Environmental Water Management Plan

Photo: Sandilong Creek, Nichols Point

Sandilong Creek

mallee
catchment management authority

Document control

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Cover image: Sandilong Creek, Nichols Point

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, present and emerging, and recognise the primacy of Traditional Owners' obligations, rights and responsibilities to use and care for their traditional lands and waters.

Executive summary

Environmental water management plans have been developed for key sites in the Mallee region by the Mallee Catchment Management Authority (CMA) in partnership with the Victorian Department of Energy, Environment and Climate Action. These plans are based on waterway management units (WMUs) of the Murray River floodplain and have been developed to guide future environmental water events at these sites.

The Nichols Point WMU is situated 5 km east of Mildura on the Murray River floodplain. This plan focuses on the target area of Sandilong Creek, and an associated billabong within the Nichols Point WMU, for environmental watering events and related infrastructure development to maximise the ecological benefits achieved through periodic inundation of a total area of 8.84 ha.

Sandilong Creek and Sandilong Billabong are located entirely within the grounds of the Riverside Golf Course. The creek was once a small anabranch of the nearby Murray River. It is now isolated from the river due to levee banks and is permanently inundated; the water level is maintained close to the pool level of the river. The billabong is isolated from the river by levees and experiences natural inundation only in extremely high river events or if a breach of the levee occurs.

Environmental values at the Sandilong Creek asset area include a diverse range of water dependent flora and fauna species including some listed under state and national Acts and initiatives. Within the target area, the Sandilong Creek is well known for its resident population of the state listed Freshwater catfish (*Tandanus tandanus).* The area contains two water-dependent ecological vegetation classes. Significant species within these EVCs are River red gum (*Eucalyptus camaldulensis*), Black box (*Eucalyptus largiflorens*), and Tangled lignum (*Duma florulenta*).

The target area has significant social values, in particular the Riverside Golf Club community, and the local indigenous community have connections to the area. The value which is central to the management of the site is the population of Freshwater catfish. This plan has been prepared with the goal of maintaining or improving surrounding vegetation, thus indirectly supporting Freshwater catfish. Management of environmental watering needs to merge the desire to maintain or improve the surrounding vegetation with the need to protect the Freshwater catfish population, and also meet the ongoing business and community functions of the Golf Club.

Sandilong Creek Target Area Management Goal

To provide a watering regime that supports water dependent native fauna and supports productive native vegetation communities within the target area

To achieve this goal, a long-term watering regime has been developed. The timing and pace of inundation and the recession of water should be managed so as to avoid potential impacts on the Freshwater catfish population.

Specific environmental objectives for Sandilong Creek and billabong target area are to:

SC2: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Sandilong Billabong, Sandilong Creek.

SC3: By 2030, improve condition and maintain extent from baseline (2006) levels of Black box (*Eucalyptus largiflorens*) to sustain communities and processes reliant of such communities at Sandilong Billabong, Sandilong Creek.

SC4: By 2030, improve the population of Freshwater catfish (*Tandanus tandanus*) at the Sandilong Creek and Billabong asset.

Hydrological requirements of the site are centred on maintaining vegetation structures surrounding target wetlands and assume that maintenance of current health requires less frequent watering with longer intervals between events than for improving condition. The hydrological regime also aims to minimise disruption to Freshwater catfish breeding patterns and provide additional nesting sites via inundation of Sandilong creek prior to the breeding season (spring and summer)

The target area is watered by the pumping of water into Sandilong Creek. The billabong is fed by a pipe from the creek and can only be filled when the creek is at sufficient depth (approximately 35 m AHD). The volume of water required to inundate the current extent is 150 ML. This will achieve a target supply level (TSL) of 35.75m AHD, with an additional 20-50 ML required to maintain at TSL.

Potential watering actions, and expected watering effects include:

Spring: Top up and maintain water level to reflect Full-Supply level of the adjacent weir pool by opening the regulators. This will (1) Provide a productivity pulse to support the food web, provide conditions to support growth of annual aquatic and emergent vegetation (2) Support communities of Freshwater catfish and other native fish within the wetland and provide habitat for frogs and waterbirds.

Autumn/winter: Allow water level to draw down by closing the regulators. Drawdown will result in drying of margins of Sandilong Creek will (1) allow sediments to consolidate, (3) provide a mosaic of feeding habitat for waterbirds and lock nutrients up in the sediment.

Management of the Common carp population and the breeding habits of Freshwater catfish within the creek are the top two knowledge gaps for the site.

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Abbreviations and acronyms

ACHRIS	Aboriginal Cultural Heritage Register and Information System
AHD	Australian Height Datum
Bonn	The Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II)
BWS	Basin-wide environmental watering strategy
CAMBA	China-Australia Migratory Bird Agreement
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment Management Authority
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DEECA	Department of Energy, Environment and Climate Action
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary Industries
DNRE	Department of Natural Resources and Environment
DSE	Department of Sustainability and Environment
EA	Ecological Associates
EPBC	Environment Protection and Biodiversity Conservation
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plan
EWR	Environmental Water Reserve
FFG	Flora Fauna Guarantee
FMU	Floodplain Management Unit
FPMMAC	First People of the Millewa-Mallee Aboriginal Corporation
G-MW	Goulburn-Murray Water
IAP2	International Association for Public Participation
JAMBA	Japan-Australia Migratory Bird Agreement
LTWP	Long-term Watering Plan
MCMA	Mallee Catchment Management Authority
MDB	Murray-Darling Basin
MDBA	Murray-Darling Basin Authority (formerly Murray-Darling Basin Commission, MDBC)
ML	Megalitres
MRCC	Mildura Rural City Council
QEEO	Quantified Environmental Expected Outcomes
Ramsar	Global treaty adopted in the Iranian city of Ramsar in 1971 that focuses on the conservation of internationally important wetlands

RAP	Registered Aboriginal Party
RGC	Riverside Golf Club
RMUF	River Murray Unregulated Flows
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
SMART	Specific, Measurable, Achievable, Relevant and Time-bound
TSL	Targeted Supply Level
VEWH	Victorian Environmental Water Holder
WMU	Waterway Management Unit

Glossary:

Sandilong Asset Wetlands: Includes Sandilong Creek, Sandilong Billabong, Lake Sandilong and Etiwanda Wetland

Nichols Point WMU wetlands: Includes Sandilong Asset Wetlands and Kings Billabong Wetlands

Target Wetlands: Sandilong Creek and Sandilong Billabong

1 Introduction

Environmental Water Management Plans (EWMPs) set long-term (8–10 years) environmental objectives for wetlands or rivers that receive environmental water. EWMPs are an important part of the Victorian Environmental Water Planning Framework and inform the development of annual seasonal watering proposals.

This Environmental Water Management Plan (EWMP) has been prepared by the Mallee Catchment Management Authority (CMA) to establish the long-term management goals for Sandilong Creek and associated billabong. These assets are located within the Nichols Point Waterway Management Unit (WMU), and are situated 5 km east of Mildura on the Murray River floodplain.

As the asset manager, Mallee Catchment Management Authority (Mallee CMA) is responsible for developing and updating this EWMP, in partnership with Traditional Owners and consultation with land managers and other stakeholders such as community groups.

The first Sandilong Creek EWMP was developed in 2014. The environmental objectives were reviewed and updated in 2020 for both Sandilong Creek and Sandilong Billabong. The latest version of the Sandilong Creek EWMP (2023) has been updated to incorporate new information and align with the Department of Energy, Environment and Climate Action (DEECA) Draft EWMP Guidelines (Version 6 – June 2022).

1.1 Purpose and scope of an EWMP

An EWMP is a management plan for a wetland, wetland complex or river system that sets out the environmental watering goals and objectives, and the water regime required to meet the set objectives. An EWMP describes the:

- consultation undertaken for EWMP preparation and implementation
- asset overview and characteristics
- water-dependent environmental values present
- water-related threats to the environmental values
- management goals for the asset
- environmental objectives, targets and values that environmental watering of the asset will support or improve
- watering requirements needed to meet environmental objectives
- environmental water delivery infrastructure, management and constraints
- risks associated with environmental water delivery
- outcomes intended to be demonstrated through monitoring and assessment, and
- knowledge gaps to address

Further information on the purposes of EWMPs and how they relate to other plans, strategies and policies is provided in Appendix 1.

1.2 Policy Context

Management of environmental water in Victoria is a statewide partnership between the Victorian Environmental Water Holder (VEWH), catchment management authorities (including Melbourne Water), DEECA, land managers including Parks Victoria and local councils, water corporations, Traditional Owner groups, and interstate agencies including the Commonwealth Environmental Water Office (CEWO) and the Murray–Darling Basin Authority (MDBA).

Environmental watering in Victoria has historically been supported by management plans such as EWMPs, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and help managers evaluate how well those assets responded to the water they received or what could be done better.

A range of international treaties, conventions and initiatives, as well as National and State Acts, policies and strategies determine management of the target area. Those with particular relevance to the Sandilong Creek and Billabong site and the management of its environmental values are listed in Table 1. For the functions and major elements of each refer to Appendix 2.

Table 1 - Legislation, agreements, conventions and listings relevant to the target area

Legislation, Agreement or Convention	Jurisdiction
EPBC Act 1999	National
Flora and Fauna Guarantee Act 1988	State
JAMBA	International
CAMBA	International
ROKAMBA	International

Sandilong Creek. ***Source: Mallee CMA***

2 Partnership and 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 (Figure 1~~Figure 1~~). The spectrum allows for a tailored approach based on stakeholder groups and their needs.

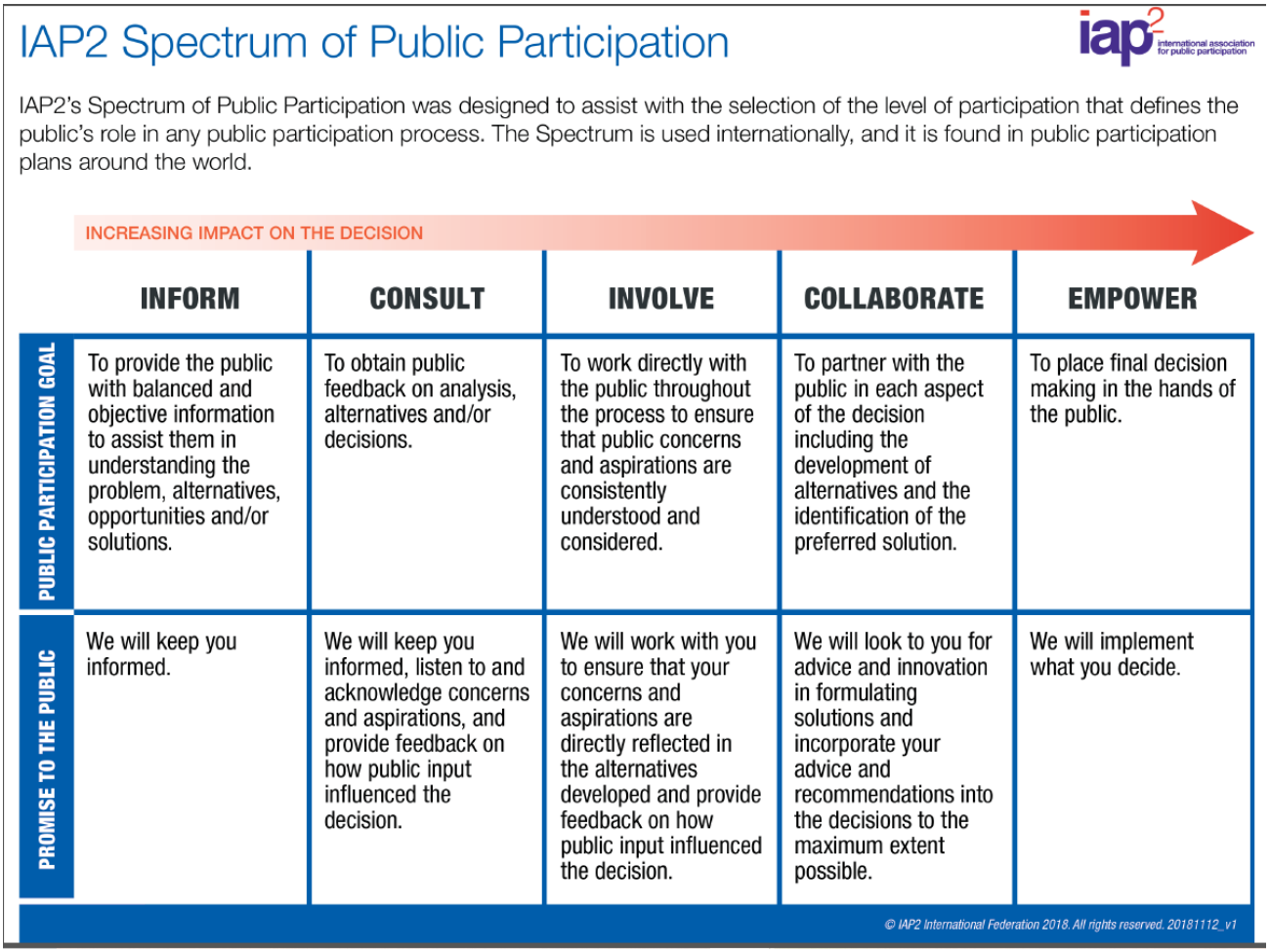

Figure 1 - IAP2 Spectrum

Source: (c) International Association for Public Participation www.iap2.org

Table 2~~Table 2~~**Error! Reference source not found.** 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 Sandilong Creek and Sandilong 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 Sandilong Creek and Sandilong B~~i~~illabong. This ensures that all stakeholders and community members are aware of the Sandilong Creek and Sandilong Billabong environmental watering operations.

Table 2~~2~~ - Stakeholder groups with an interest in environmental water at Sandilong Creek and Sandilong Billabong

Stakeholder Group	Stakeholder	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	Collaborate	Via Mallee CMA's Traditional Owner engagement team.

		benefits. environmental watering regimes and how these may be timed to support/promote cultural values.		Consultation is largely undertaken in-person and, where possible, on Country.
Victorian water holders	VEWH, CEWO	Make decisions about annual environmental water usage.	Collaborate	Via formal meetings.
River operators	Goulburn-Murray Water	Manage water storage.	Collaborate	Via formal meetings.
Scientists	Research and monitoring institutions (La Trobe Centre for Freshwater Ecology, Birdlife Australia), consultancies (Tri-State Murray NRM, Aquasave NGT, Ecology Australia), citizen scientists	Floodplain health, biodiversity and use of environmental water.	Involve	Workshops, meetings, phone calls.
Public land managers	DEECA	Managing impacts from watering such as access.	Collaborate	Via monthly meetings.
Local government	Mildura Rural City Council	Access during watering events.	Involve	Meetings, phone calls, correspondence.
Basin-wide river management	MDBA	River Murray operations.	Involve	Via formal meetings.
Private landowners and managers	Riverside Golf Club	Possible access to Sandilong Creek and Billabong during operation as defined in landholder agreements.	Collaborate	Directly affected landholders will be informed of watering proposals and asked to provide feedback if relevant.
Community (interest groups)	Environmental, recreational and social groups	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.
Media	Local, state and national media outlets	Across issues that interest the local community.	Inform	Media packs and media releases.

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.

A summary of the consultation events is included in Appendix 3.

2.2.1 Verifying asset values

Asset values at Sandilong Creek and Sandilong 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 Sandilong Creek and Sandilong 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 proposed monitoring activities will guide future watering events, as part of the adaptive management approach (see Section 8.2).

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 events (see Section 8.2).

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 Engagement

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 community, landholders, recreational users, Landcare groups, environmental groups and other interested parties to provide input to the plans. The survey supplemented earlier community engagement about the Sandilong Creek EWMPs, and ongoing community engagement that informs the Seasonal Watering Proposal (SWP).

Three of forty-seven respondents identified Sandilong Creek as the most important site (of all eight sites included in the survey), although only one completed survey for Sandilong Creek was received.

The Engagement survey asked the community to rank values at the site. Table 3 shows the ranking. For further detail about the outcomes of the 2023 community engagement please refer to Appendix 4.

Table 33 - Community Values Ranking at Sandilong Creek and Sandilong Billabong

Community Value	Value ranking
Unique landscape features and natural beauty	This value was of high importance to the respondent (score 4/5)
Recreational opportunities (e.g. birdwatching, fishing, golfing)	Recreational opportunities were of moderate importance to the respondent (score 3/5)
Exercise (trails for walking, running, cycling)	The respondent considered exercise values of Sandilong Creek to be of extremely high importance (score 5/5)
Work or Education opportunities	The respondent considered work or education opportunities to be of extremely high importance (score 5/5)
Commercial or business opportunities	The respondent considered commercial or business opportunities to be of extremely high importance (score 5/5), and uses the site for tourism operations

2.3 Traditional Owners

Sandilong Creek and Sandilong Billabong are located within the recognised Country of the First People of the Millewa-Mallee Aboriginal Corporation (FPMMAC),

FPMMAC have 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.

FPMMAC were engaged in March 2023 to collaborate on the EWMP update process. This involved a presentation to a group of Traditional Owners from FPMMAC about the sites included in the update. Discussions included ecological, social and cultural outcomes and watering regimes to support these. Engagement and discussions about these topics are on going and are essential to future watering programs.

Annual consultation is also undertaken with FPMMAC during the development of any SWPs for Sandilong Creek.

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 located within the Nichols Point WMU and situated 5 km east of Mildura on the Murray River floodplain and 5 km upstream of the Mildura Weir. The target wetlands for this EWMP include Sandilong Creek and associated billabong (Figure 2~~Figure 2~~).

