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Gunbower Creek System Environmental Water Management Plan

NORTH CENTRAL
Catchment Management Authority
Connecting Rivers, Landscapes, People

Department of Environment, Land, Water & Planning

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Front cover photo: Gunbower Creek, 27 August 2014 (North Central CMA).

The North Central CMA Region Environmental Water Management Plan for the Gunbower Creek and Lagoons is a ten year plan, compiled from the best available information. It will be subject to a five-yearly review.

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Executive summary

The Gunbower Creek System Environmental Water Management Plan (EWMP) sets out long-term objectives for the priority environmental values of the Gunbower Creek and where feasible the associated twelve Gunbower Lagoons. The EWMP is an important part of the Victorian Environmental Water Planning Framework. It provides the five to ten year management intentions, based on scientific information and stakeholder consultation, which can be used by the respective agencies; North Central Catchment Management Authority (CMA), Department of Environment, Land, Water and Planning (DELWP) and the Victorian Environmental Water Holder (VEWH); for both short and longer-term environmental water planning.

This EWMP is not a holistic management plan for the system, but is focused on environmental water management so that the Gunbower Creek System can continue to provide environmental, social, cultural and economic values for all users. Actions such as infrastructure upgrades and pest plant and animal works are documented as complementary to environmental water management in this EWMP.

The following components are the main sections featured in the Gunbower Creek System EWMP. A summary of the main conclusions to facilitate appropriate environmental water management in the Gunbower Creek System into the future are summarised below.

Hydrology and system operations

Gunbower Creek is an anabranch of the Murray River with flows regulated by the operation of the National Channel headworks and Gunbower, Thompson, Hipwell, Cohuna and Koondrook weirs. Twelve lagoons are associated with the Gunbower Creek representing natural and excised cut-off meanders of the original creek line. The system is operated as part of the Torrumbarry Irrigation Area (TIA) and as such flows are characterised by seasonal inversion and unnatural rates of variability when compared to natural conditions.

Water dependent values

The environmental values of the Gunbower Creek System are intrinsically linked with the Murray River and neighbouring Ramsar listed Gunbower Forest, through its geographical and hydrological connectivity. From a local perspective, the Gunbower Creek System is recognised for a significant number of threatened native fish species, including the nationally vulnerable Murray Cod, critically endangered Silver Perch and endangered Trout Cod and State threatened Murray-Darling Rainbowfish, nationally threatened Golden Perch and Freshwater Catfish. The abundance of instream woody habitat and vegetation communities combined with a diversity of fast and slow flowing creek reaches and shallow and deep still-water habitats further supports a variety of other aquatic fauna including waterbirds, turtles, frogs and Platypus. Many of these species including the vegetation communities in which they inhabit are listed as significant under international, national and state legislation.

Ecological condition and threats

According to the Sustainable River Audit, Index of Stream Condition and Index of Wetland Condition, the Gunbower Creek System is considered to be in poor to moderate condition- the result of a history of regulated conditions. The most notable changes include a reduction in the diversity and extent of native vegetation communities, high exotic flora species encroachment, tree death, habitat fragmentation and a loss of hydrological connectivity between the Gunbower Forest and Gunbower Creek System. This has resulted in a decline in the condition of native fish populations, in particular threatened large-bodied native fish species such as Murray Cod and Trout Cod.

However in spite of the changes, the Gunbower Creek System has immense potential for future recovery. The *Gunbower and Lower Loddon Native Fish Recovery Plan* (Mallen-Cooper et al., 2014) have been developed to provide a strategy to simultaneously address the three major limiting factors

in the system - connectivity, flow and habitat. This EWMP seeks to address flow, and to a lesser extent connectivity, as significant threats to native fish recovery in the Gunbower Creek System.

Management objectives

A long-term management goal has been defined for the Gunbower Creek System:

Gunbower Creek System long term management goal

To rehabilitate the highly valued native fish populations of the Gunbower Creek System and facilitate connection between the Murray River, Gunbower Forest floodplain and associated wetlands through an appropriate water regime.

The ecological objectives and hydrological objectives that sit under the long-term management goal for the Gunbower Creek System were informed primarily by the previous Environmental Flows assessment (Anderson et al., 2007b), Living Murray Gunbower Forest EWMP (MDBA, 2012), Mallen-Cooper et al., (2014) and were updated by Ecological Associates (2015), Clayton Sharpe and North Central CMA staff.

Managing risks to achieving objectives

The threats to achieving the ecological objectives that are either linked to or external to environmental water are identified by this EWMP. These include potential and real threats including instream barriers to fish movement, invasive plants and animals (i.e. Pale Yellow Water Lily, Common Carp) and grazing of riparian vegetation. A number of these threats align with those documented in *Gunbower and Lower Loddon Native Fish Recovery Plan* (Mallen-Cooper et al., 2014).

Environmental water delivery infrastructure

The constraints to the delivery of environmental water, including limitations imposed by irrigation delivery (i.e. low summer flows) have been identified. Infrastructure recommendations to enhance the ecological benefit of environmental water delivery have been made and include infrastructure upgrades to facilitate fish passage on major structures such as Koondrook Weir and the National Channel Headworks, as well as regulators between lagoons and the creek.

Complementary actions

Actions to complement the delivery of environmental water such as pest plant and animal control works, and works to improve farm drainage and fencing are recommended as part of this EWMP.

Demonstrating outcomes

Monitoring is required to allow the CMA to adaptively manage annual environmental water delivery and to understand the response of key values and threats to water delivery. The Gunbower Creek System EWMP recommends a suite of intervention and long-term monitoring activities that will meet the monitoring requirements.

Consultation

Key stakeholders, including DELWP, Parks Victoria, Gannawarra Shire, Shire of Campaspe, VEWH and Goulburn Murray Water (GMW) were engaged during the development of this EWMP through the Stakeholder Project Working Group (PWG). A Community Advisory Group (CAG) was also established to provide a source of local knowledge and insight into the community values, threats and expectations for the health of the Gunbower Creek System. Local landholders, irrigators, environmental and community interests group were represented on the CAG.

Knowledge gaps

The management actions in the Gunbower Creek System EWMP are based on the best available information. A number of knowledge gaps have been identified during the development of the EWMP, particularly around the influence of winter base flows on Pale Yellow Water Lily encroachment as well as limitations in the hydraulic model used to inform the flows recommendations documented in this EWMP.

Acknowledgments

Acknowledgment of Country

The North Central CMA acknowledges Aboriginal Traditional Owners within the region, their rich culture and spiritual connection to Country. We also recognise and acknowledge the contribution and interest of Aboriginal people and organisations in land and natural resource management.

Contributions to the Gunbower Creek System EWMP

The information contained in the Gunbower Creek System EWMP has been sourced from a variety of reports and field inspections and from individual knowledge and expertise. The North Central CMA acknowledges the assistance of the following people in preparing this EWMP:

- Marcus Cooling (Ecological Associates), Lance Lloyd (Lloyd Environmental), Chris Gippel (Fluvial Systems), Ivor Stuart (Kingfisher Research) and Clayton Sharpe (CPS Environmental Research)- Scientific Review Panel
- Faith Deans (GHD Pty Ltd)- co-author
- Suzanne Witteveen, Susan Watson, and Melanie Tranter (on behalf of) (DELWP)
- Gunbower Creek System Project Working Group (PWG):
    - Andrea Kelleher and Peter Johnson (DELWP)
    - Tori Perrin and Erin Ashcroft (VEWH)
    - Murray Thorson (Parks Victoria)
    - Khane Mason and Ross Stanton (GMW)
    - Alison McCallum (Shire of Campaspe)
    - Chris White (Gannawarra Shire Council)
- Community and interest group representatives on the Gunbower Creek System Community Advisory Group (CAG) (Appendix 1).
- Raj Mahendrarajah (Coliban Water)
- Anna Chatfield, Kathryn Stanislawski, John James, Michelle Maher, Louissa Rogers, Brad Drust, Emer Campbell, Ian Higgins, Kira Woods, Phil Dyson, Rebecca Horsburgh and Peter McRostie (North Central CMA).

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1. Introduction

The North Central Catchment Management Authority (CMA) has been funded through the Department of Environment, Land, Water and Planning (DEWLP) 'Victorian Basin Plan Environmental Water Management Plan Program' to prepare an EWMP for the Gunbower Creek System.

1.1. Purpose and scope of the Gunbower Creek System EWMP

The Gunbower Creek System EWMP is a ten year management plan that establishes the long-term water management goal based on the priority water dependent environmental values and their ecological condition. It defines the ecological objectives and recommends an environmental flow regime to achieve these objectives. The EWMP is based on both scientific information and stakeholder consultation and will be used by the North Central CMA when making annual environmental watering decisions, as well as DELWP and the Victorian Environmental Water Holder (VEWH) for both short and longer-term environmental water planning.

The key purposes of the EWMP are to:

- identify the long-term objectives and water requirements for the creek and where possible the lagoon system
- provide a vehicle for community consultation, including for the long-term objectives and water requirements of the creek
- inform the development of Seasonal Watering Proposals and Seasonal Watering Plans
- Inform Long-term Watering Plans that will be developed by the State under the Basin Plan Chapter 8 (DEPI, 2014a).

The scope of the EWMP includes the entire length of Gunbower Creek as well as the twelve associated Gunbower Lagoons (shown in Figure 2). For the purpose of this EWMP, the creek and lagoons will collectively be referred to as the Gunbower Creek System.

Values, threats and watering requirements specific to Gunbower Forest (including its associated wetlands) are not included in this EWMP, having been considered in The Living Murray (TLM) *Gunbower Forest Environmental Water Management Plan* (MDBA, 2012). Other waterways associated with the Gunbower Creek are not currently managed with environmental water (i.e. Taylor's Creek) and are therefore not included in this EWMP. Some of these waterways have been identified as having water dependent environmental values and may be investigated into the future.

1.2. EWMP framework

Management of environmental water is planned and implemented through the framework detailed in a number of key documents. Figure 1 illustrates the strategies, scientific reports and operational documents required for environmental water management in Victoria (DEPI, 2013a). The North Central CMA has recently developed the North Central Waterway Strategy - 2014-2022 (NCWS) which is an integrated strategy for managing and improving the region's waterways. The strategy sets priorities and outlines a regional works program to guide investment over the next eight years (North Central CMA, 2014). For the Gunbower Creek the NCWS aims are to:

- Improve the condition of the Gunbower Creek from moderate to good (based on the Index of Stream Condition (ISC)), by 2050
- Improve the condition of the Gunbower Creek by 2021 with a measured increase of two points in the streamside zone sub-index of the ISC
- Maintain all improvements in ISC scores through an appropriate maintenance program (see Section 5.2 for current condition scores).

The achievement of the NCWS resource condition target is reliant on a number of management activities including pest plant and animal control works, livestock exclusion, infrastructure and environmental water delivery. This EWMP aims to establish the long-term environmental water management goals for Gunbower Creek System to guide future management.

The North Central CMA is being funded through DELWPs 'Victorian Basin Plan Environmental Water Management Plan Program' to prepare an EWMP for the Gunbower Creek System. Once completed, this EWMP will inform annual seasonal watering proposals for the Gunbower Creek System as required.

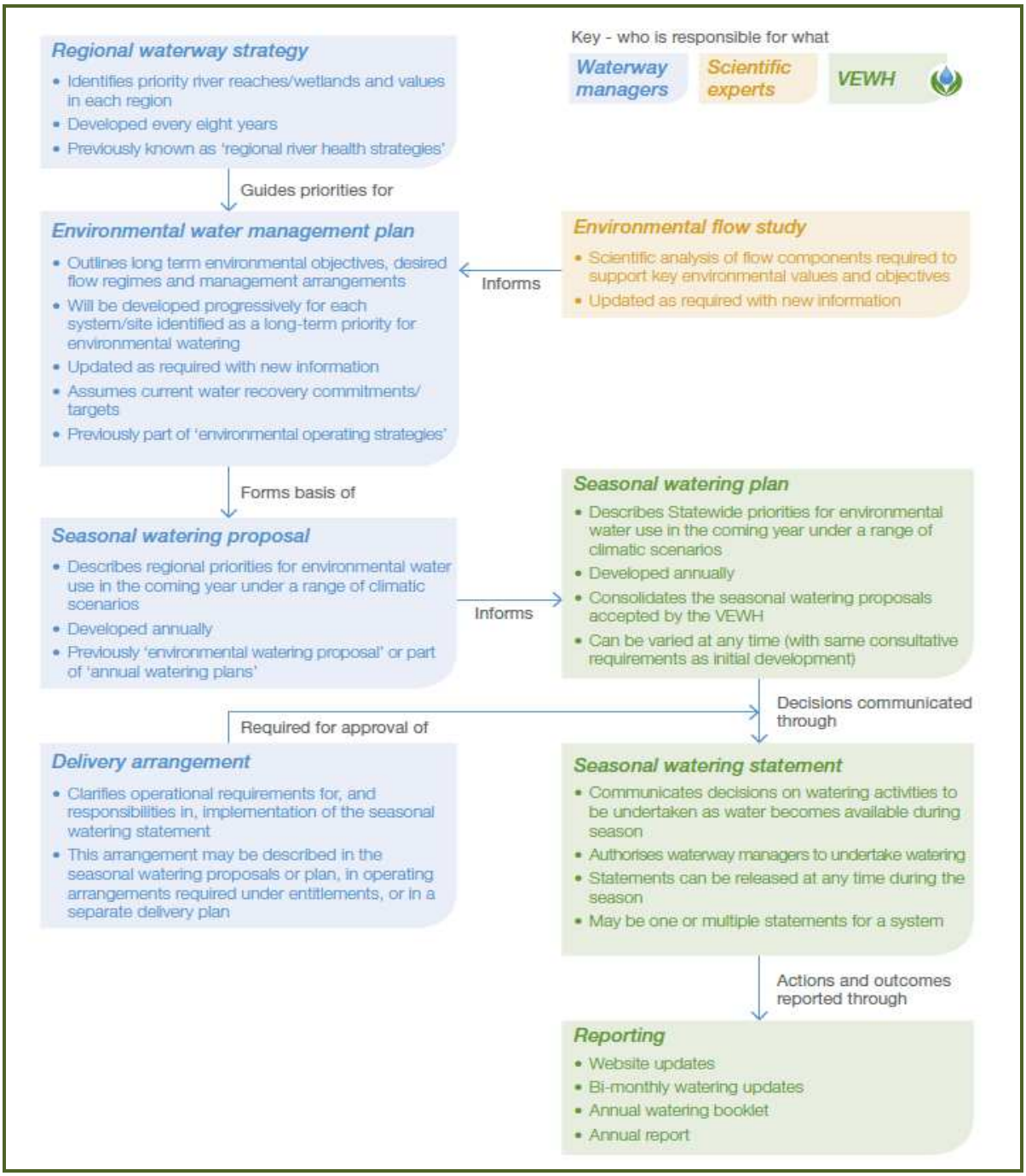

Figure 1. Planning framework for decisions regarding environmental water use and management in Victoria (VEWH, 2013).

1.3. Background information

The Gunbower Creek System EWMP builds on a range of technical investigations undertaken within the creek and lagoon system and neighboring Gunbower Forest. This includes the recent work undertaken through TLM to facilitate large scale environmental watering of Gunbower Forest via Gunbower Creek as well as the Gunbower Lagoons Modernisation Project (GLMP) implemented through the Goulburn Murray Water (GMW) Connections Project. The following sections provide a brief summary of the outcomes of these projects in the context of this EWMP:

The Living Murray Program

TLM Initiative is one of Australia's most significant river restoration programs established in response to evidence that the River Murray system was becoming degraded, threatening agriculture, natural and cultural values and communities (MDBA, 2011). Developed in 2002, TLM is a partnership of the Australian Government and the governments of New South Wales, Victoria, South Australia and the Australian Capital Territory; it is coordinated by the Murray–Darling Basin Authority (MDBA). The long-term goal of this program is to achieve a healthy working River Murray system for the benefit of all Australians.

Almost 500 GL (long term Cap equivalent) of water has now been recovered through TLM for delivery to six icon sites - Barmah–Millewa Forest; Gunbower–Koondrook–Perricoota Forest; Hattah Lakes; Chowilla Floodplain and Lindsay–Wallpolla Islands; Lower Lakes, Coorong and Murray Mouth; and the River Murray Channel. Gunbower Forest is the Victorian component of the Gunbower Koondrook-Perricoota Icon Site and spans an area of approximately 20,000 hectares. The forest is of particular importance being one of the largest remaining stand of River Red Gum Forest in Victoria and supporting a diversity of wetland habitats that are home to over 22 species of feeding, nesting and breeding waterbirds.

A EWMP has been developed for each icon site describing the TLM ecological objectives and targets, required watering regimes, works and measures (i.e. regulating structures, delivery channels, fishways required to manage environmental water), water delivery arrangements and condition and intervention monitoring for each site. For the Gunbower Forest this includes the following works and measures:

- Lower landscape works: a series of wetland regulators that target the lower landscape component of the forest to fill and top up wetlands using relatively small volumes of water (referred to as the 'lower landscape regulators' in this EWMP).
- Hipwell Road Channel: a channel and associated works to deliver large volumes of water to the mid and lower landscape components, to water large areas of the River Red Gum floodplain and create the conditions required for large colonial waterbird breeding events.

