus tandanus</i>) increased by 20 % from baseline?	Undertake fish surveys targeting Murray Freshwater Catfish (<i>Tandanus tandanus</i>)	Annually
Waterbird objectives				
KB7	Shore birds at the Kings Billabong asset	By 2030 are 80% of representative F2 and F3 recorded at in 8 years out of any 10-year period where conditions are suitable?	Undertake waterbird surveys	Annually when conditions are suitable
KB8	Listed species of waterbirds at the Kings Billabong asset	By 2030 are ≥ 6 of the nominated species occurring in 7 years of any 10-year period?	Undertake waterbird surveys	Annually when conditions are suitable
KB9 (BCT4)	Piscivorous waterbirds at Butlers Creek complex	By 2030 are 80% of representative D4 (piscivores) species recorded at the Butlers Creek complex in 8 years out of any 10-year period where conditions are suitable?	Undertake waterbird surveys	Annually when conditions are suitable

Objective number	Monitoring focus	Monitoring question	Method	When
KB10 (BCT5)	Large wading birds	Are suitable conditions for breeding and fledging of large waders provided 3 times every 10 years?	Undertake waterbird surveys targeting breeding of large waders	When conditions are suitable

11 Knowledge gaps and recommendations

There are currently no significant knowledge gaps that have been identified. However, as this EWMP is implemented knowledge gaps may be identified and incorporated into future versions.



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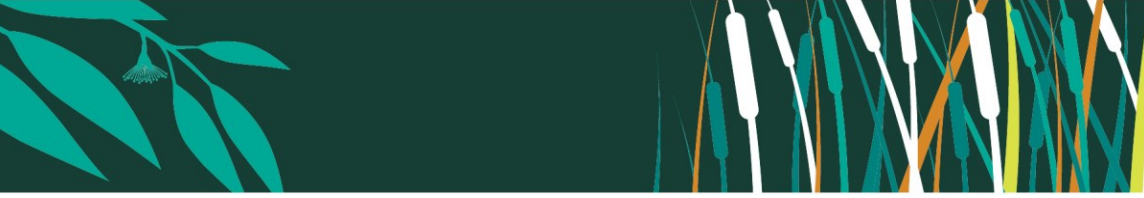
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APPENDIX 1.

FAUNA SPECIES LIST

Lifeform type: Invertebrate, Fish, Amphibian, Reptile, Bird, Mammal

Common name	Scientific name	Type
Spiny-cheeked Honeyeater	<i>Acanthagenys rufogularis</i>	B
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	B
Chestnut-rumped Thornbill	<i>Acanthiza uropygialis</i>	B
Yellow Thornbill	<i>Acanthiza nana</i>	B
Brown Goshawk	<i>Accipiter fasciatus</i>	B
Clamorous Reed Warbler	<i>Acrocephalus stentoreus</i>	B
Chestnut teal [^]	<i>Anas castanea</i>	B
Grey Teal	<i>Anas gracilis</i>	B
Pacific Black Duck	<i>Anas superciliosa</i>	B
Darter	<i>Anhinga novaehollandiae</i>	B
Red Wattlebird	<i>Anthochaera carunculata</i>	B
Southern Whiteface	<i>Aphelocephala leucopsis</i>	B
Wedge-tailed Eagle	<i>Aquila audax</i>	B
Great egret [^]	<i>Ardea alba</i>	B
Eastern Great Egret	<i>Ardea alba modesta</i>	B
Intermediate egret [^]	<i>Ardrea intermedia</i>	B
Plumed Egret	<i>Ardea intermedia plumifera</i>	B
Eastern Great Egret	<i>Ardea modesta</i>	B
White-necked Heron	<i>Ardea pacifica</i>	B
Dusky Woodswallow	<i>Artamus cyanopterus</i>	B
White-breasted Woodswallow	<i>Artamus leucorhynchus</i>	B
Masked Woodswallow	<i>Artamus personatus</i>	B
White-browed Woodswallow	<i>Artamus superciliosus</i>	B
White-striped free-tailed bat [^]	<i>Austronomus australis</i>	M
Hardhead	<i>Aythya australis</i>	B
Western Ringneck	<i>Barnardius zonarius zonarius</i>	B
Silver Perch	<i>Bidyanus bidyanus</i>	F
Musk Duck	<i>Biziura lobata</i>	B
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	B
Little Corella	<i>Cacatua sanguinea</i>	B
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	B
Curlew Sandpiper	<i>Calidris ferruginea</i>	B
Goldfish [*]	<i>Carassius auratus</i>	F
Gould's Wattle bat [^]	<i>Chalinolobus gouldii</i>	M
Red-capped Plover	<i>Charadrius ruficapillus</i>	B
Broad-shelled Turtle	<i>Chelodina expansa</i>	R
Australian Wood Duck	<i>Chenonetta jubata</i>	B

Common name	Scientific name	Type
Whiskered Tern	<i>Chlidonias hybridus</i>	B
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	B
Horsfield's Bronze-Cuckoo	<i>Chrysococcyx basalis</i>	B
Black-eared Cuckoo	<i>Chrysococcyx osculans</i>	B
Swamp Harrier	<i>Circus approximans</i>	B
Spotted Harrier	<i>Circus assimilis</i>	B
White-browed Treecreeper	<i>Climacteris affinis</i>	B
Brown Treecreeper (south-eastern ssp.)	<i>Climacteris picumnus victoriae</i>	B
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	B
Rock Dove*	<i>Columba livia</i>	B
Ground Cuckoo-shrike	<i>Coracina maxima</i>	B
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	B
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	B
White-winged Chough	<i>Corcorax melanorhamphos</i>	B
Little crow^	<i>Corvus bennetti</i>	B
Australian Raven	<i>Corvus coronoides</i>	B
Pied Butcherbird	<i>Cracticus nigrogularis</i>	B
Unspecked Hardyhead	<i>Craterocephalus stercusmuscarum fulvus</i>	F
Plains Froglet	<i>Crinia parinsignifera</i>	A
Eastern Sign-bearing Froglet^	<i>Crinia parinsignifera</i>	A
Pallid Cuckoo	<i>Cuculus pallidus</i>	B
Black Swan	<i>Cygnus atratus</i>	B
Carp*	<i>Cyprinus carpio</i>	F
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	B
Plumed Whistling-Duck	<i>Dendrocygna eytoni</i>	B
Mistletoebird	<i>Dicaeum hirundinaceum</i>	B
Little Egret	<i>Egretta garzetta nigripes</i>	B
White-faced Heron	<i>Egretta novaehollandiae</i>	B
Black-fronted Dotterel	<i>Elsayornis melanops</i>	B
Blue-faced Honeyeater	<i>Entomyzon cyanotis</i>	B
Galah	<i>Eolophus roseicapilla</i>	B
Red-kneed dotterel^	<i>Erythronys cinctus</i>	B
Nankeen Kestrel	<i>Falco cenchroides</i>	B
Australian Hobby	<i>Falco longipennis</i>	B
Peregrine Falcon	<i>Falco peregrinus</i>	B
Black Falcon	<i>Falco subniger</i>	B
Crested Shrike-tit	<i>Falcunculus frontatus</i>	B
Eurasian Coot	<i>Fulica atra</i>	B
Dusky Moorhen	<i>Gallinula tenebrosa</i>	B
Black-tailed Native-hen	<i>Gallinula ventralis</i>	B
Eastern Gambusia*	<i>Gambusia holbrooki</i>	F

Common name	Scientific name	Type
Diamond Dove	<i>Geopelia cuneata</i>	B
Peaceful Dove	<i>Geopelia striata</i>	B
Western Gerygone	<i>Gerygone fusca</i>	B
Magpie-lark	<i>Grallina cyanoleuca</i>	B
Painted Honeyeater	<i>Grantiella picta</i>	B
Australian Magpie	<i>Gymnorhina tibicen</i>	B
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	B
Whistling Kite	<i>Haliastur sphenurus</i>	B
Little Eagle	<i>Hieraaetus morphnoides</i>	B
Black-winged Stilt	<i>Himantopus himantopus</i>	B
Fairy Martin	<i>Hirundo ariel</i>	B
Welcome Swallow^	<i>Hirundo neoxena</i>	B
Tree Martin	<i>Hirundo nigricans</i>	B
Rakali	<i>Hydromys chrysogaster</i>	M
Caspian Tern	<i>Hydroprogne caspia</i>	B
Western Carp Gudgeon	<i>Hypseleotris klunzingeri</i>	F
Australian Little Bittern	<i>Ixobrychus dubius</i>	B
White-winged Triller	<i>Lalage sueurii</i>	B
White-plumed Honeyeater	<i>Lichenostomus penicillatus</i>	B
Singing Honeyeater	<i>Lichenostomus virescens</i>	B
Eastern Banjo Frog^	<i>Limnodynastes dumerilii</i>	A
Barking Marsh Frog	<i>Limnodynastes fletcheri</i>	A
Spotted Marsh Frog (race unknown)	<i>Limnodynastes tasmaniensis</i>	A
Person's Tree Frog^	<i>Litoria peronii</i>	A
Growling Grass Frog	<i>Litoria raniformis</i>	A
Major Mitchell's Cockatoo	<i>Lophochroa leadbeateri</i>	B
Square-tailed Kite	<i>Lophoictinia isura</i>	B
Western Grey Kangaroo	<i>Macropus fuliginosus</i>	M
Superb Fairy-wren	<i>Malurus cyaneus</i>	B
Variegated Fairy-wren	<i>Malurus lamberti</i>	B
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>	B
Variegated Fairy-wren	<i>Malurus lamberti</i>	B
Noisy Miner	<i>Manorina melanocephala</i>	B
Golden Perch	<i>Macquaria ambigua</i>	F
Little Grassbird	<i>Megalurus gramineus</i>	B
Hooded Robin	<i>Melanodryas cucullata cucullata</i>	B
Murray River Rainbowfish	<i>Melanotaenia fluviatilis</i>	F
Rainbow Bee-eater	<i>Merops ornatus</i>	B
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	B
Black Kite	<i>Milvus migrans</i>	B
Oriental Weatherloach*	<i>Misgurnus anguillicaudatus</i>	F