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

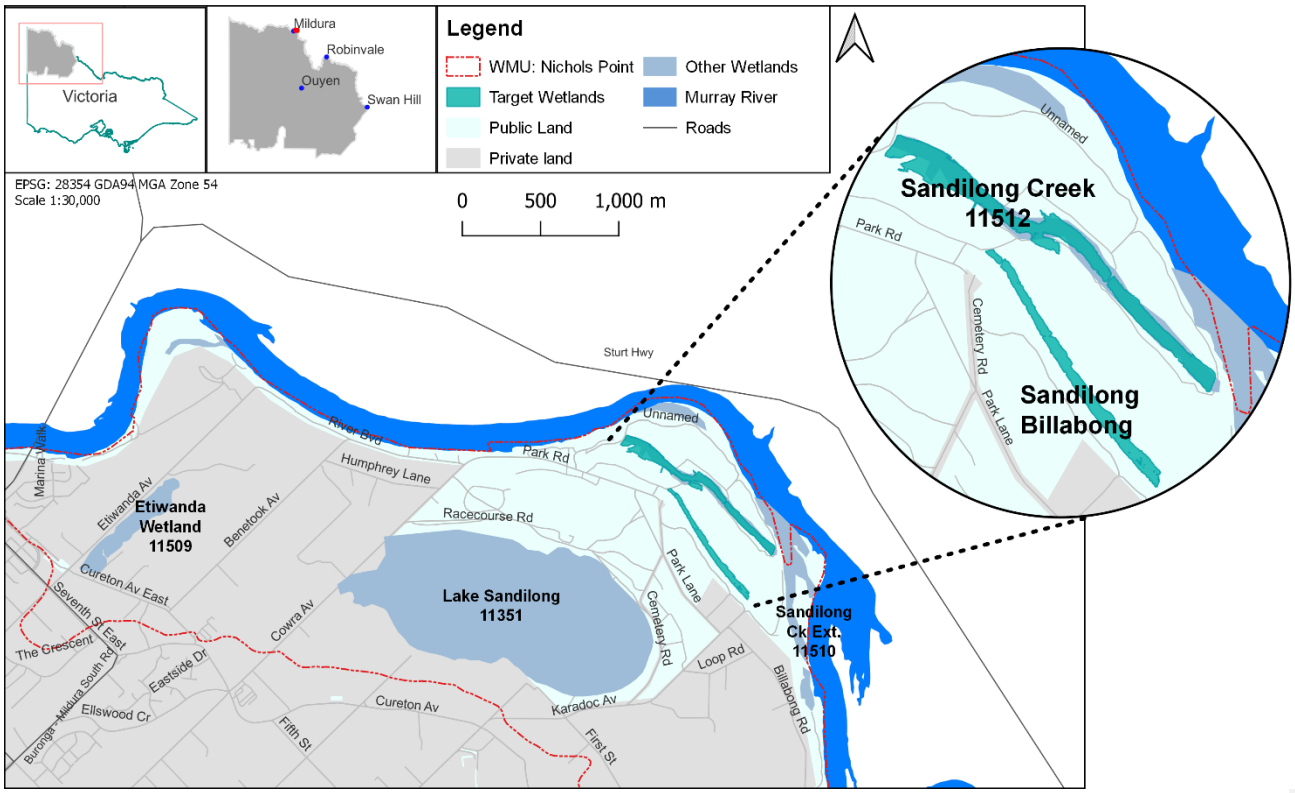

Figure 2 – Map of the Sandilong Asset wetlands in the north of Nichols Point WMU. EWMP target area emphasised in inset.

Wetland numbers correspond to IDs in the Wetland Current spatial layer from https://datashare.maps.vic.gov.au/

3.1 Catchment setting

Waterway Management Unit (WMU)

A WMU boundary denotes an area for which water regimes can be managed largely independently of neighbouring WMUs. The Nichols Point WMU encompasses two major target areas for environmental watering:

(1) Sandilong Creek and Billabong, in the north of the WMU, and the target area of this EWMP (Figure 2~~Figure 2~~).

(2) Kings Billabong Park, in the south, covered by the separate Kings Billabong EWMP (Mallee CMA, 2023).

The WMU is located in 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 red brown earths (Dermosols), cracking clays (Vertosols) and texture contrast soils (Chromosols and Sodosols) which support Riverine Grassy Forest and Riverine Grassy Chenopod Woodland ecosystems. (DEPI, 2015). The Nichols Point WMU is mostly situated on Vertosols and Hydrosols.

The Nichols Point WMU is bordered to the north by the Murray River. The land consists of riverine vegetation including River red gum (*Eucalyptus camaldulensis*), extending generally southwards to slightly higher elevations of Black box (*E. largiflorens*) floodplain and associated flora species.

River levels at the Nichols Point WMU remain relatively static under the influence of the weir pool, with inundation of the floodplain and flood runners occurring only during extreme events (Thoms et al. 2000, p 106). The wetting and drying cycles of the floodplain environment are modified from that which would have existed prior to river regulation (Ecological Associates, 2007).

Situated within close proximity to the township, the area is subject to high levels of visitation. Popular aquatic activities include swimming, boating, fishing and skiing. The northern Nichols Point WMU contains large areas of recreational land including a golf course, tennis courts, horse complex and a racecourse, as well as areas of native vegetation (Figure 3~~Figure 3~~). A houseboat mooring site is located on the Murray River adjacent the Riverside Golf Course and is used frequently to provide tourist access by boat to the golf course. Also within this WMU is the Mildura Cemetery, and areas of private land.

The Nichols Point WMU forms a significant part of the river's ecosystem. Kings Billabong Park (in the WMU) is a nationally important wetland (DCCEEW, 2023). Black box and River red gum communities form significant corridors connecting the Park and assist in the movement of terrestrial and avian fauna. Backwaters that are connected to the Murray River maintain relatively static water levels due to the influence of the Mildura Weir (Ecological Associates 2008). Some of the Murray River backwaters are known to contain aquatic species including the state listed Murray-Darling rainbowfish (*Melanotaenia fluviatilis*), the near-threatened Golden perch (*Macquaria ambigua*) and the endangered Freshwater catfish (*Tandanus tandanus*), as well as Bony herring (*Nematalosa erebi*) and Peron's tree frog (*Litoria peronii*) (Chapman, Ellis & Pyke 2009). The backwaters at this site are separated from the target area by a levee, but add value to the system due to their proximity to target wetlands and the diversity of fauna present.

Sandilong Asset Wetlands

Several wetlands exist within the northern Nichols Point WMU (herein referred to as Sandilong Asset wetlands), including Sandilong Creek and associated Sandilong Billabong (target wetlands for this EWMP), Etiwanda Wetland and Lake Sandilong (Figure 2~~Figure 2~~).

Sandilong Creek (wetland #11512) is a permanently inundated former anabranch of the Murray River that has been isolated from the river by flood levees that protect the surrounding golf course. Sandilong Billabong (unnumbered) is located to the south east of the golf course. It is fed artificially by a pipe leading from the Sandilong Creek and fills when the creek is at sufficient depth. Sandilong Creek and Billabong are described in Section 3.3.

Etiwanda Wetland (wetland #11509) is a constructed permanent wetland, which filters up to two thirds of Mildura's stormwater prior to its eventual release to the river (MRCC 2012). Mildura Rural City Council (MRCC) manage Etiwanda Wetlands, and because the wetland accommodates large volumes of stormwater, its management through delivery of environmental water is not the subject of this plan. Lake Sandilong (wetland #11351) is classified as a Shallow Freshwater Marsh (1994 wetland layer), however due to river regulation, flood levees, and the constraints of surrounding land use, this wetland is only inundated through extremely high rainfall events or when a flood overtops the levee banks.

3.2 Land status and management

The northern Nichols Point WMU area has a complex land tenure arrangement, with recreational operators and public facilities operating on leased public land (Figure 3~~Figure 3~~). Several parcels of private land exist on higher ground, outside the target area.

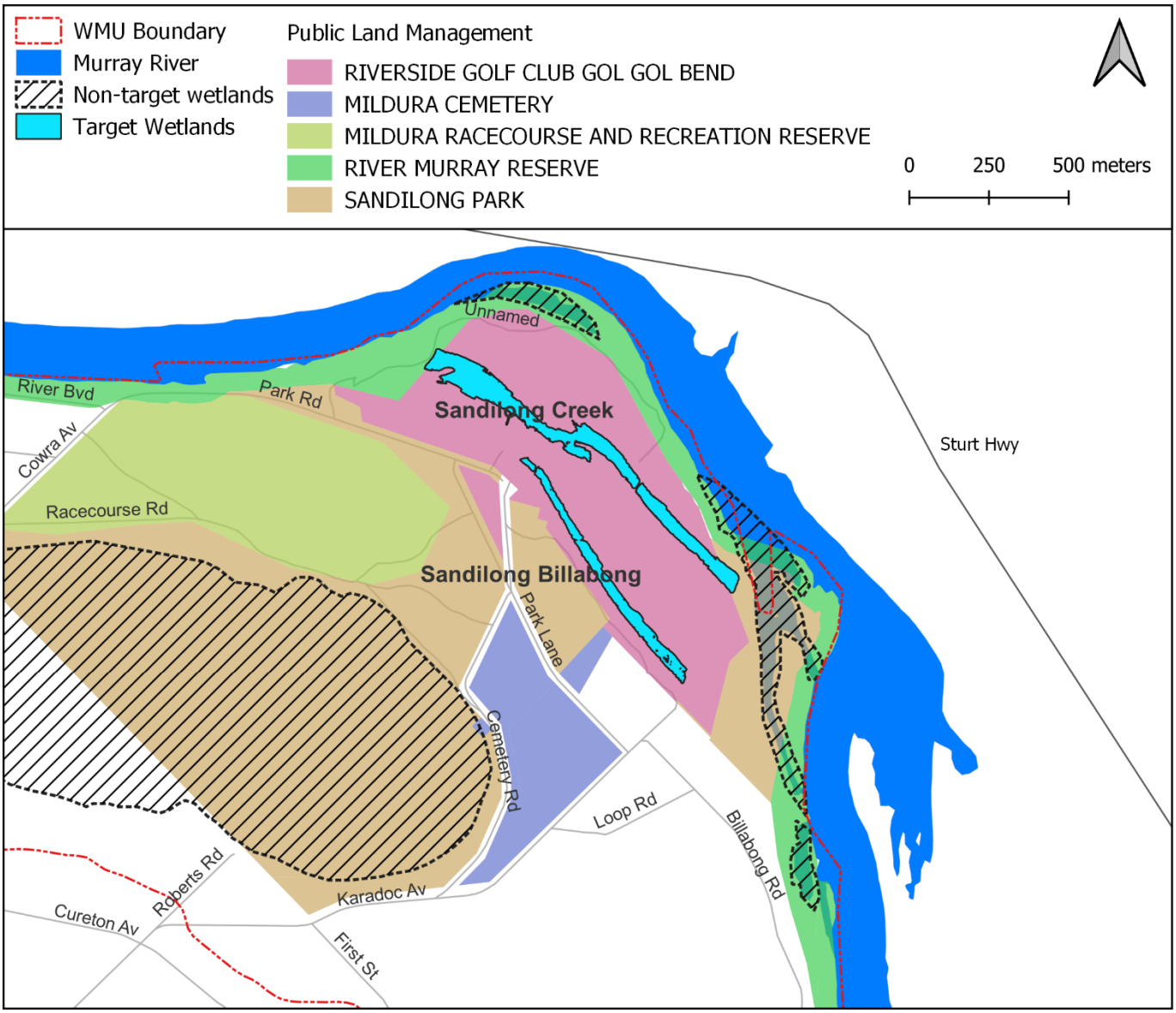

Figure 3 - Land management in the Sandilong Creek area

The target sites Sandilong Creek and Sandilong Billabong sit wholly within land leased from DEECA by the Riverside Golf Course (Figure 4~~Figure 4~~). Mildura Rural City Council manages the remaining land within the Recreation Reserve.

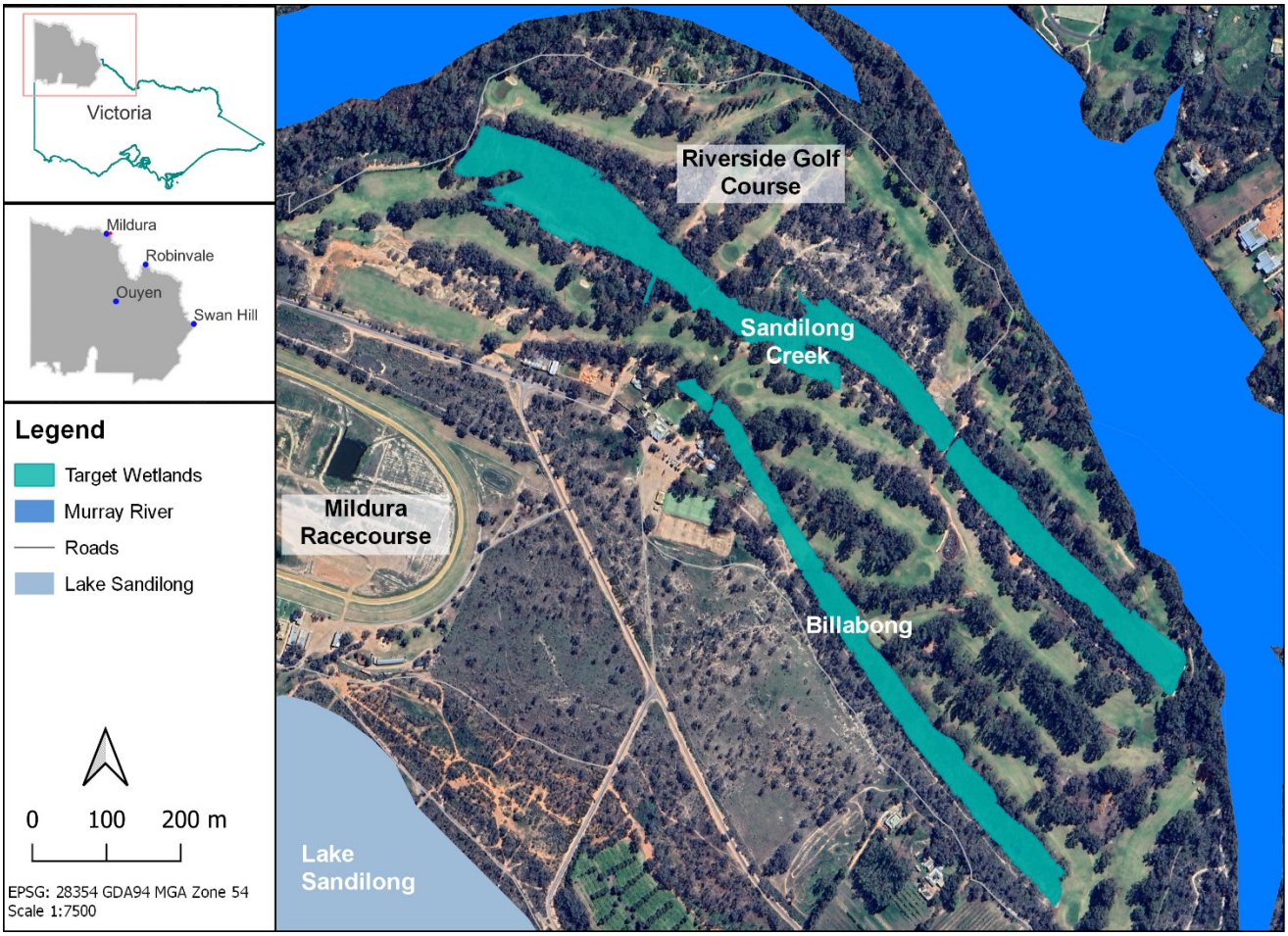

Figure 44 - Riverside Golf Course surrounding the target area

A section of land approximately 60 m in width, between the golf course and the Murray River, falls under Parks Victoria management as part of the Murray River Public Purposes Reserve (Murray River Reserve, Figure 3~~Figure 3~~). In practical terms, the Golf Club passively manages this area in keeping with the natural environment. Land and water managers for the Sandilong Creek target area are summarised in Table 4~~Table 4~~.

Table 4 - Land and Water managers for Sandilong Creek and Billabong

Group	Role
Mallee CMA	Regional waterway and environmental management
Department of Energy, Environment and Climate Action (DEECA)	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 – Registered Aboriginal Party
Riverside Golf Club	Committee of Management, Business operating within the WMU

3.3 Asset characteristics

The whole of the Nichols Point WMU has a water requirement as a floodplain complex, however due to the current uses of public land, the extent of existing flood levees designed to protect private land from flood, and the extent of private land within this WMU, an environmental watering regime is not planned for the floodplain.

The target areas for this Plan include Sandilong Creek, the associated Sandilong Billabong (Figure 2~~Figure 2~~) and the extent to which environmental water is able to be managed with current infrastructure (Figure 5~~Figure 5~~).

Freshwater catfish, Golden perch and several species of state listed turtles have been recorded in the Sandilong Creek (Ellis & Wood 2012). For more details on environmental values, please refer to Section 5.

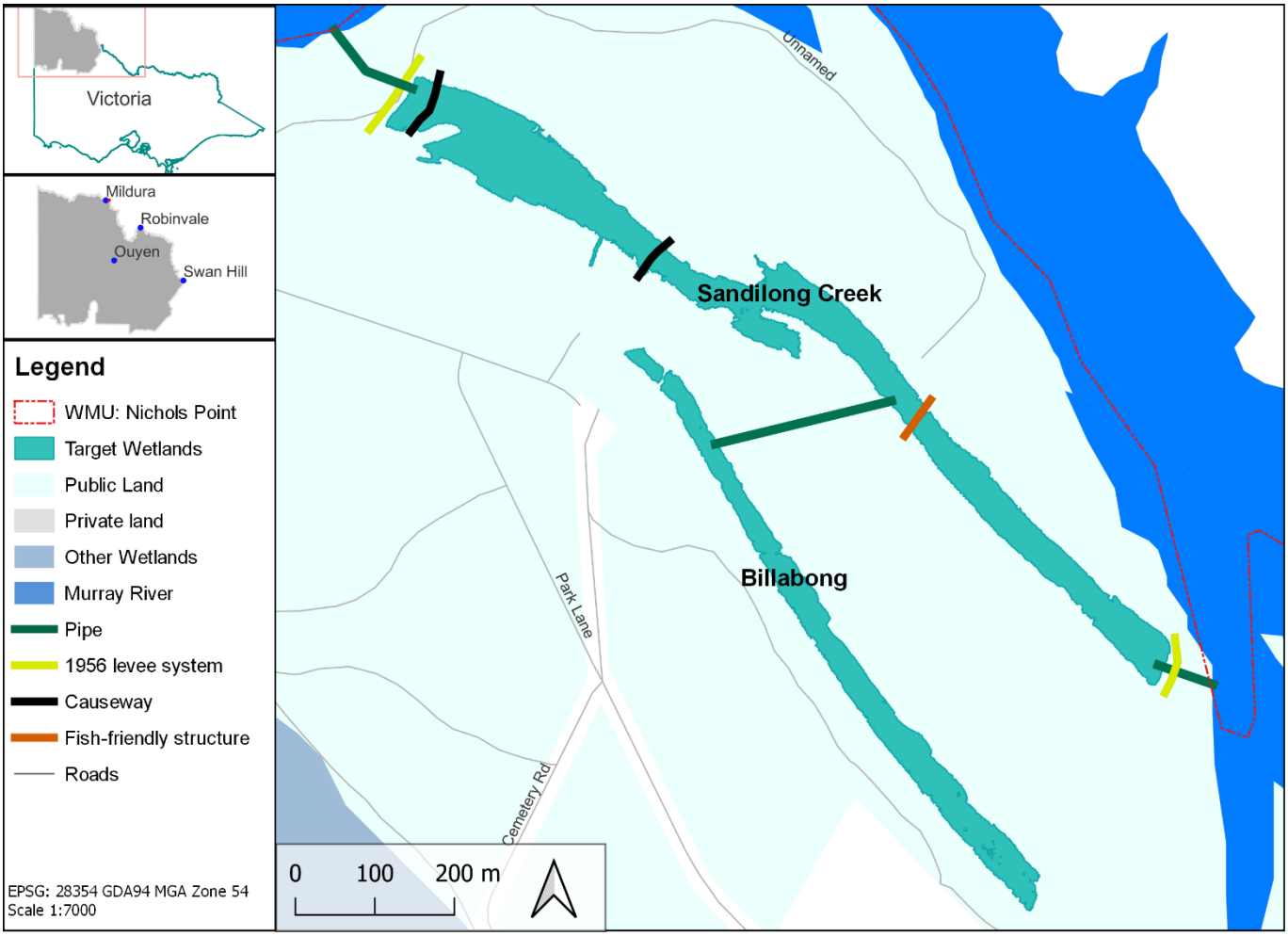

Figure 5 – Location of key infrastructure at Sandilong Creek and Billabong

3.3.1 Sandilong Creek

Sandilong Creek is a permanently inundated former anabranch of the Murray River that has been isolated from the river by flood levees to protect the golf course (constructed to 39 m AHD, Ecological Associates, 2008). The creek is currently maintained at weir pool level (34.5 m AHD), is approximately 1,190 m in length, less than 1 m deep at each end, and more than 2 m deep in several large holes (Ecological Associates 2008).