The Gunbower Creek System EWMP will build on the work undertaken through TLM through a focus on creek values and threats, for dual benefit across the entire Gunbower Island System. It will consider the overarching environmental flow requirements of the Gunbower Forest when setting realistic and achievable ecological objectives and flow regime for the creek system. This will include management of the creek during years when Gunbower Forest is receiving environmental water and as such some creek specific flow components may be partially achievable. The health of Gunbower Forest is intrinsically linked to the health of the Gunbower Creek. Therefore integrated management across the entire system that considers ecological and hydrological connectivity between the creek and forest floodplain is considered vital.

Gunbower Lagoons Modernisation Project

Stage 1 of the GLMP investigated the water savings potential and environmental benefits of reconnecting lagoon irrigation customers back to the irrigation backbone channel[1]. In order to streamline the process GMW Connections Project undertook a preliminary assessment of the twelve Gunbower Lagoons to determine the value for money for the GLMP. This resulted in the four largest lagoons - Splatt's, Turner, Upper Gunbower and Longmore, being removed from the scope of the GLMP due to the high cost associated with customers reconnecting and the low willingness for an alternative irrigation supply. In addition, Phyland and Safe's lagoons were also removed due to the low water savings potential attributed to their shallow nature.

[1] Backbone channel refers to major supply channels in the irrigation area that have a minimum channel capacity greater than 20 ML/day delivery share (GMW, 2015)

Environmental Water Investigation's (EWIs) were developed for the six remaining lagoons - Heppell, Heart, Unregulated, Gum, Cockatoo and Taylor's to document the values, threats, ecological objectives, flow requirements and watering regimes required to support their key values (North Central CMA, 2013). EWIs were used to inform the GLMP Business Case which was considered by the Federal Government for future project feasibility. As at 18 May 2015, Taylor's Lagoon is the only site to be progressed to Stage 2 of the GLMP (construction phase and reconnection of irrigation customers) and will require a separate EWMP to be developed. All other lagoons will remain as part of the irrigation network, with a primary focus on continued irrigation delivery and storage.

There is however opportunities to provide environmental benefit to a number of the lagoons through integrating management with the creek. The Gunbower Creek System EWMP aims to consider the values of the system as a whole and from a landscape perspective and proposes management actions that work within the constraints of the irrigation system. The full suite of ecological objectives and water regimes detailed in the site specific EWIs or preliminary technical reports are therefore not targeted in this EWMP; instead opportunities to provide seasonal variability and support existing values are the focus. Additional detail on each lagoon should be sourced through the appropriate EWI or technical report as detailed in the reference section of this EWMP.

1.4. Development process

The Gunbower Creek System EWMP has been developed in collaboration with stakeholders including DELWP, VEWH, Parks Victoria, Gannawarra Shire Council, Shire of Campaspe and local landholders and community members. Tasks undertaken to develop the EWMP include:

- **Scoping and collating information:** An Environmental Flows Assessment was completed for Gunbower Creek and two of its lagoons (Cockatoo Lagoon and Safe's Lagoon) in 2007 (Anderson, 2007; Anderson et al., 2007a; Anderson et al., 2007b). Since this time, significant investment in the Gunbower Forest Icon site has resulted in the commissioning of technical investigations, monitoring and research particularly relating to the planning and operation of the newly constructed Hipwell Road Channel, which was constructed through TLM program to divert water to Gunbower Forest. In addition, work has also been undertaken to identify the ecological objectives and watering requirements for the Gunbower Lagoons as part of the GLMP. A summary of relevant technical work undertaken to date is shown in Appendix 2.
- **Consultation and technical input:** The following groups were established to provide critical input into the project (see Section 10 for additional information):
    - Scientific Review Panel (SRP): As the Gunbower Creek Environmental Flows Assessment was undertaken in 2007, a SRP was convened to refine the ecological objectives and flow regime (including re-running the HEC-RAS model) based on monitoring results, new technical investigations, operational management and up-to-date scientific understanding of flora and fauna flow requirements.
    - Stakeholder Project Working Group (PWG): A stakeholder PWG was developed to provide strategic advice and on-ground experience relating specifically to environmental water management in the Gunbower Creek System. The PWG included a range of agency stakeholders with varying experience and interest in the operation of the system.
    - Community Advisory Group (CAG): An expression of interest process was run to assist with forming a CAG for the EWMP project. Interested community members including representatives from various interest groups as well as the Torrumbarry Water Service Committee, were engaged to provide background information as well as feedback on community values and threats as well as management actions in the system.

Information from the above tasks was analysed to provide justification and evidence for the following sections of the EWMP:

- **Water dependent values**: environmental values were derived from various sources identified during data collation. Additional data identified during the SRP review as well as PWG and CAG engagement activities was also incorporated, specifically related to large-bodied fish. The water dependent values (fauna, vegetation communities and flora) are presented by reach and by lagoons within each reach. Terrestrial species are not considered within this EWMP due to the close proximity of the Gunbower Forest. Social including cultural, economic and recreational values are also described.
- **Ecological condition and condition trajectory without environmental water:** the condition, as reported in the Murray Darling Basin Wide Sustainable Rivers Audit (SRA), the Victorian statewide Index of Stream Condition (ISC) and Index of Wetland Condition (IWC), is discussed in light of local scale habitat and fauna condition monitoring of the system. The condition trajectory under a "do-nothing" scenario considers the flow regime under a consumptive water regulated system only.
- **Management objectives:** the water management goal and associated ecological objectives for the Gunbower Creek System are based on the key water dependent values, the current condition and the condition trajectory. The objectives are further aligned with the Gunbower Forest Environmental Watering Plan (MDBA, 2012) and the broader environmental objectives outlined in the Basin-wide Environmental Watering Strategy (MDBA, 2014). Hydrological requirements and associated flow recommendations are based on the ecological objectives, HEC-RAS modelling outputs and technical advice (through SRP).
- **Managing risks**: the risks to achieving the ecological objectives for the Gunbower Creek System are based on monitoring data, community concerns and SRP feedback. Management actions to mitigate each risk have been recommended and residual risk (assuming full adoption of the management action) identified.
- **Environmental water delivery infrastructure:** current constraints in delivering the environmental flow recommendations as well as achievement of ecological objectives are identified. This includes barriers to fish movement and management of the lagoons in insolation of the creek.
- **Complementary actions:** a number of actions to assist with achieving the Gunbower Creek management objective have been identified during the EWMP development process. These actions are prioritised based on their relevance to environmental water management in the system.
- **Demonstrating outcomes:** monitoring to adaptively manage the delivery of environmental water and to demonstrate the outcomes against the ecological objectives are based on best available science monitoring method. Justification for a suite of long term and intervention monitoring recommendations are also given.
- **Knowledge gaps and recommendations:** a number of knowledge gaps were identified during the process of developing the ecological objectives, management actions and risk analysis sections. A range of activities aimed at addressing these knowledge gaps are given as well as an indication of their priority ranking.
- **Consultation:** consultation activities undertaken in the development of this EWMP included presenting components of the EWMP to the CAG as summarised in Appendix 1.

2. Site overview

2.1. Site location

The Gunbower Creek is a 144 kilometre long anabranch of the Murray River located in the north-east of the North Central CMA region in the mid-Murray Floodplain. The creek forms the southern border of the Ramsar listed Gunbower Forest and extends from the Murray River at Torrumbarry, through the townships of Gunbower and Cohuna to return to the river at Koondrook (MDBA, 2012). Twelve lagoons, largely located in the upper reaches of the creek system, are associated with Gunbower Creek. These lagoons represent a series of oxbow lakes as well as natural and excised cut-off meanders of the original creek line (North Central CMA, 2013d). The entire system is utilised as part of the Torrumbarry Irrigation Area (TIA) servicing customers in the local, Kerang, Murrabit and Benjeroop localities as well as the townships of Gunbower, Leitchville and Cohuna. Figure 2 illustrates the location of the Gunbower Creek System within the North Central CMA region.

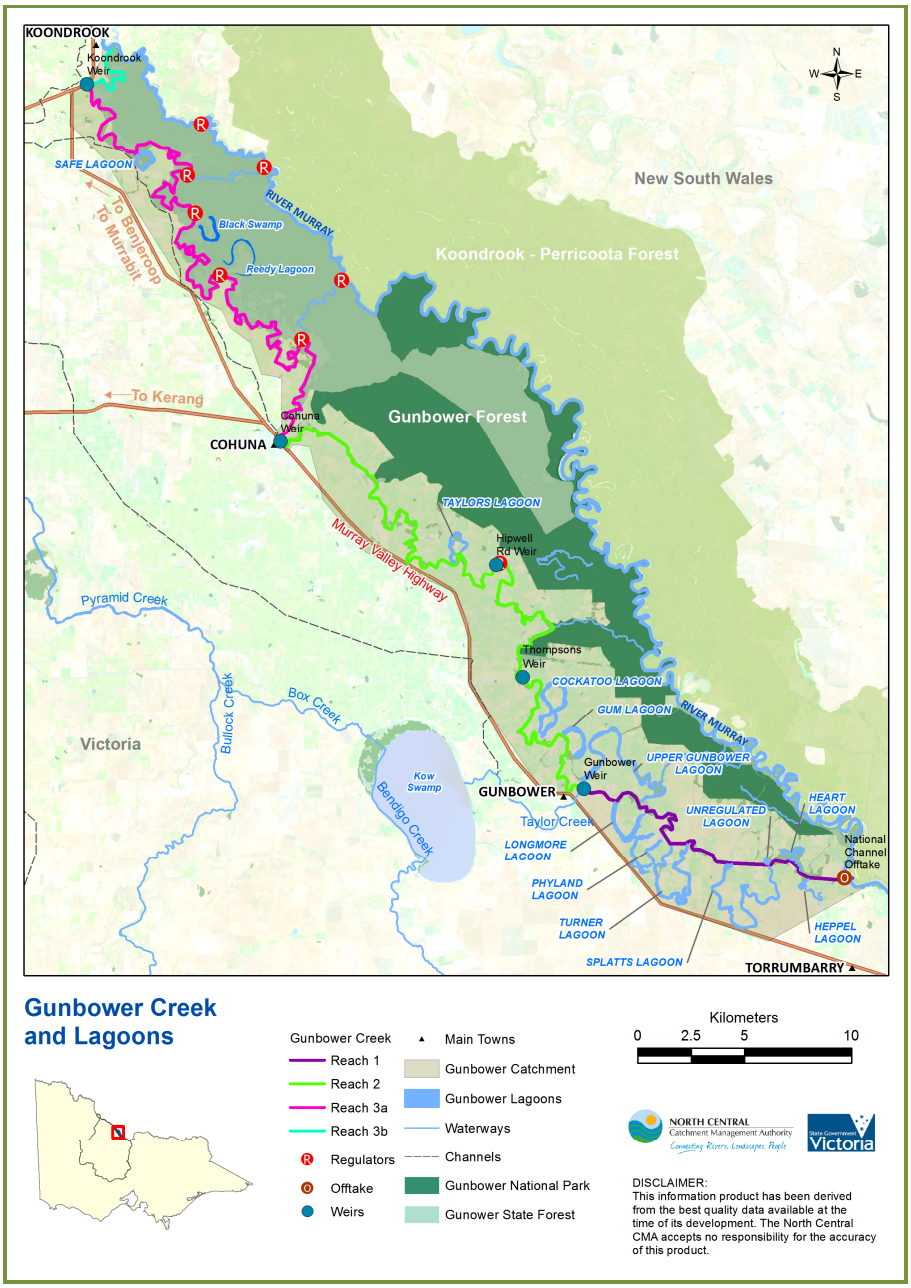

Figure 2. Gunbower Creek System location map

2.2. Catchment setting

2.2.1. Climate

Climate data obtained from the Bureau of Meteorology (BOM) for Kerang meteorological station shows that variability is a key component of the climate in the Gunbower Creek locality (Hale & Butcher, 2011). Average rainfall in Kerang is 374.2 mm/year, with an average high of 37.4 mm in October which is significantly wetter than January to April (average of 25.1 mm/ month). Average temperature ranges from 31.6 °C in January to 14.1 °C in July at Kerang (nearest temperature station), with the minimum temperature dropping to a low of 4°C in July (BOM, 2015). Evaporation rates from the 'Kerang Model Farm', a meteorological station located approximately 25 kilometres south-west of Koondrook, shows pan evaporation (Class A Pan) rates of approximately 1,384.1 mm ranging from 32.8 mm in June to up to 233.3 mm in January between 1991 and 2013 (Jones and Jones, 2013).

2.2.2. Hydrophysical characteristics

The Gunbower Creek flows in a north-westerly direction, meandering through agricultural land before forming the southern boundary of the Gunbower Forest. Five major regulating structures are located along its length being Gunbower, Thompson, Hipwell, Cohuna and Koondrook weirs, which separate the creek into a series of fast and slow flowing reaches. With the exception of these structures, the creek profile is relatively uniform with an average drop of six metres across its entire length as shown in Figure 3 (Anderson et. al., 2007a).

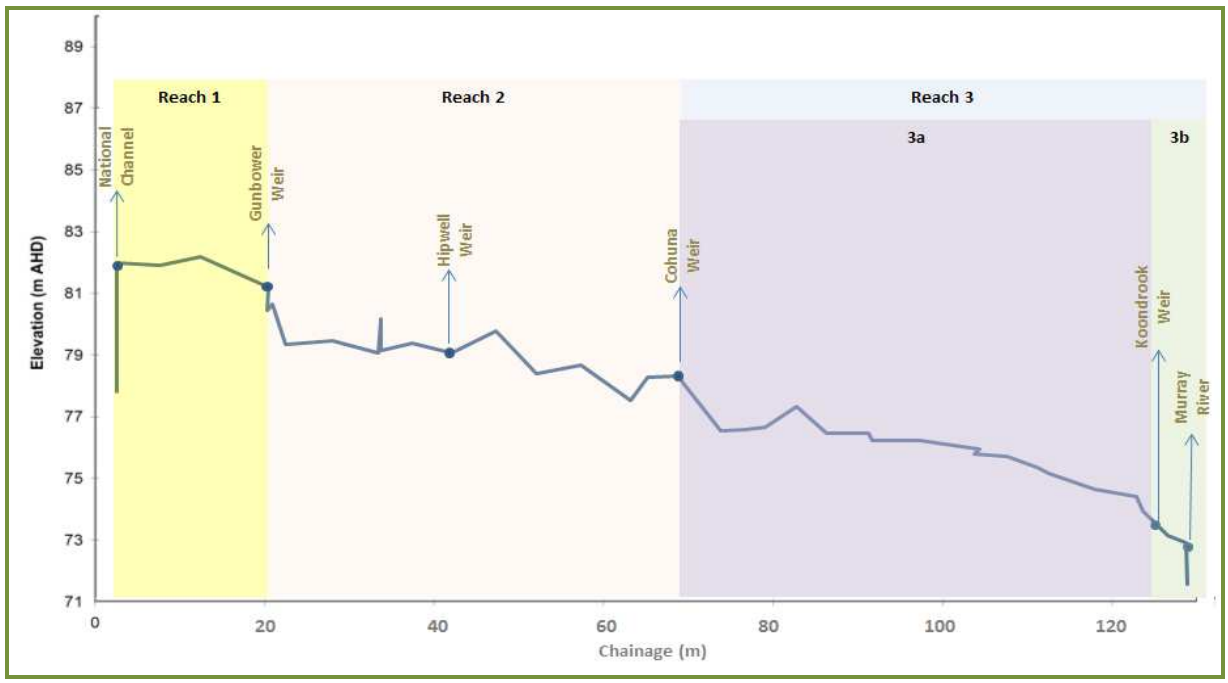

Figure 3. Profile of the Gunbower Creek (source: based on from Anderson et al., 2007)

At low flow conditions the channel form of Gunbower Creek is generally U-shaped, ranging from 30-60 metres in width and up to five metres in depth at bank-full conditions. The weirs create a series of wide and deep still-water habitats which provide conditions similar to that of permanent wetlands. Irrigation channels and conduits, namely Taylors Creek, No. 1, No. 2, No. 3 and No. 4 channels, divert water directly from the weir pools to service customers within the TIA. The lagoons adjoining the creek provide deep and shallow channelized and marsh like habitat.

For the purpose of this EWMP, the Gunbower Creek is divided into three reaches delineated by the major regulating structures as shown in Table 1. A description of the hydrophysical characteristics of each reach is provided below.

Table 1. Reaches of the Gunbower Creek System and associated lagoons

Reach No.	Location	Average reported reach capacity (ML/day)	Lagoons associated with reach	Approx. length (km)
1	Headworks to Gunbower Weir (National Channel)	3,800	Heppell, Heart, Unregulated, Splatts, Turner, Phyland, Longmore and Upper Gunbower	18
2	Gunbower Weir to Cohuna Weir	1,200-1,650[1]	Gum, Cockatoo and Taylor's	47
3a	Cohuna Weir to Koondrook Weir	800-1,200[2]	Safe's	58
3b	Koondrook Weir to confluence with the Murray River	1,600	N/A	6

[1] Noted capacity of 1,200 ML/day without irrigation. Maximum regulated flow with high irrigation demand estimated at 1,650 ML/day (A. Chatfield (North Central CMA], pers. comm., 16 April 2015)

[2] Cohuna Weir rated at 1,200 ML/day when 400 ML/day is entering Yarran Creek (regulator opened). Operationally the maximum is 800 ML/day without Yarran (K. Mason [GMW], pers comm., 15 May 2015).