Common name	Scientific name	Type
Carpet Python	<i>Morelia spilota metcalfei</i>	R
Southern free-tail bat^	<i>Mormopterus planiceps</i>	M
Restless Flycatcher	<i>Myiagra inquieta</i>	B
Bony Herring	<i>Nematalosa erebi</i>	F
Blue-winged parrot^	<i>Neophema chrysostoma</i>	B
Tiger Snake	<i>Notechis scutatus</i>	R
Nankeen Night Heron	<i>Nycticorax caledonicus</i>	B
Long-eared bat^	<i>Nyctophilus sp</i>	M
Crested Pigeon	<i>Ocyphaps lophotes</i>	B
Crested Bellbird	<i>Oreoica gutturalis</i>	B
Blue-billed Duck	<i>Oxyura australis</i>	B
Rufous Whistler	<i>Pachycephala rufiventris</i>	B
Spotted Pardalote	<i>Pardalotus punctatus punctatus</i>	B
Striated Pardalote	<i>Pardalotus striatus</i>	B
House Sparrow*	<i>Passer domesticus</i>	B
Australian Pelican	<i>Pelecanus conspicillatus</i>	B
Welcome Swallow	<i>Petrochelidon neoxena</i>	B
Tree Martin	<i>Petrochelidon nigricans</i>	B
Red-capped Robin	<i>Petroica goodenovii</i>	B
Great Cormorant	<i>Phalacrocorax carbo</i>	B
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	B
Pied Cormorant	<i>Phalacrocorax varius</i>	B
Common Bronzewing	<i>Phaps chalcoptera</i>	B
Little Friarbird	<i>Philemon citreogularis</i>	B
Noisy Friarbird	<i>Philemon corniculatus</i>	B
Flathead Gudgeon	<i>Philypnodon grandiceps</i>	F
Dwarf Flathead Gudgeon	<i>Philypnodon macrostomus</i>	F
Yellow-billed Spoonbill	<i>Platalea flavipes</i>	B
Royal Spoonbill	<i>Platalea regia</i>	B
Crimson Rosella	<i>Platycercus elegans</i>	B
Yellow Rosella	<i>Platycercus elegans flaveolus</i>	B
Glossy Ibis	<i>Plegadis falcinellus</i>	B
Tawny Frogmouth	<i>Podargus strigoides</i>	B
Hoary-headed Grebe	<i>Poliiocephalus poliocephalus</i>	B
Regent Parrot	<i>Polytelis anthopeplus monarchoides</i>	B
Chestnut-crowned Babbler	<i>Pomatostomus ruficeps</i>	B
White-browed Babbler	<i>Pomatostomus superciliosus</i>	B
Purple Swampphen	<i>Porphyrio porphyrio</i>	B
Australian Spotted Crane	<i>Porzana fluminea</i>	B
Baillon's Crane	<i>Porzana pusilla palustris</i>	B
Red-rumped Parrot	<i>Psephotus haematonotus</i>	B

Common name	Scientific name	Type
White-plumed honeyeater [^]	<i>Ptilotula penicillata</i>	B
Red-necked Avocet	<i>Recurvirostra novaehollandiae</i>	B
Australian Smelt	<i>Retropinna semoni</i>	F
Grey Fantail	<i>Rhipidura albiscarpa</i>	B
Willie Wagtail	<i>Rhipidura leucophrys</i>	B
Yellow-bellied Sheath-tail Bat	<i>Saccolaimus flaviventris</i>	M
Weebill	<i>Smicromis brevirostris</i>	B
Australasian shoveler [^]	<i>Spatula rhynchotis</i>	B
Freckled Duck	<i>Stictonetta naevosa</i>	B
Apostlebird	<i>Struthidea cinerea</i>	B
Common Starling [*]	<i>Sturnus vulgaris</i>	B
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	B
Zebra Finch	<i>Taeniopygia guttata</i>	B
Australian Shelduck	<i>Tadorna tadornoides</i>	B
Freshwater Catfish	<i>Tandanus tandanus</i>	F
Australian White Ibis	<i>Threskiornis molucca</i>	B
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	B
Red-backed Kingfisher	<i>Todiramphus pyrrhopygius</i>	B
Sacred Kingfisher	<i>Todiramphus sanctus</i>	B
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	M
Common Greenshank	<i>Tringa nebularia</i>	B
Marsh Sandpiper	<i>Tringa stagnatilis</i>	B
Common Blackbird [*]	<i>Turdus merula</i>	B
Masked Lapwing	<i>Vanellus miles</i>	B
Lace Monitor	<i>Varanus varius</i>	R
Little Forest Bat [^]	<i>Vespadelus vulturnus</i>	M
Silvereye	<i>Zosterops lateralis</i>	B

^{*}Introduced species [^]Data obtained from citizen science projects.

Source: (GHD, 2016b; a; Biosis, 2016, DELWP, 2016b; DELWP, 2022; unpublished fish survey data - Mallee CMA)

APPENDIX 2.

ECOLOGICAL VEGETATION CLASSES

EVC no.	EVC name	Bioregional conservation status	Description
102	Low Chenopod Shrubland	Depleted	Chenopod shrubland to 1 m tall occupying broad, flat alluvial terraces occur along the Murray River, west from Mildura to the border. Also found in narrow bands fringing raak and saline lakes such as Lake Tyrell and on relict lakebed surfaces such as Pine Plains. The field layer is characterised by succulents and a suite of annual herbs.
103	Riverine Chenopod Woodland	Depleted	Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. Confined to heavy clay soils on higher level terraces within or on the margins of riverine floodplains (or former floodplains), naturally subject to only extremely infrequent incidental shallow flooding from major events if at all flooded.
104	Lignum Swamp	Vulnerable	Typically treeless shrubland to 4 m tall with robust (but sometimes patchy) growth of lignum. Widespread wetland vegetation type in low rainfall areas on heavy soils, subject to infrequent inundation resulting from overbank flows from rivers or local runoff.
806	Alluvial plains semi-arid grassland	Vulnerable	Grassland (turf) to herbland to < 0.2 m tall with only incidental shrubs. Flood-promoted flora, potentially including a wide range of opportunistic ephemeral / annual species occupying low-lying areas within at least previously flood-prone (mostly) higher-level terraces, which may be effectively shallow lakes when flooded. Also sometimes on flats along creeks of the further north-west, in habitat akin to that of Floodway Pond Herbland.
808	Lignum Shrubland	Least concern	Relatively open shrubland of species of divaricate growth form. The ground-layer is typically herbaceous or a turf grassland, rich in annual/ephemeral herbs and small chenopods. Characterised by the open and even distribution of relatively small Lignum shrubs. Occupies heavy soil plains along Murray River, low-lying areas on higher-level (but still potentially flood-prone) terraces.

813	Intermittent Swampy Woodland	Depleted	Eucalypt woodland to 15 m tall with a variously shrubby and rhizomatous sedgy - turf grass understorey, at best development dominated by flood stimulated species in association with flora tolerant of inundation. Flooding is unreliable but extensive when it happens. Occupies low elevation areas on river terraces (mostly at the rear of pointbar deposits or adjacent to major floodways) and lacustrine verges (where sometimes localised to narrow transitional bands). Soils often have a shallow sand layer over heavy and frequently slightly brackish soils.
818	Shrubby Riverine Woodland	Least concern	Eucalypt woodland to open forest to 15 m tall of less floodprone (riverine) watercourse fringes, principally on levees and higher sections of point-bar deposits. The understorey includes a range of species shared with drier floodplain habitats with a sparse shrub component, ground-layer patchily dominated by various life-forms. A range of large dicot herbs (mostly herbaceous perennial, several with a growth-form approaching that of small shrub) are often conspicuous.
823	Lignum Swampy Woodland	Depleted	Understorey dominated by Lignum, typically of robust character and relatively dense (at least in patches), in association with a Eucalypt and/or Acacia woodland to 15 m tall. The ground layer includes a component of obligate wetland flora that is able to persist even if dormant over dry periods.

Source: (DSE, 2004; DELWP, 2016a,)

APPENDIX 3.

FLORA SPECIES LIST

Common name	Scientific name
Small Cooba	<i>Acacia ligulata</i>
Mallee Wattle	<i>Acacia montana</i>
Spine Bush	<i>Acacia nyssophylla</i>
Umbrella Wattle	<i>Acacia oswaldii</i>
Willow Wattle	<i>Acacia salicina</i>
Eumong	<i>Acacia stenophylla</i>
Cattle Bush	<i>Alectryon oleifolius</i> subsp. <i>canescens</i>
Orange Fox-tail*	<i>Alopecurus aequalis</i>
Lesser Joyweed	<i>Alternanthera denticulata</i> s.l.
Jerry-jerry	<i>Ammannia multiflora</i>
Box Mistletoe	<i>Amyema miquelii</i>
Nodding Chocolate-lily	<i>Arthropodium fimbriatum</i>
Bridal Creeper*	<i>Asparagus asparagoides</i>
Asparagus*	<i>Asparagus officinalis</i>
Common Woodruff	<i>Asperula conferta</i>
Wimmera Woodruff	<i>Asperula wimmerana</i>
Onion Weed*	<i>Asphodelus fistulosus</i>
Aster-weed*	<i>Aster subulatus</i>
Small Saltbush	<i>Atriplex eardleyae</i>
Slender-fruit Saltbush	<i>Atriplex leptocarpa</i>
Spreading Saltbush	<i>Atriplex limbata</i>
Flat-top Saltbush	<i>Atriplex lindleyi</i>
Corky Saltbush	<i>Atriplex lindleyi</i> subsp. <i>inflata</i>
Old-man Saltbush	<i>Atriplex nummularia</i>
Dwarf Old-man Saltbush	<i>Atriplex nummularia</i> subsp. <i>omissa</i>
Coral Saltbush	<i>Atriplex papillata</i>
Hastate Orache*	<i>Atriplex prostrata</i>
Mat Saltbush	<i>Atriplex pumilio</i>
Silver Saltbush	<i>Atriplex rhagodioides</i>
Berry Saltbush	<i>Atriplex semibaccata</i>
Spiny-fruit Saltbush	<i>Atriplex spinibractea</i>
Sprawling Saltbush	<i>Atriplex suberecta</i>
Common Wallaby-grass	<i>Austrodanthonia caespitosa</i>
Bristly Wallaby-grass	<i>Austrodanthonia setacea</i>