The creek has some remnant fringing River red gum community with Eumong and chenopod understorey. In some locations the understorey is dominated by exotic grass and weed species, and further from the banks of the creek, understorey has been thinned or removed (Sunraysia Environmental 2008). The creek itself contains some aquatic vegetation dominated by Cumbungi (*Typha* spp.) and Common reed (*Phragmites australis*) (Ecological Associates, 2008) and provides habitat for resident native fish populations including Freshwater catfish (Chapman, Ellis & Pyke 2009).

Whilst Sandilong Creek is isolated from the river by levees, it is connected by pipes with valves to control the water level (Figure 5~~Figure 5~~). The creek has three causeways providing crossings for golfers, golf club machinery and staff, one of which was funded by the Mallee CMA and allows fish passage. The remaining two causeways limit movement of aquatic fauna within the creek (Figure 5~~Figure 5~~).

Sandilong Creek. ***Source: Mallee CMA***

3.3.2 Sandilong Billabong

Sandilong Billabong is approximately 900 m long and 30 m wide (EA 2008) and is located to the south east of the golf course (Figure 4~~Figure 4~~). It is located on the edge of a rise in the floodplain and would once have been classed a freshwater meadow or shallow freshwater marsh. In the past, Sandilong Billabong received saline irrigation drainage water (Ecological Associates 2008), although it is now generally dry, only filling naturally if a significant flood event were to occur that overtopped or breached the levee, or through a significant rainfall event.

Sandilong Billabong is fed artificially by a pipe leading from the Sandilong Creek (Figure 5~~Figure 5~~), and can only be filled when the creek is at a sufficient depth (approximately 35 m AHD). To the east of the billabong is a narrow corridor of River red gum and Black box, and the golf course, and to the west is a narrow corridor of Black box and private land.

This combined target area represents approximately 8.84 ha. Constraints and proposed infrastructure are discussed fully in Section 9. Expansion of the target area would need careful consideration of the implications for the golf club and neighbouring landholders and land managers. Given the modified and irrigated environment of the target area, further ecological benefits arising from expansion of the inundation zone are unlikely.

A brief overview of the main characteristics of the wetlands within the target area is provided in Table 5~~Table 5~~. Classification of Sandilong Asset wetlands is provided in Figure 6~~Figure 6~~.

Table 55 - Wetland characteristics at Sandilong Creek and Sandilong Billabong

Characteristics	Description
Name	Sandilong Creek and billabong
Mapping ID (Wetland Current layer)	11512 (Sandilong Creek) Sandilong Billabong is excluded from Wetland Current Layer
Area of wetlands in target area	8.84 ha
Bioregion	Robinvale Plains
Conservation status	Bioregional Conservation Status: areas of EVCs listed as Depleted and Least Concern
Land status	Recreation Reserve
Land manager	Riverside Golf Club (land leased from DEECA)
Surrounding land use	Recreation, irrigated horticulture, Murray River floodplain, Murray River Reserve and Murray River
Water supply	Piped from Murray River, maintained close to weir pool level (no natural supply due to levees)
Wetland category (Wetland Current layer)	Not Classified
Wetland depth at capacity*	35.75 m AHD maximum at gauge point (34.5 m + 1.25 m AHD); depth approximately 2.5 m

Note: *Capacity is governed by golf course operations

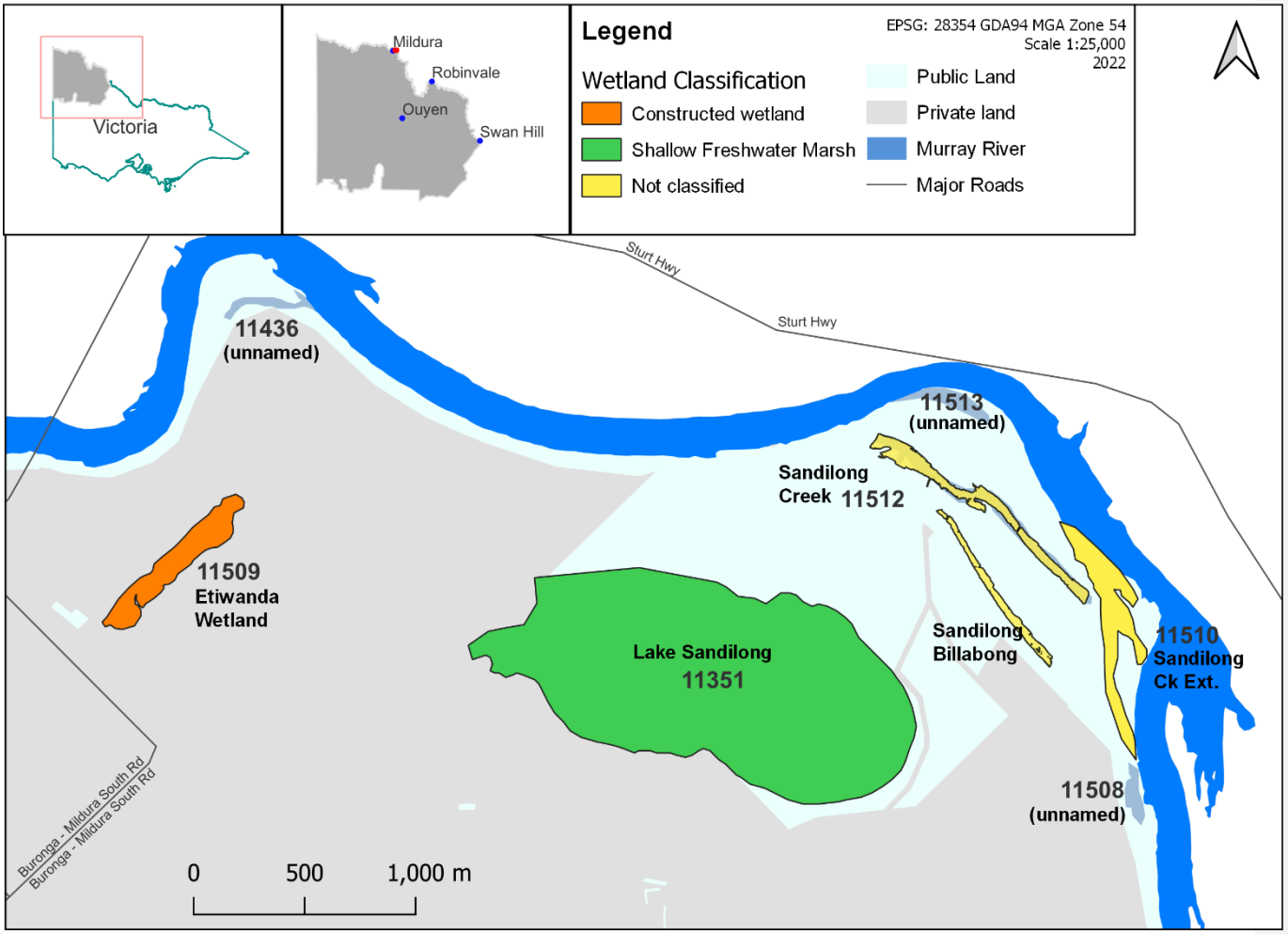

Figure 6 - Sandilong Asset wetland types.

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 (subject to availability in the channel to deliver water for the environment) and delivered to wetlands or streams to protect their environmental values and health.

Upon recommendation of the Minister for Water, the Governor in Council has appointed Commissioners to Victoria's first independent body for holding and managing environmental water. 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 and their responsible agencies listed in Table 6~~Table 6~~.

Table ~~66~~ - Summary of environmental water sources available to the Sandilong Creek target area

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 Office
Donated water	Riverside Golf Club, Mallee CMA

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 (DSE 2005a). A wetland's hydrology is determined by surface and groundwater inflows and outflows in addition to precipitation and evapotranspiration (Mitsch and Gosselink, 2000 in DSE 2005a). Duration, frequency and seasonality (timing) are the main components of the hydrological regime for wetlands and rivers.

The target area is located on the Victorian floodplain of the Murray River (chainage 894 to 891 km). It is within the influence of the Mildura weir (upstream river gauge # 414210).

Natural

Prior to river regulation in the reach of the Murray River below Euston Weir, the floodplain experienced inundation more frequently and these events had a greater duration (Ecological Associates, 2007). Natural flows were highest in spring and lowest in autumn. The temporary 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 flora species and offered more regular access to a wider range of habitat and food sources for aquatic species. Sandilong Creek was once connected to the river to form a small anabranch and would have experienced both inundation and dry spells as water levels fluctuated in the main channel of the Murray. Sandilong Billabong would have filled when the floodplain was inundated, and slowly dried after the floodwaters had receded.

Current

The Mildura weir along with others along the length of the Murray River were installed in the 1920's and 30's and has had a significant impact on the flow and flood regime in the river. Locks and weirs were completed at Mildura (downstream) in 1927 (G-MW 2013), and at Euston (upstream) in 1937 . In this part of the Murray River, the frequency, duration and magnitude of all but the largest floods have been reduced due to effects of major storages in the Murray and its tributaries (Thoms et al. 2000).

High flows (except for the extreme flood events) have been affected, which reduces the flooding of anabranches and floodplain habitats such as those within the Nichols Point WMU. A reduction in the frequency of inundation of these habitats was identified as a key threatening process in this reach by the River Murray Scientific Panel which was commissioned by the then Murray Darling Basin Commission (Thoms et al. 2000). Extreme low flow events have been removed, due to the requirement of minimum flows for irrigation and interstate agreements (SKM 2002).

The Nichols Point WMU is located 5 km upstream of the Mildura Weir. The influence of the weir pool has meant that the water level has remained relatively constant for the past eighty years. Sandilong Creek is isolated from the Murray River by levees; flow into the creek is managed by valves at either end of the creek which are functional under normal operating conditions of the Mildura weir pool. The creek is generally maintained at approximately 34.5 m AHD (at or near weir pool height) for the benefit of the Golf Club. Also within the levee, Sandilong Billabong was previously regularly inundated by irrigation drainage water, but now only fills through a breach in the levee during a flood significant flood event (>38.5 m AHD), or through an environmental watering event where the creek is filled via temporary pumping to a sufficient level to allow water to be gravity fed to the billabong.

4.1 Groundwater and salinity interactions

An investigation of surface water, groundwater and irrigation water interaction was recommended for Sandilong Creek in the 2014 EWMP. The impact(s) of nearby irrigation on the health of Sandilong Creek and Billabong health remains a knowledge gap.

4.2 Environmental watering

Environmental watering began in Sandilong Creek in Spring 2011 to improve the health of the system by manipulating water levels. A partial drying phase (draw down) was implemented during the winter of 2012, followed by a slow fill event to return the creek to its former static level, and then a second watering event commenced in October 2012. Watering recommenced in December 2013 intermittently, with subsequent fills commencing in January 2014, April 2014 and April 2015.

The water for each of these events was obtained from various sources as outlined in Table 7~~Table 7~~. No pumping of the site has occurred since Autumn 2014/15, and the creek is generally maintained at weir pool levels, although in 2022 levels were manipulated to manage Common carp.

Table 7~~7~~ - A summary of environmental watering events in Sandilong Creek

Water year	Time of inflow	Environmental Water Source	Source volume (ML)	Total volume (ML)	Area (ha) inundated
2011/12	Spring - Autumn	EWR	20.09	150	8.84
		RMUF	99.47		
		Internal diversion	30.44		
2012/13	Spring - Autumn	EWR	150.17	150	8.84
2013/14	Summer-Autumn	EWR	143	143	8.84
2014/15	Autumn	EWR	136.7	136.7	8.84
2015/16 to 2022	No pumping of the site has occurred since Autumn 2014/15. Between Autumn 2015 and Autumn 2022, valves were open and Sandilong Creek was maintained at weir pool levels. In 2022 water levels were manipulated (dropped and then re-filled) by connecting and disconnecting to the weir pool using valves at each end of Sandilong Creek as a Common carp management tool.				

The aim of environmental watering events and partial draw-downs was to introduce some variability to the level in Sandilong Creek and to return water to the billabong to improve vegetation health, which would in turn provide habitat, feeding and breeding opportunities to increase the abundance, distribution and diversity of native wetland

species in the target area. Due to the high visitor numbers at the golf course, environmental watering at this location also provides an ideal demonstration site for raising community awareness of wetland management.

Since construction of flood levees (*circa* 1956), the creek and the billabong have lacked natural connectivity to the river. Currently, water levels in Sandilong Creek can be controlled through pipes with valves and carp screens at either end of the creek (refer to Figure 5~~Figure 5~~). Water has been pumped into the billabong site using temporary pumps and earthen levees to prevent back flow.

More recently the billabong has been filled by an existing pipe connecting to the creek. When the creek is at sufficient depth, water is gravity fed to the billabong. Each watering event inundated the target area to the maximum extent (8.84 ha, 35.75 m AHD) and included both the creek and the billabong. The creek was then partially drawn down before refilling to the former static water level. A complete drying phase for the creek was not conducted due to the presence of Freshwater catfish.

Anecdotal evidence suggests that the watering was effective in improving the health of trees lining the billabong in the target area in 2011/12. Other observations noted by the Mallee CMA include reduced dominance of Cumbungi, promotion of native fringing vegetation, zooplankton populations and improvement in bank stability. A study of fish movement within the creek was undertaken at commencement of the October 2012 watering event, which suggested that a breeding population of Freshwater catfish exists and is undergoing recruitment (Ellis & Wood 2012). During consultation with Riverside Golf Club, it was suggested that the number and diversity of birdlife surrounding the creek and billabong had dramatically increased since the watering program had commenced (RGC Committee 2013, pers. comm., 15 Oct)

5 Water-dependant values

5.1 Environmental Values

5.1.1 Ecosystem type and function

Sandilong Creek and Sandilong Billabong have not been classified under Victoria's state-wide wetland classification system (Figure 6~~Figure 6~~), and the billabong has not yet been included in Victoria's current wetland spatial dataset. Prior to the formation of the levees the creek was an intermittent wetland, but it is now generally maintained around weir pool height (approximately 34.5m AHD). It has the potential to contribute to the ecology of the wider river system by providing refuge, habitat and food sources for many aquatic species and water dependent birdlife.

The billabong was once an intermittent wetland filling during flood events and slowly drying. This area contributed to floodplain ecology through natural wetting and drying cycles and would have once provided habitat and food sources for a range of aquatic and terrestrial fauna. Through the formation of the levees to protect the golf course, this billabong has not been subject to natural inundation events, and was, for a time, inundated with saline irrigation drainage water (Ecological Associates, 2008). Recent improvements to irrigation efficiency have resulted in drying of the billabong bed (Ecological Associates, 2008) and decreasing vegetation quality in and around the bed.

Modified riparian conditions and altered water regimes in the target area (due to river regulation, altered land use and the installation of levees and causeways) limit the capacity of Sandilong Creek and Sandilong Billabong to perform all functions of floodplain wetlands. For example, without human intervention, the creek and billabong are unable to absorb or release floodwaters during a small flood event, and organic material is generally retained by the creek rather than releasing into the river where it would otherwise maintain riverine food chains.

Sandilong Creek does, however, consistently perform two key ecosystem functions of floodplain wetlands, which are detailed below.

Provision of wetland habitat for water-dependent species

Sandilong Creek is significant because it is one of only "a small number of sites" in Victoria that has a naturally occurring breeding population of Freshwater catfish (DSE 2005b, Whiterod et al., 2022 and Ewing et al., 2023), which are classified as Endangered under the *Flora and Fauna Guarantee Act 1988.* Sandilong Creek supports several species of native fish, frogs, turtles and waterbirds.

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

Wetlands act as refugia for frogs, native fish and waterbirds during periods of extended drought in an arid landscape. Inundation of areas of the wetland woodland mosaic provides a diversity of feeding, breeding and nursery sites for native water-dependent biota. Sandilong Creek is a long-narrow wetland with steep banks and undercut habitat. The creek hosts pockets of submerged vegetation (primrose and ribbon weed), and fragmented emergent vegetation (Cumbungi and Common reed) (Whiterod et al., 2022), which promote aquatic productivity and habitat value for fish, frogs, turtles and waterbirds. Large woody structures and rocks (near culverts) provide substrates for biofilms, which are grazed by macroinvertebrates and fish. Established and recruiting River red gum and Eumong communities that surround Sandilong Creek (Whiterod et al., 2022) provide hollows for 10 microbat species recorded at the site (Ewing et al., 2023)

The environmental watering regime proposed in this plan may help restore the balance within these ecosystems and help the wider river system. A healthy wetland system in the creek and billabong helps promote primary production and nutrient cycling and helps maintain a balance between complex systems. Vegetation condition, extent and diversity can be enhanced when the wetland system is well maintained, in turn improving fauna condition, recruitment and shelter potential. Sound ecological diversity and effective water management may also provide a level of natural control of pest species including Common carp and weeds, which are known to exist at the site from time to time.

5.1.2 Flora and fauna values

Ecological Vegetation Classes (EVC)

A recent survey by Ecology Australia identified Intermittent Swampy Woodland (EVC 813) and Tall Marsh (EVC 821) EVCs at Sandilong Creek (Ewing et al., 2023, Table 8). Both EVCs have Robinvale Plains bioregional conservation status of 'Least Concern'. It is noted that the observed EVCs differ from the modelled EVCs at the target wetlands (modelled EVCs included Shrubby Riverine Woodland EVC 818, and Grassy Riverine Forest EVC 106, DEECA NatureKit, 2023). The observed EVCs at Sandilong Creek have not been fully mapped across the target wetlands. Sandilong Billabong is modelled as having Shrubby Riverine Woodland (EVC 818) and Riverine Chenopod Woodland (EVC 103).

Riverine Chenopod woodland is depleted in the Robinvale Plains bioregion. Extended descriptions of these EVCs are provided in Appendix 5.