Source: Anderson et al. (2007a); Ecological Associates (2015)

2.2.2.1. Reach 1: Gunbower Creek inlet to Gunbower Weir

Reach 1 extends for approximately 18 kilometres from the inlet of Gunbower Creek from the Murray River above Torrumbarry Weir to Gunbower Weir within the Murray Fans and Victorian Riverina bioregions (DEPI, 2014c). The Torrumbarry Weir located on the Murray River, provides head to the National Channel Inlet Regulator, which controls all inflows to Gunbower Creek (North Central CMA, 2013e). This reach has a long history of water management, having historically been desnagged and dredged to improve its delivery capacity. The upper portion, known as the National Channel, was straightened and enlarged in the 1890s to improve its delivery capacity. As a result this reach is generally made up of deep open water, overcut benches, high silt bedloads and low instream woody habitat (IWH) (Anderson et al., 2007a).

Eight lagoons are associated with Reach 1 of the Gunbower Creek, five of which were excised during the construction of the National Channel. The remaining three lagoons are natural billabongs cut-off from the flow path of Gunbower Creek through natural processes. The lagoons are generally shallow (<2 metres deep), support incised channels, restricted littoral zones and overcut benches, the legacy of over 100 years of water regulation (Anderson et al., 2007a; North Central CMA, 2013d). Six of these lagoons have regulating structures that allow them to be managed in isolation with the creek, whilst the remaining two are unregulated (fluctuate with levels in the creek and weir pools). The lagoons, from upstream to downstream are as follows:

- **Heppell Lagoon** was originally the uppermost section of Gunbower Creek, but was isolated by the construction of the National Channel. The lagoon is shallow (<2 metres deep) comprising of a narrow incised creek line and a U-shaped billabong located at the downstream end of the lagoon. Levels in the lagoon are held by the downstream regulator on the National Channel (North Central CMA, 2014f).
- **Heart Lagoon** is a shallow (< 2 metres deep) excised cut-off of the Gunbower Creek that comprises of a heart-shaped main channel as well as a secondary, tea-pot shaped arm. The inlet and outlet are located alongside one another and respond to fluctuations in the National Channel (as there are no regulating structures). The lagoon can receive water via a drainage line connected to the Gunbower Creek and is part of the Welton Nature Conservation Reserve (North Central CMA, 2014e).
- **Splatts Lagoon** is a deep (>2 metres deep) former section of the Gunbower Creek that has been isolated by the construction of the National Channel. The lagoon can receive runoff from the Patho Plains (pastoral farmland to the south of Gunbower) via Maher Creek an ephemeral tributary and is also connected to the National Channel at both its upstream and downstream ends (North Central CMA, 20143b).

- **Unregulated Lagoon** is a small, shallow (<2 metre deep) horse-shoe shaped former meander that is connected to the Gunbower Creek by a narrow, excavated, unregulated inlet at the upstream end (North Central CMA, 2014c).
- **Longmore Lagoon** is a large, relatively shallow (average depth <2 metres) natural backwater of Gunbower Creek comprising two half-circular meanders connected by a narrow channel. The eastern meander is narrower with steeper banks whilst the western meander is wider and shallower. The lagoon is connected to Gunbower Creek through two regulating structures at each end of the western channel (North Central CMA, 2013b).
- **Turner Lagoon** is a long and narrow former meander of the Gunbower Creek which has been isolated by the National Channel. Patho Creek contributes catchment runoff to the lagoon at its southern boundary. The lagoon is connected to the Gunbower Creek through regulating structures at its upstream and downstream ends and includes Phyland Lagoon (see below), which is connected midway along its the western arm. The lagoon contains a series of deep pools (North Central CMA, 2013c).
- **Phyland Lagoon** is a small, shallow (<1.5 metre), boomerang shaped natural billabong that branches from the east side of Turner Lagoon (not directly connected to the Gunbower Creek). The lagoon is unregulated and levels are dictated by heights in neighbouring Turner Lagoon (North Central CMA, 20143c).
- **Upper Gunbower Lagoon** is long and narrow former section of the Gunbower Creek that straddled Gunbower Weir. A head difference of 1.2 metres between the upstream and downstream regulators allows for slow-flowing conditions to be created (North Central CMA, 2013c).

Gunbower Weir, which is located at the downstream end of the reach, provides supply to the No. 1 Channel as well as Taylor's Creek which connects to Kow Swamp, Pyramid Creek and the Loddon River at Kerang. The entire reach passes mainly through highly developed farmland (North Central CMA, 2013e; Ecological Associates, 2015).Figure 4 illustrates the location of the key features described in Reach 1.

Figure 4. Physical characteristics of Reach 1

2.2.2.2. Reach 2: Gunbower Weir to Cohuna Weir

Reach 2 extends for approximately 47 kilometres from the Gunbower Weir to Cohuna Weir within the Murray Fans and Victorian Riverina bioregions (DEPI, 2014c). Connectivity between reaches 1 and 2 is facilitated by a fishway at Gunbower Weir (see Section 8 on infrastructure). The reach includes:

- Thompson's Weir a fixed crest weir that maintains the level for irrigation diverters upstream
- The outlet to Deep Creek which was modified for irrigation delivery to deliver water from the Murray River through the Gunbower Forest but is decommissioned: and
- the Wee Wee Rup Regulator (also known as Mulley's regulator) which allows water to be returned to the creek from the 6/1 Channel (which offtakes at Gunbower Weir and bypass approximately 28 kilometre of Reach 2 of the creek).

The reach also includes Hipwell Weir, constructed in 2013-2014 through TLM project to provide headwater to the Hipwell Road Offtake Regulator and Hipwell Road Channel for environmental water supply to the middle and lower Gunbower Forest (North Central CMA, 2013e). In addition the reach includes the following three shallow (<2 metres deep) natural billabongs, with only Gum Lagoon able to be managed in isolation of the creek:

- **Gum Lagoon** is a shallow (<1 metre deep), C-shaped natural billabong located 4.5 kilometres downstream of Gunbower Weir. The lagoon is relatively wide in comparison to the majority of lagoons in the system and is connected to the Gunbower Creek via Stoney Creek. The lagoon supports a series of shallow swampy island zones (North Central CMA, 2014d).
- **Cockatoo Lagoon** is shallow (<2 metre deep), loop-shaped, natural billabong that is regulated by the Thompsons Weir pool. The lagoon is connected to Gunbower Creek at three points, being the inlet, outlet and at the north-west edge via an excavated channel knows as 'Jumbo's Cut' (constructed to aid in flushing water to reduce blue-green algae blooms). A series of pool habitats are supported by the deeper sections of the lagoon (North Central CMA, 2014a).
- **Taylors Lagoon** is a shallow (<2 metre deep), loop-shaped, natural billabong located upstream of Cohuna Weir. The lagoon is connected to Gunbower Creek via a narrow excavated connection at the upstream end and a broad pool at the downstream end (North Central CMA, 2014b).

The upstream and downstream ends of Reach 2 maintains a similar channel capacity, however a section located downstream of Thompson's Weir known as the 'Narrows', forms a natural flow bottle neck. The restricted capacity of the channel creates a stretch of faster flowing water. The reach terminates at Cohuna Weir which supplies water to upstream pumping irrigation customers and via the offtake to the No. 3 Channel. Coliban Water also extracts water from the Cohuna Weir pool for treatment at the Cohuna Water Treatment Plant for potable supply to the township of Cohuna. The weir creates a deep broad channel immediately upstream of Cohuna. The majority of the reach passes through developed agricultural land, with the exception of sections where the creek forms the boundary of the Gunbower Forest (SKM, 2002; SKM, 2006 cited in Ecological Associates, 2015). Figure 5 illustrates the location of the key features described in Reach 2.

Figure 5. Physical characteristics of Reach 2

2.2.2.3. Reach 3a: Cohuna Weir to Koondrook Weir

Reach 3a extends for approximately 58 kilometres from the Cohuna to Koondrook Weir within the Murray Fans bioregion (DEPI, 2014c). A large proportion of the reach forms the southern boundary of the Gunbower Forest providing connectivity between the floodplain and creek environments. In comparison to reaches 1 and 2, Reach 3a contains high value woody habitat.

Several kilometres of fast-flowing habitat is present immediately downstream of the Cohuna Weir. The mid to lower proportion of the reach includes a number of offtakes known as the 'lower landscape regulators' which supply environmental water to the lower Gunbower Forest. This includes offtakes to Reedy Lagoon, Yarran Creek, Black Swamp and Little Gunbower Creek as well as one associated lagoon:

- **Safe's Lagoon** is a shallow (approximately 1 metre deep), unregulated natural billabong located 8 kilometres upstream of Koondrook Weir at the edge of the Gunbower Forest. The lagoon maintains natural connections to Gunbower Creek at both its upstream and downstream arms (North Central CMA, 2013a).

The Koondrook Weir provides water to the No. 4 and No. 5 channels during the irrigation season. The upper and lower bounds of the weir level are managed by automated doors that open and close in response to water levels in the creek (Ecological Associates, 2015). Figure 6 illustrates the location of the key features described in Reach 3a.

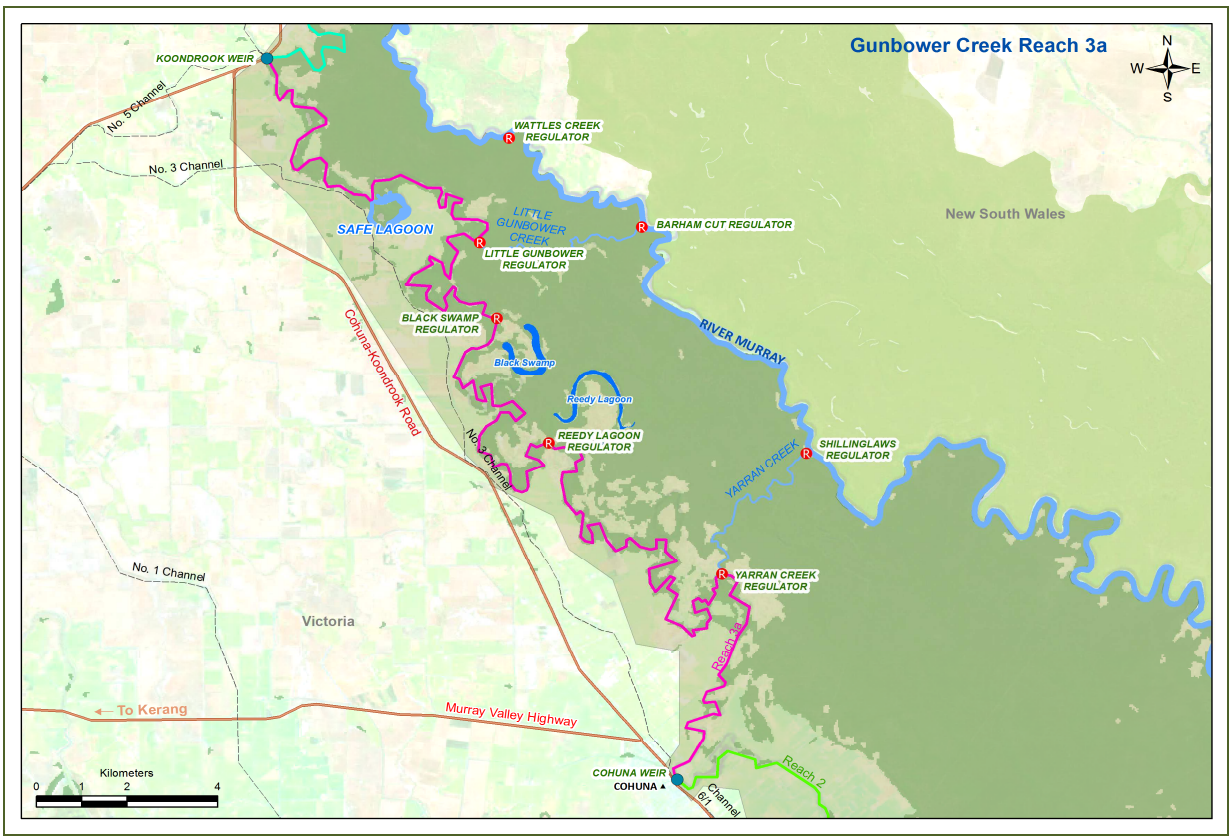

Figure 6. Physical characteristics of Reach 3a

2.2.2.4. Reach 3b: Koondrook Weir to Murray River

Reach 3b extends for approximately six kilometres from the Koondrook Weir to the confluence with the Murray River at the township of Koondrook in the Murray Fans bioregion (DEPI, 2014c). In the upper sections, the channel form is generally U-shaped whereas the lower sections feature low benches. As there are no irrigation customers in Reach 3b only excess or environmental water is passed over the Koondrook Weir. The Murray River can contribute to the water regime of this reach when Murray River discharge is elevated and water backs up into the lower portion of the reach (Ecological Associates, 2015). The primary outfall of flood water from Gunbower Forest resulting from both natural and managed events is also located in this reach and is known as Chinaman's Bend. Figure 7 illustrates the location of the key features described in Reach 3b.

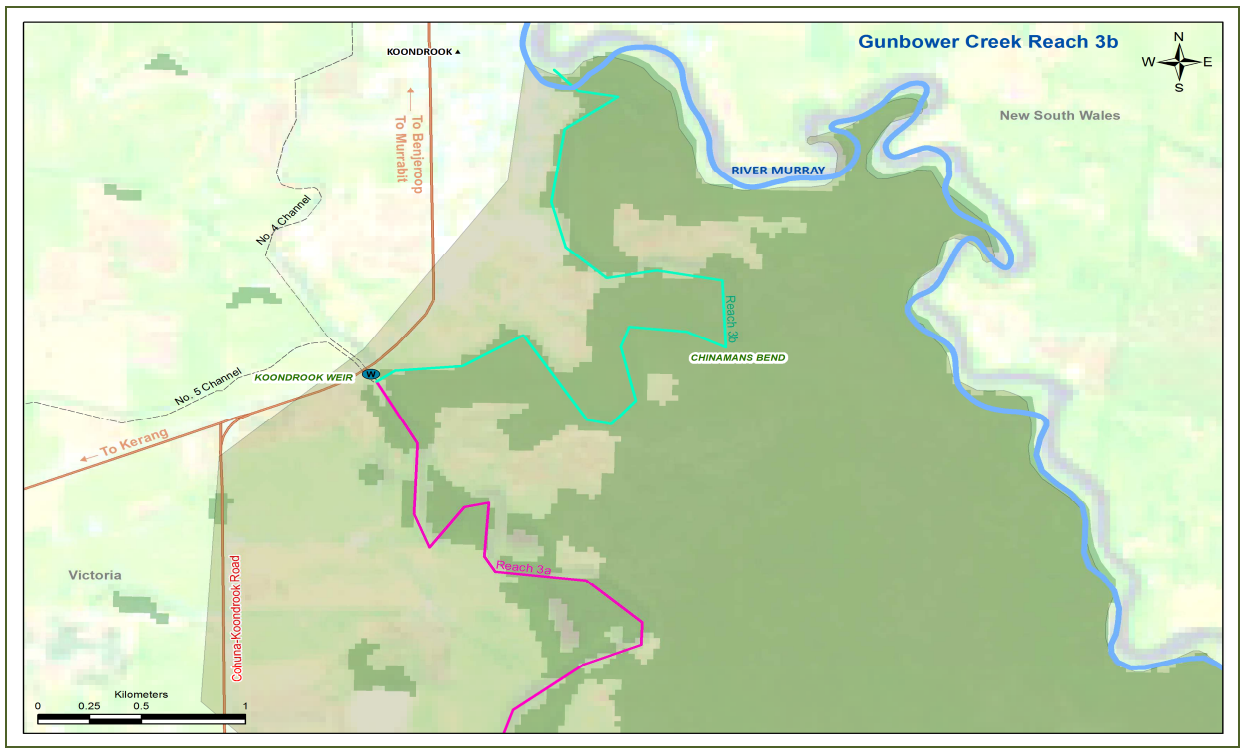

Figure 7. Physical characteristics of Reach 3a

2.3. Land use

Land use in the catchment surrounding the Gunbower Creek System is dominated by irrigated agriculture. Dairy is the dominant agricultural industry although other agricultural activities include irrigated pasture, cattle and sheep, stone fruit, vegetables and orchards (SKM, 2009). The area also supports pig farming and sand dune extraction enterprises (specifically Gum and Taylor's Lagoons respectively) as well as lifestyle properties and hobby farms. The creek itself is a major irrigation carrier for the TIA conveying water to irrigation, stock and domestic customers in the local, Kerang (via Macorna Channel, Kow Swamp and Pyramid Creek), Benjeroop and Murrabit areas (via No. 3, 4 and 5 Channels). The creek also supplies consumptive water to the townships of Gunbower, Cohuna and Leitchville. The Gunbower lagoons also operate as part of the TIA, storing water for local licensed irrigators (North Central CMA, 2013d).