Graceful Spear-grass	<i>Austrostipa acrociliata</i>
Plump Spear-grass	<i>Austrostipa aristiglumis</i>
Balcarra Spear-Grass	<i>Austrostipa nitida</i>
Knotty Spear-grass	<i>Austrostipa nodosa</i>
Rough Spear-grass	<i>Austrostipa scabra</i> subsp. <i>falcata</i>
Bearded Oat*	<i>Avena barbata</i>
Pacific Azolla	<i>Azolla filiculoides</i>
Ferny Azolla	<i>Azolla pinnata</i>
Jerry Water-fire	<i>Bergia ammannioides</i>
Small Water-fire	<i>Bergia trimera</i>
Marsh Club-sedge	<i>Bolboschoenus medianus</i>
Billabong Daisy	<i>Brachyscome gracilis</i> subsp. <i>robusta</i>
Woodland Swamp-daisy	<i>Brachyscome basaltica</i> var. <i>gracilis</i>
Variable Daisy	<i>Brachyscome ciliaris</i>
Variable Daisy	<i>Brachyscome ciliaris</i> var. <i>lanuginosa</i>
Lobe-seed Daisy	<i>Brachyscome dentata</i>
Hard-head Daisy	<i>Brachyscome lineariloba</i>
Mediterranean Turnip*	<i>Brassica tournefortii</i>
Lesser Quaking-grass*	<i>Briza minor</i>
Great Brome*	<i>Bromus diandrus</i>
Red Brome*	<i>Bromus rubens</i>
Leek Lily	<i>Bulbine semibarbata</i>
Small Purslane	<i>Calandrinia eremaea</i>
Slender Cypress-pine	<i>Callitris gracilis</i> subsp. <i>murrayensis</i>
Pale Beauty-heads	<i>Calocephalus sonderi</i>
Blue Burr-daisy	<i>Calotis cuneifolia</i>
Hairy Burr-daisy	<i>Calotis hispidula</i>
Yellow Burr-daisy	<i>Calotis lappulacea</i>
Rough Burr-daisy	<i>Calotis scabiosifolia</i>
Tufted Burr-daisy	<i>Calotis scapigera</i>
Riverina Bitter-cress	<i>Cardamine moirensis</i>
Plains Sedge	<i>Carex bichenoviana</i>
Ward's Weed*	<i>Carrichtera annua</i>
Malta Thistle*	<i>Centaurea melitensis</i>
Spiked Centaury	<i>Centaureum spicatum</i>
Hornwort	<i>Ceratophyllum demersum</i>
Flat Spurge	<i>Chamaesyce drummondii</i>
Crested Goosefoot	<i>Chenopodium cristatum</i>
Small-leaf Goosefoot	<i>Chenopodium desertorum</i> subsp. <i>microphyllum</i>



Nitre Goosefoot	<i>Chenopodium nitrariaceum</i>
Rhodes Grass*	<i>Chloris gayana</i>
Windmill Grass	<i>Chloris truncata</i>
Spear Thistle*	<i>Cirsium vulgare</i>
Camel Melon*	<i>Citrullus lanatus</i>
Pink Bindweed	<i>Convolvulus erubescens</i> spp. agg.
Common Cotula	<i>Cotula australis</i>
Water Buttons*	<i>Cotula coronopifolia</i>
Dense Crassula	<i>Crassula colorata</i>
Swamp Crassula	<i>Crassula helmsii</i>
Purple Crassula	<i>Crassula peduncularis</i>
Sieber Crassula	<i>Crassula sieberiana</i> s.l.
Rosinweed	<i>Cressa australis</i>
Paddy Melon*	<i>Cucumis myriocarpus</i> subsp. <i>leptodermis</i>
Native Scurf-pea	<i>Cullen australasicum</i>
Hoary Scurf-pea	<i>Cullen cinereum</i>
Grey Scurf-pea	<i>Cullen discolor</i>
Woolly Scurf-pea	<i>Cullen pallidum</i>
Spreading Scurf-pea	<i>Cullen patens</i>
Tough Scurf-pea	<i>Cullen tenax</i>
Golden Dodder	<i>Cuscuta tasmanica</i>
Couch*	<i>Cynodon dactylon</i> var. <i>dactylon</i>
Native Couch	<i>Cynodon dactylon</i> var. <i>pulchellus</i>
Variable Flat-sedge	<i>Cyperus difformis</i>
Drain Flat-sedge*	<i>Cyperus eragrostis</i>
Tall Flat-sedge	<i>Cyperus exaltatus</i>
Lax Flat-sedge	<i>Cyperus flaccidus</i>
Flecked Flat-sedge	<i>Cyperus gunnii</i> subsp. <i>gunnii</i>
Spiny Flat-sedge	<i>Cyperus gymnocaulos</i>
Curry Flat-sedge*	<i>Cyperus hamulosus</i>
Button Rush	<i>Cyperus leptocarpus</i>
Curly Flat-sedge	<i>Cyperus rigidellus</i>
Nutgrass*	<i>Cyperus rotundus</i>
Yelka	<i>Cyperus victoriensis</i>
Star Fruit	<i>Damasonium minus</i>
Pale Flax-lily	<i>Dianella longifolia</i> s.l.
Riverine Flax-lily	<i>Dianella porracea</i>
Silky Umbrella-grass	<i>Digitaria ammobila</i>
Brown Beetle-grass	<i>Diplachne fusca</i> subsp. <i>fusca</i>

Rounded Noon-flower	<i>Disphyma crassifolium</i> subsp. <i>clavellatum</i>
Twin-flower Saltbush	<i>Dissocarpus biflorus</i> var. <i>biflorus</i>
Stinkwort*	<i>Dittrichia graveolens</i>
Slender Hop-bush	<i>Dodonaea viscosa</i> subsp. <i>angustissima</i>
Tangled Lignum	<i>Duma florulenta</i>
Globular Pigweed	<i>Dysphania glomulifera</i> ssp. <i>glomulifera</i>
Barnyard Grass*	<i>Echinochloa crus-galli</i>
Yellow Twin-heads	<i>Eclipta platyglossa</i>
Water Hyacinth*	<i>Eichhornia crassipes</i>
Nodding Saltbush	<i>Einadia nutans</i>
Small Elachanth	<i>Elachanthus pusillus</i>
Waterwort	<i>Elatine gratioloides</i>
Common Spike-sedge	<i>Eleocharis acuta</i>
Pale Spike-sedge	<i>Eleocharis pallens</i>
Small Spike-sedge	<i>Eleocharis pusilla</i>
Common Wheat-grass	<i>Elymus scaber</i> var. <i>scaber</i>
Spiny Emex*	<i>Emex australis</i>
Ruby Saltbush	<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>
Spider Grass	<i>Enteropogon acicularis</i>
Common Bottle-washers	<i>Enneapogon avenaceus</i>
Spider Grass	<i>Enteropogon acicularis</i>
Tall Nut-heads	<i>Epaltes cunninghamii</i>
Cane Grass	<i>Eragrostis australasica</i>
Stink Grass*	<i>Eragrostis cilianensis</i>
Common Love-grass	<i>Eragrostis brownii</i>
Close-headed Love-grass	<i>Eragrostis diandra</i>
Mallee Love-grass	<i>Eragrostis dielsii</i>
Southern Cane-grass	<i>Eragrostis infecunda</i>
Purple Love-grass	<i>Eragrostis lacunaria</i>
Weeping Love-grass	<i>Eragrostis parviflora</i>
Bristly Love-grass	<i>Eragrostis setifolia</i>
Spreading Emu-bush	<i>Eremophila divaricata</i> subsp. <i>divaricata</i>
Common Emu-bush	<i>Eremophila glabra</i>
Spotted Emu-bush	<i>Eremophila maculata</i> subsp. <i>maculata</i>
Woolly-fruit Bluebush	<i>Eriochiton sclerolaenoides</i>
Blue Heron's-bill	<i>Erodium crinitum</i>
Tall Nut-heads	<i>Ethuliopsis cunninghamii</i>
River Red-gum	<i>Eucalyptus camaldulensis</i>
Black Box	<i>Eucalyptus largiflorens</i>



Annual Cudweed	<i>Euchiton sphaericus</i>
Flat Spurge	<i>Euphorbia drummondii</i> s.l.
Leafless Ballart	<i>Exocarpos aphyllus</i>
Pale-fruit Ballart	<i>Exocarpos strictus</i>
Summer Fringe-sedge	<i>Fimbristylis aestivalis</i>
Veiled Fringe-sedge	<i>Fimbristylis velata</i>
Sea Heath	<i>Frankenia</i> spp.
Fumitory*	<i>Fumaria</i> spp.
Hairy Carpet-weed	<i>Glinus lotoides</i>
Slender Carpet-weed	<i>Glinus oppositifolius</i>
Small-flower Mud-mat	<i>Glossostigma cleistanthum</i>
Spoon-leaf Mud-mat	<i>Glossostigma diandrum</i>
Indian Cudweed	<i>Gnaphalium polycaulon</i>
Silky Goodenia	<i>Goodenia fascicularis</i>
Pale Goodenia	<i>Goodenia glauca</i>
Spreading Goodenia	<i>Goodenia heteromera</i>
Cut-leaf Goodenia	<i>Goodenia pinnatifida</i>
Small-flower Goodenia	<i>Goodenia pusilliflora</i>
Comb Grevillea	<i>Grevillea huegelii</i>
Silver Needlewood	<i>Hakea leucoptera</i> subsp. <i>leucoptera</i>
Hooked Needlewood	<i>Hakea tephrosperma</i>
Rough Raspwort	<i>Haloragis aspera</i>
Toothed Raspwort	<i>Haloragis odontocarpa</i>
May Smocks	<i>Harmsiodoxa blennodioides</i>
Short Cress	<i>Harmsiodoxa brevipes</i> var. <i>brevipes</i>
Jersey Cudweed	<i>Helichrysum luteoalbum</i>
Common Heliotrope*	<i>Heliotropium europaeum</i>
Northern Barley-grass*	<i>Hordeum glaucum</i>
Barley-grass*	<i>Hordeum leporinum</i>
Hydrilla	<i>Hydrilla verticillata</i>
Smooth Cat's-ear*	<i>Hypochaeris glabra</i>
Flatweed*	<i>Hypochaeris radicata</i>
Grass Cushion	<i>Isoetopsis graminifolia</i>
Inland Club-sedge	<i>Isolepis australiensis</i>
Broad-fruit Club-sedge	<i>Isolepis cernua</i> var. <i>platycarpa</i>
Spiny Rush*	<i>Juncus acutus</i> subsp. <i>acutus</i>
Tussock Rush	<i>Juncus aridicola</i>
Toad Rush	<i>Juncus bufonius</i>
Gold Rush	<i>Juncus flavidus</i>