Table 8 - EVCs at Sandilong Creek and Billabong

EVC number	EVC name	Robinvale Plains Bioregional Conservation Status
813	Intermittent Swampy Woodland	Least Concern
821	Tall Marsh	Least Concern
818	Shrubby Riverine Woodland	Least Concern
103	Riverine Chenopod Woodland	Depleted

Intermittent Swampy Woodland

Eucalypt woodland to 15m tall with a variously shrubby and rhizomatous sedgy – turf grass understorey, dominated by flood stimulated species, in association with flora tolerant of inundation (RobP_EVCs_combined.pdf (environment.vic.gov.au). The EVC typically has 20% tree canopy cover of River red gum (*Eucalyptus camaldulensis*) and Black box (*E. largiflorens*), with understories including Eumong (*Acacia stenophylla*) and Tangled lignum (*Duma florulenta*). The EVC prefers intermittent (1-6 months duration) or episodic inundation (6 months duration), but not permanent inundation.

Tall Marsh

The Tall Marsh EVC is described as wetland dominated by tall emergent graminoids (rushes, sedges, reeds), typically in thick, species-poor swards and with soils that are almost permanently moist (RobP_EVCs_combined.pdf (environment.vic.gov.au). Large non-tufted graminoid species (40% cover) typical of the Tall Marsh EVC include Cumbungi (*Typha spp.*) and Common reed (*Phragmites australis*). Permanent or seasonal inundation (>6 months duration) is preferred.

Shrubby Riverine Woodland

Shrubby Riverine Woodland is described as a Eucalypt woodland to open forest to 15 m tall of less flood-prone (riverine) watercourse fringes, principally on levees and higher sections of point-bar deposits. (RobP_EVCs_combined.pdf (environment.vic.gov.au). Ten percent canopy cover of River red gum and Black box, with 50% understorey foliage cover, and conspicuous large dicot herbs are typical of this EVC. Additional species that occur in this EVC include Eumong and Tangled lignum.

Riverine Chenopod Woodland (Black Box Chenopod Woodland)

Eucalypt woodland to 15 m tall with a diverse shrubby and grassy understorey occurring on most elevated riverine terraces. (RobP_EVCs_combined.pdf (environment.vic.gov.au). The EVC is naturally subject to extremely infrequent, incidental, shallow flooding from major events, if at all. The EVC typically has 10% Black box and Eumong canopy cover with 50% understorey cover predominantly from medium and small shrubs and herbs.

Sandilong Creek. *Source: Mallee CMA*

Water-dependent Fauna

85 fauna species have been recorded at Sandilong Asset wetlands (encompassing Sandilong Creek, Sandilong Billabong, Lake Sandilong and Etiwanda Wetland) (DEECA NatureKit 2023). Water-dependent species of conservation significance that are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), Victoria's *Flora and Fauna Guarantee Act 1988* (FFG Act) or the Victorian Advice list, are shown in Table 9.

Table 9 - Listed water-dependent fauna at Sandilong Asset wetlands (NatureKit and DCCEEW protected matters searches conducted 2023)

Scientific Name	Common Name	Type	FFG Act	EPBC Act
Emydura macquarii	Murray River turtle	R	CE	
Tandanus tandanus	Freshwater catfish	F	E	
Ixobrychus dubius	Australian little bittern	B	E	
Chelodina expansa	Broad-shelled turtle	R	E	

Scientific Name	Common Name	Type	FFG Act	EPBC Act
Litoria raniformis	Growling grass frog	A	Vu	Vu
Ardea alba modesta	Eastern great egret	B	Vu	
Aythya australis	Hardhead	B	Vu	
Maccullochella peelii	Murray cod	F		Vu
*Calidris ferruginea**	Curlew sandpiper	B		CE

Lifeform type: Amphibian (A), Bird (B), Fish (F), Reptile (R) EPBC threatened status/Victorian Status - FFG: VU = Vulnerable, EN = Endangered, CE = Critically Endangered, NT = Near Threatened

* listed under Bonn convention, CAMBA (China-Australia Migratory Bird Agreement), JAMBA (Japan-Australia Migratory Bird Agreement) and ROKAMBA (Republic of Korea-Australia Migratory Bird Agreement)

Table 9 includes a range of listed water dependent species which will benefit from the wetlands in the target area receiving water on a more regular basis. Species included in the list may forage or nest in or on water, inhabit, or breed in water, or require flooding to trigger breeding or fledging. The Freshwater catfish, which is directly dependent on water, appears to have found suitable habitat in the creek system (Chapman, Ellis & Pyke 2009). In order to provide both habitat and breeding opportunities for listed species, wetlands such as the Sandilong Creek and the surrounding ecosystem including the River red gum and Black box communities must be maintained in good condition. A complete list of native species recorded in Sandilong Creek wetlands is appended (Appendix 6).

Fish

Several fish surveys have been conducted in Sandilong creek. Of note are surveys conducted to inform environmental watering programs, and to monitor impacts of inflows on fish movement. The results of these surveys are provided in Table 10**Error! Reference source not found.**.Freshwater catfish have been recorded in all surveys at Sandilong creek. The 2012 survey (Ellis and Wood, 2012) noted that two size cohorts were found: 100-200mm and 300-400m, suggesting that a breeding population may exist within the creek. During the 2022 survey, Whiterod and colleagues noted that sampled Freshwater catfish ranged in length from 290-445mm (Whiterod et al. 2022), consistent with recruitment and/or a breeding population.

Reptiles

Several species of turtles have been recorded at Sandilong Creek (Table 10). The omnivorous Murray River turtle (*Emydura macquarii*) is found primarily in rivers, floodplain waterbodies such as backwaters, oxbows, anabranchs and deep, permanent waterholes, preferring those that are deep, clear, permanent and flowing (Young, 2001; Chessman, 2011, 1988). The Broad-shelled turtle (*Macrochelodina expansa*) is an obligate carnivore, feeding on crustaceans and invertebrates (Chessman, 1983), takes advantage of temporary waterbodies as well as permanent and nests primarily after rain (Chessman, 2011). The Eastern snake-necked turtle (*Chelodina longicollis*) is dependent on freshwater habitats, including wetlands, feeds on aquatic invertebrates, tadpoles and small fishes, and nests in sand or soft sediments along stream banks, laying eggs in summer.

Amphibians

The Growling Grass Frog (*Litoria ranformis*) is listed under as Vulnerable under the *EPBC* and *FFG* Acts. The Growing 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 and prey species include invertebrates and tadpoles. Breeding is triggered by flooding of wetlands and floodplains during spring and summer (Clemann and Gillespie, 2012).

Several incidental observations of Eastern sign-bearing froglet (*Crinia parinsignifera),* Barking marsh frog (*Limnodynastes fletcheri)*, Spotted marsh frog (*Limnodynastes tasmaniensis)* and Peron's tree frog (*Litoria peronii*) were made at Sandilong Creek by Ecology Australia during February of 2023 (Ewing et al., 2023, See **Error! Reference source not found.**).

Table 10. Aquatic species recorded during surveys of Sandilong Creek

Scientific name	Common name	Type	FFG	EPBC	2009 survey	2012 survey	2022 survey	2023 survey
Chelodina expansa	Broad-shelled turtle	R	CE			✓	✓	
Chelodina longicollis	Common long-necked turtle	R				✓	✓	
Emydura macquarii	Murray River turtle	R	E		✓	✓	✓	
Craterocephalus stercusmuscarum fulvus	Fly-specked hardyhead	F				✓		
Craterocephalus fulvus	Unspecked hardyhead						✓	✓
Hypseleotris spp.	Carp gudgeon	F			✓	✓	✓	✓
Macquaria ambigua	Golden perch	F				✓		
Philypnodon grandiceps	Flat-headed gudgeon	F			✓	✓	✓	✓
Philypnodon macrostomus	Dwarf flat-headed gudgeon	F			✓	✓	✓	
Retropinna semoni	Australian smelt	F				✓	✓	✓
Tandanus tandanus	Freshwater catfish	F	E		✓	✓	✓	✓
*Cyprinus carpio**	Common carp*	F				✓	✓	✓
Cyprinus carpio/Carassius auratus* hybrid*	Carp/Goldfish hybrid*	F				✓		
Carassius auratus	Goldfish	F					✓	✓
*Gambusia holbrooki**	Gambusia (Mosquito Fish)*	F			✓		✓	✓
Cherax destructor	Common yabby	C					✓	✓
Paratya australiensis	Freshwater shrimp	C					✓	
Crinia parinsignifera	Eastern sign-bearing froglet	A						✓
Limnodynastes fletcheri	Barking marsh frog	A						✓
Limnodynastes tasmaniensis	Spotted marsh frog	A						✓
Litoria peronii	Peron's tree frog	A						✓

* denotes species' exotic/introduced origin

Lifeform type: Amphibian (A), Bird (B), Fish (F), Reptile (R)

EPBC threatened status/Victorian Status - FFG: VU = Vulnerable, EN = Endangered, CE = Critically Endangered

Surveys by Chapman, Ellis and Pyke, 2012, Ellis and Wood, 2019, Whiterod et al., 2022 and Ewing et al., 2023

Microbats

Ecology Australia (Ewing et al., 2023) conducted biodiversity assessments at Sandilong Creek in Autumn and Spring, and during the 2022/23 summer. Sandilong Creek had the highest bat call activity (496 calls/night) of all Mallee wetland sites assessed by 'ultrasonic recorders', and the highest diversity of identified microbat species (at least 11 species). Although microbats aren't water-dependent, they roost in the hollows and crevices of riparian trees such as River red gums, and forage for insects over water (Ewing et al., 2023). Microbat species found at Sandilong Creek include: Gould's wattled bat (*Chalinolobus gouldi),* Chocolate wattled bat (*Chalinolobus morio),* Long-eared bats *(Nyctophilus Spp.*), Inland free-tailed bat (*Ozimops petersi),* Southern free-tailed bat *(Ozimops planiceps),* White-striped free-tailed bat *(Austronomous australis),* Inland broad-nosed bat *(Scotorepens balstoni),* Little broad-nosed bat *(Scotorepens greyii),* Inland forest bat *(Vespadelus baverstocki),* Southern forest bat *(Vespadelus regulus)* and Little forest bat *(Vespadelus vulturnus).*

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, **Error! Reference source not found.**~~Table 11~~). 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). Waterbirds from each group except for small waders were recorded at Sandilong Creek by Ecology Australia (Ewing et al., 2023).

Table 11. 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. Pacific black duck, Hardhead)	Generalists; plankton, small invertebrates, plant material	Shallow Water (Dabblers)	Solitary
Grazing Waterfowl (e.g. Australian wood duck)	Plant material, seeds, invertebrates	Shallow Water, littoral zone	Colonial or solitary
Fish Eaters (e.g. Cormorants, Egrets, Herons)	Fish	Open and deep water	Colonial
Small Waders (e.g. Stilt, Plovers, Dotterels)	Small invertebrates, seeds	Littoral zone, mudflats	Solitary
Large Waders (e.g. Australian white 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

Flora

A total of 54 species of flora have been recorded at the Sandilong Asset wetlands (Appendix 6), six of which have conservation significance in the Victorian Biodiversity Atlas NatureKit (listed under the *EPBC Act*, the *FFG Act* or the Victorian Advisory list, Table 12). A recent biodiversity survey described Sandilong Creek as a species rich site, with a significantly higher level of native species cover than exotic species cover (Ewing et al., 2023). Twenty-two species found at the Sandilong Asset wetlands are introduced species (Appendix 6).

Table 12 - Listed species of flora at Sandilong Asset Wetlands

Scientific Name	Common Name	FFG Act	EPBC Act
Duma horrida subsp. horrida	Spiny lignum	CE	-
Sarcozona praecox	Sarcozona	E	-
Eremophila divaricata subsp. divaricata	Spreading emu bush	Vu	
Calotis cuneifolia	Blue burr-daisy	E	
Malacocera tricornis	Goat head	Vu	-
Frankenia serpyllifolia	Bristly Sea-heath	Vu	-

EPBC threatened status/Victorian Status - FFG: Vu = Vulnerable, E = Endangered, CE = Critically Endangered, R = Rare

Several native amphibious plant species were recorded at Sandilong Creek in biodiversity assessments by Ecology Australia (Ewing et al., 2023, Table 13). One exotic amphibious species (*Juncus acutus subsp. acutus*) was also noted. Amphibious species are predicted to benefit from the delivery of environmental water.

Table 13 – Native amphibious flora at Sandilong Creek

Scientific name	Common name	Arp	Ate	Atw
Acacia stenophylla	Eumong			✓
Cyperus gymnocaulos	Spiny flat-sedge		✓	
Duma florulenta	Tangled lignum			✓
Eucalyptus largiflorens	Black box			✓
Ludwigia peploides subsp. montevidensis	Water primrose	✓		
Marsilea drummondii	Common nardoo	✓		
Typha domingensis	Cumbungi		✓	

Arp - Amphibious, fluctuation-responder, floating species, with various growth characteristics, that feature morphological plasticity in response to water level fluctuations
Ate - Amphibious, fluctuation-tolerant, emergent species which are mostly monocotyledons (emergent plants that tolerate wetting and drying).
Atw - Amphibious, fluctuation-tolerant, emergent plants which are woody (trees and shrubs that tolerate wetting and drying).
Source: Ewing et al., 2023.

As noted above, River red gum, Black box and Lignum are key features of the ecological vegetation communities that fringe Sandilong Creek. The condition of Black box can be dependent on the frequency of inundation events, which in turn can impact on bud size and abundance of flowering (Roberts & Marston 2011). River red gum need flooding to meet all their water requirements; without flooding, distribution and quality can be limited (Di Stephano 2001). Flowering of River red gum occurs in summer, with seed fall occurring in spring, which is aligned to spring flood events (Roberts & Marston 2011), and allows distribution and germination of seed, thereby promoting recruitment. Understorey species often flower at this time also, generating a diversity of flora on the floodplain (S. Erlandsen 2013, pers. comm., 18 Sept).

River red gum and Black box trees provide habitat including feeding, breeding and refuge areas for fish, reptiles, mammals and birds DEC 2011). These trees can provide shelter for hollow-seeking native birds such as the Major Mitchell's cockatoo, and provide perching sites for visiting birdlife. Fallen limbs can provide hollow logs as harbour and nesting sites for reptiles. Healthy River red gums contribute to the wetland ecosystem by depositing organic material, and submerged fallen trees provide habitat (Roberts & Marston 2011) for aquatic species such as the Freshwater catfish. Healthy Black box helps provide important vegetative corridors to other areas above the floodplain for a range of transient native fauna. Also important in Black box communities and present in the target area are Lignum species (*Duma spp.).* Healthy Lignum provides shelter for a range of birdlife, nesting sites for smaller birds, and cover for frogs and reptiles.

To promote vigorous growth in River red gum forests, inundation every 1-3 years is needed. For Black box, this interval is 3-7 years. Lignum inundation requirements vary from 1-5 years (Roberts & Marston 2011).

5.1.3 Current ecological condition

Neither Sandilong Creek nor Sandilong Billabong have been previously assessed using the DEPI's Index of Wetland Condition. Extensive flooding of the Murray River occurred during late 2022 and continued into early 2023. Sandilong Creek and Sandilong Billabong were inundated during this event, thus their current ecological condition is unknown and may deviate from what has previously been reported.

Under normal conditions, Sandilong Creek is not hydrologically connected to the river and has a stable water level limiting the range of habitats and diversity and restricting the flora and fauna communities within or near the creek. The billabong has also lost its connectivity and without environmental watering would remain dry unless significant rainfall and associated runoff (or significant riverine floods) caused it to fill. Prior to the 2022 floods, Sandilong Billabong had been dry for approximately eight years (D. Gardiner pers. Comm. 2022).

Historically, the condition of the remnant vegetation has varied across the site. The River red gum and Black box trees lining the creek and fairways have benefitted from the irrigation of the golf course fairways and greens, and the canopy was generally in good condition. Native vegetation along the billabong was in poorer condition. The understorey surrounding the billabong has limited diversity of native species and the overstorey of Black box has suffered in dry years. The understorey lining the creek represents one of the most intact riparian vegetation communities in the area.

Native aquatic life at the site is limited by loss of connectivity to the river, blockages within the creek, stable water levels in the creek, Cumbungi growth, sedimentation due to lack of flow through and the carp population in the creek. Aquatic life at Sandilong Billabong has been impacted by extended dry conditions, and potentially impacted by salinity and saline drainage water.

5.2 Shared Benefits

Although the primary requirement of environmental watering is to achieve environmental objectives and outcomes, environmental water can provide benefits beyond environmental objectives. Shared benefits will be considered where they are compatible with the environmental objectives of the site.

Sandilong Creek exists within the Riverside Golf Course and so forms an integral part of the course itself. This is a shared value, along with the natural habitat the creek provides for native fish, birds and other fauna and flora. Sandilong Creek also contains historical values, as it used to contain a local swimming pool, remnants of which are visible.

5.2.1 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.

Within the Mallee CMA region, the Murray River and its associated waterways continue to be culturally significant 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 all of the target area at Sandilong Creek 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, 2022a). The Mallee CMA have engaged with FPMMAC about this EWMP and is committed to working with Traditional Owners 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)a.

5.2.2 Recreational values

Sandilong Creek forms part of the Riverside Golf Course. The Club's members are passionate about the natural aspects of the course. Club members are engaged and positive about the watering plan, and there is significant opportunity for wider public education in wetland management and appreciation.

The Riverside Golf Club holds key events each year including:

- March: Catch a Carp Day;
- April: Opens;
- June: Ladies' Club Championships;
- July: Golf Week; and
- August: Men's Club Championships.

The committee and management have expressed their preference to avoid receding waters during golfing events (as listed above); inundation to the maximum extent is ideal at these times to maximise course aesthetics. Conversely, lower water levels are preferred for the Catch a Carp Day (March).

Adjoining the golf course is the Murray River which is popular for boating, camping, fishing, bushwalking and swimming. Houseboats often moor at the designated landing site adjacent the golf course and visitors decamp

to play golf. On the floodplain is a horse racing course and horse complex. Situated beside the Golf Course is the Nichols Point Tennis Club. A community survey for the update of this EWMP revealed that Sandilong Creek is also a site of tourism operations.

5.2.3 Education values

The target wetlands are subject to high visitation by golfers and walkers, which makes them ideal for demonstration sites of wetland management practices. This provides an opportunity for the local community to gain significant awareness and appreciation of the value a healthy wetland.

Sandilong creek is also a monitoring site of several citizen science groups, including Waterwatch and Waterbug Blitz.

5.2.4 Economic Values

Sandilong Creek is situated within the Riverside Golf Course. The broader Sandilong asset area contains several recreational businesses, including the racing club and tennis club. A community consultation survey used to inform this EWMP revealed that Sandilong Creek is also used for tourism operations.