2.4. Land status and management

2.4.1. Land status

The majority of the land immediately adjacent to the Gunbower Creek System upstream of Cohuna Weir is listed as Natural Features Reserve and Public Land Frontage Reserve under the *Crown Land (Reserves) Act 1978* and *Crown Land (Unreserved) Act 1978.* This land is managed for public purpose, in particular for the protection of natural features (VEAC, 2008). On average the riparian reserve zone is approximately 50 metres wide with the exception of Reach 2 where it is approximately 40 metres wide. In the upstream reaches, the creek frontage connects to a number of Community Use Areas (include recreational areas near the Gunbower township) as well as the southern border of the Welton Nature Conservation Reserve which encompasses Heart and Unregulated lagoons and meets the southern border of Heppell Lagoon (North Central CMA, 2013c; North Central CMA, 2013e; North Central CMA, 2014f). In these reaches, the majority of land beyond that designated as crown land is considered private and utilised for a range of agricultural practices. There are two grazing licenses with a 20 metre buffer of Reach 1 and 37 in Reaches 2, 3a and 3b. Downstream of Cohuna Weir, the majority of the riparian zone of Gunbower Creek is listed as Public Land Frontage Reserve and merges with the Gunbower State Forest which stretches for approximately 8,840 hectares. Table 2 provides a summary of the land status and management of components of the Gunbower Creek System.

Table 2. Land status and management of the Gunbower Creek System

Location	Land Manager	Land Status
Creek	DELWP	Natural Features Reserve, Public Land Water Frontage Reserve and State Forest
Heart	Parks Victoria	Nature Conservation Reserve
Unregulated	Parks Victoria	
Heppell	DELWP	Natural Features Reserve
Gum	DELWP	
Cockatoo	DELWP	Natural Features Reserve and Public Land Water Frontage Reserve
Taylor's	DELWP and Parks Victoria (GMW water managers)	
Safe's	Parks Victoria (GMW water managers)	
Longmore	DELWP	
Splatts	DELWP and Parks Victoria	
Turner	DELWP and GMW	
Phyland	DELWP and GMW	
Upper	DELWP and GMW	
Source: North Central CMA (2014a; 2014b; 2014c; 2014e; 2014f; 2014g; 2013a; 2013b; 2013c; 2013d)		

2.4.2. Environmental Water Management

There are several agencies directly involved in environmental water management in Victoria, and other agencies, such as public land managers, play an important role in facilitating the delivery of environmental watering outcomes. Table 3 summarises the agencies and groups that have involvement in environmental water management for the Gunbower Creek System.

Table 3. Roles and responsibilities for environmental water in the Gubower Creek System system

Agency	Responsibilities/involvement
Department of Environment, Land, Water and Planning (DELWP)	• Manage the water allocation and entitlements framework • Develop state policy on water resource management and waterway management approved by the Minister for Environment and Climate Change and Water • Develop state policy for the management of environmental water in regulated and unregulated systems • Act on behalf of the Minister for Environment and Climate Change and Water to maintain oversight of the VEWH and waterway managers (in their role as environmental water managers) • Legislative responsibilities for the management of flora and fauna • Provides approval of EWMPs and endorsement of SWPs.
Victorian Environmental Water Holder(VEWH)	• Make decisions about the most effective use of the Water Holdings, including use, trade and carryover • Authorise waterway managers to implement watering decisions • Liaise with other water holders to ensure coordinated use of all sources of environmental water • Publicly communicate environmental watering decisions and outcomes • Author of the Statewide Seasonal Watering Plan • Approves final endorsement of SWPs • Approves delivery of environmental water (Seasonal Watering Statement) and funds environmental water related monitoring.
Commonwealth Environmental Water Holder (CEWH)	• Make decisions about the use of Commonwealth water holdings, including providing water to the VEWH for use in Victoria • Liaise with the VEWH to ensure coordinated use of environmental water in Victoria • Report on management of Commonwealth water holdings.
Murray-Darling Basin Authority (MDBA)	• Implement the Murray-Darling Basin Plan - the Basin Plan sets legal limits on the amount of surface water and groundwater that can be taken from the Basin from 1 July 2019 onwards • Integrate Basin wide water resource management • Manage TLM water entitlements. • Own Living Murray infrastructure within Gunbower Creek
North Central CMA	• Waterway Manager • Gunbower Forest Living Murray Icon Site Manager

Agency	Responsibilities/involvement
	• Identify regional priorities for environmental water management in regional Waterway Strategies • In consultation with the community assess water regime requirements of priority rivers and wetlands to identify environmental watering needs to meet agreed objectives identify opportunities for, and implement, environmental works to use environmental water more efficiently. • Propose annual environmental watering actions to the VEWH and implement the VEWH environmental watering decisions. • Provide critical input to management of other types of environmental water (passing flows management, above cap water) report on environmental water management activities undertaken.
Goulburn Murray Water (GMW)	• Water Corporation – Storage Manager and Resource Manager • Work with the VEWH and waterway managers in planning for the delivery of environmental water to maximise environmental outcomes • Operate water supply infrastructure such as dams and irrigation distribution systems to deliver environmental water • Ensure the provision of passing flows and compliance with management of diversion limits in unregulated and groundwater system • Provides endorsement of SWP and facilitates on-ground delivery.
Parks Victoria	• Land Manager • Implement the relevant components of EWMPs • Operate, maintain and replace, as agreed, the infrastructure required for delivery of environmental water, where the infrastructure is not part of the GMW irrigation delivery system • Where agreed, participate in the periodic review of relevant EWMPs and provides endorsement of SWPs • Manage and report on other relevant catchment management and risk management actions required due to the implementation of environmental water.
Input and advice into Gunbower Creek System environmental watering	
Barapa Barapa and Yorta Yorta Nation Aboriginal Corporation	• Traditional owners of the area encompassing Gunbower Creek and Lagoon systems • Involved in a variety of North Central CMA projects involving Gunbower Island • In 2015-16 the North Central CMA will undertake a project to develop an engagement framework for annual environmental water management
Gunbower Creek and Lagoons Community Advisory Group (CAG)	• Provide a source of local knowledge and insight into community values and expectations for the health of Gunbower Creek and Gunbower Lagoons. • Includes landowners, recreational users, environmental and interest groups • Facilitate the exchange of knowledge, perspectives and networks between members of the group • Consulted in the development of this EWMP.
Gunbower Creek and Lagoons Project Working Group (PWG)	• To ensure that the organisations they represent are kept up to date regarding this project, and if any issues arise as a result of this project, then they are addressed through the PWG • Includes DELWP, Parks Victoria, GMW, Shire of Campaspe, Gannawarra Shire Council, VEWH • Consulted in the development of this EWMP.
Gunbower Island Community Reference Group (CRG)	• Provide a source of local knowledge and insight into community values and expectations for the health of Gunbower Creek and Gunbower Lagoons. • Includes landowners, recreational users, environmental and interest groups • Facilitate the exchange of knowledge, perspectives and networks between members of the group • Consulted in the development of this EWMP.

2.5. Wetland characteristics, depletion and rarity

Victoria's wetland classification and inventory was updated in 2013 and replaces the system developed by Corrick and Norman. The updated classification is based on the Australian National Aquatic Ecosystem (ANAE) Classification Framework with data on wetlands and their classification attributes converted into spatial Geographic Information System (GIS) layers.

The Framework structure produces 37 wetland types that were adopted to distinguish naturally-occurring from human-made wetlands in the first level of the classification hierarchy. Aquatic ecosystem habitats: palustrine, lacustrine and estuarine distinguish wetlands in the second level of the classification hierarchy and wetland attributes: water regime, salinity, landscape context, soils and wetland vegetation distinguish wetlands in the third level of the hierarchy (DEPI, 2014e).

Under Corrick and Norman Classification, ten of the Gunbower Lagoons were considered to be deep freshwater marshes prior to European settlement (WETLAND_1788). The remaining two lagoons – Upper Gunbower and Safe's Lagoons, were undefined with the exception of areas of Upper Gunbower Lagoon which were classified as deep freshwater marsh, permanent open freshwater and freshwater meadow. All of the lagoons are now (WETLAND_1994) classified as permanent open freshwater with the exception of Heppell Lagoon, Upper Gunbower Lagoon, Taylor's and Safe's Lagoon which have retained their Corrick and Norman pre-European wetland classification of deep freshwater marsh (Corrick & Norman, 1980; DELWP, 2015a; DELWP, 2015b). In Victoria, the North Central CMA region, Victorian Riverina and Murray Fans bioregions the area of permanent open freshwater has doubled in size since European occupation and the wetland type is now considered over represented in the landscape. Conversely deep freshwater marsh is now considered depleted in Victoria, the North Central CMA region and both Victorian Riverina and Murray Fans bioregion with up 69% reduction since European settlement. Table 4 illustrates the area, proportion, depletion and rarity of each of the major Corrick and Norman wetland classifications across various defined landscapes.

Table 4. Area, depletion and rarity of Corrick and Norman wetland classifications in the region

Region	Pre-European area (ha)	Current area (ha)	Change (%)	Lagoons contribution to current area (%)
Permanent open water				
Victoria	70,612	165,069	-134%	0.2
North Central catchment	14,121	28,360	-101%	1.3
Victoria Riverina bioregion	2,919	9,170	-214%	2.18
Murray Fans bioregion	57	296	-421%	60.6
Deep freshwater marsh				
Victoria	176,044	54,360	69%	0.3
North Central catchment	10,526	4,880	54%	3.2
Victoria Riverina bioregion	8,785	3,687	58%	0.16
Murray Fans bioregion	795	384	52%	39.1

Only three lagoons are classified under the Victorian wetland classification system, being Heppell and Taylor's Lagoons as temporary freshwater swamps and Splatt's Lagoon as permanent freshwater marsh and meadow (DEPI, 2014e; DELWP, 2015c). Temporary freshwater swamps are defined as those wetlands that are inundated annually to frequently and hold water for at least one month to more than one year prior to drying while permanent freshwater marshes and meadows are defined as those that are inundated constantly, rarely completely drying (DEPI, 2014e). A comparison of percentage reduction since European settlement could not be undertaken as there has not been a comprehensive update of the WETLAND_1788 layer to meet the new wetland classification categories. In addition, the small area of the total system which is classified is small, meaning that an assessment of the systems contribution to the current area of each wetland classification is negligible (i.e. less than 0.1%). Table 5 provides an overview of the wetland characteristics for each of the lagoons in the Gunbower Creek System.

Table 5. Wetland Classifications for the Gunbower Lagoons

	Lagoon name											
	Heppell	**Heart**	**Unregulated**	**Splatts**	**Turner**	**Phyland**	**Longmore**	**Upper**	**Gum**	**Cockatoo**	**Taylor's**	**Safe's**
Alternative name	N/A	N/A	N/A	Lagoon No. 1	Lagoon No. 2	Lagoon No. 2	Lagoon No. 4	Lagoon No. 3	N/A	N/A	N/A	Safety Lagoon
Wetland ID	44745	45365	45358	44812	45350	45346	54344	45336	45334	45332	45304	45247
Area (ha)	6	15	3.5	74	78	13.5	75	120	33	87	30	67
Bioregion	Victorian Riverina	Murray Fans	Murray Fans	Murray Fans	Victorian Riverina	Victorian Riverina	Victorian Riverina	Murray Fans/ Victorian Riverina	Victorian Riverina	Murray Fans/ Victorian Riverina	Murray Fans	Murray Fans
Conservation Status	No status defined	No status defined	No status defined	No status defined	No status defined	No status defined	No status defined	No status defined	No status defined	No status defined	No status defined	No status defined
Land status	Crown land	Crown land	Crown land	Crown land	Crown land	Crown land	Crown land	Crown land	Crown land	Crown land	Crown land	Crown land
Land Manager	DELWP	Parks Victoria	Parks Victoria	DELWP and Parks Vic	DELWP and GMW	DELWP and GMW	DELWP	DELWP and GMW	DELWP	DELWP	DELWP and Parks Vic	Parks Victoria
Surrounding Land Use	Cropping, irrigated pasture	Welton Nature Reserve	Welton Nature Reserve	Irrigated pasture, dairying, aqua-culture	Irrigated pasture, dairying, orchard	Irrigated pasture, dairying, orchard	Irrigated pasture, dairying	Cropping, grazing	Cropping, irrigated pasture, intensive piggery	Dairy farming, cropping, irrigated pasture	Cropping, irrigated pasture, sand dune excavation	Dairy farming, cropping, irrigated pasture
Historical water supply	Original channel of Gunbower Creek as well as natural billabong	Natural billabong	Original channel of Gunbower Creek	Original channel of Gunbower Creek	Original channel of Gunbower Creek	Natural billabong	Natural billabong	Original channel of Gunbower Creek	Natural billabong	Natural billabong	Natural billabong	Natural billabong
Current water Supply	Excised in 1890s- Murray River or National Channel	National Channel	Excised in 1890s - National Channel	Excised in 1890s - National Channel or via Mahers Creek	Excised in 1890s - National Channel or via Patho Creek	Turner Lagoon	Gunbower Creek	Excised in 1890s - Gunbower Creek	Upper Gunbower Lagoon via Stoney Crossing	Gunbower Creek	Gunbower Creek	Gunbower Creek

	Lagoon name											
	Heppell	**Heart**	**Unregulated**	**Splatts**	**Turner**	**Phyland**	**Longmore**	**Upper**	**Gum**	**Cockatoo**	**Taylor's**	**Safe's**
1788 wetland category (Corrick and Norman)	Deep freshwater marsh	Deep Freshwater Marsh	Deep Freshwater Marsh	Deep Freshwater Marsh	Deep Freshwater Marsh	Deep Freshwater Marsh	Deep Freshwater Marsh	Mostly unclassified-areas of deep freshwater marsh, permanent open freshwater, freshwater meadow	Deep Freshwater Marsh	Deep Freshwater Marsh	Deep freshwater marsh (lagoon); Shallow freshwater marsh (island swamp)	Not defined-watercourse Area
1994 wetland category (Corrick and Norman)	Deep freshwater marsh	Permanent Open Freshwater	Permanent Open Freshwater	Permanent Open Freshwater	Permanent Open Freshwater	Permanent Open Freshwater	Permanent Open Freshwater	Mostly unclassified-areas of deep freshwater marsh, permanent open freshwater, freshwater meadow	Open Water	Permanent Open Freshwater	Deep freshwater marsh (lagoon); Shallow freshwater marsh (island swamp)	Not defined-watercourse Area
2013 Victorian Wetland Classification	Temporary freshwater swamps	Unknown	Unknown	Permanent freshwater marshes & meadows	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Temporary freshwater swamps	Unknown
volume (ML) @ FSL	165.3	147	22	927	1,502	163	757	1,425	290	1,020	29	410
FSL (m AHD)	86.3	85.3	85	85	85	84.9[1]	84.5	84.3	83.8	83.15	81.6	78.4[2]
Mean wetland depth (m)	1.5	1.12	0.51	1.06	1.82	1.11	1.09	1.69	0.8	1.5	1 to 2	1.02
Wetland inflow height (m AHD)	85.3-86.3	84	84.3	U/S= 83.34 D/S=82.51	U/S= 81.94 D/S= 81.49	82.9	U/S= 82.7 D/S= 82.2	U/S= 82.43 D/S= 82.96	Unknown	Unknown	>80.93	>77

Key:
[1]Paul Lacy [Goulburn Murray Water] pers comm., 31 July 2013 cited in North Central CMA (2013c)
[2]GMW (2013a)
Source: North Central CMA (2014a; 2014b; 2014c; 2014e; 2014f; 2014g; 2013a; 2013b; 2013c; 2013d)

2.6. Water sources

The total volume of water available to the Gunbower Creek System includes unregulated flows, environmental entitlements and consumptive water. Each of these sources has different conditions and levels of certainty associated with them. A description of each is provided below.

2.6.1. River Murray Unregulated Flows (RMUF)

Unregulated flows in the River Murray system are defined as water that cannot be captured in Lake Victoria and is, or will be, in excess of the required flow to South Australia. If there is a likelihood of unregulated flow event in the River Murray system, the MDBA provides this advice to jurisdictions. The Upper States then advise the Authority on altered diversion rates and environmental releases within their existing rights to unregulated flows. These flows occur usually during wet periods and after heavy rainfall.

Based on the information received from jurisdictions, the Authority reassesses the event and, if necessary, limits the upper states' access to ensure that the unregulated flow event is not over committed. The Authority then issues formal unregulated flow advice to jurisdictions including any limits to states' access.

Depending on the volume of water remaining, the Authority advises on the availability and volume of RMUF. Whilst there is a range of measures that can be undertaken by the upper states as part of their 'prior rights' during unregulated flows, RMUF events are prioritised solely for the environment (DEPI, 2013a). RMUF can be used in the Gunbower Creek System during declared periods in the Murray system.