Common Blown-grass	<i>Lachnagrostis filiformis</i> s.s.
Willow-leaf Lettuce*	<i>Lactuca saligna</i>
Prickly Lettuce*	<i>Lactuca serriola</i>
Golden-top*	<i>Lamarckia aurea</i>
Thin Duckweed	<i>Landoltia punctata</i>
Stalked Plover-daisy	<i>Leiocarpa websteri</i>
Common Peppercross*	<i>Lepidium africanum</i>
Hoary Cress*	<i>Lepidium draba</i>
Warty Peppercross	<i>Lepidium papillosum</i>
Veined Peppercross	<i>Lepidium phlebopetalum</i>
Native Peppercross	<i>Lepidium pseudohyssopifolium</i>
Button Rush	<i>Lipocarpha microcephala</i>
Wimmera Rye-grass*	<i>Lolium rigidum</i>
Red Bird's-foot Trefoil	<i>Lotus cruentus</i>
Clove-strip	<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>
Box Thorn*	<i>Lycium</i> spp.
Harlequin Mistletoe	<i>Lysiana exocarpi</i>
Grey Bluebush	<i>Maireana appressa</i>
Short-leaf Bluebush	<i>Maireana brevifolia</i>
Black Cotton-bush	<i>Maireana decalvans</i>
Hairy Bluebush	<i>Maireana pentagona</i>
Goat Head	<i>Malacocera tricornis</i>
Horehound*	<i>Marrubium vulgare</i>
Narrow-leaf Nardoo	<i>Marsilea costulifera</i>
Common Nardoo	<i>Marsilea drummondii</i>
Moonah	<i>Melaleuca lanceolata</i> subsp. <i>lanceolata</i>
Little Medic*	<i>Medicago minima</i>
Burr Medic*	<i>Medicago polymorpha</i>
Lucerne*	<i>Medicago sativa</i> subsp. <i>sativa</i>
Bokhara Clover*	<i>Melilotus albus</i>
Sweet Melilot*	<i>Melilotus indicus</i>
Common Ice-plant*	<i>Mesembryanthemum crystallinum</i>
Small Ice-plant*	<i>Mesembryanthemum nodiflorum</i>
Bush Minuria	<i>Minuria cunninghamii</i>
Smooth Minuria	<i>Minuria integerrima</i>
Blue Rod	<i>Morgania glabra</i> spp. <i>agg.</i>
Tangled Lignum	<i>Muehlenbeckia florulenta</i>
Creeping Myoporum	<i>Myoporum parvifolium</i>
Mousetail	<i>Myosurus australis</i>

Coarse Water-milfoil	<i>Myriophyllum caput-medusae</i>
Robust Water-milfoil	<i>Myriophyllum papillosum</i>
Red Water-milfoil	<i>Myriophyllum verrucosum</i>
Water Nymph	<i>Najas tenuifolia</i>
Common Evening-primrose*	<i>Oenothera stricta</i> subsp. <i>stricta</i>
Pimelea Daisy-bush	<i>Olearia pimeleoides</i>
Austral Adder's-tongue	<i>Ophioglossum lusitanicum</i>
Babbagia	<i>Osteocarpum acropterum</i> var. <i>deminutum</i>
Bonefruit	<i>Osteocarpum salsuginosum</i>
Swamp Lily	<i>Ottelia ovalifolia</i> subsp. <i>ovalifolia</i>
Grassland Wood-sorrel	<i>Oxalis perennans</i>
Soursob*	<i>Oxalis pes-caprae</i>
Hairy Panic	<i>Panicum effusum</i>
Coast Barb-grass*	<i>Parapholis incurva</i>
Paspalum*	<i>Paspalum dilatatum</i>
Water Couch*	<i>Paspalum distichum</i>
Knottybutt Grass	<i>Paspalidium constrictum</i>
Warrego Summer-grass	<i>Paspalidium jubiflorum</i>
Water Couch*	<i>Paspalum distichum</i>
Slender Knotweed	<i>Persicaria decipiens</i>
Common Reed	<i>Phragmites australis</i>
Fog-fruit*	<i>Phyla canescens</i>
Sandhill Spurge	<i>Phyllanthus lacunellus</i>
Earth Moss	<i>Physcomitrella patens</i> subsp. <i>readeri</i>
Austral Pillwort	<i>Pilularia novae-hollandiae</i>
Rice Millet*	<i>Piptatherum miliaceum</i>
Weeping Pittosporum	<i>Pittosporum angustifolium</i>
Clay Plantain	<i>Plantago cunninghamii</i>
Ribwort*	<i>Plantago lanceolata</i>
Crowned Plantain	<i>Plantago turrifera</i>
Forde Poa	<i>Poa fordeana</i>
Poached-eggs Daisy	<i>Polycalymma stuartii</i>
Prostrate Knotweed*	<i>Polygonum aviculare</i> s.l.
Annual Beard-grass*	<i>Polypogon monspeliensis</i>
Curly Pondweed	<i>Potamogeton crispus</i>
Blunt Pondweed	<i>Potamogeton ochreatus</i>
Fennel Pondweed	<i>Potamogeton pectinatus</i>
Perfoliate Pondweed	<i>Potamogeton perfoliatus</i> s.l.
Floating Pondweed	<i>Potamogeton tricarlinatus</i> s.l.

Jersey Cudweed	<i>Pseudognaphalium luteoalbum</i>
Spiny Mud-grass	<i>Pseudoraphis spinescens</i>
Wiry Noon-flower*	<i>Psilocaulon granulicaule</i>
Pink Mulla-mulla	<i>Ptilotus nobilis</i> subsp. <i>nobilis</i>
Long Tails	<i>Ptilotus polystachyus</i> var. <i>polystachyus</i>
Crimson Tails	<i>Ptilotus sessilifolius</i> var. <i>sessilifolius</i>
Inland Buttercup	<i>Ranunculus pentandrus</i> var. <i>platycarpus</i>
False Sow-thistle*	<i>Reichardia tingitana</i>
Hedge Saltbush	<i>Rhagodia spinescens</i>
Paper Sunray	<i>Rhodanthe corymbiflora</i>
Sand Twin-leaf	<i>Roepera ammophila</i>
Scrambling Twin-leaf	<i>Roepera angustifolia</i>
Pointed Twin-leaf	<i>Roepera apiculata</i>
Pale Twin-leaf	<i>Roepera glauca</i>
Tiny Bristle-grass*	<i>Rostraria pumila</i>
Slender Dock	<i>Rumex brownii</i>
Glistening Dock	<i>Rumex crystallinus</i> s.s.
Narrow-leaf Dock	<i>Rumex tenax</i>
Common Wallaby-grass	<i>Rytidosperma caespitosum</i>
Bristly Wallaby-grass	<i>Rytidosperma setaceum</i>
Prickly Saltwort	<i>Salsola tragus</i> subsp. <i>tragus</i>
Wild Sage*	<i>Salvia verbenaca</i>
Beaded Glasswort	<i>Sarcocornia quinqueflora</i>
Sarcozona	<i>Sarcozona praecox</i>
Prickly Fan-flower	<i>Scaevola spinescens</i>
Arabian Grass*	<i>Schismus barbatus</i>
River Club-sedge	<i>Schoenoplectus tabernaemontani</i>
Short-wing Saltbush	<i>Sclerochlamys brachyptera</i>
Grey Copperburr	<i>Sclerolaena diacantha</i>
Black Roly-poly	<i>Sclerolaena muricata</i>
Spear-fruit Copperburr	<i>Sclerolaena patentiscuspis</i>
Streaked Copperburr	<i>Sclerolaena tricuspid</i>
Slender Groundsel	<i>Senecio glossanthus</i> s.l.
Fleshy Groundsel	<i>Senecio gregorii</i>
Riverina Groundsel	<i>Senecio productus</i> subsp. <i>productus</i>
Cotton Fireweed	<i>Senecio quadridentatus</i>
Desert Cassia	<i>Senna artemisioides</i> spp. <i>agg.</i>
Whorled Pigeon-grass*	<i>Setaria verticillata</i>
Variable Sida	<i>Sida corrugata</i>

Variable Sida (narrow-leaf form)	<i>Sida corrugata</i> var. <i>angustifolia</i>
Pin Sida	<i>Sida fibulifera</i>
Twiggy Sida	<i>Sida intricata</i>
Narrow-leaf Sida	<i>Sida trichopoda</i>
Mallee Catchfly*	<i>Silene apetala</i> var. <i>apetala</i>
Smooth Mustard*	<i>Sisymbrium erysimoides</i>
London Rocket*	<i>Sisymbrium irio</i>
Quena	<i>Solanum esuriale</i>
Rough Sow-thistle*	<i>Sonchus asper</i> s.l.
Common Sow-thistle*	<i>Sonchus oleraceus</i>
Salt Sea-spurrey	<i>Spergularia brevifolia</i>
Lesser Sand-spurrey*	<i>Spergularia diandra</i>
Lesser Sea-spurrey	<i>Spergularia marina</i> s.s.
Red Sand-spurrey*	<i>Spergularia rubra</i> s.l.
Spreading Nut-heads	<i>Sphaeromorphaea australis</i>
Rat-tail Couch	<i>Sporobolus mitchellii</i>
Star Bluebush	<i>Stelligera endecaspinis</i>
Smooth Blue-rod	<i>Stemodia glabella</i> s.s.
Velvet Thread-petal	<i>Stenopetalum velutinum</i>
Small-leaf Swainson-pea	<i>Swainsona microphylla</i>
Dwarf Swainson-pea	<i>Swainsona phacoides</i>
Silky Swainson-pea	<i>Swainsona sericea</i>
Desert Glasswort	<i>Tecticornia triandra</i>
Annual Spinach	<i>Tetragonia moorei</i>
Desert Spinach	<i>Tetragonia eremaea</i> s.l.
Annual Spinach	<i>Tetragonia moorei</i>
Grey Germander	<i>Teucrium racemosum</i> s.l.
Caltrop*	<i>Tribulus terrestris</i>
Cluster Clover*	<i>Trifolium glomeratum</i>
Woolly Clover*	<i>Trifolium tomentosum</i> var. <i>tomentosum</i>
Arrowleaf Clover*	<i>Trifolium vesiculosum</i> var. <i>vesiculosum</i>
Spurred Arrowgrass	<i>Triglochin calcitrapa</i> s.l.
Needle Grass	<i>Triraphis mollis</i>
Narrow-leaf Cumbungi	<i>Typha domingensis</i>
Small Nettle*	<i>Urtica urens</i>
Eel Grass	<i>Vallisneria americana</i> var. <i>americana</i>
Common Verbena	<i>Verbena officinalis</i> s.l.
Common Vetch*	<i>Vicia sativa</i>
Annual New Holland Daisy	<i>Vittadinia cervicalis</i> var. <i>subcervicalis</i>



Fuzzy New Holland Daisy	<i>Vittadinia cuneata</i>
Dissected New Holland Daisy	<i>Vittadinia dissecta</i> s.l.
Rat's-tail Fescue*	<i>Vulpia myuros</i>
River Bluebell	<i>Wahlenbergia fluminalis</i>
Annual Bluebell	<i>Wahlenbergia gracilentia</i> s.l.
Mallee Annual-bluebell	<i>Wahlenbergia tumidifructa</i>
Bluebell	<i>Wahlenbergia</i> spp.
Green-tufted Stubble-moss	<i>Weissia controversa</i>
Common Early Nancy	<i>Wurmbea dioica</i>
Bathurst Burr*	<i>Xanthium spinosum</i>
Noogoora Burr species aggregate*	<i>Xanthium strumarium</i> s.l.