5.3 Trajectory of change

Management intervention began in Sandilong Creek with environmental watering events in 2011/12. Although water levels in the creek and billabong could be actively managed (achieving additional ecological outcomes through the variation of water levels), Sandilong Creek has been maintained at or near weir pool height (34.5m AHD) since Autumn 2015 and the Billabong has been dry for several years. If water levels are kept static in the creek, Cumbungi are predicted to again dominate the creek banks, limiting opportunistic germination of other species and subsequently limiting the recruitment of fauna species which require a variety of habitats and plants as food sources. Due to river regulation and existing levees, natural flood events alone would not be enough to limit Cumbungi growth and sustain these communities.

There has been works in and around the creek such as rubbish removal, carp removal, willow removal, and an improvement to fish passage. The Golf Club is supportive and has assisted with these works where possible. Efforts to build on these works and improve the health of the riparian vegetation and in-stream habitat are ongoing.

Sandilong Billabong especially, without delivery of environmental water is likely to continue to degrade. Previous watering events have aided recovery, however the surrounding vegetation has suffered considerably in past years and both the overstorey and understorey will continue to decline without further watering events. This will impact on both water dependent and vegetation dependent bird life, and ground dwelling fauna.

6 Managing water-related threats

The water-dependent values for the target area are described in Section 5. Threats to these values are the result of such factors as human intervention and extreme climatic events. Some of the threats which may have an impact on the target area include:

- Changed water regime
- Loss or reduction of wetland connectivity
- In-stream structures which inhibit fish passage
- Reduced water quality
- Introduction/increase of exotic flora and fauna
- Reduction in biodiversity of native flora allowing some species to become dominant
- Loss of woody debris and native hollow-bearing trees

The regulation of the Murray River and the installation of levee banks to protect the golf course from significant flooding has seen the water regime altered throughout Sandilong Creek and Sandilong Billabong. Flow events of the magnitude required to allow flows into the creeks and wetlands of the floodplain are less frequent and of shorter duration. This, combined with dry conditions over the last two decades affects the vigour of the vegetation and can place trees under stress, affecting the productivity and functioning of the floodplain ecosystem.

The almost static water level of Sandilong Creek has significantly altered the general ecology and diversity of the area, allowing some species of aquatic flora and fauna to flourish and reducing the capacity to support a more diverse ecosystem (e.g., dominance of Cumbungi and Common reed). Fluctuating water levels more closely mimicking natural flows can help restore balance.

The levees at either end of Sandilong Creek inhibit connectivity with the Murray River, preventing natural flow through and variable water levels. Two causeways limit movement of aquatic fauna within the creek. The billabong has lost connectivity with the river through the construction of levees during the 20th century. These threats have reduced the functionality of the billabong and led to a loss of a range of habitat niches and reduction in the extent and quality of available habitat.

Common carp infestation has been linked to increased turbidity and elevated nutrient levels, damage to aquatic plants and possibly algal blooms and bank erosion (Vilizzi et al., 2015 and Weber and Brown, 2009). Common carp infestation, combined with loss of flow through, may increase the possibility of water quality issues in the target area. Common carp also spread disease and compete with native species for food sources and habitat (Vilizzi et al., 2015 and Weber and Brown, 2009).

Rabbit infestation can impact on vegetation quality, extent and diversity and also on water quality through increased sediment entering the water bodies. Rabbits have been a problem in the past in the Nichols Point WMU, however a control program implemented by the Golf Course, with support from the Mallee CMA has helped to reduce rabbit density within the course. At the time of writing, rabbit numbers are likely to have been affected by the 2022-23 flood. In addition, the risks associated with rabbit numbers will vary with the population. The main risks will be around vegetation and weeds with some native species being vulnerable to rabbit grazing and additional opportunities for weeds.

Environmental weeds are an ongoing threat and management issue on the Murray River floodplain. These may pose an enhanced threat when water is applied. Of concern for this site are introduced grasses, several species of noxious weed, and garden escapees from neighbouring properties. A list of exotic flora species identified at Sandilong Asset wetlands are provided in Appendix 6.

The altered water regime is considered the major threat for the target area of the Nichols Point WMU and is the primary factor behind the development of this environmental water management plan.

Assessing risks.

Consideration of risk provides a link between recognition of system threats and key management processes, including decade and seasonal planning. Risk assessments are composed of both likelihood and consequence

components. In this instance, likelihood is influenced by the probability that there will be sufficient environmental water to maintain creek flows and water levels.

From a seasonal watering perspective, prioritisation of watering actions will be based on consequence. While consequence for an individual wetland can be determined, environmental water allocations require consideration of the consequences at larger scales. For the Mallee CMA it is their region, for the VEWH it is Victoria and the CEWH it is the Murray Darling Basin.

Sandilong Creek is of value due to its vegetation communities and Freshwater catfish population. The vegetation communities have the capacity to resist or recover from dry periods. Freshwater catfish were once common across the region, however, their population and distribution have declined. Freshwater catfish are, however, present in a number of wetlands in the region. In terms of identifying risks, Freshwater catfish are capable of moving to avoid adverse conditions, although their needs and cues for movement remain uncertain. The Freshwater catfish population is vulnerable to both dry periods and changes in connectivity that may allow increases in Common carp numbers. While the effective management of connectivity is still uncertain, management of connectivity has the potential to facilitate Freshwater catfish movements to both complete their life cycle and evade disturbance due to poor water quality or drying.

Not all consequences can be identified as readily and so we have provided a process that can be followed in Appendix 7.

7 Management goals, objectives and targets

6.1 Management goal

The management goal for Sandilong Creek and Sandilong Billabong was developed through consultation with experts and stakeholders including DEECA, and Riverside Golf Club. The goal considers the values the wetland supports and the potential threats that need to be managed. This includes consideration of the values the wetland has historically supported and the likely values it could support into the future.

Management goal: To provide a watering regime that supports water dependent native fauna and supports productive native vegetation communities within the target area

This goal is strongly linked to the goals of the Mallee Waterway Strategy 2014-2022 (Mallee CMA 2014), which are to:

- Increase the diversity and structure of native vegetation
- Increase the control of undesirable flora and fauna
- Increase the delivery of watering regimes which meet environmental objectives
- Maintain cultural heritage values
- Increase target audiences' awareness and understanding
- Increase target audiences' skill and participation
- Increase amenity

6.2 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) were refined 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 (the extent to which targets are Specific, Measurable, Achievable, Relevant and Time-bound), mapping to Basin Plan and update of each objective for Sandilong can be found in Section 5.17.1 of Butcher et al. (2020) and Appendix 8. Following stakeholder consultation in 2023, and following recommendations from a biodiversity assessment report by Ecology Australia (Ewing et al., 2023) one additional ecological objective has been developed for the Sandilong Creek and Sandilong Billabong asset (SC4). The ecological objectives and targets for Sandilong Creek and Billabong are shown in Table 14.

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.

Note, the numbering of the environmental objectives in this EWMP has been adopted from the assessment by Butcher et al. (2020).

Table 14 - Environmental objectives and targets

Environmental objective	Target
SC2: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Sandilong Billabong, Sandilong Creek.	• By 2030, in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Sandilong Billabong, Sandilong Creek with ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4
SC3: By 2030, improve condition and maintain extent from baseline (2006) levels of Black box (*Eucalyptus largiflorens*) to sustain communities and processes reliant of such communities at Sandilong Billabong, Sandilong Creek	• A positive trend in the condition score of Black box dominated EVC benchmarks at Sandilong Billabong, Sandilong Creek at 50% of sites over the 10 year period. OR • By 2030, at stressed sites (see Wallace et al. 2020) at Sandilong Billabong, Sandilong Creek: in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10. Baseline condition of Black box trees needs to be established to ensure TCI good is achievable - may need to rewrite target and adaptively manage this as condition improves.
SC4: By 2030, improve the population of Freshwater catfish (*Tandanus tandanus*) at the Sandilong Creek and Billabong asset.	By 2030, maintain a self-sustaining population of Freshwater catfish (*Tandanus tandanus*) at the Sandilong Creek and Billabong asset: - YoY recorded in 8 out of 10 years • - Abundance of adult fish increased by 20% from baseline of xx (year, levels, citation)

6.3 Regional significance

The significant environmental, social, cultural and economic values of Sandilong Creek and Billabong are described in Section 5. The area is rich in biodiversity, provides essential habitat for native species, and is a refuge for listed flora and fauna species. In a regional context, permanent wetlands provide important standing water habitat for a range of species. These types of habitats become more important during periods of drought when they provide an important refuge for populations of waterbirds, frogs, reptiles and wetland specialist fish species. The nature of the connection between the river and the wetland is critical to both the species that can use the wetland, but also the extent to which invasive species such as carp will enter and proliferate. Species known to move between the river and wetlands include the Murray River turtle, Broad-shelled turtle, Common long-necked turtle, Freshwater catfish, Golden perch, Carp gudgeon and Common yabby. Some of these species will breed in the wetland, while for others, the wetland provides an abundant source of food that will influence condition and fecundity.

Sandilong Creek is a high value site for conservation of Freshwater catfish. Providing some fluctuation to water levels is an important tool in improving aquatic vegetation diversity which may in turn support the population of Freshwater catfish (DSE 2005b). Inundation of part of the area surrounding the creek may provide additional forage areas, habitat and breeding sites, as well as improving the overall ecology of the target area through recruitment of key native species and reducing the prevalence of weeds. Ecology Australia have suggested that a range of hydrological regimes be trialled at Sandilong Creek to evaluate Freshwater catfish recruitment response (Ewing et al., 2023).

Other important native aquatic species have been recorded in the creek including the Broad-shelled, Common long-necked and Murray River turtles, and Golden perch, indicating the site is worthy of enhancement through environmental watering. Aquatic macrophytes provide important forage, breeding and nursery habitat and refugia for aquatic fauna. The nearby billabong also presents as potential extended habitat for local turtle and frog populations through the delivery of environmental water intermittently to the billabong. At the eastern end of the billabong, a community of Tangled lignum offers shelter for a range of native fauna. Ecology Australia recently identified Sandilong Creek as a key wetland for the priority hydrological management for microbats (Ewing et al., 2023), which are indirectly water-dependent due to their reliance upon hollows in water-dependent trees and macroinvertebrates for habitat and food, respectively.

River red gum communities line the creek. Black box communities occur higher on the floodplain, and surrounding the billabong. These communities can provide shelter and habitat in the form of tree hollows and hollow logs for fauna including microbats and hollow-dependent birds. River red gum can provide snags that could be used as habitat by the Freshwater catfish and other native large-bodied fish. Healthy River red gums can also improve wetland health through moderating water temperatures by shading, and delivery of dissolved organic carbon (Roberts & Marston 2011). Lignum is an important understorey component in floodplain environments (Roberts & Marston 2011).

Therefore, the specific values within the target area for this plan that make this area a priority for protection, enhancement and education through environmental water management are the: Freshwater catfish (*Tandanus tandanus*); Black box (*Eucalyptus largiflorens*); and Tangled lignum (*Duma florulenta*).

These values are interconnected. Environmental watering supports aquatic macrophytes, River red gum, Black box and Lignum communities and has the potential to improve wetland condition and contribute to primary production. Aquatic macrophytes are key components in aquatic food webs and provide habitat, supporting macroinvertebrates, fish, microbats, turtles and waterbirds. Black box and River red gum provide hollows and shelter for microbats and birds, while River red gums provide shade and a source of large wood (snags) for Freshwater catfish. Lignum provides shelter for reptiles and smaller native birds.

6.4 Alignment to Basin Plan

Key elements of the Basin Plan have been integrated into the Sandilong Creek EWMP objectives, including adopting the same conceptual framework. The EWMP objectives were also developed based on the same ecological knowledge about how Murray River floodplains work.

Under the Basin Plan, the overall environmental objectives for the water-dependent ecosystems of the Murray–Darling Basin are:

- to protect and restore water-dependent ecosystems of the Murray–Darling Basin (8.05)
- to protect and restore the ecosystem functions of water-dependent ecosystems (8.06)
- to ensure that water-dependent ecosystems are resilient to climate change and other risks and threats (8.07).

The Sandilong Creek EWMP objectives were developed to align with these overall objectives and to integrate and encode the intent of Basin Plan. Table 15~~Table 15~~ shows the alignment between the EWMP objectives and the Basin Plan's overall environmental objectives and subobjectives under sections 8.05, 8.06 and 8.07. The Mapping of EWMP objectives to other policy instruments, such as the long term watering plan, and Schedule 7 targets and Basin wide Environmental Watering strategy are shown in Appendix 9.

Table 15 – Alignment of EWMP objectives with the Basin Plan

EWMP objective	Alignment with Basin Plan		
	8.05 Ecosystem and biodiversity	**8.06** Ecosystem function	**8.07** Ecosystem resilience
SC2: By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Sandilong Billabong, Sandilong Creek.	3b	-	-
SC3: By 2030, improve condition and maintain extent from baseline (2006) levels of Black box (*Eucalyptus largiflorens*) to sustain communities and processes reliant of such communities at Sandilong Billabong, Sandilong Creek	3b	-	-
SC4: By 2030, improve the population of Freshwater catfish (*Tandanus tandanus*) at the Sandilong Creek and Billabong asset.	3a, 3b	-	-

Sandilong Creek. *Source: Mallee CMA*

8 Environmental water requirements and intended water regime

8.1 Environmental water requirements and intended water regime

As detailed above, the ecological objectives at this site are centred on maintaining and improving the Black box and Lignum communities, and supporting the Freshwater catfish population.

Freshwater catfish prefer slow-flowing water bodies, and little is known about the response of this species to flood events. Hydrological requirements of Freshwater catfish are therefore aimed at minimising disruption to breeding patterns, and avoiding complete draw down of Sandilong Creek. Inundation of Sandilong Creek prior to commencement of the breeding season (Spring and Summer) may offer additional nesting sites. Rapid fill events should be avoided during this time to minimise turbidity, reduce the chance of silt settling on eggs and to reduce the risk of a significant change in water temperature. Water levels should be maintained at 35.7m AHD throughout the breeding season, with drawdown commencing after the breeding season to reduce the risk of exposing active nesting sites.

At Sandilong Creek and Billabong, nearly all of the Lignum and the majority of the Black box are located within 20m of the wetland edges, and will therefore benefit from wetland flooding. Black box require flooding every three to seven years, with durations of two to six months. The species can tolerate shorter flood durations but plant vigour will suffer. Although the timing of flood events is not crucial for Black box, it will affect understorey and other woodland biota. Black box trees may survive prolonged periods of twelve to sixteen years with no flooding, but tree health will suffer and woodlands will become dysfunctional (Roberts and Marston, 2011).

Lignum can tolerate a wide range of wet and dry conditions as well as moderate salinity levels. Flood requirements vary with frequencies of one to three years needed to maintain large shrubs with vigorous canopy, and flooding every three to five years for maintenance of healthy shrubs. Intervals of seven to ten years can be tolerated by small shrubs but growth will decline and these plants do not accommodate nesting by birds. Durations of three to seven months is required to sustain vigorous canopy, but continuous flooding is detrimental. Although timing of flooding is not crucial for Lignum, following natural seasonality is encouraged to provide for understorey and wetland plants (Roberts & Marston 2011).

Minimum, maximum and optimal watering regimes for Sandilong Creek and Sandilong Billabong are shown in Table 16.

Table 16 - Seasonally Adaptive Watering Regime

Minimum watering regime - Sandilong Creek Frequency: Two watering events every ten years. Timing: Raise the level of the creek slowly in spring-summer by 1.2 m to 35.7 m AHD Duration: Two months, slow recession January - March Maximum interval between events: Seven years
Maximum watering regime – Sandilong Creek Frequency: Five watering events every ten years. Timing: Raise the level of the creek slowly in spring-summer by 1.2 m to 35.7 m AHD Duration: Four Months. Slow recession from February - March Maximum interval between events: Two years
Optimal watering regime – Sandilong Creek Frequency: Three watering events every ten years. Timing: Raise the level of the creek slowly in spring-summer by 1.2 m to 35.7 m AHD Duration: Three months, slow recession from January - March Maximum interval between events: Four years
Minimum watering regime – Sandilong Billabong Frequency: Two watering events every ten years. Timing: Inundate the billabong area in spring-summer to 35.7 m AHD Duration: Maintain the water in the billabong for two months. Maximum interval between events: Eight years
Maximum watering regime – Sandilong Billabong Frequency: Four watering events every ten years. Timing: Inundate the billabong area in spring to 35.7 m AHD Duration: Maintain the water in the billabong for six months. Maximum interval between events: Two years
Optimal watering regime – Sandilong Billabong Frequency: Three watering events every ten years Timing: Inundate the billabong area in spring to 35.7 m AHD Duration: Maintain the water in the billabong for three months. Maximum interval between events: Three years

8.1.1 Expected watering effects

Potential watering actions and expected watering effects for Sandilong Creek in an optimal year are outlined in Table 17.

Table 17 - Expected watering effects to achieve environmental objectives.

Objective Code	Environmental objective	Potential watering action	Expected watering effects
SC2	By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Sandilong Billabong, Sandilong Creek.	Spring/summer Top up and maintain water level to reflect Full-Supply level of the adjacent weir pool by opening the regulators. Autumn/winter Allow water level to draw down by closing the regulators. Note, water level is not to be drawn down completely, so as to support Freshwater catfish.	Spring/Summer: Topping up and the maintenance of water level will: Provide a productivity pulse to support the food web, provide conditions to support growth of annual aquatic and emergent vegetation Support communities of Freshwater catfish and other native fish within the wetland and provide habitat for frogs and waterbirds Autumn/Winter Drawdown will result in drying of margins of Sandilong Creek; allowing sediments to consolidate, provide conditions to support growth of aquatic or amphibious vegetation.
SC3	By 2030, improve condition and maintain extent from baseline (2006) levels of Black box (*Eucalyptus largiflorens*) to sustain communities and processes reliant of such communities at Sandilong Billabong, Sandilong Creek.		
SC4	By 2030, improve the population of Freshwater catfish (*Tandanus tandanus*) at the Sandilong Creek and Billabong asset.		

8.2 Seasonally adaptive approach

The annual environmental water planning process in Victoria uses a seasonally adaptive approach, which identifies the priorities for environmental watering under different climatic conditions such as drought, dry, average and wet. This means that watering events can be tailored to current conditions and be easily adapted in response to short-term climatic variability, as conditions can change quickly during a water year.

Seasonal conditions can vary considerably between years, which affects both the environmental water needs of particular sites and/or assets (the demand) and the volume of water available (the supply).

Annual water planning includes a flexible decision framework to guide prioritisation of allocation of water for the environment, as well as site environmental watering proposals, water availability forecasts and management objectives for water resource scenarios.

The water regime for Sandilong Creek and Sandilong Billabong is outlined above in Table 16, and can be delivered in a seasonally adaptive manner. 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. Due to the inter-annual variability of these estimates (particularly the 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.

Because the billabong has a different water requirement to the creek, but cannot be watered without a creek fill, regimes are proposed for each zone separately. Watering of the creek could occur in isolation if the connecting pipe were closed off for the duration of the event. The billabong could be filled separately through the installation of a temporary pump.