2.6.2. Water entitlements

There is no environmental water entitlement for the Gunbower Creek System and as such securing water is subject to State watering priorities. Environmental water sources potential available for use within the system are summarised below and are classified as one of two types in Victoria:

- High-reliability water shares (HRWS), which is a legally recognised, secure entitlement to a defined share of water.
- Low-reliability water shares (LRWS), which are water shares with a relatively low reliability of supply. Allocations are made to high-reliability water shares before low-reliability shares (DEPI, 2014d).

It is important to note that water availability will vary from season to season, according to climatic conditions, volumes held in storage and carryover entitlements.

TLM Initiative

TLM was established in 2002 as a partnership of the Commonwealth, NSW, Victorian, South Australian and ACT governments. The long term goal of this program is to achieve a healthy working Murray River system for the benefit of all Australians. As detailed in Section 1.3, 480 GL has been recovered for environmental watering at six Icon Sites including Gunbower–Koondrook–Perricoota Forest, in which Gunbower Forest is part of (DEPI, 2013a). It should be noted that there is no specific TLM allocation for the Gunbower Creek although environmental water has been used in the past to support ecological objectives shared with the Gunbower Forest.

Bulk entitlement (Murray River – Flora and Fauna) Conservation Order 1999

The VEWH manages the Bulk Entitlement (River Murray – Flora and Fauna), a 27.6 GL entitlement of environmental water for the Murray River. The entitlement aims to benefit flora and fauna of wetlands along or with access to the Murray River system (DEPI, 2013a). It has been used at a range of wetlands including Gunbower Forest and the Kerang Ramsar wetlands. It can also be traded on the water market on an annual basis. The use of this in the Gunbower Creek System is not guaranteed and is at the discretion of the VEWH (VEWH, 2012).

Commonwealth Environmental Water Holder (CEWH)

The *Commonwealth Water Act 2007* establishes the CEWH to manage the Commonwealth's environmental water holdings for the purpose of protecting or restoring the environmental assets of the Murray-Darling Basin, and of other areas outside the Basin where the Commonwealth holds water, so as to give effect to relevant international agreements. Water held in the Murray-Darling Basin is required to be managed in accordance with the environmental watering plan, part of the Basin Plan being developed by the MDBA in consultation with state governments and stakeholders (CEWH, 2015). The entitlement can be used across multiple system including the Murray, Goulburn, Broken, Loddon and Campaspe upon agreement with the CEWH.

Environmental Entitlement (Murray System - NVIRP Stage 1) 2012

GMW Connections Project is an irrigation modernisation project developing an improved water delivery network across northern Victoria. The Connections Project is funded by the Victorian Government, Commonwealth Government and Melbourne Water and each investor will receive a defined share of the water savings achieved from improving the efficiency of the channel delivery network. The Commonwealth and Victorian Governments' shares of the water savings will deliver environmental benefits.

While improving irrigation efficiency, the Connections Project will reduce outfall volumes to wetlands. Under the statuary approvals, the Connections Project must ensure there is no net impact on high environmental values. 'Mitigation water' will therefore be delivered to support environmental values. Mitigation water is defined as the volume of water required to offset the impact of the Connections Project on wetlands that have become reliant on outfalls. Mitigation water will be represented as an obligation in the water corporation's Bulk Entitlement and will be deployed according to an Environmental Watering Plan (DEPI, 2013a). Mitigation water will be available to Taylor's Lagoon as per the GLMP detailed in Section 1.3.

2.6.3. Other water sources

Irrigation and consumptive water en-route

As the Gunbower Creek and lagoons are managed as irrigation storages and carriers there are also opportunities to work with MDBA and GMW to utilise consumptive water en-route to provide environmental benefit to the creek and some of the lagoons (i.e. those able to receive through flow) (DEPI, 2013a). Additional environmental water (from one or more of the above sources) may be required to underwrite the losses associated with utilising consumptive water en-route.

Private donations

People who hold water entitlements sometimes donate water to their local catchment management authority for environmental use. Additionally, people have donated money to non-governmental organisations to buy temporary water allocations for environmental use. While the scale of donated water is generally small relative to other water sources, it can provide a valuable contribution, especially in times of critical needs (DEPI, 2013a). Private donations may apply to any component of the Gunbower Creek System.

The water sources potential available for use in the Gunbower Creek System including conditions of availability and use, are summarised in Table 6.

Table 6. Potential water sources available in the Gunbower Creek System (North Central CMA, 2015a)

Water Entitlement	Volume (ML)	Flexibility of management	Conditions of availability of use	Management responsibility
TLM program	TBA	Agreement is required with the MDBA	Only available for use within Icon Sites e.g. Gunbower Forest	MDBA
Bulk entitlement (Murray River – Flora and Fauna) Conservation Order 1999	28,750 (HRWS)	Fully flexible management	Can be used across multiple systems, within relevant trade protocols	VEWH
	40,000 (RMUF)	Flexible management in declared periods only	Only available for use during declared periods of unregulated flows on the Murray system	VEWH
Commonwealth Water Holdings	TBA	Agreement is required with the CEWH	Can be used across multiple systems, within relevant trade protocols	CEWH
Victorian Rescue Water	Variable	Fully flexible management	Only available during extended dry periods for emergency watering of River Red Gums	VEWH
Private donations	Variable	Agreement is required with private donator	Can be used at any location for any agreed purpose	VEWH/CMA
Consumptive water en-route	Variable	Management within constraints of domestic supply system/process	Water intended for consumption is diverted en route to any sites where is it practically feasible to divert the water	VEWH
Environmental Entitlement (Murray System - NVIRP Stage 1) 2012	Water savings created in the Murray system as part of NVIRP Stage 1	Fully flexible management	Can only be used in wetlands that have an approved Environmental Watering Plan with mitigation water recommended. Can be used across multiple systems, within relevant trade protocols	VEWH

2.7. Related agreements, policy, plans and activities

There are a range of international treaties, conventions and initiatives, as well as National and Victoria State Acts, policies and strategies that direct or inform environmental water management in Victoria. Those that may have particular relevance to the management of environmental and cultural values in the Gunbower Creek System are listed below. The function and major elements of each can be sources from Appendix 3.

International treaties, conventions and initiatives:

- Japan Australia Migratory Birds Agreement (JAMBA) 1974 – four of the species listed under this agreement has been recorded in the Gunbower Creek System.
- China Australia Migratory Birds Agreement (CAMBA) 1986 – five of the species listed under this agreement has been recorded in the Gunbower Creek System.
- Republic of Korea Australia Migratory Birds Agreement (ROKAMBA) 2002 –one species listed under this agreement has been recorded in the Gunbower Creek System.
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention) 1979 - there are currently no records of species listed under this agreement in the Gunbower Creek System.

Commonwealth legislation and policy:

- *Aboriginal and Torres Strait Islander Heritage Protection Act 1984* (Part IIA) – Gunbower Creek System is known to support places of cultural significance and contains a number of sites registered with Aboriginal Affairs Victoria.

- *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) - five migratory and two waterbird species, as well as three fish, one frog and one water dependent plant species listed under this Act have been recorded in the Gunbower Creek System.
- *Water Act 2007* – to provide for the protection of ecological values in Gunbower Creek and the Lagoons through appropriate management of Murray-Darling Basin water resources.

Victorian legislation:

- *Aboriginal Heritage Act 2006* – the Gunbower Creek System is known to support places of cultural significance.
- *Catchment and Land Protection Act 1994* - governs the management of land surrounding Gunbower Creek and the Lagoons including pest plant and animal control.
- *Water Act 1989* - provides a formal means for the integrated management of water in Victoria.
- *Wildlife Act 1975* - Parks Victoria and DELWP manage the Gunbower Creek System in accordance with this Act.
- *Flora and Fauna Guarantee Act 1988* (FFG Act) – seventeen fauna species and two flora species are listed under this Act have been recorded within the Gunbower Creek System.

National policies and strategies:

- The National Cultural Flows Research Project – this project is investigating indigenous water values and uses to form the basis for cultural flow water entitlements. These would be legally and beneficially owned by the Indigenous Nations and are of a sufficient and adequate quantity and quality to improve the spiritual, cultural, environmental, social and economic conditions of those Indigenous Nations. The cultural flows framework is under development but may influence the Gunbower Creek System as it is an area of cultural sensitivity.

Victorian policy and strategies:

- Victorian threatened flora and fauna species (DELWP advisory lists) – 31 fauna and 16 flora species on the DELWP advisory lists have been recorded within the Gunbower Creek System.
- *Victorian Waterway Management Strategy 2013 (VWMS***) –** This strategy outlines the direction for the Victorian Government's investment over an eight year period (beginning in 2012-13). The overarching management objective is to maintain or improve the environmental condition of waterways to support environmental, social, cultural and economic values (DEPI 2013).

Regional strategies and plans:

- *North Central CMA Regional Catchment Strategy 2013-19 (RCS)* - The RCS provides long-term vision for Natural Resource Management (NRM) within the North Central Catchment Management Authority region. The RCS sets regional priorities for the management of natural assets, sets overall direction for investment and coordination of effort by landholders, partner organisations and the wider community. It provides a framework that supports and encourages participation in protecting and enhancing our environment (North Central CMA, 2012).
- *North Central Waterway Strategy 2014-2022 (NCWS)* - This regional strategy is an action out of the VWMS and provides the framework for managing rivers and wetlands with the community over the next eight years. It delivers key elements of the VWMS including developing work programs to maintain or improve the environmental condition of waterways in the north central region. In this strategy, Gunbower Creek and Heart Lagoon, Unregulated Lagoon, Gum Lagoon, Cockatoo Lagoon, Taylor Lagoon and Safe's Lagoon are priority sites (North Central CMA, 2014g).

Site specific strategies and plans:

- *Gunbower Creek Waterway Action Plan 2007-2017 (WAP)* - the purpose of the Waterway Action Plan (WAP) is to improve the ecological health of Gunbower Creek. The WAP focuses on improving Gunbower Creek from the headworks structure, where the National Channel becomes Gunbower Creek, to where Gunbower Creek re-enters the River Murray at Koondrook (North Central CMA, 2007).
- *Gunbower Forest EWMP*- the EWMP established a series of priorities, environmental objectives and associated watering actions for the use of TLM water within the icon site which includes the use of Gunbower Creek as a delivery conduit. Outcomes relating to the maintenance of healthy fish populations in the wetlands and on the floodplain are directly linked with the creek and lagoon habitat values.
- *Gunbower Lagoons Modernisation Project* - the objectives of the GLMP are to: deliver water savings; deliver environmental benefits; and connect irrigators to the modernised backbone supply system and improve their level of service. The GLMP was nominated as a 'Special Project' under the G-MW Connections Project Stage 2 Business Case. The G-MW Connections Project is a $2 billion works program to upgrade ageing irrigation infrastructure across the Goulburn-Murray Irrigation District (GMID) to save water that is lost through seepage, leakage, evaporation and system inefficiencies (North Central CMA, 2013d).
- *Gunbower and Lower Loddon Native Fish Recovery Plan* - the Recovery Plan will restore native fish populations and waterway health through strategic on-ground actions. These actions include proven techniques such as fishways, screens on irrigation channels to prevent native fish from being lost to the irrigation network (common overseas), environmental flows and habitat rehabilitation, such as re-snagging and riparian revegetation. They will address the three key factors responsible for the decline of native fish populations within the Murray Darling Basin being loss of connectivity for fish movement and migration, alteration of natural flows regimes and loss of habitat (Mallen-Cooper et al., 2014).
- *Loddon River EWMP*- a guide to future environmental flows in Loddon River system which is connected to Gunbower Creek through Pyramid Creek. Connectivity between these two systems is particularly important for rehabilitation of native fish population as per the *Gunbower and Lower Loddon Native Fish Recovery Plan*.

3. Hydrology and system operations

3.1. River hydrology

3.1.1. Pre-regulation

Prior to regulation the Gunbower Creek and Forest would have formed a contiguous floodplain ecosystem separated from the neighbouring Koondrook-Perricoota Forest by the Murray River. Overbank flooding events of >30,000 ML/day in the Murray River occurred every six to seven years in ten, inundating the Gunbower Forest floodplain and its wetlands (Mallen-Cooper et al., 2014). Excess floodwater, rich in organic matter, minerals and nutrients would drain into the Gunbower Creek before re-entering the Murray River at the downstream end of the system. Historically the natural flow path of the Gunbower Creek would have included the meanders known as the Gunbower Lagoons, before seven - Heart, Phyland, Longmore, Gum, Cockatoo, Taylor's and Safe's Lagoons, became cut-off billabongs through natural riverine processes (see Table 5 for more details) (Hale & Butcher, 2011).

The historical commence-to-flow of Gunbower Creek at Torrumbarry is estimated to be 13,700 ML/day. Modelling of natural river levels (MDBA BIGmod, unpublished data) for a 100 year period (1900-2000) show that Gunbower Creek would have naturally operated as an ephemeral stream which flowed freely during winter and spring and decreased in early summer (Mallen-Cooper et al., 2013).The deeply incised nature of some of the creek's reaches would have resulted in a series of deep pools that remained even during dry years (Anderson et al., 2007b). At times, back water from the Murray River would also create slow-moving conditions in the lower reaches of the Gunbower Creek before draining back to the river in late spring and summer (Anderson, 2007). Figure 8 shows modelled pre-European flows at Torrumbarry during a dry and wet decade.

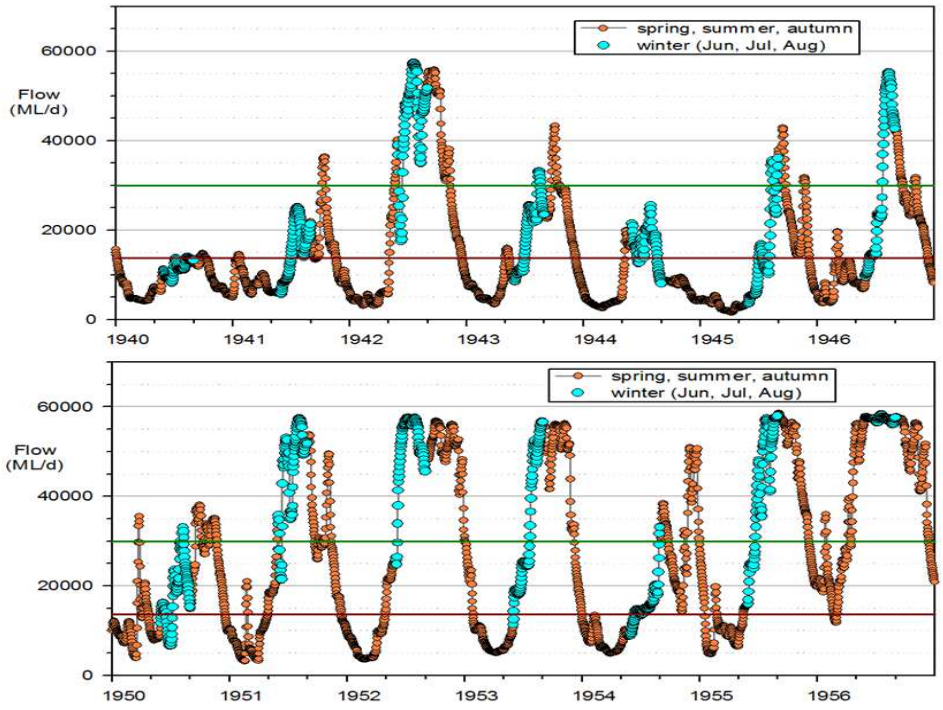

Figure 8. Modelled monthly flows in the River Murray at Torrumbarry for a 'dry' (top) and 'wet' (bottom) decade. Note Gunbower Creek commence to flow (red line) and overbank flooding level (green line) (Mallen-Cooper et al., 2014)

During periods of high flows in the Gunbower Creek, Taylor's Creek would receive and convey water to Kow Swamp, Pyramid Creek and into the Loddon River System linking an extensive network of distributary channels, anabranches and tributaries extending from Creswick in the south to Swan Hill in the north. High flow events would also result in inflow to the natural billabongs. A number of these, in particular Splatts and Turners Lagoons, would also receive catchment runoff from the Patho and

Maher creek catchments to the south (Gippel, 2013; North Central CMA, 2013d). Through evaporation and seepage the majority of the billabongs would have periodically dried during the summer months (North Central CMA, 2013d).

3.1.2. Post-regulation

Irrigation started in the Gunbower district in the mid-1800s with water being directly pumped from the Murray River and Gunbower Creek (Mallen-Cooper et al., 2014). At the time Gunbower Creek provided the main gravity-feed channel and passed water from the Murray River to the Macorna Channel and Kow Swamp (Davis et al., 1902 cited in Mallen-Cooper et al., 2014). In 1881 the *Victorian Water Conservancy Act 1881* established both waterworks and irrigation trusts to carry out water supply works throughout northern Victoria. The Gunbower Scheme involved several important works to improve the supply and reliability from the River Murray. This included the erection of headworks, the deepening and widening of the intake of Gunbower, Taylor's and Deep creeks and the construction of the National Channel in 1890 (Mallen-Cooper et al., 2014). This resulted in the excision of a number of natural meanders in the upper Gunbower Creek, forming a series of lagoons now known as Heppell, Unregulated, Splatts, Turners and Upper Gunbower lagoons (North Central CMA, 2013d).