*Introduced species

Source: (DELWP, 2016; DELWP, 2022)

APPENDIX 4.

KINGS BILLABONG & BUTLERS CREEK EWMP UPDATED ENVIRONMENTAL OBJECTIVES, FURTHER INFORMATION (FROM BUTCHER ET AL 2020)

Kings Billabong EWMP – Information describing rationale behind updated environmental objectives and targets (from Butcher et al 2020)

SMARTness and rationalisation

Site-specific environmental objectives for the King's Billabong EWMP (DSE 2010b).

EWMP objectives
KB1: Increase diversity of macrophytes, especially emergent macrophytes
KB2: Reduce the abundance or dominance of <i>Vallisneria</i>
KB3: Increase abundance and diversity of zooplankton and macro- invertebrates
KB4: Increase breeding opportunities for frogs, including <i>Litoria raniformis</i> (Growling Grass Frog)
KB5: Increase abundance and diversity of small bodied native fish
KB6: Maintain self-sustaining population structure of <i>Tandanus tandanus</i> (Freshwater catfish) and increase abundance.
KB7: Increase foraging habitat for shore birds
KB8: Maintain aquatic refuge for water dependent birds
KB9: Maintain a variety of habitat types for waterbird species diversity

Assessment of SMARTness of current King's Billabong EWMP objectives. Scoring: 1 is criterion met, 0 is criterion not met, and 0.5 is partially met

Objective	Specific		Measurable			Achievable		Relevant		Timely	
	Magnitude clearly specified	Location and scale detailed	Indicators available or easily developed	Can be analysed using accepted statistical practices	Capacity to collect data exists	Under river operating constraints and current climate variability	Considered feasible by knowledgeable stakeholders	Matters driven by environmental watering and/or works and measures	Linked to BP objectives	Absolute date or time period specified	Considers likely lags in response
KB1	0	0	1	1	1	0.5	1	1	0.5	0	0
KB2	0	0	1	1	1	0.5	1	0.5	1	0	0
KB3	0	0	1	1	1	0.5	1	1	0	0	0
KB4	0	0	1	1	1	0.5	1	1	1	0	0
KB5	0	0	1	1	1	0.5	1	1	1	0	0
KB6	0	0	0.5	0.5	0.5	0.5	1	1	1	0	0
KB7	0	0	1	1	1	0.5	1	1	1	0	0
KB8	0	0	1	1	1	0.5	1	1	1	0	0

KB9	0	0	1	1	1	0.5	1	1	1	0	0
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Rationalised environmental objectives for the King's Billabong EWMP DSE 2010b).

Objective	Issue	Outcome
KB1	No issue with objective other than its not fully SMART and no baseline data.	Objective updated to align with Basin Plan language
KB2	Introduce a drying period – <i>Vallisneria</i> is a obligate aquatic – may have to put up with it as you want macrophyte outcomes and to keep Kings Billabong as a refuge in dry times. Suggest delete.	Delete
KB3	Zooplankton and macroinvertebrates are notoriously variable and difficult to measure as an outcome of watering. Not considered a priority value for the asset by the MCMA. Likelihood that invertebrate communities will be adequately supported from the other watering actions at the asset.	Delete
KB4	Two elements in the one objective – split.	One objective for frogs in general and the other for listed species – Growling Grass Frog.
KB5	No major issues, just requires alignment with Basin Plan and specifics of the native fish species included	No significant changes, just alignment with Basin Plan
KB6	No issue with objective other than its not fully SMART	No significant changes, just alignment with Basin Plan
KB7	No issue with objective other than its not fully SMART	Objective updated to align with Basin Plan language – KB9 merged into the one objective
KB8	Justification for refuge objective is to provide opportunity for listed species which have been recorded in the FMU such as <i>Anas rhynchotis</i> (Australasian Shoveler), <i>Porzana pusilla</i> (Baillon's Crane), <i>Oxyura australis</i> (Blue-billed Duck)	Ballion's crane is now assessed as least concern, Blue-billed duck and the shoveler are both considered Vulnerable under the new conservation status (provisional). Overall there are 8 waterbirds species listed as recorded at the site – these will be added to the objective.
KB9	No issue with objective other than its not fully SMART	Merged with KB 7

Mapping to Basin Plan

Basin Plan Schedule 8 and 9 criteria.

Schedule 8 criteria met	Schedule 9 criteria met
From DELWP (2015a)	
1: JAMBA, CAMBA 4: FFG Act, EPBC act, DSE Listed 5: Supports significant biodiversity	1: Supports the creation and maintenance of vital habitats and populations 2: water quality - ecosystem processes supports the transportation and dilution of nutrients, organic matter and sediment; supports the dilution of carbon and nutrients from the floodplain to the river system 4: lateral connectivity - (between floodplains, anabranches and wetlands)
Updated assessment	
3(b): Prevents declines in native biota 4(a): EPBC listed spp and communities (Growling Grass Frog) 4(b): State listed species (Freshwater catfish and seven species of waterbird)	1(a): creates vital habitat - a refugium for native water-dependent biota during dry periods and drought 1(c): Vital habitat - feeding, breeding, nursery sites 1(e): Vital habitat - preventing decline of native biota

Mapping King's Billabong EWMP objectives to Basin Plan EWP objectives, Schedule 7 targets, BWS QEEO, and LTWP Vic Murray objective.

EWMP objectives	Relevant Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
KB1: Increase diversity of macrophytes, especially emergent macrophytes	8.05,3(b) 8.06,6(b)	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species	B2.11	LTWPVM2
KB2: Reduce the abundance or dominance of <i>Vallisneria</i>	Not applicable – not considered an invasive	Not applicable	None specified	None specified
KB3: Increase abundance and diversity of zooplankton and macro-invertebrates	8.05,3(b)	Condition of priority asset - prevention of decline in native biota	None specified	None specified
KB4: Increase breeding opportunities for frogs, including <i>Litoria raniformis</i> (Growling Grass Frog)	8.06,6(a) 8.05,3(a)	Condition of priority ecosystem functions - creation of vital habitat - feeding, breeding, nursery Condition of priority asset - supports listed species and communities	None specified	LTWPVM20 None specified for listed species
KB5: Increase abundance and diversity of small bodied native fish	8.05,3(b)	Condition of priority asset - prevention of decline in native biota Recruitment and populations of native fish	B4.5 (or B4.1?)	LTWPVM15
KB6: Maintain self-sustaining population structure of <i>Tandanus tandanus</i> (Freshwater catfish) and increase abundance.	8.05,3(a) 8.05,3(b)	Condition of priority asset - supports listed species and communities Condition of priority asset - prevention of decline in native biota	None specified	None specified
KB7: Increase foraging habitat for shore birds	8.05,3(b)	Condition of priority asset - prevention of decline in native biota	None specified	LTWPVM12 LTWPVM13
KB8: Maintain aquatic refuge for water dependent birds	8.07,3 8.05,3(a)	Condition of priority asset - Vital habitat - refugia Condition of priority asset - supports listed species and communities	None specified	None specified
KB9: Maintain a variety of habitat types for waterbird species diversity	8.05,3(b)	Condition of priority asset - prevention of decline in native biota	B3.1	LTWPVM12

Updated objectives for King's Billabong

Current objective	KB1: Increase diversity of macrophytes, especially emergent macrophytes
Comments	Adopted WRIGs developed by DELWP. Some species need to be identified as currently not all aquatic WRIGs represented in the flora lists in the EWMP.
EWP objective(s)	8.05,3(b) 8.06,6(b)