For all watering regimes, recession of water should occur slowly, and not immediately after Freshwater catfish spawning is likely to have occurred, so as to minimise disturbance to nest sites. Freshwater catfish are believed to nest and spawn in spring and summer when temperatures increase to 20-24^{o}C.

The broad seasonally adaptive management approach for Sandilong Creek is summarised in Figure 7. During drought and dry periods, the Freshwater catfish population is most vulnerable to loss of habitat. Aquatic macrophytes have a range of strategies to deal with dry periods through seed-banks or resistant vegetative structures. Under drought and dry conditions, the priority will be to maintain refuge habitat for Freshwater catfish. This will include consideration of both the amount of aquatic habitat, but also the associated water quality which will decline as the wetland dries. Maintaining Freshwater catfish refuges should also protect aquatic macrophytes allowing a limited number of species to contribute seeds to the seed-back and ensuring that there are viable seeds available to respond to the return of wet conditions.

As the amount of environmental water increases under median and wet conditions, so the focus of environmental watering should shift to improving the condition of long-lived vegetation including River red gum and Black box. Given the limited volumes of environmental water the objective is to protect the current extent of long-lived vegetation. If environmental flows are associated with widespread tree germination, this may pose a risk to aquatic macrophytes and will need to be managed carefully.

For Freshwater catfish populations average and wet conditions provide opportunities for successful recruitment and for Sandilong Creek to act as a source of Freshwater catfish recruits to the broader region through connection to the Murray River.

Figure 7 – Seasonally adaptive approach

9 Environmental water delivery infrastructure

9.1 Water delivery infrastructure

The target area of this EWMP does not contain any permanent water delivery infrastructure. As mentioned previously, Sandilong Creek is connected to the river at both ends by pipes that have valves that can be opened and closed as required. Additional water delivery to the creek or billabong would occur via temporary pumps.

9.2 Constraints

The existing arrangements and surrounding land use limit the extent of area of floodplain which can be inundated by environmental watering (Sandilong Creek and Sandilong Billabong) to 8.84 ha. The extent of inundation cannot be increased without interference to the operation of the golf course. Watering events predominantly occur via a pipe and valve through the levee, although temporary pumps can and have been used to water the target wetlands.

With current infrastructure, the billabong cannot be watered without first inundating the creek to a sufficient depth (approximately 35 m AHD). Temporary pumps could be used to independently fill the billabong. Without closing off the fill pipe, the billabong will be watered during every event, in conjunction with the creek.

Fish passage within the creek is inhibited by two of the three causeways (Figure 5~~Figure 5~~). A fish-friendly structure was placed at the swing bridge causeway during 2010 (Figure 8) however two obstructive causeways remain. Besides impact on aquatic fauna, these two crossings are submerged during watering events, and a low level of damage is sustained to the crossing surface, which must be rebuilt after the water has receded. The submersion of these two crossings impedes golf course operations as they are used as machinery crossings as well as pedestrian crossings. The centre crossing is also used by golfers visiting from the river. It is recommended that these causeways be modified to enable fish passage and access by golfers, golf course staff and machinery (Figure 9). One of these crossings (nearest the clubhouse) would need to be constructed to a standard capable of supporting heavy machinery, as it is a high-use crossing for golf club machinery. Note: risks and water-related threats are detailed in Section 6.

The proposed infrastructure would provide greater movement of fish and other aquatic species within the creek, provide further habitat, and help return the creek to a more natural structure.

Figure 8 - A fish friendly causeway installed near the swing bridge site in 2010

The water in Sandilong Creek is usually maintained at weir pool height (approximately 34.5 m AHD). This means that any increase or decrease in water levels must be achieved through pumping or opening the upstream valve during a natural rise in the Murray River, which could be augmented with pumping.

The inlet pipes are located within the creek bed at each end of the creek and pass through the levee at each location. The levees are constructed to approximately 39 m AHD, which is around 5 m above creek level. Investigations could be undertaken to design and cost suitable structures. The likely impact of restoring connectivity on the Freshwater catfish population should be investigated.

In the longer term, investigations should be undertaken to determine options for the installation of regulator structures in the levee at either end of the creek (Figure 9). Modification of the existing levee, however, requires careful consideration of all potential risks and implications.

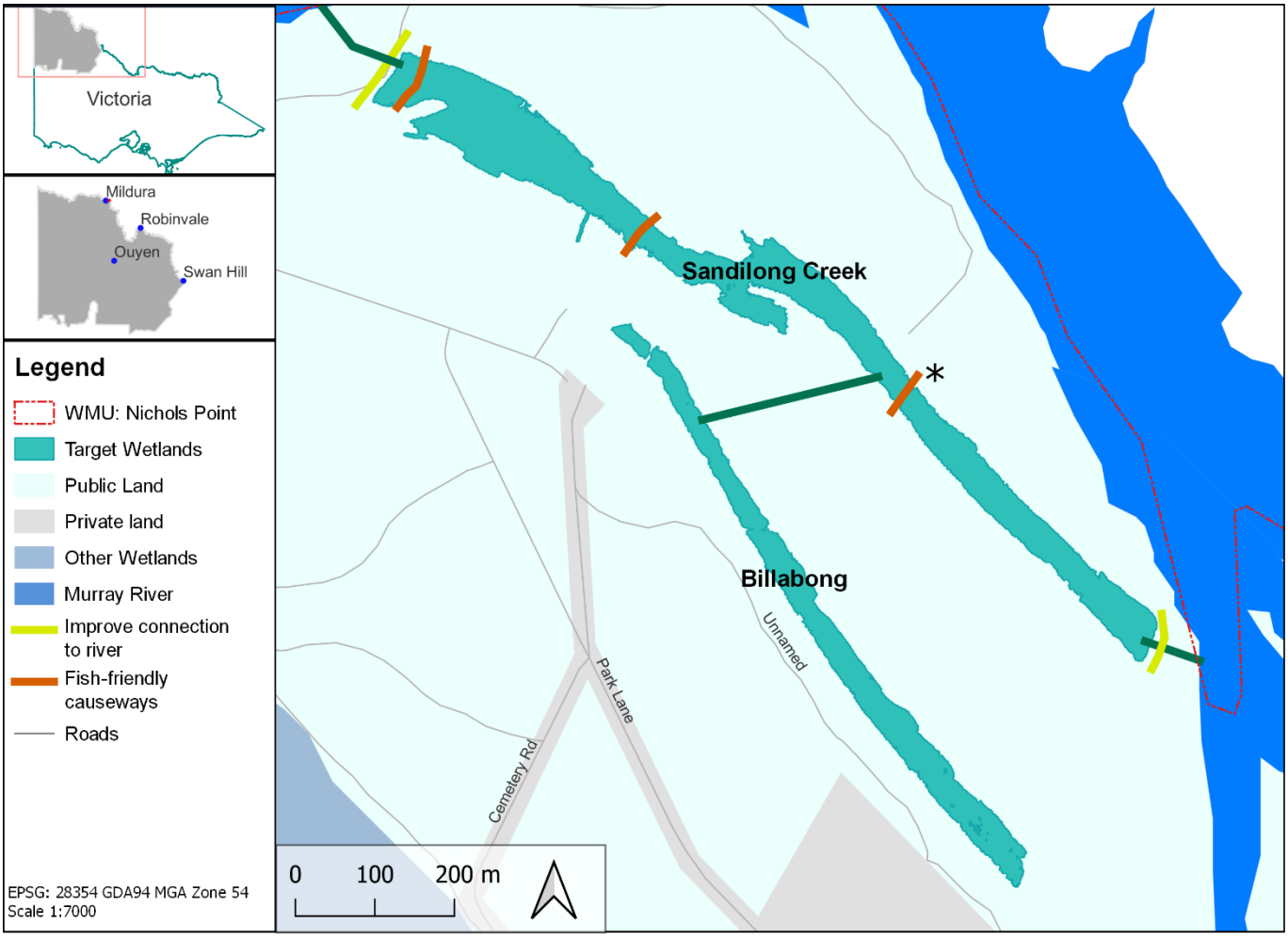

Figure 9 – Opportunities to improve fish passage at Sandilong Creek (existing structure marked *)

10 Demonstrating outcomes – monitoring and assessment

Ecological monitoring is required to demonstrate the effectiveness of environmental watering in achieving ecological objectives, to help manage environmental risks and to identify opportunities to improve the efficiency and effectiveness of the program. Detailed monitoring is dependent upon funding from the State or Commonwealth governments. The broad program logic for the creek is:

- Objectives (Section 7.2)
- Environmental flows to provide:
  - Habitat
- Outcomes
  - Improved condition of long-lived vegetation
  - Maintain distribution of long-lived vegetation
  - Populations of Freshwater catfish

10.1 Environmental Monitoring

The watering program for Sandilong Creek and Billabong has been designed to optimise ecological outcomes. There will be opportunities to review and improve operations based on monitored responses to actual events to improve how environmental water is managed to achieve the ecological objectives. Proposed environmental monitoring at Sandilong Creek and Billabong is shown in Table 18.

Table 18 - Links between environmental objectives, monitoring questions and survey methods

Objective	Monitoring focus	Monitoring question	Method	When
SC2	Lignum condition and extent	Has environmental water increased lignum condition and extent? Does lignum condition meet targets? Is there evidence of lignum recruitment?	Direct assessment, transects survey, phot point monitoring, remote sensing	Lignum condition plots measured annually
SC3	Black box condition and extent	Are new trees being recruited into the forest and woodland populations? Does Black box condition meet targets?	Evaluate survival of seedlings over a 15 period, transect survey, photo point monitoring, remote sensing	Stand condition plots measured annually
SC4	Freshwater catfish population	Has environmental water increased the abundance of Freshwater catfish? Are young of year targets being met? What is the abundance of Common carp (key threat)	Electrofishing field surveys	Annual

10.2 Monitoring priorities at the asset

The highest priorities for monitoring at Sandilong Creek and Billabong are the monitoring questions that most strongly influence watering decisions and the evaluation of watering effectiveness.

All these priorities align with the following long-term outcomes of the Mallee Regional Catchment Strategy Waterway theme:

- 3.2.1 The condition of high value aquatic and riparian habitat is improved
- 3.2.2 Appropriate water regimes are restored to priority waterways and connectivity is improved.

Table 19 lists the monitoring priorities at Sandilong Creek and Billabong

Table 19 - Monitoring priorities at Sandilong Creek and Billabong

Monitoring priority	Reason for priority
Water delivery	Water is managed to meet vegetation and native fish requirements and EWMP objectives
Index of wetland condition assessments	These will review and report on changes in hydrology and water quality that impact on flora and fauna
Lignum condition and extent	Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan
Black Box stand condition and extent	Key for assessing progress against objectives of the Basin Plan Environmental Watering Plan (EWP), Basin Plan Schedule 7 targets, Basin wide Environmental Watering strategy (BWS) and Victorian Murray Long Term Watering Plan Important long-term indicator of the effectiveness of environmental water.
Freshwater catfish abundance and age diversity, Common carp abundance	Sandilong creek is one of few sites with a breeding population of Freshwater catfish, which are listed as vulnerable under State and Commonwealth legislation, and whose responses to environmental water are unclear. Electrofishing to monitor freshwater catfish is also a useful tool for Common carp monitoring and removal.

11 Adaptive Management

Mallee CMA uses an adaptive management approach in planning, and managing environmental watering actions.

Adaptive management is the process of incorporating new scientific and operational information into the implementation of a project or plan to ensure that management actions are appropriate, effective and contribute to goals efficiently. It is a standard and well-established practice for environmental water management, recognising the inherent uncertainties and risks associated with the complex relationships between changes to hydrology and ecological responses, and the potential for a watering event to provide both positive and adverse outcomes.

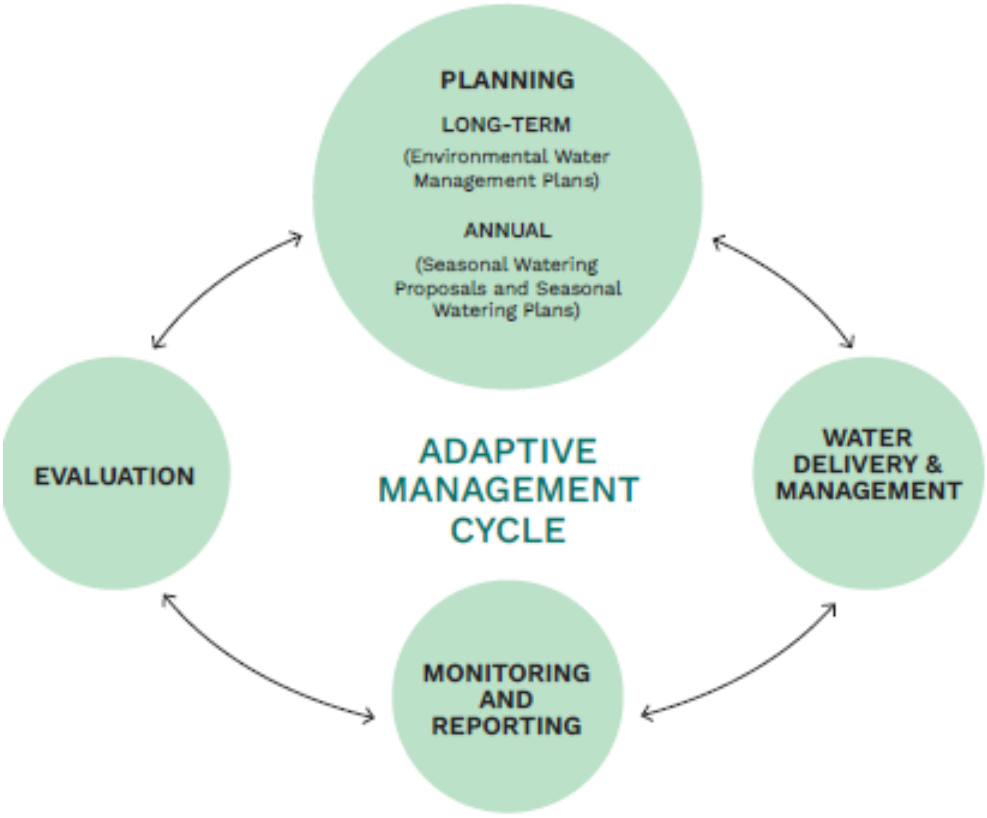

Figure 10~~Figure 10~~ shows an illustration of the adaptive management cycle for environmental water delivery.

Figure 10 - The adaptive management cycle for environmental water delivery and management

Mallee CMA uses three main pathways to identify inputs to the adaptive management process (also referred to as lessons):

- monitoring to detect differences between what was planned and the outcomes at the environmental watering site
- incidental observations by managers, operators or other observers that identify opportunities to reduce risk or improve outcomes
- research or investigations into hydraulic or ecological management practices that could improve the conceptual models on which operations are based.

In 2022, Mallee CMA further refined its adaptive management approach, implementing the Environmental Watering Adaptive Management Framework (Mallee CMA 2022b)

Mallee CMA formally documents lessons to strengthen organisational memory and provide transparency in continual improvement measures. Recording of lessons is crucial for both annual environmental watering actions

and long-term planning. Demonstrating continual improvement provides the justification for monitoring programs and confirms that assets are being managed responsibly.

Mallee CMA's adaptive management framework has several components that work together to build lessons learned from environmental watering actions and program partners into the environmental water program. In this way, we iteratively improve the way environmental watering is undertaken using the best available evidence.

The EWMP will be constantly refined to incorporate learnings from ecological monitoring as well as feedback from community consultation.

Land managers and river operators are included in the operational planning cycle which include adaptive management processes to incorporate learnings and risk management.

11.1 Adaptive management program components

The four main components of this program are as follows:

11.1.1 Environmental watering database

Mallee CMA uses an Environmental Watering Database for storage of watering information. It stores hydrological, environmental, and ecological watering event details, including data for informing adaptive management decisions.

11.1.1.1 Annual adaptive management checkpoint

An annual adaptive management checkpoint (AM Checkpoint) for each of Mallee CMA's Seasonal Watering Proposals provides a structured and formalised forum for evaluation and review.

The outcomes from each AM Checkpoint:

- informs the annual reporting to relevant stakeholders, including VEWH and DEECA
- identifies the key lessons from environmental water delivery events throughout the year, to be documented into the Watering Event Lessons (WEL) Record (below)
- informs Mallee CMA environment water annual planning for subsequent years.

11.1.1.2 Watering Event Lessons (WEL) record

Key decisions and justifications, new knowledge and lessons learned are documented in a 'live', site-specific, centralised, document called a Watering Event Lessons (WEL) Record. The WEL Record provides an opportunity for planning and delivery information to be systematically recorded and retained for subsequent evaluation at the AM Checkpoint (see above).

The WEL Record is also used to capture outcomes and knowledge generated from lesson review at the AM Checkpoint.

WEL Records are updated at the end of each watering event providing an accessible library of lessons ready to be uploaded into the CMA's organisational knowledge base via the EWMP update process.

11.1.1.3 Seasonal watering proposal presentation adaptive management section

The annual seasonal watering proposals presentation to Mallee CMA Chief Executive Officer and Executive Management includes a section on adaptive management.

This section explicitly focuses on outcomes and observations from previous events and any subsequent changes being made as a response within that years' Seasonal Watering Proposal. This promotes for the broader dissemination of findings and outcomes within Mallee CMA.

11.1.1.4 Monitoring consultants' findings summary

Monitoring consultants are required to synthesise their results and describe the implications of results for ongoing environmental watering programs. This promotes the transfer and uptake of knowledge from monitoring and other investigations into Mallee CMA water planning and management.

Figure 11
~~Figure 11~~ shows how adaptive management processes are integrated with Mallee CMA's environmental watering program.