In 1917, the River Murray Commission was established to regulate the river's contribution to irrigation. Pumps were used to deliver water from the Murray River to the National Channel until construction of the Torrumbarry Weir in 1923. The construction of Torrumbarry Weir and Lock between 1919 and 1924 allowed Murray River waters to be backed up for gravitational supply to Gunbower Creek throughout most of the year (North Central CMA, 2007).

Approximately 30% of the average annual flow in the Murray River is now diverted into the TIA via the National Channel and Gunbower Creek (O'Connor et al., 2008 cited in Sharpe & Stuart, 2015). This has changed the frequency, duration and seasonality of the flow regime and has prohibited natural wetting and drying within the creek and lagoons. Even in large natural floods the National Channel offtake regulator and associated levee system is designed to hold back high water levels rather than be overtopped (Mallen-Cooper et al., 2013). In addition, sections of the creek are lined with levees, designed to increase the capacity of the creek and reduce the occurrence of overbank flooding. Overbanking flooding is now largely absent from the system and there is a reduced input of floodplain organic matter, carbon, nutrients and biota into the creek. The watering regime of the creek is now also seasonally inversed with prolonged high flows throughout spring, summer and autumn and low to no flows during winter (Figure 10) (Anderson et al., 2007b). The lagoons are operated at full capacity through the spring to autumn period with a drawdown to the inlet sill level in winter (Howard et al., 2013).

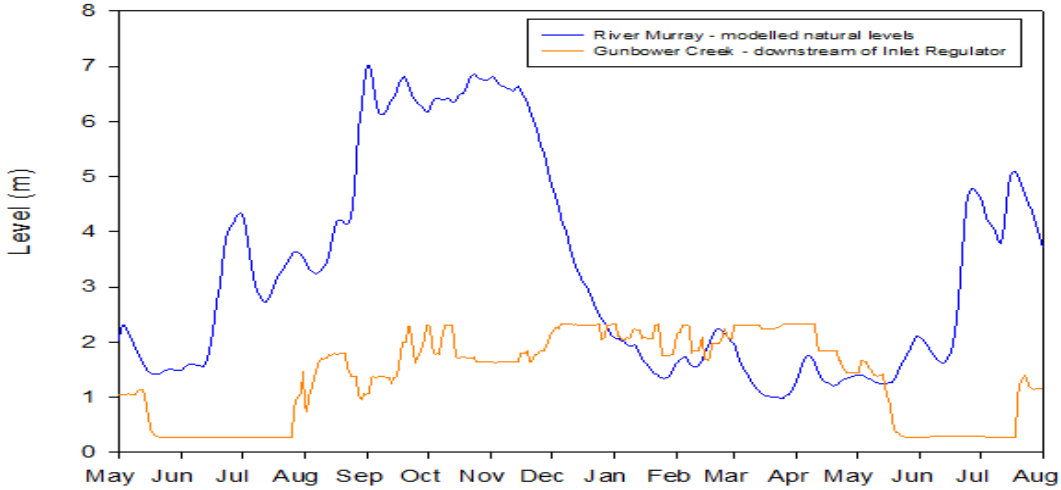

Figure 9. Daily level in the River Murray (modelled for 2002) compared with daily level in the Gunbower Creek for 2002, showing zero winter flow and frequent oscillation in summer but within expected range of natural (Mallen-Cooper et al., 2013).

3.2. System Operations

GMW usually begins filling the Gunbower Creek System in mid-July each year to ensure that the creek weir pools and lagoons are at full supply level by the start of irrigation season on the 15 August. Eight of the lagoons have regulating structures that allow management in isolation of the Gunbower Creek. These are periodically topped up throughout the season in response to irrigation demand. Lagoons without regulating structures (i.e. Heart, Unregulated, Cockatoo, Taylor's and Safe) for the most part are held at full supply level, although they will respond to fluctuations in the Gunbower Creek or downstream weir pools (North Central CMA, 2007; North Central CMA, 2013d). Table 7 and Table 8 show the major regulating structures used to control supply to town, irrigation, stock and domestic customers as well as environmental water delivery (i.e. to Gunbower Forest via the lower landscape regulators and Hipwell Road) in the Gunbower Creek and Gunbower Lagoons, respectively. This includes a description of the function of each structure, flow capacity, infrastructure for fish passage and whether they are utilised for GMW water accounting.

Table 7. Major regulating structures in the Gunbower Creek

Reach	Structure	Function	Fish passage	Flow gauging	Flow capacity
1	National Channel Headworks offtake	Diverts from the Torrumbarry Weir pool to the National Channel	No	Yes[2]	3,800 ML/day
1-2	Gunbower Weir	Provides headwater for the offtake to Taylors Creek (which flows to Kow Swamp, an off-stream storage in the TIA). Also maintains levels for direct diverters upstream and provides flows to the No. 1 Channel	Yes- Vertical slot	Yes	1,750 ML/day
2	Thompsons Weir	Provides headwater level for gravity-fed irrigation channels/ direct diverters upstream	Yes- Rock ramp	No	1,600 ML/day
2	Hipwell Road Weir and offtake regulator	Provides headwater to divert the maximum volume of water into Gunbower Forest via the offtake regulator	Yes- Vertical slot/ fish lock	Yes (offtake) [2]	1,650 ML/day
2-3a	Cohuna Weir	Provides flow to the No. 3 Channel and also maintains level for direct diverters upstream on Gunbower Creek	No[1]	Yes	900 ML/day
3a-3b	Koondrook Weir and Spillway	Provides headwater level for flows into the No. 4 and No. 5 Channels	No[1]	Yes (knife edge)[2]	900 ML/day

[1] fishway design underway at time of EWMP development. Fishway construction likely to be funded during life of EWMP.

[2] Refers to flow gauging utilised by GMW for watering accounting

Source: North Central CMA (2013e)

Table 8. Irrigation demand, supply and infastructure for lagoons within the Gunbower Creek System

Reach	Lagoon	Irrigation supply	Existing Infrastructure
Regulated lagoons			
1	Heppell	Supplied from Torrumbarry Weir Pool and National Channel with six stock and domestic entitlements HRWS of 14 ML and LRWS of 7 ML	Two regulating structures at the upstream and downstream ends as well as seven pumps and five instream barriers (pipe culverts)
1	Splatts	49 customers with HRWS of 3,266 ML and LRWS of 1,486 ML	Two regulating structures at the upstream and downstream ends
1	Turner	HRWS of 4,043 ML and LRWS of 1,827 ML	Two regulating structures
1	Phyland	Two customers with HRWS of 757 ML and LRWS of 353 ML	Existing pipe structure under Phyland Road which provides flows between Phyland and Turner Lagoons
1	Longmore	11 customers with HRWS of 3,431 ML and LRWS of 1,588 ML	Two regulating structures as well as a number of road crossing pipe culverts

Reach	Lagoon	Irrigation supply	Existing Infrastructure
1	Upper	40 customers with HRWS of 6,022 ML and LRWS of 3,313 ML	Two regulating structures at upstream and downstream ends
2	Gum	HRWS of 591 ML and LRWS of 274 ML	Two regulating structures with one downstream pipe culvert between Stoney Creek and Gum Lagoon and one outlet to Gunbower Creek
Self-adjusted lagoons (i.e. in response to creek or weir levels)			
1	Heart	HRWS of 776 ML and LRWS of 354 ML	No infrastructure however directly connected to the National Channel
1-2	Unregulated	Irrigation and stock and domestic entitlements with HRWS of 174 ML and LRWS of 77 ML	No infrastructure however directly connected to the National Channel
2	Cockatoo	HRWS of 1286 ML and LRWS of 589 ML	Regulator at the north western arm and pipe culvert at two inlets of the creek
2	Taylor's	10 irrigation diversion pumps and one regulated farm channel offtake	No regulating structures however influenced by Creek height with upstream end artificially connected to the creek by a straight cut channel which includes culvert
3a	Safe's	No irrigation diversions (surrounding irrigators divert from the Creek)	No regulating structures however influenced by the Koondrook Weir Pool
Source: North Central CMA (2014a; 2014b; 2014c; 2014e; 2014f; 2014g; 2013a; 2013b; 2013c; 2013d)			

During the irrigation season, flows in the Gunbower Creek fluctuate largely in response to demand and extraction. Recent modernisation aimed at increasing the efficiency of the system now means that irrigation customers are generally able to order and access water within 24 hours. As shown in Figure 10, this can create wide daily oscillations in flow as noted in a 24 hour period during September 2013 where levels fluctuated by up to 600 ML (Sharpe & Stuart, 2015). Although corresponding changes in depth are considered narrow from hour to hour, this can equate to an average variance during the September to November period of more than 0.2 metres downstream of the headworks and 0.1 metres upstream of Gunbower Weir per week (Ecological Associates, 2015). Figure 10 shows the fluctuation in hourly discharge downstream of Cohuna Weir between July 2014 and February 2015.

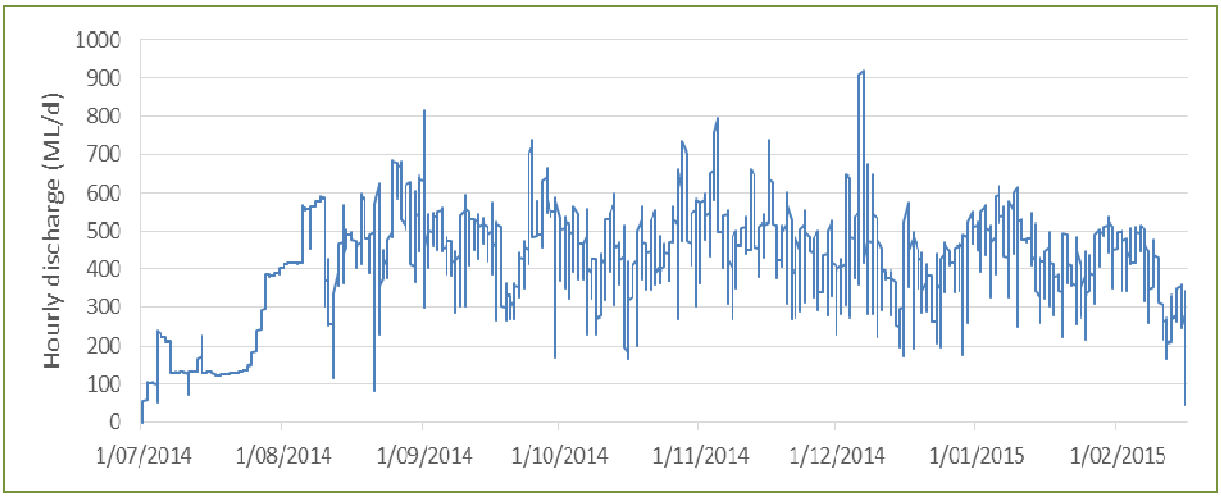

Figure 10. Dischage downstream of Cohuna Weir between July 2014 and February 2015 (Sharpe & Stuart, 2015).

The majority of irrigation water is extracted at Gunbower, Cohuna and Koondrook weirs, with only excess water (i.e. a rain rejection) passed over Koondrook spillway to enter Reach 3b. As there is no passing flow requirement at Koondrook Weir, the creek acts for the most part as a terminal system (Mallen-Cooper et al., 2014). The exception is when the reach is under the influence of Murray River backwater, which is noted to occur approximately 50% of the time in the last 4.1 kilometers of the creek (Anderson et al., 2007 cited in Ecological Associates, 2015).

At the end of the irrigation season (15 May) GMW closes the National Channel Headworks offtake and drains the weir pools, returning this water to the Murray River by passing it over Koondrook Weir. This results in the creek and lagoons rapidly drawing down to the weirs (within 30 cm of full supply) and lagoon sill levels, exposing benches and restricting water to a series of unconnected deep pools (Plate 1) (North Central CMA, 2015a). This is particularly evident in the lower reaches of the creek, with a CAG landholder noting that mudflat areas large enough to walk across would historically form in the bed of the creek (see Appendix 1). During the May 2014 irrigation shut off, discharge from Cohuna Weir was noted to fall from 276 ML/day to 7 ML/day in 48 hour period and remained below 10 ML/day until the end of June (Sharpe & Stuart, 2015). This is considered representative of the rate of fall noted to occur in the system at the end of each irrigation season (Ecological Associates, 2015).

Plate 1. Winter drawdown, Right: upstream of Cohuna Weir May 2012, Left: upstream of Koondrook Weir July 2013

3.3. Groundwater-surface water interactions

3.3.1. System overview

For most of its length, Gunbower Creek is a lateral stream that traverses the junction of the modern Murray River floodplain with the older Riverine Plain alluvium further west. Gunbower Island, which includes the Gunbower Forest between the creek and Murray River, is formed from floodplain alluvium and Aeolian deposits laid down in recent geological times and is known geologically as Coonambidgal Formation. The island comprises a myriad of unconsolidated sandy prior streams inter-bedded with silts and clays. These sediments infill a broad depression incised about eight metres into the upper surface of the Riverine Plain by the Murray River. The strata have been extensively re-worked during periods of over-bank flooding and times of great aridity (including the last glacial maximum).

The vast alluvial deposits of the Riverine Plain occur southwest of Gunbower Island beyond the Gunbower Creek. They comprise clays and inter-bedded sandy prior streams known collectively as Shepparton Formation. The formation extends from the land surface to a depth of about 50 to 80 metres. It comprises alluvium deposited by the ancestral streams of the modern rivers, and is sourced largely from erosion of the western uplands. The Shepparton Formation extends, at a depth of about 10 metres, beneath the Coonambidgal Formation under Gunbower Island.

Beneath the Shepparton Formation are the Calivil and Renmark Formations. These two formations are often considered as a single unit comprising coarse sands with occasional gravels and sometimes minor lignite. Similar to the overlying Shepparton Formations these strata were also deposited by ancestral streams eroding the western uplands.

In the northwest sector of Gunbower Island, at depths ranging from about 10 to 30 metres, the lower Shepparton Formation gives way to fine, partially consolidated beach sands. These strata were deposited during the regression of the Murray Sea between two to three million years ago. Gunbower Island lies within the eastern coastal margin of the marine incursion. Known geologically as Parilla Sand these strata are typically up to 50 metres thick. At depths of 100 to 120 metres the entire alluvial and marine sedimentary pile is underlain by bedrock comprising granites and folded

meta-sediments, largely sandstones and slates. These rocks date from the early Palaeozoic times (about 490 million years through to about 360 million years before present) (North Central CMA, 2015b).

3.3.2. Hydrogeology

The aquifers of the Shepparton Formation and the Parilla Sand in the region of Gunbower Island comprise high salinity groundwater ranging from 20,000 to 40,000 EC. Salinity occurs through capillary action when the groundwater reaches within 1.5 metres of the land surface. This was a common occurrence within the Barr Creek catchment west of Gunbower Creek prior to the onset of the Millennium Drought. Salinity was severe in the drainage depressions immediately west of the creek. The arid conditions that prevailed from 1996 through 2009 saw the regional watertable fall to about 3 metres, and some of the affected land has partially improved in consequence. Figure 11 illustrates the typical watertable fluctuations in irrigated land west of Gunbower Creek before the Millennium Drought.

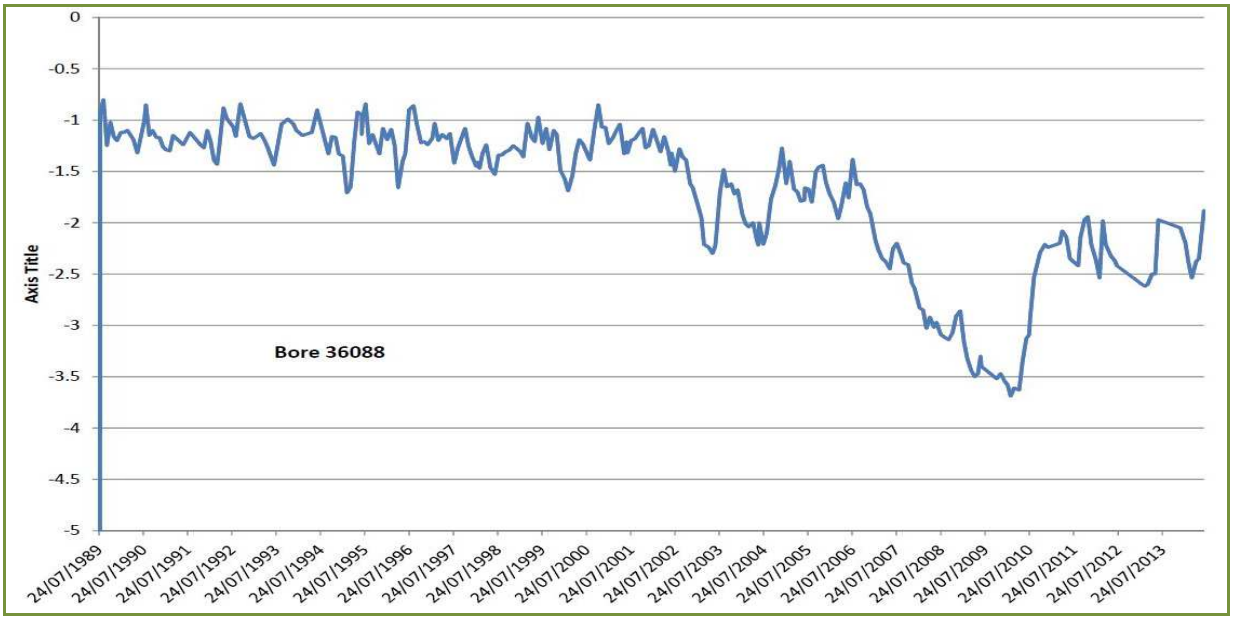

Figure 11. Groundwater hydrograph illustrating typical watertable fluctuations in irrigated lands of the Riverine Plains west of Gunbower Creek before and after the Millennium drought

The Shepparton and Calivil/Renmark formations are hydraulically connected. The overlying Coonambidgal Formation also appears to be connected to the underlying formations in some areas, however, in other areas, the interaction is limited. The formation/ aquifers in the vicinity of Gunbower Creek are summarised in Table 9.