Schedule 7 targets	Condition of priority asset - prevention of decline in native biota Diversity of native water dependent vegetation Condition of priority ecosystem functions - creation of vital habitat - habitat for prevention of decline in native species
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota PEF 1(e) Vital habitat - preventing decline of native biota
BEWS QEEO	None specified
LTWP objective	LTWPM2 Improve the species richness of aquatic vegetation in wetlands
LTWP target	None specified for non-woody vegetation
2020 Objective:	By 2030, improve vital habitat at the King's Billabong asset by increasing the diversity of aquatic macrophytes present across a range of Water Regime Indicator Groups.
2020 Targets:	<p>By 2030, increase diversity of native of macrophytes at the King's Billabong asset with ≥ 2 species from each of the following Water Regime Indicator Groups present in 80% of years:</p> <ul style="list-style-type: none"> Aquatic (obligate submerged) (Aos) (Blunt Pondweed <i>Potamogeton ochreatus</i>, Curly Pondweed <i>Potamogeton crispus</i>, Eel Grass <i>Vallisneria australis</i>, Hornwort <i>Ceratophyllum demersum</i>) Aquatic (submerged to partially emergent) (Ase) (Red Water-milfoil <i>Myriophyllum verrucosum</i>, Robust Water-milfoil <i>Myriophyllum papillosum</i>, Star Fruit <i>Damasonium minus</i>, Swamp Lily <i>Ottelia ovalifolia</i> subsp. <i>Ovalifolia</i>) Aquatic graminoids (persistent) (Agp) (Common Reed <i>Phragmites australis</i>, Narrow-leaf Cumbungi <i>Typha domingensis</i>, River Club-sedge <i>Schoenoplectus tabernaemontani</i>) Aquatic to semi-aquatic (persistent) (Asp) (Austral Pillwort <i>Pilularia novae-hollandiae</i>, Clove-strip <i>Ludwigia peploides</i> subsp. <i>Montevidensis</i>, Common Nardoo <i>Marsilea drummondii</i>, Spiny Mud-grass <i>Pseudoraphis spinescens</i>, Swamp Crassula <i>Crassula helmsii</i>) <p>By 2030, increase diversity of native of macrophytes at the King's Billabong asset with ≥ 5 species from each of the following Water Regime Indicator Groups present in 80% of years:</p> <ul style="list-style-type: none"> Seasonally immersed – low growing (Slg) (Lesser Joyweed <i>Alternanthera denticulata</i> s.s., Common Woodruff <i>Asperula conferta</i>, Marsh Club-sedge <i>Bolboschoenus medianus</i>, Tufted Burr-daisy <i>Calotis scapigera</i>, Rosinweed <i>Cressa australis</i>, Native Couch <i>Cynodon dactylon</i> var. <i>pulchellus</i>, Common Spike-sedge <i>Eleocharis acuta</i>, Pale Spike-sedge <i>Eleocharis pallens</i>, Small Spike-sedge <i>Eleocharis pusilla</i>, Spreading Goodenia <i>Goodenia heteromera</i>, Rough Raspwort <i>Haloragis aspera</i>, Nodding Club-sedge <i>Isolepis cernua</i>, Slender Knotweed <i>Pericaria decipiens</i>, Narrow-leaf Dock <i>Rumex tenax</i>, Beaded Glasswort <i>Sarcocornia quinqueflora</i>, Rat-tail Couch <i>Sporobolus mitchellii</i>, Blue Rod <i>Stemodia florulenta</i>, River Bluebell <i>Wahlenbergia fluminalis</i>) Seasonally inundated – emergent non woody (Sen) (Spiny Flat-sedge <i>Cyperus gymnocaulos</i>, Brown Beetle-grass <i>Diplachne fusca</i> subsp. <i>Fusca</i>, Southern Cane-grass <i>Eragrostis infecunda</i>, Tussock Rush <i>Juncus aridicola</i>, Gold Rush <i>Juncus flavidus</i>, Warrego Summer-grass <i>Paspalidium jubiflorum</i>)

Current objective	KB2: Reduce the abundance or dominance of <i>Vallisneria</i>
Comments	Deleted

Current objective	KB3: Increase abundance and diversity of zooplankton and macro- invertebrates
Comments	Deleted

Current objective	KB4: Increase breeding opportunities for frogs, including <i>Litoria raniformis</i> (Growling Grass Frog)
Comments	Objective split into two – one for frog outcomes and the other for the listed species
EWP objective(s)	8.06,6(a)
Schedule 7 targets	Condition of priority ecosystem functions - creation of vital habitat - feeding, breeding, nursery

PEA/PEF criteria met	PEF criteria: 1 (c) Vital habitat - feeding, breeding, nursery sites
BWS QEEO	None specified
LTWP objective	LTWPM20 Maintain species richness of frog communities
LTWP target	Maintain the number of native frog species recorded in 80% of years to 2025
2020 Objective KB4a:	By 2030 increase breeding of frogs at the Kings Billabong asset.
2020 Targets KB4a:	By 2030, breeding of frogs at the Kings Billabong asset occurs in 80% of years, including Barking marsh frog (<i>Limnodynastes fletcheri</i>), Plains froglet (<i>Crinia parainsignifera</i>), Southern bullfrog (<i>Limnodynastes dumerilii</i>), and Spotted marsh frog (<i>Limnodynastes tasmaniensis</i>), measured by presence of adults calling via audio recordings, and/or presence of tadpoles
EWP objective(s)	8.05,3(a)
Schedule 7 targets	Condition of priority asset - supports listed species and communities
PEA/PEF criteria met	PEA 4 (a) EPBC listed spp and communities
BWS QEEO	None specified
LTWP objective	LTWPM20 Maintain species richness of frog communities
LTWP target	Maintain the number of native frog species recorded in 80% of years to 2025
2020 Objectives KB4b:	By 2030, improve biodiversity at the Kings Billabong asset by supporting the life cycle of EPBC listed Growling Grass Frog (<i>Litoria raniformis</i>).
2020 Target KB4b:	By 2030, maintain self-sustaining population of Growling Grass Frog, <i>Litoria raniformis</i> , at the Kings Billabong asset with evidence of breeding and recruitment in 80% (presence of tadpoles) of years. Note only recorded once to date

Current objective	KB5: Increase abundance and diversity of small bodied native fish
Comments	No significant changes, just alignment with Basin Plan
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of priority asset - prevention of decline in native biota
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota
BEWS QEEO	B4.5 Improved community structure of key native fish species
LTWP objective	LTWPM15 Maintain abundance of small-bodied native fish in wetlands
LTWP target	No negative trend in the abundance of small-bodied wetland specialist native fish in 2025
2020 Objective:	By 2030, protect and restore biodiversity by maintaining representative populations of native small-bodied fish at the Kings Billabong asset, including Australian Smelt (<i>Retropinna semoni</i>), Carp gudgeon (<i>Hypseleotris</i> spp.), Flat-headed Gudgeon (<i>Philypnodon grandiceps</i>), Murray-Darling Rainbowfish (<i>Melanotaenia fluviatilis</i>), Un-specked Hardyhead (<i>Craterocephalus stercusmuscarum fulvus</i>).
2020 Targets:	By 2030, maintain self-sustaining populations of Australian Smelt (<i>Retropinna semoni</i>), Carp gudgeon (<i>Hypseleotris</i> spp.), Flat-headed Gudgeon (<i>Philypnodon grandiceps</i>), Murray-Darling Rainbowfish (<i>Melanotaenia fluviatilis</i>), Un-specked Hardyhead (<i>Craterocephalus stercusmuscarum fulvus</i>) at the Kings Billabong asset. Measured as: <ul style="list-style-type: none"> Adults or YoY for each species recorded in 8 out of 10 years

Current objective	KB6: Maintain self-sustaining population structure of <i>Tandanus tandanus</i> (Freshwater Catfish) and increase abundance.
Comments	No significant changes, just alignment with Basin Plan
EWP objective(s)	8.05,3(a) 8.05,3(b)
Schedule 7 targets	Condition of priority asset - supports listed species and communities Condition of priority asset - prevention of decline in native biota
PEA/PEF criteria met	PEA 4 (b) State listed ecosystems

	PEA 3(b) Prevents declines in native biota PEF 1(e) Vital habitat - preventing decline of native biota
BWS QEEO	None specified
LTWP objective	None specified
LTWP target	None specified
2020 Objective:	By 2030, improve the population of Freshwater catfish (<i>Tandanus tandanus</i>) at the Kings Billabong asset.
2020 Targets:	By 2030, maintain a self-sustaining population of Freshwater catfish (<i>Tandanus tandanus</i>) at the Kings Billabong asset: - YoY recorded in 8 out of 10 years - Abundance of adult fish increased by 20% from baseline of xx (year, levels, citation)

Current objective	KB7: Increase foraging habitat for shore birds
Comments	Merged shallow and deep feeding guilds into one objective.
EWP objective(s)	8.05,3(b) 8.06,6(b)
Schedule 7 targets	Condition of priority asset - Vital habitat - feeding, breeding, nursery
PEA/PEF criteria met	PEA 3(a) iii Vital habitat - feeding, breeding, nursery sites PEF 1 (c) Vital habitat - feeding, breeding, nursery sites
BWS QEEO	B3.1 That the number and type of water bird species present in the Basin will not fall below current observations
LTWP objective	LTWPM12: Improve habitat for waterbirds LTWPM13: Improve feeding areas for waterbirds
LTWP target	Appropriate water regime to support feeding and habitat areas for guilds of waterbirds delivered at 50% of sites, 8 years in 10
2020 Objective:	By 2030, maintain representative populations of the shallow-water and deep feeding guilds of waterbirds, including shorebirds (F2 and F3, after Jaensch 2002) at the Kings Billabong asset, by maintaining a mixture of foraging habitats.
2020 Targets:	By 2030, 80% of the following representative F2 and F3 species recorded at the Kings Billabong asset in 8 years out of any 10-year period where conditions are suitable. <ul style="list-style-type: none"> Representative F2 species include the following ducks and allies: Australasian Grebe (<i>Tachybaptus novaehollandiae</i>), Australian White Ibis (<i>Threskiornis molucca</i>), Black Swan (<i>Cygnus atratus</i>), Dusky Moorhen (<i>Gallinula tenebrosa</i>), Eurasian Coot (<i>Fulica atra</i>) Grey Teal (<i>Anas gracilis</i>), Masked Lapwing (<i>Vanellus miles</i>), Pacific Black Duck (<i>Anas superciliosa</i>) Representative F3 species include: Australasian Darter (<i>Anhinga novaehollandiae</i>), Little Pied Cormorant (<i>Microcarbo melanoleucos</i>), Little Black Cormorant (<i>Phalacrocorax sulcirostris</i>), Australian Pelican (<i>Pelecanus conspicillatus</i>), By 2030, 50% of the following representative shorebird F2 species recorded at the Kings Billabong asset in 8 years out of 10 years over any 10 year period. <ul style="list-style-type: none"> Representative F2 species include the following shorebirds: Sharp-tailed Sandpiper (<i>Calidris acuminata</i>), Red-capped Plover (<i>Charadrius ruficapillus</i>), Black-fronted Dotterel (<i>Elseyornis melanops</i>), Red-kneed Dotterel (<i>Erythronyx cinctus</i>), Black-winged Stilt (<i>Himantopus himantopus</i>), Red-necked Avocet (<i>Recurvirostra novaehollandiae</i>) Feeding habitat defined as a mixture of deep feeding areas (water >1 m) and shallow feeding areas (<0.5 m depth and or drying mud) with intermittent inundation of densely vegetated shrublands.