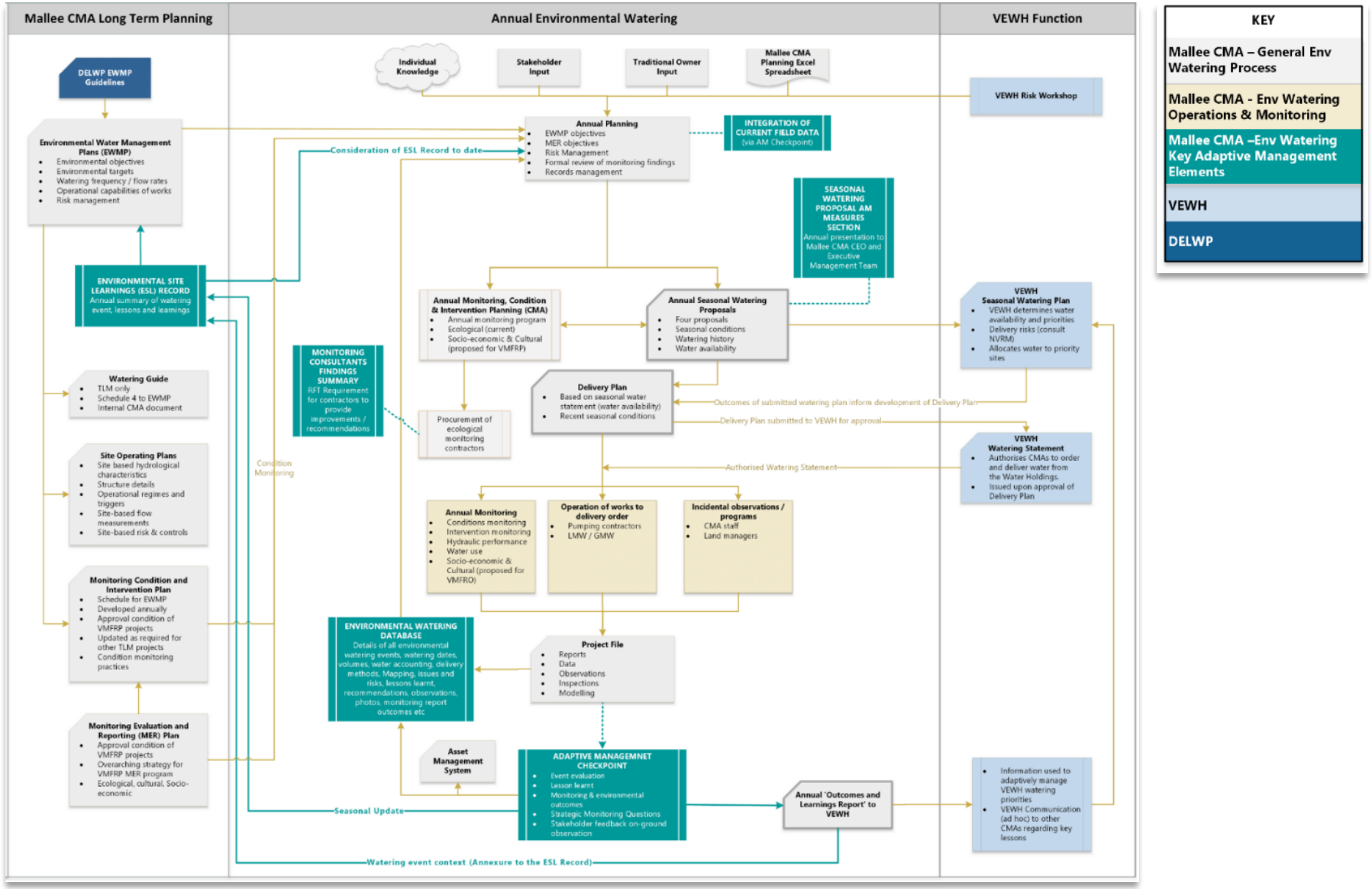

Figure 11 - Mallee CMA environmental watering program with adaptive management processes (green boxes)

12 Knowledge gaps and recommendations

This plan is based on best information at the time of writing. In some cases, information is scarce or outdated. Further investigation and information collection will continue and the results of this further work will continue to build a better picture of the site and add rigor to future planning. Some areas where further knowledge would be beneficial are outlined in

Table 20~~Table 20~~. Any future monitoring plan could include a number of these recommendations.

Table 20 - Knowledge gaps and recommendations for the target area

Knowledge and data gaps	Action recommended	Responsibility
Conceptual and detail designs for management works	Engage consultants to carry out investigations and designs	Implementation of any of these recommendations would be dependent on investment from Victorian and Australian Government funding sources as projects managed through the Mallee CMA
Connectivity pros and cons	Investigate benefits and potential negative impacts on Freshwater catfish population in providing connectivity to the Murray River	
Role of wetland on turtle and frog breeding and population	Annual fish surveys each spring to determine if: species diversity is maintained; varying size cohorts continue to occur; and exotic species are controlled. Assessment of spawning timings, durations, water depths, temperatures, etc. Assessment of Freshwater catfish population diversity and estimate sustainable population size; Catch-a-Carp Days Annual turtle and frog surveys.	
Effects of watering program on carp breeding and populations		
Understanding Freshwater catfish population dynamics (e.g. spawning habits)		
Impact of watering program on littoral vegetation	Assessment of littoral vegetation extent and diversity before and after watering events	
Role of Cumbungi as habitat for aquatic and terrestrial fauna; its ability to recover from semi-regular inundation	Field surveys of reed-dwelling fauna (e.g., Clamorous reed warbler). Annual assessment of Cumbungi extent	
Impact on riparian vegetation condition and diversity	Annual vegetation assessments (including understorey diversity and condition)	
Impact on exotic weed species	Assessment of weed proliferation before and after watering event	
Accurate depth & volume measurements for wetland	Determination of depth/volume to commence to flow to billabong	
Index of wetland condition	Conduct assessment of creek and billabong separately	
Impacts of nearby irrigation on wetland health	Investigation of surface water, groundwater and irrigation water interaction	
Nesting habits of birds at the site	Survey of species and numbers	

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14 EWMP Appendices

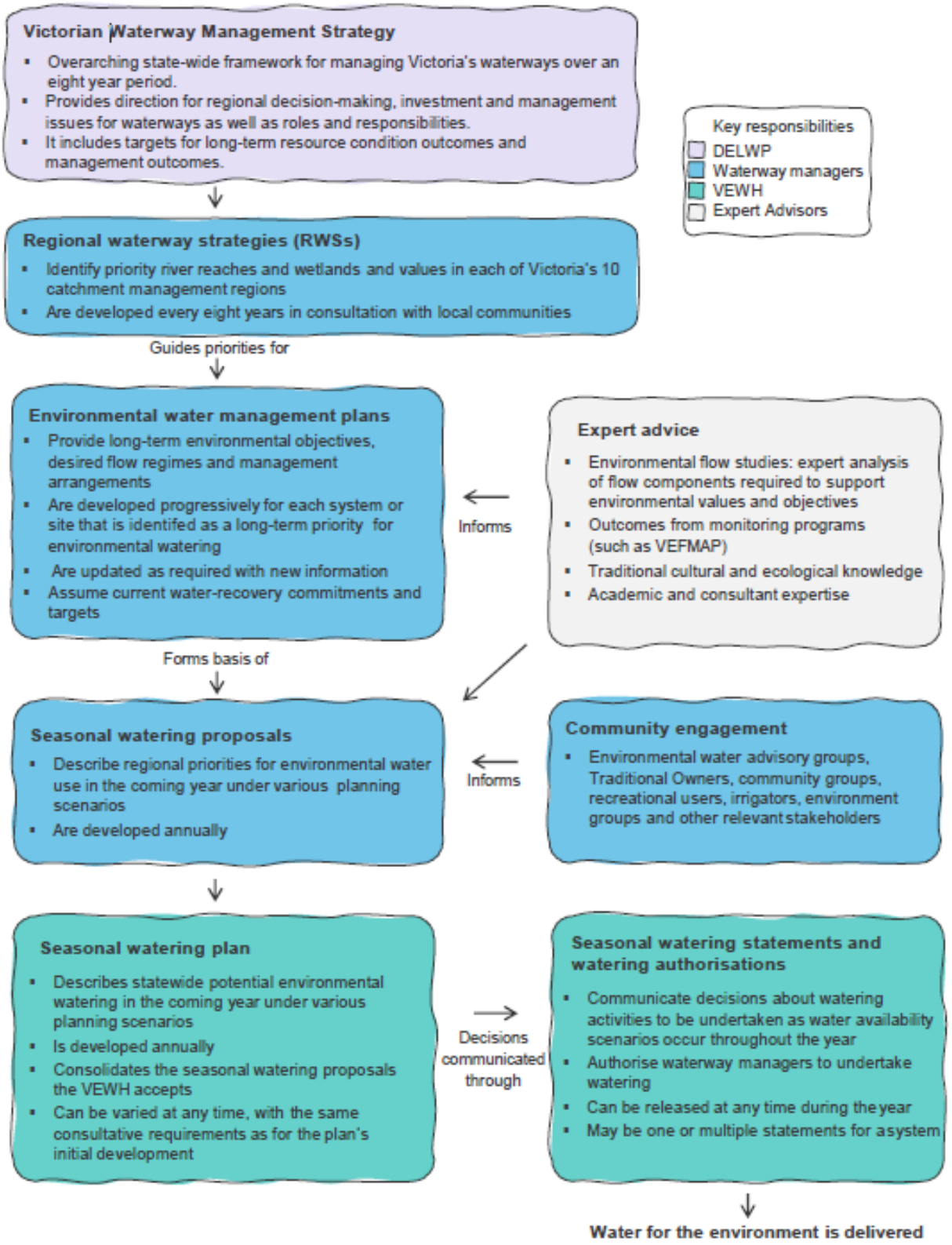
Appendix 1 – EWMP context

Environmental Water Management Plan Context

Environmental water in Victoria is managed as an integral part of the Victorian Waterway Management Program. The state-level Victorian Waterway Management Strategy (VWMS) provides the overarching framework for environmental water management (see accompanying figure). The Mallee Waterway Strategy (2014-22) drives implementation of the VWMS at the regional level. Information from the Mallee Waterway Strategy is a key input to environmental water planning arrangements, including the selection of eligible assets to receive environmental water. Environmental water management plans are site-specific plans developed for a wetland or wetland complex deemed a priority to receive environmental water through the Mallee Waterway Strategy development process. This document is the Environmental Water Management Plan (EWMP) *for Sandilong Creek in* the Mallee Catchment Management region.

Environmental watering in the Mallee Region has historically been supported by management plans such as this one, that document key information including the watering requirements of an asset, predicted ecological responses and water delivery arrangements. These plans support annual decisions about which sites should receive water and assist managers to evaluate how well those assets respond to the water they receive or what could be done better. Environmental water management at Sandilong Creek is further underpinned by the Murray-Darling Basin Plan 2012 (Commonwealth) and the associated Basin-wide environmental watering strategy. In accordance with Basin Plan requirements, Victoria has also developed the Victorian Murray Water Resource Plan and Victorian Murray Long-Term Watering Plan, which apply at Sandilong Creek.

Mallee Catchment Management Authority (MCMA), the Victorian Department of Energy, Environment and Climate Action (DEECA), the Victorian Environmental Water Holder (VEWH) and Traditional Owner groups have worked together to develop several EWMPs for watered assets throughout the Mallee region. These plans are continually updated through an adaptive management process. A primary purpose of EWMPs is to provide a consistent set of documents that support seasonal watering proposals to be submitted by asset managers to the VEWH annually.


Victorian Waterway Management Strategy
Overarching state-wide framework for managing Victoria's waterways over an eight year period.
Provides direction for regional decision-making, investment and management issues for waterways as well as roles and responsibilities.
It includes targets for long-term resource condition outcomes and management outcomes.
Key responsibilities
DELWP
Waterway managers
VEWH
Expert Advisors
Regional waterway strategies (RWSs)
Identify priority river reaches and wetlands and values in each of Victoria's 10 catchment management regions
Are developed every eight years in consultation with local communities
Guides priorities for
Environmental water management plans
Provide long-term environmental objectives, desired flow regimes and management arrangements
Are developed progressively for each system or site that is identifed as a long-term priority for environmental watering
Are updated as required with new information
Assume current water-recovery commitments and targets
Informs
Expert advice
Environmental flow studies: expert analysis of flow components required to support environmental values and objectives
Outcomes from monitoring programs (such as VEFMAP)
Traditional cultural and ecological knowledge
Academic and consultant expertise
Forms basis of
Seasonal watering proposals
Describe regional priorities for environmental water use in the coming year under various planning scenarios
Are developed annually
Informs
Community engagement
Environmental water advisory groups, Traditional Owners, community groups, recreational users, irrigators, environment groups and other relevant stakeholders
Seasonal watering plan
Describes statewide potential environmental watering in the coming year under various planning scenarios
Is developed annually
Consolidates the seasonal watering proposals the VEWH accepts
Can be varied at any time, with the same consultative requirements as for the plan's initial development
Decisions communicated through
Seasonal watering statements and watering authorisations
Communicate decisions about watering activities to be undertaken as water availability scenarios occur throughout the year
Authorise waterway managers to undertake watering
Can be released at any time during the year
May be one or multiple statements for a system
Water for the environment is delivered

Appendix 2 – Legislative Framework

Bilateral migratory bird agreements

Australia is a signatory to the following international bilateral migratory bird agreements:

- Japan-Australia Migratory Bird Agreement (JAMBA);
- China-Australia Migratory Bird Agreement (CAMBA); and
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

These agreements require that the parties protect migratory birds by: limiting the circumstances under which migratory birds are taken or traded; protecting and conserving important habitats; exchanging information; and building cooperative relationships

Convention on the Conservation of Migratory Species of Wild Animals (Bonn)

This convention (known as the Bonn Convention or CMS) aims to conserve terrestrial, marine and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. The Convention was signed in 1979 in Bonn, Germany, and entered into force in 1983

Commonwealth Legislation

Environment Protection and Biodiversity Conservation Act 1999 (EPBC)

This is the key piece of legislation pertaining to biodiversity conservation within Australia. It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places – defined in the EPBC Act as matters of national environmental significance.

Water Act 2007 (Commonwealth Water Act)

This establishes the Murray-Darling Basin Authority (MDBA) with the functions and powers, including enforcement powers, needed to ensure that Basin water resources are managed in an integrated and sustainable way.

Aboriginal and Torres Strait Islander Heritage Protection Act 1984

This aims to preserve and protect areas and objects in Australia and Australian waters that are of particular significance to indigenous people from injury or desecration

State legislation and listings

Flora and Fauna Guarantee Act 1988 (FFG)

This is the key piece of Victorian legislation for the conservation of threatened species and communities and for the management of potentially threatening processes.

Environmental Effects Act 1978

Potential environmental impacts of a proposed development are subject to assessment and approval under this Act. A structural works program and any associated environmental impacts would be subject to assessment and approval under the Act.

Planning and Environment Act 1987

This controls the removal or disturbance to native vegetation within Victoria by implementation of a three-step process of avoidance, minimisation and offsetting.

Water Act 1989 (Victorian Water Act)

This is the key piece of legislation that governs the way water entitlements are issued and allocated in Victoria. The Act also identifies water that is to be kept for the environment under the Environmental Water Reserve. The Act provides a framework for defining and managing Victoria's water resources.

Aboriginal Heritage Act 2006

All Aboriginal places, objects and human remains in Victoria are protected under this Act.

Other relevant legislation

The preceding legislation operates in conjunction with the following other Victorian legislation to influence the management and conservation of Victoria's natural resources as well as outline obligations with respect to obtaining approvals for structural works:

- *Environment Protection Act 1970*
- *Catchment and Land Protection Act 1994*
- *Heritage Act 1995*
- *Conservation, Forests and Lands Act 1987*
- *Land Act 1958*
- *Heritage Rivers Act 1992*
- *Wildlife Act 1975*
- *Murray Darling Basin Act 1993*
- *National Parks Act 1975*
- *Parks Victoria Act 1998*
- *Forests Act 1958*

Appendix 3 – 2023 Stakeholder and Community Engagement Process

Community Survey Development and Implementation

The content of an online community survey for each site was designed by Alluvium in late 2022, with review by Mallee CMA. 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.

Traditional Owner Consultation

Sandilong Creek and Sandilong Billabong are located on recognised Country of the First People of Millewa Mallee Aboriginal Corporation (FPMMAC). Several non-RAP groups have contested Country in the Mallee region and have interest in Mallee Wetlands.

Alluvium Consulting Australia made recommendations for engagement with Traditional Owner groups in the Stakeholder Engagement plan, including that the engagement with each group be held on a one-to-one basis, with the level, place and style of engagement self-determined by the Traditional Owners. Engagement was to be help at the IAP2 level of collaborate, if wished by the Traditional Owner Group.

Engagement was coordinated and facilitated by the Traditional Owner engagement unit at Mallee CMA. Discussions about the updating of the EWMPs were held with the FPMMAC, in accordance with FPMMAC preferences stated in the 2022 EWMP guidelines. Alluvium recognises that Mallee CMA is committed to working with Traditional Owners from across the Mallee Region 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 RCS, 2022).

Consultations with Traditional Owners are ongoing.

Agency Consultation

Mallee CMA facilitated meetings of with key environmental management agencies as part of annual discussions about the seasonal watering proposals. Agencies included:

- Parks Victoria
- Lower Murray Water
- Goulburn Murray Water
- Mildura Rural City Council
- DEECA
- VEWH

Discussions at the agency collaboration group meetings generally related to watering infrastructure and site access.

Appendix 4 - Sandilong Creek and Sandilong Billabong Community Values Survey Outcomes

Survey Data

Three of forty-seven respondents identified Sandilong Creek as the most important site (of all eight sites), although only one completed survey for Sandilong Creek was received. The one respondent is a resident and visitor to the region who visits the site daily, during all seasons except winter. The respondent visits Sandilong Billabong for walking/running, socialising and for tourism operations. The respondent did not respond to optional demographics questions.

The respondent considers Traditional Owner values, exercise, work or education opportunities and commercial and business opportunities as extremely important (5/5) at Sandilong Creek. Unique landscape features and natural beauty were of high importance (4/5), while recreational opportunities were of moderate importance (3/5). Note: the responded ticked 'Sandilong Creek' as the visited location within the EWMP area, but the 'importance of values' ranking information was completed for Sandilong Billabong.

Survey respondents were asked to rank the importance of known values at the site. These rankings are summarised in the table below

Community Values rankings Sandilong Creek

Community Value	Value ranking
Unique landscape features and natural beauty	This value was of high importance to the respondent (score 4/5)
Recreational opportunities (e.g. birdwatching, fishing, golfing)	Recreational opportunities were of moderate importance to the respondent (score 3/5)
Exercise (trails for walking, running, cycling)	The respondent considered exercise values of Sandilong Creek to be of extremely high importance (score 5/5)
Work or Education opportunities	The respondent considered work or education opportunities to be of extremely high importance (score 5/5)
Commercial or business opportunities	The respondent considered commercial or business opportunities to be of extremely high importance (score 5/5), and uses the site for tourism operations

Agency Consultation Meeting Comments

Sandilong Creek was not mentioned in the agency collaboration meeting notes.