Table 9. Summary of Formations and Aquifers in the Vicinity of Gunbower Creek

Formation/ Aquifer	Description	Relevance and extent
Coonambidgal Formation	Sediments comprising the alluvial flood plain of the modern rivers.	Up to ten metres thick comprising shallow sandy prior streams inter- bedded with clays. Comprises low salinity groundwater proximal to the Murray River.
Shepparton Formation	Alluvium comprising most of the land surface of the Riverine Plains. Includes sandy prior streams inter-bedded with clays following erosion of the western uplands by the ancestral streams of the modern rivers.	Up to 50 metres thick. Comprises saline groundwater ranging from 20,000 to 40,000 uS/cm in the vicinity of Gunbower Creek. In most instances it is the watertable aquifer within the irrigated land where groundwater is typically present within one to three metres of the land surface.
Calivil and Renmark Formations	Coarser grained alluvium including sands and clays deposited by ancestral rivers.	Thickness is variable consistent with location. The formation can vary from one or two metres up to 50 metres or more. It comprises ancient stream tracts filled with coarse sand and gravel derived from erosion of the Western Uplands.

Parilla Sand	Semi-consolidated fine grained marine sands formed as beach ridges during the recession of the Murray Sea.	Occurs as buried strata in the northern part of Gunbower Island near Cohuna. Comprises high salinity groundwater typically 40,000 uS/cm or more.
Bedrock	Granites and metasediments that form the basement rocks within the Murray Basin.	Consolidate rocks that generally form fractured rock aquifers where they are exposed at the land surface. Given these rocks are buried at significant depth in the area it is unlikely they make a significant contribution to groundwater flow.

Groundwater salinity in the deeper formations is high. It is also high in the Coonambidgal except in areas proximal to the Murray River where shallow sandy prior streams often comprise low salinity groundwater. For the most part, however, groundwater in the Shepparton and Coonambidgal Formations is quite saline and typically 30,000 to 40,000 EC.

3.3.3. Summary and conclusions

Despite the presence of shallow groundwater, Gunbower Creek does not act as a drain for saline groundwater. It is not sufficiently incised in the landscape to achieve this. Additionally, when filled with surface water the consequent positive head prevents groundwater discharge to the creek. As the Gunbower Creek is an integral part of the irrigation supply system the head is generally kept well above that of the groundwater heads in the adjacent irrigated terrain. The ongoing management of the creek and lagoons as components of the irrigation network will therefore prevent the discharge of groundwater into the creek and wetland bed (North Central CMA, 2015b).

3.4. Water quality

Water quality is systematically measured at a number of locations in the Gunbower Creek and lagoons as well as Torrumbarry Weir and on the Murray River at Koondrook. This includes continuous water quality loggers that were installed as part of TLM intervention monitoring program and include in-situ optical dissolved oxygen (DO) and temperature sensors (in the upper and lower sections of the water column) that log a reading every 15 minutes. These loggers have historically been located at Cohuna Weir pool (Reach 2), Yarran Creek junction (Reach 3a) and Condidorios Bridge (Reach 3b) (North Central CMA, 2014h), although their location is likely to change in the future in response to environmental watering of the forest. The loggers are used primarily to assess the risk of blackwater in the system and can be accessed in real time via the Hydroshare website. In addition spot water quality monitoring is also undertaken during the annual fish surveys which are conducted as part of the TLM monitoring program (Sharpe et. al., 2014). Parameters measured include pH, DO, turbidity, temperature and electrical conductivity.

GMW also conducts regular water quality monitoring (i.e. parameters listed above) at key locations in the creek as well as Blue Green Algae (BGA) counts at Cockatoo, Gum, Turner, Splatts, Upper Gunbower, Longmore and Taylor's lagoons. Coliban Water also measures these parameters as well as alkalinity, arsenic, cyanide, iron, lead, manganese, mercury, nickel, sodium, tin, total organic carbon, zinc and colour of raw water prior to treatment at the Cohuna Water Treatment Plant (i.e. potable water supply). A summary of the key water quality parameters against the Australian and New Zealand Environment Conservation Council (ANZECC) *Guidelines for Lowland Streams of South-east Australia* and Environmental Protection Authority (EPA) *Guidelines for Shallow Inland Lakes* is given below.

3.4.1. Turbidity and nutrients

Turbidity and nutrients are noted to increase throughout the Gunbower Creek and regularly exceed the ANZECC guidelines for each parameter. This is caused by the slow degradation to the submerged clayey banks of the creek, which also aligns with an increase in phosphorus associated with the fine clay fraction that causes turbidity (Anderson et al., 2007), and inputs from the surrounding agricultural land including farm drainage, runoff and stock access (Plate 2). These conditions contribute significantly to eutrophic conditions which are often indicated by the presence of Azolla (*Azolla spp*.), Pale Yellow Water Lily (*Nymphaea spp.)* infestations as well as Blue Green Algae blooms

(see Section 5). Possible additional causes for high turbidity and nutrient concentrations include wind induced wave action (i.e. for shallow lagoons), mumbling of Common Carp (*Cyprinid carpio*) and pumping of irrigation water. The adoption of re-use systems to capture irrigation tail water for re-use on farm has assisted with reducing the input of nutrients; however levels continue to exceed EPA guidelines regularly.

Plate 2. Cattle pug, defecate and urinate on banks and in water (source: A. Dickens, 4 June 2015)

3.4.2. Temperature

Water temperatures in the creek and lagoons (when full) are considered cooler than unregulated systems however this is considered to be a low risk to biodiversity. There are no EPA or ANZECC guidelines noted for temperature.

3.4.3. Salinity

Under current operations salinity is not considered a major concern in the Gunbower Creek with all measured sites below the ANZECC and EPA guidelines. There is however the potential for groundwater intrusion at a number of lagoons (i.e. Cockatoo, Splatts) should conditions be returned to more natural wetting and drying regime. Under the GLMP, Taylor's Lagoon will be the only lagoon removed from the irrigation network.

3.4.4. BGA

The Gunbower Creek and lagoons have experienced various BGA issues in the past. A review of BGA alerts from GMW between 2002-2013 shows that high (level of ≥10 mm^3/L for all monitored species and/or >4 mm^3/L for species listed as toxic or the presence of or cyanobacterial scums) and medium (levels ≥0.4 - 10 mm^3/L for all monitored species and/ or ≥0.4 - 4 mm^3/L for species listed as toxic) alerts were issued for ten out of the eleven monitored years. The majority of alerts pertained to Gum, Longmore and Splatts lagoons as well as sections of Gunbower Creek. High alerts trigger a warning to be issued for recreational, stock and domestic users (data supplied by R. Bradshaw [GMW] pers comm., 4 May 2015). Coliban Water treats raw water using a powder activated carbon unit to remove BGAs during the water treatment process (R. Mahendrarajah [Coliban Water] pers comm., 19 May 2015).

3.4.5. Dissolved oxygen

Dissolved oxygen is a major consideration in planning the timing and volume of environmental water delivery into Gunbower Forest. The use of continuous probes at Koondrook Weir pool and Cohuna Weir pool show a considerable drop in DO levels over the summer months, when temperatures increase (North Central CMA, 2014h). A number of lagoons are also noted to have low DO issues, particularly associated with the warmer summer months (North Central CMA, 2013d). Monitoring during environmental watering events in the Gunbower Creek System show that the preferred DO range for biota (>4 mg/L) has been maintained consistently in the system for most of the year (North Central CMA, 2014H).

3.4.6. Other

Additional parameters monitored by Coliban Water include pesticides, heavy metals and water colour. Based on guidelines set by Coliban Water, there have been no detections of pesticide or heavy metal levels that are cause for concern. Water colour is however noted to be double the aesthetic

guidelines levels for the system (R. Mahendrarajah [Coliban Water] pers comm., 19 May 2015). pH is also measured by GMW although not considered to be a major concern in the Gunbower Creek System with EPA and ANZECC guidelines of 6.5-8 rarely exceeded.

Further information on the site specific water quality parameters for each lagoon is available in the respective EWIs and Technical Reports.

3.5. Environmental watering

Environmental water has been delivered under the Victorian and TLM programs to the Gunbower Forest using Gunbower Creek since the late 1990s. As noted in Section 2.2.2.3, this has historically occurred through the Murray River and via the lower landscape regulators below Cohuna Weir (Reach 3a) which includes filling of the Yarran and Little Gunbower creeks, Reedy and Black Lagoon before overtopping to inundate parts of the lower Gunbower Forest. In 2014, through the construction of the Hipwell Road Weir and offtake regulator in Reach 2, environmental water is now passed through Reach 1 and 2 to inundate the mid to lower forest floodplain. Commencement of large events can occur outside the irrigation season to reduce the interruption associated with sharing the creek's capacity with irrigation customers (North Central CMA, 2015a).

As well as supporting floodplain values, the North Central CMA has also recently provided environmental water to the Gunbower Creek aimed at supporting native fish populations. Between August 2013 and April 2014 environmental water was delivered through the creek designed to support the natural spawning cycles of Murray Cod (*Maccullochella peelii*). Winter low flows designed to connect pools and inundate low benches in the creek to support native fish were also provided in 2013 and 2014 (A. Chatfield [North Central CMA] pers comm., 18 March 2015). Table 10 provides a summary of the recent environmental watering history in the system and also documents a number of significant events outside normal irrigation flows (i.e. 2010-11 flooding).

Table 10. Summary of recent environmental flows and significant events in Gunbower Creek

Date	Detail
October 2010	700 ML/day steady state flow achieved in spring using consumptive water en-route.
November 2010	G-MW maintained a passing flow over Koondrook Weir to mitigate hypoxic blackwater that entered Gunbower Creek from the Murray River. Anecdotal evidence of fish kills with the Creek and lagoons were noted.
January and February 2011 floods occur	During the widespread flooding of summer 2011, GMW closed the National Channel to facilitate a drawdown of Gunbower Creek. This allowed Taylors Creek to run backwards, draining Kow Swamp to allow sufficient air space for flood water from the Bendigo Creek. There was limited irrigation demand following the floods.
April 2011	TLM environmental water was used to cover losses associated with using consumptive water en-route to deliver a 1,000-1,200 ML/day spring pulse down Gunbower Creek targeting native fish.
Spring 2011	A series of freshes and a base-flow were delivered using consumptive water en-route and TLM environmental water to cover the losses. This flow complemented unregulated flow experienced in 2010-11 to support fringing vegetation and native fish populations in the creek. Monitoring at the Gunbower Weir fishway detected some fish migration in response to the flow.
Spring 2012	Using consumptive water en-route, with environmental water covering the losses, a series of freshes and base-flows were provided in the Gunbower Creek. Similar to the spring 2011 flow, the event aimed to consolidate the benefits unregulated flows in 2011-12 to support fringing vegetation and aid in the recovery fish population following the previous blackwater event.
July to August 2013	Environmental water was delivered during the irrigation shut-down period to provide low flows to the lower reaches of Gunbower Creek. A flow path that bypassed the Hipwell Road Channel construction site was used, which included diverting water into Taylor's Creek at Gunbower Weir, into No. 1 Channel, before outfalling back into Gunbower Creek from the 6/1 channel downstream of the construction site (upstream of Cohuna). The water then continued over Cohuna and Koondrook Weirs to re-enter the Murray River.
September 2013 to June 2014	As of March 2014, over 15 GL of environmental water was delivered to achieve a series of flow components targeted towards large bodied native fish, in particular Murray Cod. Flows from March 2014 onwards were used to support the survival of juvenile fish recruited during earlier flows, by providing habitat and food resources in preparation for winter.

Date	Detail
2014-2015	Flows were directed down Gunbower Creek to supply water to the Hipwell Road Channel for delivery to the Gunbower Forest. This was also an opportunity to test the capacity of the Gunbower Creek downstream of Hipwell Road (found to be 1,200 ML/d) and allow for the exchange of nutrients between the Creek and forest (via Chinaman's Bend).
Source: North Central CMA (2015a); E. Ashcroft [VEWH] pers comm., 20 May 2015)	

As there is currently no environmental water delivery to the Gunbower lagoons, water levels are dictated by the volume of irrigation water held within regulated lagoons or the level of the creek adjoining unregulated lagoons. Because of this the lagoons rarely dry, although they have historically drawn down considerably during the off-irrigation period (winter). The exception to this was during the Millennium Drought when lagoon and creek levels were maintained during winter in an effort to conserve water. The wetting and drawdown sequence for the lagoons is illustrated in Table 11.

Table 11. Gunbower Lagoons wetting/ drying calendar

	Year														
Lagoon name	**2000-2001**	**2001-2002**	**2002-2003**	**2003-2004**	**2004-2005**	**2005-2006**	**2006-2007**	**2007-2008**	**2008-2009**	**2009-2010**	**2010-2011**	**2011-2012**	**2012-2013**	**2013-2014**	**2014-2015**
Heppell	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW	DW
Heart	DW	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW
Unregulated	DW	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW
Splatts	DW	DW	DW	DW	DW	W	W	W	W	W	DW	DW	DW	DW	DW
Turner	DW	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW
Phyland	DW	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW
Longmore	DW	DW	DW	DW	DW	W	W	W	W	W	DW	DW	DW	DW	DW
Upper	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW	DW
Gum	DW	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW
Cockatoo	DW	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW
Taylors	DW	DW	DW	DW	DW	W	W	W	W	W	W	DW	DW	DW	DW
Safe's	DW	DW	DW	DW	W	W	W	W	W	W	W	DW	DW	DW	DW
KEY: W- wet (relatively consistent high level), DW- wet with drawdown (however not complete dry) Source: North Central CMA (2014a; 2014b; 2014c; 2014e; 2014f; 2014g; 2013a; 2013b; 2013c; 2013d)															

4. Water Dependent Values

4.1. Listings

The Gunbower Creek System is of basin wide significance supporting a diversity of native fauna species including fish, freshwater turtles, waterbirds, frogs and Platypus. It is a valuable refuge and source population for the wider Murray Darling Basin including the Murray River and the adjoining Ramsar listed Gunbower Forest. In particular, the system is recognised for its habitat value to endangered fish species including Murray Cod, Silver Perch (*Bidyanus bidyanus*) and Freshwater Catfish (*Tandanus tandanus*) as well as migratory and federally listed waterbird species.

Table 12 details the legislations, agreements, conventions and listings that are relevant to the Gunbower Creek System. As shown, management of the system falls under three international listings (JAMBA, CAMBA and ROKAMBA), one national listing (EPBC Act) and two Victorian State listings. A full list of flora and fauna recorded within the Gunbower Creek system is shown in Appendix 4 and Appendix 5.

Table 12. Significance of Gunbower Creek System and its associated species

Legislation, Agreement or Convention	Jurisdiction	Listed
Japan Australia Migratory Birds Agreement (JAMBA)	International	✓
China Australia Migratory Birds Agreement (CAMBA)	International	✓
Republic of Korea Australia Migratory Birds Agreement (ROKAMBA)	International	✓
Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)	International	×
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	National	✓
Flora and Fauna Guarantee Act 1988 (FFG Act)	State	✓
Victorian advisory lists	State	✓

4.2. Fauna

4.2.1. Fish

The most abundant native fish species recorded in the Gunbower Creek System include Carp Gudgeon (*Hyseleotris spp.)*, Australian Smelt (*Retropinna semoni*) as well as strong populations of Flathead Gudgeon (*Philypnodon grandiceps*), Dwarf Flatheaded Gudgeon (*Philypnodon macrostomus*) and Unspecked Hardyhead (*Craterocephalus stercusmuscarum fulvus*). The only small-bodied species considered to be in low abundance and underrepresented in the Gunbower Creek System when compared with the wider catchment is Murray-Darling Rainbow Fish (*Melanotaenia fluviatilis*) (Mallen-Cooper et al., 2014).

Although generally recorded in low abundance in the Gunbower Creek System, the population of large and medium-bodied native fish species is considered significant. Five species of conservation significance have been recorded including Silver Perch, Golden Perch (*Macquaria ambigua*), Murray Cod and Trout Cod (*Maccullochella macquariensis).* With the exception of Silver Perch in Upper Gunbower Lagoon, all of these species have been recorded exclusively within the creek.