Current objective	KB8: Maintain aquatic refuge for water dependent birds
Comments	The justification for this objective is about listed species – combining this into the objective.
EWP objective(s)	8.07,3

	8.05,3(a)
Schedule 7 targets	Condition of priority asset - supports listed species and communities
PEA/PEF criteria met	PEA 4 (a) EPBC listed spp and communities PEA 3(b) is essential for maintaining, and preventing declines of, native water-dependent biota PEF 1(a) creates vital habitat - a refugium for native water-dependent biota during dry periods and drought
BWS QEEO	None specified
LTWP objective	None specified
LTWP target	None specified
2020 Objective:	By 2030, maintain vital habitat to provide a refugium for listed species of waterbirds at the Kings Billabong asset.
2020 Targets:	By 2030, maintain vital habitat to provide a refugium for listed species of waterbirds at the Kings Billabong asset, with ≥6 of the following species occurring in 7 or any 10 year period: <ul style="list-style-type: none"> Australasian Shoveler (<i>Anas rhynchos</i>), Hardhead (<i>Aythya australis</i>), Little Egret (<i>Egretta garzetta nigripes</i>), Caspian Tern (<i>Hydroprogne caspia</i>), Blue-billed Duck (<i>Oxyura australis</i>), Freckled Duck (<i>Stictonetta naevosa</i>), Common Greenshank (<i>Tringa nebularia</i>), Marsh Sandpiper (<i>Tringa stagnatilis</i>)

Current objective	KB9: Maintain a variety of habitat types for waterbird species diversity
Comments	Merged with KB7

Butlers Creek EWMP – Information describing rationale behind updated environmental objectives and targets (from Butcher et al 2020)

SMARTness and rationalisation

Site-specific environmental objectives for the Butlers Creek EWMP (Riverness and Ecological Associates 2016a).

EWMP objectives
BTC1: Self-sustaining population of Growling Grass Frogs
BTC2: Self-sustaining population of Freshwater Catfish
BTC3: Maintain high levels of aquatic productivity
BTC4: Feeding by piscivorous waterbirds
BTC5: Foraging, nesting and recruitment by large wading birds

Assessment of SMARTness of current Butlers Creek EWMP objectives. Scoring: 1 is criterion met, 0 is criterion not met, and 0.5 is partially met

Objective	Specific		Measurable			Achievable		Relevant		Timely	
	Magnitude clearly specified	Location and scale detailed	Indicators available or easily developed	Can be analysed using accepted statistical practices	Capacity to collect data exists	Under river operating constraints and current climate variability	Considered feasible by knowledgeable stakeholders	Matters driven by environmental watering and/or works and measures	Linked to BP objectives	Absolute date or time period specified	Considers likely lags in response
BTC1	0	0	1	1	1	0.5	1	1	1	0	0
BTC2	0	0	0.5	0.5	1	0.5	0.5	1	1	0	0
BTC3	0	0	1	1	1	0.5	1	0.5	1	0	0
BTC4	0	0	0.5	0.5	0.5	0.5	1	0.5	1	0	0
BTC5	0	0	1	1	1	0.5	1	1	1	0	0

Rationalisation of environmental objectives for the Butlers Creek EWMP (Riverness and Ecological Associates 2016a).

Objective	Issue	Outcome
BTC1	No issue with objective other than its not fully SMART	Objective updated to align with Basin Plan language
BTC2	Not considered viable at the asset by MCMA. Current management regime not favorable for catfish.	Deleted
BTC3	Not considered viable at the asset by MCMA. Productivity objectives were included in EWMPs as a fundamental ecological function; however this is not a specific value of the site and water is not delivered solely for productivity outcomes at this wetland; it will be an outcome achieved	Deleted

Objective	Issue	Outcome
	by the delivery of water for the other objectives at the asset	
BTC4	Ducksfoot and Baggs Lagoons are deep water habitats that supports 19 species of piscivorous waterbirds. No indication of which species are common – will need to establish baseline or assume that water delivery for breeding of Eastern Great Egrets and Little Egrets will sustain deep water habitat	Cascade objective – achieved via watering for breeding outcomes in BTC
BTC5	The EWMP indicates that Little Egret and Great Eastern Egrets both breed at Ducksfoot and Baggs Lagoons. Objective relates to nesting, feeding and recruitment	Rationalised to a breeding objective for Eastern Great Egrets as the target species. Watering to meet Eastern Great Egret breeding requirements will also meet the breeding watering requirements of Little Egrets and maintain feeding habitat (<1m deep) for diving fish eating species (darter, cormorants, grebes) (objective BTC4)

Mapping to Basin Plan

Basin Plan Schedule 8 and 9 criteria for which the asset is identified as a PEA in the Victorian Murray LTWP (DELWP 2015).

Schedule 8 criteria met	Schedule 9 criteria met
From DELWP (2015a)	
None specified	<p>1: Supports the creation and maintenance of vital habitats and populations</p> <p>2: water quality - ecosystem processes supports the transportation and dilution of nutrients, organic matter and sediment; supports the dilution of carbon and nutrients from the floodplain to the river system</p> <p>4: lateral connectivity - (between floodplains, anabranches and wetlands)</p>
Updated assessment	
<p>3(a)iii: Provides vital habitat - important feeding, breeding and nursery sites for native water-dependent biota</p> <p>4(a): EPBC listed spp and communities Growling Grass Frog (<i>Litoria raniformis</i>)</p> <p>4(c): Supports threatened species – FFG listed – to be specified in future</p>	<p>1(c): Vital habitat - feeding, breeding, nursery sites</p> <p>4(b): lateral connectivity - off-stream primary productivity</p>

Mapping Butlers Creek EWMP objectives to Basin Plan EWP objectives, Schedule 7 targets, BWS QEEO, and LTWP Vic Murray objective.

EWMP objectives	Relevant Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
BTC1: Self-sustaining population of Growling Grass Frogs	8.05,3(a)	Condition of priority asset - supports listed species and communities	None specified	None specified
BTC2: Self-sustaining population of Freshwater Catfish	8.05,3(a)	Condition of priority asset - supports listed species and communities	None specified	None specified

EWMP objectives	Relevant Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
BTC3: Maintain high levels of aquatic productivity	8.06,7	Condition of priority ecosystem functions – connectivity – off-stream productivity	None specified	None specified
BTC4: Feeding by piscivorous waterbirds	8.06,6(b)	Condition of priority ecosystem functions - creation of vital habitat - feeding	None specified	LTWPVM13
BTC5: Foraging, nesting, and recruitment by large wading birds	8.06,6(a) 8.06,6(b)	Recruitment and populations of native water-dependent birds Condition of priority ecosystem functions – vital habitat (breeding)	B3.3 B3.4	LTWPVM10 LTWPVM11

Updated objectives for Butlers Creek

Current objective	BTC1: Self-sustaining population of Growling Grass Frogs
EWP objective(s)	8.05,3(a)
Schedule 7 targets	Condition of priority asset - supports listed species and communities
PEA/PEF criteria met	PEA criteria: 4 (a) EPBC listed spp and communities PEF criteria: Not applicable
BEWS QEEO	None specified
LTWP objective	None specified
LTWP target	None specified
2020 Objective:	By 2030, improve biodiversity at the Butlers Creek asset by supporting the life cycle of EPBC listed Growling Grass Frog (<i>Litoria raniformis</i>)
2020 Targets:	Maintain self-sustaining population of Growling Grass Frog (<i>Litoria raniformis</i>) at the Butlers Creek asset with evidence of breeding and recruitment in 80% of years by 2030

Current objective	BTC2: Self-sustaining population of Freshwater Catfish
Comments	Deleted

Current objective	BTC3: Maintain high levels of aquatic productivity
Comments	Deleted

Current objective	BTC4: Feeding by piscivorous waterbirds
Comments	No data on abundance of piscivores, though most expected species have been recorded at the site. Need baseline data on numbers and which species are resident.
EWP objective(s)	8.05,3(a) 8.06,6(b)
Schedule 7 targets	Condition of priority assets – vital habitat (habitat to prevent declines)
PEA/PEF criteria met	PEA criteria: 3(a)iii Vital habitat - feeding, breeding, nursery sites PEF criteria: 1(c) Vital habitat - feeding, breeding, nursery sites
BWS QEEO	B3.1: Number and type of waterbird species present in the Basin will not fall below current observations
LTWP objective	LTWPVM13: Improve feeding areas for waterbirds

LTWP target	Appropriate water regime to support feeding and habitat areas for guilds of waterbirds delivered at 50% of sites, 8 years in 10
2020 Objective:	By 2030, maintain representative populations of piscivores (guild D4, after Jaensch 2002) at the Butlers Creek asset.
2020 Targets:	<p>By 2030, 80% of representative D4 (piscivores) species recorded at the Butlers Creek asset in 8 years out of any 10-year period where conditions are suitable.</p> <ul style="list-style-type: none"> Representative D4 species include: Australasian Grebe (<i>Tachybaptus novaehollandiae</i>), White-necked Heron (<i>Ardea pacifica</i>), Australian Pelican (<i>Pelecanus conspicillatus</i>), Great Cormorant (<i>Phalacrocorax carbo</i>), Little Black Cormorant (<i>Phalacrocorax sulcirostris</i>), Australian Darter (<i>Anhinga novaehollandiae</i>), Hoary-headed Grebe (<i>Poliiocephalus poliocephalus</i>).