Appendix 5 – Ecological vegetation classes (EVCs)

Descriptions of each EVC in the Sandilong Creek target area

EVC no.	EVC name	Bioregional conservation status	Description
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.
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.
813	Intermittent Swampy Woodland	Least concern	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 point-bar 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. Recruitment: continuous.
821	Tall Marsh	Least Concern	Wetland dominated by tall emergent graminoids (rushes, sedges, reeds), typically in thick species-poor swards. Competitive exclusion in core wetland habitat - of optimum growing conditions for species tolerant of sustained shallow inundation. Occupies wetlands usually associated with anabranch creeks. Soils are almost permanently moist. Dominant species are tolerant of relatively deep and sustained inundation, but not total immersion for any sustained period. Recruitment: Episodic/Flood: desirable period of disturbance is every year

Source: (DSE, 2004. Available at: https://www.environment.vic.gov.au/__data/assets/pdf_file/0030/48747/RobP_EVCs_combined.pdf)

Appendix 6 – Flora and fauna species list

Source: Victorian Biodiversity Atlas (NatureKit, April 2023)

14.1.1.1 Flora – Native species recorded in Sandilong Asset wetlands

Scientific Name	Common Name	FFG Act	VIC ADV List	EPBC Act Status
Atriplex lindleyi	Flat-top Saltbush			
Atriplex lindleyi subsp. inflata	Corky Saltbush			
Atriplex pumilio	Mat Saltbush			
Brachyscome lineariloba	Hard-head Daisy			
Calandrinia eremaea	Small Purslane			
Calotis cuneifolia	Blue burr-daisy	En		
Chenopodium nitrariaceum	Nitre Goosefoot			
Crassula colorata	Dense Crassula			
Crassula sieberiana s.l.	Sieber Crassula			
Disphyma crassifolium subsp. clavellatum	Rounded Noon-flower			
Duma florulenta	Tangled Lignum			
Duma horrida subsp. horrida	Spiny Lignum	CE	Rare	
Enchylaena tomentosa var. tomentosa	Ruby Saltbush			
Eremophila divaricata subsp. divaricata	Spreading emu-bush	Vu		
Eucalyptus largiflorens	Black Box			
Euchiton sphaericus	Annual Cudweed			
Frankenia serpyllifolia	Bristly Sea-heath	Vu	Rare	
Lachnagrostis filiformis s.l.	Common Blown-grass			
Maireana appressa	Grey Bluebush			
Maireana pentagona	Hairy Bluebush			
Malacocera tricornis	Goat Head	Vu	Rare	
Pittosporum angustifolium	Weeping Pittosporum			
Rhagodia spinescens	Hedge Saltbush			
Sarcozona praecox	Sarcozona	En	Rare	
Sclerolaena diacantha	Grey Copperburr			
Sclerolaena tricuspis	Streaked Copperburr			
Senecio glossanthus s.l.	Slender Groundsel			
Senecio spanomerus	Mallee Groundsel			
Tecticornia indica	Brown-head Glasswort			
Tecticornia pergranulata	Blackseed Glasswort			
Tecticornia pruinosa	Bluish Glasswort			
Wahlenbergia gracilenta s.l.	Annual Bluebell			

14.1.1.2 Flora – Exotic species recorded in Sandilong Asset wetlands

Scientific Name	Common Name
Mesembryanthemum nodiflorum	Small Ice-plant

Scientific Name	Common Name
Lolium rigidum	Wimmera Rye-grass
Sonchus oleraceus	Common Sow-thistle
Parapholis incurva	Coast Barb-grass
Spergularia diandra	Lesser Sand-spurrey
Bromus rubens	Red Brome
Medicago polymorpha	Burr Medic
Hordeum murinum s.l.	Barley-grass
Monoculus monstrosus	Tripteris
Spergularia rubra s.l.	Red Sand-spurrey
Melilotus indicus	Sweet Melilot
Lactuca serriola	Prickly Lettuce
Lycium ferocissimum	African Box-thorn
Vulpia myuros	Rat's-tail Fescue
Avena spp.	Oat
Opuntia spp.	Prickly Pear
Rostraria pumila	Tiny Bristle-grass
Hypochaeris glabra	Smooth Cat's-ear
Schismus barbatus	Arabian Grass
Bromus diandrus	Great Brome
Phalaris minor	Lesser Canary-grass
Reichardia tingitana	False Sow-thistle

14.1.1.3 Fauna – Native species recorded Sandilong Asset Wetlands

Scientific Name	Common Name	FFG Act	VIC ADV List	EPBC Act Status
Cherax destructor destructor	Common Yabby			
Porphyrio melanotus	Australasian Swamphen			
Ardea alba modesta	Eastern Great Egret	Vu	Vu	
Eolophus roseicapilla	Galah			
Vanellus miles	Masked Lapwing			
Aythya australis	Hardhead	Vu	Vu	
Phalacrocorax varius	Pied Cormorant		NT	
Ptilotula penicillata	White-plumed Honeyeater			
Grallina cyanoleuca	Magpie-lark			
Ardea pacifica	White-necked Heron			
Acanthagenys rufogularis	Spiny-cheeked Honeyeater			
Fulica atra	Eurasian Coot			
Egretta novaehollandiae	White-faced Heron			
Ocyphaps lophotes	Crested Pigeon			
Nematalosa erebi	Bony Herring			
Tachybaptus novaehollandiae	Australasian Grebe			
Manorina melanocephala	Noisy Miner			
Malurus cyaneus	Superb Fairy-wren			
Tandanus tandanus	Freshwater Catfish	En	En	

Scientific Name	Common Name	FFG Act	VIC ADV List	EPBC Act Status
Hypseleotris klunzingeri	Western Carp Gudgeon (Species Complex)			
Phaps chalcoptera	Common Bronzewing			
Platycercus elegans	Crimson Rosella			
Anas gracilis	Grey Teal			
Philypnodon grandiceps	Flatheaded Gudgeon			
Chenonetta jubata	Australian Wood Duck			
Anas superciliosa	Pacific Black Duck			
Chelodina longicollis	Eastern Snake-necked Turtle			
Threskiornis molucca	Australian White Ibis			
Gallinula tenebrosa	Dusky Moorhen			
Dacelo novaeguineae	Laughing Kookaburra			
Acrocephalus australis	Reed-Warbler			
Anhinga novaehollandiae	Australasian Darter			
Malurus spp.	Fairywrens			
Porzana pusilla	Baillon's Crake		Vu	
Gymnorhina tibicen	Australian Magpie			
Pelecanus conspicillatus	Australian Pelican			
Cracticus nigrogularis	Pied Butcherbird			
Ixobrychus dubius	Australian Little Bittern	En	En	
Craterocephalus stercusmuscarum fulvus	Unspecked Hardyhead			
Nycticorax caledonicus	Nankeen Night-Heron		NT	
Cygnus atratus	Black Swan			
Haliastur sphenurus	Whistling Kite			
Merops ornatus	Rainbow Bee-eater			
Phalacrocorax sulcirostris	Little Black Cormorant			
Corvus spp.	Ravens and Crows			
Psephotus haematonotus	Red-rumped Parrot			
Chelodina expansa	Broad-shelled Turtle	En	En	
Platalea flavipes	Yellow-billed Spoonbill			
Emydura macquarii	Murray River Turtle	CE	Vu	
Ardea alba	Great Egret		Vu	
Rhipidura albiscapa	Grey Fantail			
Geopelia placida	Peaceful Dove			
Accipiter cirrocephalus	Collared Sparrowhawk			
Philypnodon macrostomus	Dwarf Flatheaded Gudgeon			
Corcorax melanorhamphos	White-winged Chough			
Pardalotus striatus	Striated Pardalote			
Hirundo neoxena	Welcome Swallow			
Acanthiza nana	Yellow Thornbill			
Zosterops lateralis	Silvereye			
Coracina novaehollandiae	Black-faced Cuckoo-shrike			
Colluricincla harmonica	Grey Shrike-thrush			
Philemon citreogularis	Little Friarbird			
Corvus coronoides	Australian Raven			

Scientific Name	Common Name	FFG Act	VIC ADV List	EPBC Act Status
Pachycephala rufiventris	Rufous Whistler			
Phalacrocorax carbo	Great Cormorant			
Microcarbo melanoleucos	Little Pied Cormorant			
Anthochaera carunculata	Red Wattlebird			
Poodytes gramineus	Little Grassbird			
Milvus migrans	Black Kite			
Crinia parinsignifera	Eastern Sign-bearing Froglet			
Limnodynastes dumerilii	Southern Bullfrog (ssp. unknown)			
Litoria peronii	Peron's Tree Frog			
Limnodynastes tasmaniensis	Spotted Marsh Frog (race unknown)			
Poliocephalus poliocephalus	Hoary-headed Grebe			
Limnodynastes fletcheri	Barking Marsh Frog			
Litoria raniformis	Growling Grass Frog	Vu	En	Vu
Rhipidura leucophrys	Willie Wagtail			
Macquaria ambigua	Golden Perch		NT	
Retropinna semoni	Australian Smelt			
Maccullochella peelii	Murray Cod			Vu
*Calidris ferruginea**	Curlew Sandpiper	CE		CE
Haliaeetus leucogaster	White-bellied Sea Eagle	En		Marine

*Migratory bird – listed Bonn, CAMBA, JAMBA and ROKAMBA

14.1.1.4 Fauna – Exotic species recorded in Sandilong Asset wetlands

Scientific Name	Common Name
Passer domesticus	House Sparrow
Gambusia holbrooki	Eastern Gambusia
Turdus merula	Common Blackbird
Cyprinus carpio	European Carp
Columba livia	Domestic Pigeon
Sturnus vulgaris	Common Starling

Appendix 7 – Assessing Risk - Consequence

When prioritizing wetland watering, it is often difficult because there is no framework by which you can compare the fate of different species. To support prioritization, this guide seeks to put each wetland and its associated species within a regional context. For example, Freshwater catfish are a high priority because loss from Sandilong Creek would represent loss from the region. The process can also be used when communicating the rationale behind decisions or support engagement by providing a framework for discussion.
The process is presented in Figure A1, with a more detailed explanation provided in Tables A1 and A2.

Table A1.

Row	Question	Rationale	Response	Risk	Go To
1	Will the species persist *in situ*?	If the species will survive without intervention,	Yes	Low	
		It becomes a lower priority	No		Row 2
2	Will the species persist in a connected refuge?	If the species has the capacity (its own capability and appropriate	Yes		Table 2
		connectivity) to survive, it becomes a lower priority	No		Row 3
3	Is the species common?	If a species is common then there may be other populations that are	Yes	Med	
		more likely or easier to protect than the ones in the wetland.	No	High	

Table A2

Row	Question	Rationale	Response	Risk	Go To
1	Is the species short or long lived?	Long-lived species often have greater capacity to endure periods of	Long	Med	
		hardship, whereas short lived species are programmed to die.	Short		Row 2
2	Does the species need the wetland to recruit?	If the species requires the wetland to recruit then sustaining will require	No	Med	
		protection of wetland condition.	Yes		Row 3
3	Is the species common?	If a species is common then there may be other populations that are more	Yes	Mod	
		likely or easier to protect than the ones in the wetland.	No	High	

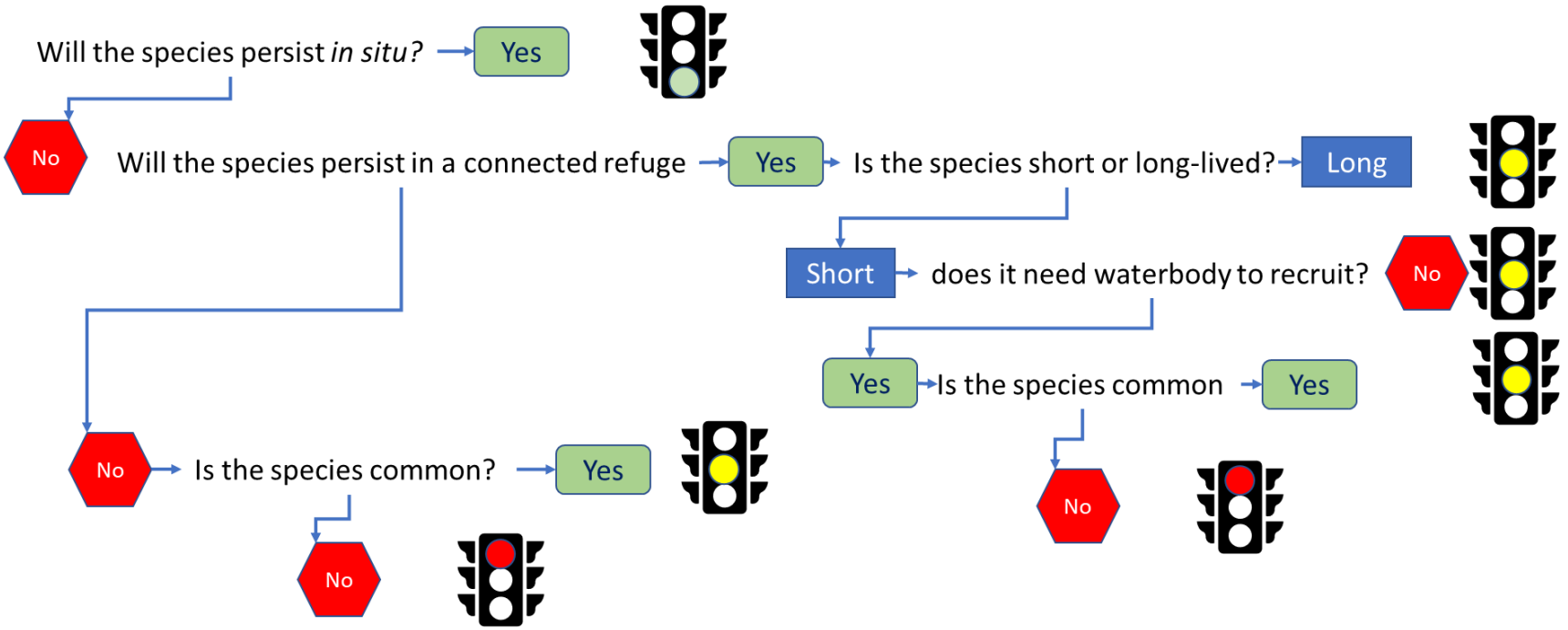


Figure A1 – Decision tree for assessing risk

Appendix 8 - SMARTness of Sandilong Creek EWMP objectives, Butcher et al., 2020

5.24 Sandilong Creek

5.24.1 SMARTness and rationalisation

Site-specific environmental objectives for the Sandilong Creek EWMP (Sunraysia Environmental 2014).

EWMP objectives
SC1: Maintain the terrestrial vegetation structure – (Sandilong Creek)
SC2: Maintain health of Black Box and Lignum communities – (Billabong)
SC3: Improve health of Black Box and Lignum communities – (Billabong)

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

	Specific		Measurable			Achievable		Relevant		Timely	
Objective	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
SC1	0	0	1	1	0.5	0	1	0	0	0	0
SC2	0	0	1	1	1	0.5	1	1	1	0	0
SC3	0	0	1	1	1	0.5	1	1	1	0	0

Rationalised environmental objectives for the Sandilong Creek EWMP (Sunraysia Environmental 2014).

Objective	Issue	Outcome
SC1	Terrestrial vegetation by definition is not water dependent – this objective is not applicable to the EWMP	Deleted
SC2	Objective is focused on both Lignum and Black Box – consider splitting.	Split into separate objectives for Lignum and Black Box. Focus of objective now on Lignum
SC3	Objective is focused on both Lignum and Black Box – consider splitting.	Split into separate objectives for Lignum and Black Box. Focus of objective now on Black Box

5.24.2 Mapping to Bain Plan

Basin Plan Schedule 8 and 9 criteria.

Schedule 8 criteria met	Schedule 9 criteria met
From DELWP (2015a)	
1: JAMBA, CAMBA, ROKAMBA, BONN **4:** EPBC Act, FFG Act, DSE Listed **5:** High level of ecological communities which would support high level of biodiversity as a result of environmental watering.	**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	

Mapping Sandilong 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
SC1: Maintain the terrestrial vegetation structure – (Sandilong Creek)	Not applicable	Not applicable	Not applicable	Not applicable
SC2: Maintain health of Black Box and Lignum communities – (Billabong)	8.05,3(b)	Condition of priority asset - prevention of decline in native biota Condition of water-dependent vegetation	B2.8	LTWPVM6 LTWPVM8
SC3: Improve health of Black Box and Lignum communities – (Billabong)	8.05,3(b)	Condition of priority asset - prevention of decline in native biota Condition of water-dependent vegetation	B2.8	LTWPVM6 LTWPVM8

5.24.3 Updated objectives for Sandilong Creek

Current objective	SC1: Maintain the terrestrial vegetation structure – (Sandilong Creek)
Comments	Deleted

Current objective	SC2: Maintain health of Black Box and Lignum communities – (Billabong)
Comments	Focus of objective changed to lignum. Blackbox component covered in SC3. Objective updated to align with Basin Plan language
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of native water dependent vegetation
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota
BWS QEEO	B2.10 Maintain extent of Lignum along the Murray River from the junction with the Wakool River to downstream of Lock 3, including Chowilla and Hattah Lakes
LTWP objective	LTWPVM8 Improve the condition of shrub and lignum dominated EVCs
LTWP target	A positive trend in the condition score of Shrub and Lignum dominated EVC benchmarks at 50% of sites over the 10 year period to 2025
2020 Objective:	By 2030, improve condition and maintain extent from baseline levels of Lignum (*Duma florulenta*) to sustain communities and processes reliant on Lignum communities at Sandilong Billabong, Sandilong Creek.
2020 Targets:	By 2030, in standardised transects that span the floodplain elevation gradient and existing spatial distribution at Sandilong Billabong, Sandilong Creek with ≥70% of Lignum plants in good condition with a Lignum Condition Score (LCI) ≥4.

Current objective	SC3: Improve health of Black Box and Lignum communities – (Billabong)
Comments	Focus of objective changed to Black Box. Lignum component covered in SC2. Objective updated to align with Basin Plan language
EWP objective(s)	8.05,3(b)
Schedule 7 targets	Condition of native water dependent vegetation
PEA/PEF criteria met	PEA 3(b) Prevents declines in native biota
BEWS QEEO	B2.8 By 2024 improve condition of Black Box and River Red Gum
LTWP objective	LTWPVM6 Improve the condition of Black Box dominated EVCs
LTWP target	A positive trend in the condition score of Black Box dominated EVC benchmarks at 50% of sites over the 10 year period to 2025
2020 Objective:	By 2030, improve condition and maintain extent from baseline (2006) levels of Black Box (*Eucalyptus largiflorens*) to sustain communities and processes reliant of such communities at Sandilong Billabong, Sandilong Creek
2020 Targets:	A positive trend in the condition score of Black box dominated EVC benchmarks at Sandilong Billabong, Sandilong Creek at 50% of sites over the 10 year period. OR
	By 2030, at stressed sites (see Wallace et al. 2020) at Sandilong Billabong, Sandilong Creek: in standardised transects that span the floodplain elevation gradient and existing spatial distribution, ≥70% of viable trees will have a Tree Condition Index Score (TCI) ≥ 10. Baseline condition of Black Box trees needs to be established to ensure TCI good is achievable - may need to rewrite target and adaptively manage this as condition improves.

Appendix 9 - Mapping of objectives to the Basin Plan and other policy instruments

Mapping of updated Sandilong Creek 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, DELWP 2015) Victorian Murray objectives

EWMP objectives	Basin Plan EWP objective	Relevant Schedule 7 target	Relevant BWS QEEO	LTWP objective
SC2	8.05,3(b)	Condition of priority asset - prevention of decline in native biota Condition of water-dependent vegetation	B2.10	LTWPVM6 LTWPVM8
SC3	8.05,3(b)	Condition of priority asset - prevention of decline in native biota Condition of water-dependent vegetation	B2.8	LTWPVM6 LTWPVM8
SC4	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

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