Current objective	BTC5: Foraging, nesting and recruitment by large wading birds
Comments	Little Egret and Eastern Great Egret are identified as the key species that breed at Butlers Creek – watering for breeding outcomes for Eastern Great Egret will achieve water requirements of the Little Egret (Cottingham et al. 2016)
EWP objective(s)	8.06,6(a) 8.06,6(b)
Schedule 7 targets	Recruitment and populations of native water-dependent birds Condition of priority ecosystem functions – vital habitat (breeding)
PEA/PEF criteria met	PEA criteria: 3(a)iii Vital habitat - feeding, breeding, nursery sites PEF criteria: 1(c) Vital habitat - feeding, breeding, nursery sites
BEWS QEEO	B3.3: Breeding events (the opportunities to breed rather than the magnitude of breeding per se) of colonial nesting waterbirds to increase by up to 50% compared to the baseline scenario B3.4: Breeding abundance (nests and broods) for all of the other functional groups to increase by 30-40% compared to the baseline scenario, especially in locations where the Basin Plan improves over bank flows
LTWP objective	LTWPVM10: Improve breeding opportunities for colonial-nesting waterbirds LTWPVM11: Improve breeding opportunities for waterbirds
LTWP target	Water required for successful colonial waterbird breeding delivered in at least 2 years in 10 by 2025
2020 Objective:	Protect and restore ecosystem functions of water-dependent ecosystems that support successful breeding of large waders at Ducksfoot Lagoon by providing conditions for breeding and fledging at least 3 times every 10 years
2020 Targets:	<p>Increased frequency in successful breeding (recruitment into adult population – i.e. fledging) of one or more of the listed colonial nesting species 3 years in 10, when conditions are favourable:</p> <ul style="list-style-type: none"> Eastern Great Egret (<i>Ardea modesta</i>), Little Egret (<i>Ardea intermedia</i>), Darter (<i>Anhinga novaehollandiae</i>), Little black cormorant (<i>Phalacrocorax sulcirostris</i>) Little pied cormorant (<i>Microcarbo melanoleucos</i>), White-necked heron (<i>Ardea pacifica</i>), and Yellow spoonbill <i>Platalea flavipes</i>) Water regime to meet Eastern Great Egret as meeting watering requirements for this species will support other species listed

APPENDIX 5 - INDEX OF WETLAND CONDITION METHOD

Sub-indices

The table below shows what is measured for each of the six sub-indices and how each sub-index is scored. The sections below describe this in greater detail. Further information can be found on the IWC website (www.dse.vic.gov.au/iwc).

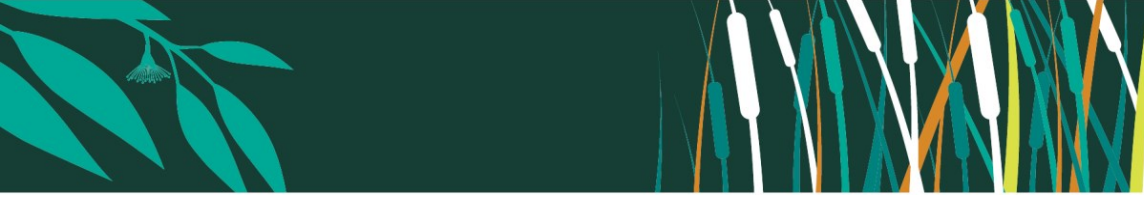
IWC sub-indices and measures

Sub-index	What is measured	How it is scored
Wetland catchment	The intensity of the land use within 250 metres of the wetland	The more intensive the land use the lower the score
	The width of the native vegetation surrounding the wetland and whether it is a continuous zone or fragmented	The wider the zone and more continuous the zone, the higher the score
Physical form	Whether the size of the wetland has been reduced from its estimated pre-European settlement size	A reduction in area results in a lowering of the score
	The percentage of the wetland bed which has been excavated or filled	The greater the percentage of wetland bed modified, the lower the score
Hydrology	Whether the wetland's water regime (i.e. the timing, frequency of filling and duration of flooding) has been changed by human activities	The more severe the impacts on the water regime, the lower the score
Water properties	Whether activities and impacts such as grazing and fertilizer run-off that would lead to an input of nutrients to the wetland are present	The more activities present, the lower the score
	Whether the wetland has become more saline or in the case of a naturally salty wetland, whether it has become more fresh	An increase in salinity for a fresh wetland lowers the score or a decrease in salinity of a naturally salty wetland lowers the score
Soils	The percentage and severity of wetland soil disturbance from human, feral animals or stock activities	The more soil disturbance and the more severe it is, the lower the score
Biota	The diversity, health and weediness of the native wetland vegetation	The lower the diversity and poorer health of native wetland vegetation, the lower the score
		The increased degree of weediness in the native wetland vegetation, the lower the score

Scoring method

Each subindex is given a score between 0 and 20 based on the assessment of a number of measures as outline above. Weightings are then applied to the scores as tabulated below. The maximum possible total score for a wetland is 38.4. For ease of reporting, all scores are normalised to an integer score out of 10 (i.e. divide the total score by 38.4, multiply by 10 and round to the nearest whole number).

IWC sub-index	Weight
Biota	0.73
Wetland catchment	0.26
Water properties	0.47
Hydrology	0.31
Physical form	0.08
Soils	0.07



Five wetland condition categories have been assigned to the sub-index scores and total IWC scores as tabulated over page. The five category approach is consistent with the number of categories used in other condition indices such as the Index of Stream Condition. Biota sub-index score categories were determined by expert opinion and differ to those of the other sub-indices.

Non-biota sub-index score range	Biota sub-index score range	Total score range	Wetland condition category
0-4	0-8	0-2	Very poor
5-8	9-13	3-4	Poor
9-12	14-16	5-6	Moderate
13-16	17-18	7-8	Good
16-20	19-20	9-10	Excellent
N/A	N/A	N/A	Insufficient data

APPENDIX 6 – COMMUNITY ENGAGEMENT 2023

SUMMARY

To update the community values present at Kings Billabong, Mallee CMA engaged with the local community through an online survey. The survey was designed to enable community, landholders, recreational users, Landcare groups, environmental groups and other interested parties to provide input to the plans. The online survey itself was designed by Mallee CMA and hosted on their website in January and February of 2023. Specifically, the survey aimed to:

1. Understand the purpose(s) for which respondents use each wetland complex,
2. Understand the sub-location (within a complex), frequency and seasonality of visits,
3. Confirm existing, and identify new, water-dependent values at each site, and
4. Understand the importance of values at a given site to the community member

This method of engagement was at the Consult and Involve level of the International Association for Public Participation (IAP2) spectrum.

2.1.1 Survey Summary

42.55% of respondents (20/47) considered Kings Billabong Park as the most important waterway. Eighteen respondents attempted all or part of the Kings Billabong Community Values survey. Over 94% of survey participants visit Kings Billabong. Around 50% (8/17 and 9/17 of participants) visited Butlers Creek and Ducksfoot Lagoon.

Two thirds of respondents identified Kings Billabong as the most important wetland at the site. 22% of respondents (4/18) identified Butlers Creek as the most important, while 2/18 respondents identified Ducksfoot Lagoon as the most important wetland in Kings Billabong Park.

Over half of survey participants (10/17) were recreational users. One third of participants (6/18) were residents. Survey responses were also received from visitors to the region, a business operator, community environmental group member, scientist (researcher or citizen scientists) and a participant to visits Kings Billabong Park for connection to Country.

Visit frequency ranged from weekly to less than once per year, with a modal frequency of every few months. Participants visit Kings Billabong Park in all seasons.

Over 60% of survey participants (11 of 18) use Kings Billabong Park for Walking/Running. Birdwatching (7/18), fishing (8/18), socialising (7/18), nature appreciation (7/18) and canoeing/kayaking (6/18) were common activities. Individual participants used Kings Billabong Park for each of Education, Tourism operations and camping.

Participants were adults from all age category, except for the 55-64 category.

Survey respondents were asked to rank the importance of known values at Kings Billabong, Butlers Creek and Ducksfoot Lagoon. These rankings are described below and summarised in **Table 21 - Table 23**.

Values Rankings (site specific):

Kings Billabong:

Participants placed very high importance and meaning (weighted score above 4/5) to the unique landscape features and natural beauty, recreational and exercise values at Kings Billabong. Participants placed high importance on the control of pest animals and plants (4/5). Lower importance was placed on commercial or business opportunities (from

extremely important to not important at all, weighted average 2.33/5). Work or education opportunities were of moderate to high important to participants (3.67/5). One of the twelve participants who answered the Kings Billabong Survey identified as Aboriginal or Torres Strait Islander.

Butlers Creek:

Unique landscape features and natural beauty were extremely important (weighted score 5/5) to all users of Butlers Creek. Recreational values were very important (4.75/5) as were exercise values (4/5). Commercial or business opportunities were of low importance to participants (2/5). The importance of work or education values ranged from not important to extremely important (3/5).

Ducksfoot Lagoon:

The two respondents placed high importance (4-4.5/5) on the unique landscape features and natural beauty, recreational opportunities, exercise and work/education opportunities at Ducksfoot lagoon. Commercial opportunities were of low importance (1.5/5) at the site.

Table 21 - Community Values Rankings – Kings Billabong. Twelve completed surveys

Community Value	Value Ranking
Unique landscape features and natural beauty	Unique landscape features and natural beauty were of extremely high importance to over half (7/12) of survey respondents (weighed score 4.42/5).
Recreational opportunities (e.g. birdwatching, fishing)	Recreational opportunities were of extremely high importance to over half (7/12) of survey respondents (weighed score 4.42/5).
Exercise (trails for walking, running, cycling)	Eleven of twelve respondents considered the exercise values of Kings Billabong to be of high to extremely high importance (score 4.25/5)
Work or Education opportunities	The ranking of work or education opportunities ranged from extremely important to not important at all, with an average score of 3.67/5. Five respondents considered such opportunities to be extremely important. Four respondents considered work or education opportunities as of moderate importance.
Commercial or business opportunities	Commercial or business opportunities were of low importance to respondents (score 2/5), and ranged from moderate importance, to not important at all.

Table 22 - Community Values ranking – Butlers Creek. Four completed surveys

Community Value	Value Ranking
Unique landscape features and natural beauty	Unique landscape features and natural beauty were of extremely high importance to all respondents (score 5/5)
Recreational opportunities (e.g. birdwatching, fishing)	Recreational opportunities were of very high importance to the respondents (score 4.75/5)
Exercise (trails for walking, running, cycling)	Exercise values were of moderate to extremely high importance to respondents (score 4/5)
Work or Education opportunities	Work or education opportunities ranged from extremely important to not important at all, with an average score of 3/5.
Commercial or business opportunities	Commercial or business opportunities were of low importance to respondents (score 2/5), and ranged from moderate importance, to not important at all.

Table 23 - Community Values ranking – Ducksfoot Lagoon. Two completed surveys

<i>Community Value</i>	<i>Value Ranking</i>
Unique landscape features and natural beauty	This value was of very high importance to respondents (score 4.5/5)
Recreational opportunities (e.g. birdwatching, fishing)	Recreational opportunities were of very high importance to the respondents (score 4.5/5).
Exercise (trails for walking, running, cycling)	The respondents considered exercise values to be of high importance (score 4/5).
Work or Education opportunities	The respondents considered work or education opportunities to be of high importance (score 4/5)
Commercial or business opportunities	Commercial or business opportunities were of very low importance to respondents (score 1.5/5)



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