Murray Cod is considered mostly confined to Reach 3a of the Gunbower Creek where intact riparian vegetation, abundant IWH and fast flowing water is present (Plate 3) (Ecological Associates, 2015). Reach 3a is also noted as the only location in which Trout Cod has been recorded during annual fish surveys. Recent angler reports however suggest that the abundance of the species has recently increased signifying an expansion from the Murray River System (upstream of Barmah) into downstream areas. In the Gunbower Creek this can occur through larval drift through the Headworks regulator. Similar to Murray Cod the species will seek out strong flowing habitats with abundant snags (Ecological Associates, 2015).

In contrast, Freshwater Catfish (*Tandanus tandanus*) have been recorded almost exclusively in the lagoon system, specifically in Phyland, Turner, Gum, Cockatoo and Safe's lagoons (Plate 3). Although populations in Phyland and Turner lagoons have demonstrated some natural recruitment, the larger population is considered to be of low abundance and genetically distinct from other populations in Northern Victoria (North Central CMA, 2013e). The presence of regulators and other barriers to fish movement, prohibit the expansion of the species in the system (North Central CMA, 2013e).

All of the significant species recorded in the Gunbower Creek System are listed under the FFG *Lowland Riverine Fish Community of the Southern Murray-Darling Basin.* Historically this community was dispersed throughout the lowland areas of the Murray and Darling River systems but anthropogenic change has altered this distribution and abundance (SAC, 1998). The Gunbower Creek system supports nine out of the fifteen fish species in this ecological community. In addition to the species noted above, the Sustainable Rivers Audit (SRA) identified three additional species that would be expected to occur in the middle Murray River Catchment (Gunbower and Koondrook-Perricoota area). Only one of these species – Short-finned Eel (*Anguilla australis*), is likely to utilise the habitat available within the Gunbower Creek System (Davies et al., 2008 cited in Mallen-Cooper et al., 2014). This species is not considered significant in Victoria although listed as rare in South Australia (Lintermans, 2007). Table 14 lists the significant fish species recorded in the Gunbower Creek System.

Plate 3. Left- Murray Cod, April 2014, Right- Freshwater Catfish, September 2009

4.2.2. Waterbirds

The Gunbower Creek system provides important habitat for a diversity of waterbird species. Historically ten species have utilised the Gunbower Lagoons (and to greater extent the neighboring Gunbower Forest) as critical breeding habitat (Plate 8). In particular large colonies of Australian Darter (*Arhinga melanogaster*) and Australian White Ibis (*Threskiornis molucca*) are known to frequent Cockatoo and Gum lagoons, respectively. Table 13 lists the waterbirds recorded as breeding in the Gunbower Creek System. Note that there are no waterbird breeding records for the Gunbower Creek itself.

Table 13. Waterbirds recorded breeding in the Gunbower Lagoons

Common Name	Scientific Name	Location
Australian Darter	*Arhinga melanogaster*	Cockatoo, Turner, Taylor's
Australian White Ibis	*Threskiornis molucca*	Longmore, Gum
Black Swan	*Cygnus atratus*	Longmore, Taylor's
Grey Teal	*Anas gracilis*	Splatts
Intermediate Egret	*Ardea intermedia*	Heppell
Little Black Cormorant	*Phalacrocorax sulcirostris*	Turner, Cockatoo
Little Pied Cormorant	*Phalacrocorax melanoleucos*	Cockatoo, Turner, Taylor's
Pacific Black Duck	*Anas superciliosa*	Splatts
Purple Swamphen	*Porphyrio porphyrio*	Heart
White-bellied Sea-eagle	*Haliaeetus leucogaster*	Safe's
Shading refers to listed species as significant as per Table 14		

Aside from providing breeding habitat, the Gunbower Creek System also supports a diversity of feeding waterbirds. Both the creek and lagoon system support migratory species such as Glossy Ibis (*Plegadis falcinellus*), Caspian Tern (*Hydroprogne caspia*) and Eastern Great Egret (*Ardea intermedia*). Common Greenshank (*Tringa nebularia*) has also been recorded utilising the creek habitat in Reach 2 as well as Cattle Egret *(Ardea ibis)* at Heppell and Cockatoo Lagoons. Historically the system has also supported a number of nationally endangered species including Australasian Bittern (*Botaurus poiciloptilus*) and Little Bittern (*Ixobrychus dubius*) as well as state listed species such as Ballion's Crake (*Porzana pusilla palustris*), Brolga (*Grus rubicunda*) and Little Egret (*Egretta garzetta nigripes*). Table 14 lists the significant waterbird species recorded in the Gunbower Creek System.

Plate 4. Left- Australian White Ibis at Longmore Lagoon, November 2012, Right- Purple Swamphen nesting at Heart Lagoon, November 2012

4.2.1. Mammals

Two water dependent mammal species - Water Rat (*Hydromys chrysogaster*) and Platypus (*Ornithorhynchus anatinus*) (Plate 5) have been recorded in the Gunbower Creek System. Although neither of these species is listed under legislation, the national conservation status of Platypus has recently been elevated to near threatened as per the *Action Plan for Australian Mammals* (CSIRO, 2014). This is in response to a decline and in some cases a loss, of Platypus from locations within Victoria. In the Gunbower Creek system, Platypus have been frequently observed in Upper Gunbower, Turner's, Gum, Splatts, Longmore, Cockatoo, Taylor and Phyland Lagoons as well as reaches 1 and 2. The very sporadic and infrequent nature of sightings in the creek downstream of Cohuna is likely to reflect the occurrence of transient animals (i.e. dispersing juveniles) rather than established resident populations. Heppell, Heart and Unregulated Lagoons do not appear to support resident populations, likely attributed to their small size and low foraging habitat availability (Serena & Williams, 2013).

The Platypus population of the Gunbower Creek System is estimated to comprise in the order of 220 resident animals, with as few as 65 breeding age females. From a regional perspective the population is significant being the 'only sizeable breeding population known to inhabit either the Murray River or its downstream anabranch systems and the lower tributary reaches downstream of Echuca' (Serena & Williams, 2011 cited in Serena & Williams, 2013). For this reason, the population is of particular importance as a source population for juvenile dispersal in to the Murray River (Serena & Williams, 2013).

Plate 5. Left-Platypus (photo courtsey of Australian Platypus Conservancy), Right- Platypus at Upper Gunbower Lagoon (photo courtesy of N. Rowlands)

4.2.2. Other fauna

The Murray-Darling Basin and the Gunbower Creek System supports three significant freshwater turtle species - Broad-shelled Turtle (*Chelodina expansa*) (Plate 6), Eastern Long-necked Turtle (*Chelodina longicollis*) and Murray River Turtle (*Emydura macquarii*). All three species have been recorded in each of the lagoons, with the exception of Unregulated Lagoon which does not have a record for Broad-shelled or Murray River Turtle and Taylor's Lagoon which does not have a record for Eastern Long-necked Turtle. Records indicate that Murray River and Broad-shelled Turtle have a preference for the upper and lower reaches of the Gunbower Creek respectively; however this pattern is inconclusive due to the limited sampling effort and number of surveys undertaken.

Eight frog species have been recorded in the Gunbower Creek System, with one – Growling Grass Frog (*Litoria raniformis*) listed as nationally threatened. This species was last recorded in Upper Gunbower Lagoon and Reach 3a during surveys in 1982 and 2013-2014 respectively (C. Sharpe [CPS Environmental] pers comm., 11 February 2015). Common frog species recorded include Barking Marsh Frog (*Limnodynastes fletcheri*), Common Froglet (*Crinia signifera*), Peron's Tree Frog (*Litoria peronii*), Plains Froglet (*Crinia parinsisnifera*), Pobblebonk (*Limnodynastes dumerilii*), Sloane's Froglet (*Crinia sloanei*) and Spotted Marsh Frog (*Limnodynastes tasmaniensis*).

In addition to the species noted above, the system also supports a wide range of aquatic macroinvertebrates including Shrimp, Yabbies and adult and larval aquatic insects (Douglas et al., 1998 and Richardson et al., 2005 cited in Ecological Associates, 2015). Murray River Spiny Crayfish (*Euastacus armatus*) which is listed as threatened in Victoria has also been recorded in the Gunbower Creek upstream of Gunbower Weir (Plate 6) (Clayton Sharpe [CPS Environmental Research] pers. comm., 11 Feb 2015). Table 14 lists other significant fauna species recorded in the Gunbower Creek System.

Plate 6. Left- Broad-shelled Turtle hatching, November 2012 (D. Kleinert), Right- Murray River Spiny Crayfish, April 2008 (D. Cook)

Table 14. Significant fauna species recorded in the Gunbower Creek System

Common Name	Scientific	R1									R2				3a		3b	Status			
		Creek	Heppell	Heart	Unreg	Splatt's	Turner	Phyland	Longmore	Upper	Creek	Gum	Cockatoo	Taylors	Creek	Safe	Creek	Internat-ional	EPBC	FFG	DELWP
Native fish																					
Murray-Darling Rainbowfish	*Melanotaenia fluviatilis*	✓				✓	✓		✓		✓		✓		✓	✓				L	VU
Freshwater Catfish[1]	*Tandanus tandanus*						✓	✓				✓	✓			✓					
Golden Perch[2]	*Macquaria ambigua*	✓		✓		✓			✓	✓	✓				✓		✓				NT
Murray Cod	*Maccullochella peelii*	✓									✓				✓		✓		VU	L	VU
Silver Perch	*Bidyanus bidyanus*	✓								✓	✓				✓		✓		CR	L	VU
Trout Cod	*Maccullochella macquariensis*														✓				EN	L	CR
Un-specked Hardyhead[3]	*Craterocephalus stercusmuscarum fulvus*	✓				✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓			L	
Waterbirds																					
Australasian Bittern	*Botaurus poiciloptilus*										✓								EN	L	EN
Australasian Shoveler	*Anas rhynchotis*	✓				✓	✓						✓								VU
Azure Kingfisher	*Alcedo azurea*	✓	✓	✓	✓	✓			✓	✓	✓	✓			✓		✓				NT
Ballion's Crake	*Porzana pusilla palustris*										✓									L	VU
Brolga	*Grus rubicunda*					✓		✓			✓									L	VU
Caspian Tern	*Hydroprogne caspia*										✓		✓					C/J	M	L	NT
Cattle Egret	*Ardea ibis*		✓										✓					C/J	M		
Common Greenshank	*Tringa nebularia*										✓							C/J/R	M		VU
Eastern Great Egret	*Ardea modesta*		✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	C/J	M	L	VU
Glossy Ibis	*Plegadis falcinellus*						✓				✓	✓						C			NT
Hardhead	*Aythya australis*						✓		✓		✓		✓								VU
Inland Dotterel	*Charadrius australis*					✓															VU
Intermediate Egret	*Ardea intermedia*		✓						✓		✓		✓		✓					L	EN
Little Bittern	*Ixobrychus dubius*														✓				EN	L	EN
Little Egret	*Egretta garzetta nigripes*	✓	✓								✓									L	EN
Musk Duck	*Biziura lobata*										✓										VU
Nankeen Night Heron	*Nycticorax caledonicus australasiae*	✓	✓		✓	✓	✓		✓	✓	✓		✓	✓		✓					NT
Pied Cormorant	*Phalacrocorax varius*	✓			✓	✓	✓		✓	✓	✓	✓			✓	✓					NT
Royal Spoonbill	*Platalea regia*	✓			✓					✓	✓	✓			✓						NT
Spotted Harrier	*Circus assimilis*										✓										NT
Whiskered Tern	*Chlidonias hybridus javanicus*										✓				✓						NT
White-bellied Sea-Eagle	*Haliaeetus leucogaster*	✓	✓			✓	✓				✓		✓		✓	✓				L	VU
Reptiles																					
Broad-shelled Turtle	*Chelodina expansa*		✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓				
Eastern Long-necked Turtle	*Chelodina longicollis*	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓					
Murray River Turtle	*Emydura macquarii*	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	✓					

Common Name	Scientific	R1									R2				3a		3b	Status			
		Creek	Heppell	Heart	Unreg	Splatt's	Turner	Phyland	Longmore	Upper	Creek	Gum	Cockatoo	Taylors	Creek	Safe	Creek	Internat-ional	EPBC	FFG	DELWP
Amphibians																					
Growling Grass Frog	*Litoria raniformis*									✓					✓				VU	L	EN
Invertebrates																					
Murray River Spiny Crayfish	*Euastacus armatus*										✓									L	NT

Key:

International Status: C= CAMBA, J= JAMBA, R= ROKAMBA

EPBC Status: M= Migratory species, EN= Endangered, VU= Vulnerable, CR= Critically Endangered

FFG Status: L= listed as threatened

DELWP Status: CR- Critically Endangered, EN- Endangered, VU- Vulnerable, NT- Near Threatened, DD- Data Deficient

[1] One individual caught by anglers in the Gunbower Creek following the 2010-11 floods (M. Tranter, pers comm., 14 May 2015)

[2] Conservation status only applies to natural occurring populations.

[3] Un-specked Hardyhead was not included in the April 2013 release of the Advisory List of Threatened Vertebrate Fauna in Victoria (DSE, 2013). The species has been reassessed as abundant across many locations within Victoria, however as it is currently gazetted under FFG (October 2012).

4.3. Vegetation communities and flora

Approximately 80% of the Gunbower Creek System is located in the Murray Fans with the remaining 20% in the Victorian Riverina Bioregion. The majority of the Murray Fans bioregion extends downstream of Cockatoo Lagoon in Reach 2, although sections intersect Reach 1 at Heart, Splatts and Unregulated Lagoons as well parts of Upper Gunbower Lagoon. This bioregion is characterised by flat to gently undulating landscapes with evidence of former stream channels, braided old river meanders, palaeochannels and broad floodplain areas. The adjoining Victorian Riverina bioregion, which extends through a large portion of the TIA, is characterised by fertile, river alluvium soils and is bordered by the Goldfields, Central Victorian Uplands and Murray Mallee bioregions (DSE, 2013a).

Eleven water dependent Ecological Vegetation Classes (EVCs) and associated complexes have been recorded in the Gunbower Creek System as summarised in Table 15 and shown in Appendix 6. Nine of these are located in the Murray Fans and ten in the Victorian Riverina Bioregion. The majority of the riparian vegetation of both the creek and lagoons consists of an overstorey of River Red Gum (*Eucalyptus camaldulensis*) and Black Box (*Eucalyptus largiflorens*) and a sparse understory of Tangled Lignum (*Muehlenbeckia florulenta*), salt bushes (*Atriplex spp.)* and native wattles (*Acacia spp*.). In general, the width of the riparian zone increases from upstream to downstream. This is attributed to the close proximity of Gunbower Forest, particularly in sections of reaches 2, 3a and 3b, forming a continuous zone of Riverine Grassy Woodland (EVC 295) and Riverine Swampy Forest (EVC 814) vegetation. Around the lagoons, the riparian zone is characterised predominately by Riverine Chenopod Woodland (EVC 103) and Sedgy-Riverine Forest (EVC 816). Although similar in composition, the greatest difference noted between lagoons is the spatial distribution of their riparian zones, which range from relatively intact areas of Black Box derived EVCs to those where only scattered River Red Gums remain (Australian Ecosystems, 2013).

Similar to the riparian zone, the composition of aquatic vegetation in the Creek and lagoons is comparable across the system. In the lagoons, this zone is dominated by Billabong Wetland Aggregate (EVC 335) and supports a low native diversity of robust species such as River Club-sedge (*Schoenoplectus tabernaemontani*), Cumbungi (*Typha spp.)* and Tall Spike-sedge (*Eleocharis sphacelata*). The major difference between lagoons is attributed to the distribution and dominance of species present, creating a range of different habitat values for waterbirds, Freshwater Catfish, turtles and Platypus. The more channelised areas of the lagoons and the creek are generally dominated by species such as Hornwort, Yellow Bladderwort (*Utricularia australis*) and Water Millfoil (*Myriophyllum spp*.) as well as the small floating fern Pacific Azolla (*Azolla filiculoides*). In the slow-flowing or still areas of the system, invasive species such as Pale Yellow Water Lilly (*Nymphaea mexicana*) and Parrot's Feather (*Myriophyllum aquaticum*) are abundant (Australian Ecosystems, 2013; Ecological Associates, 2015).These species are supported by the elevated summer water levels and nutrient levels from surrounding farmland. Table 16 and Plate 7 summarises the significant water dependent flora species recorded within the Gunbower Creek system.

Plate 7. Left- River Swamp Wallaby-grass, Right- Wavy Marshwort

Table 15. Conservation status of water dependent EVCs within Gunbower Creek System

EVC Name	EVC No.	Conservation status	R1									R2				3a		3b
			Creek	Heppell	Heart	Unreg	Splatt's	Turner	Phyland	Longmore	Upper	Creek	Gum	Cockatoo	Taylors	Creek	Safe	Creek
Murray Fans																		
Billabong Wetland Aggregate	335	D			✓	✓					✓			✓	✓		✓	
Floodplain Riparian Woodland	56	D				✓										✓		
Grassy Riverine Forest	106	D			✓							✓						✓
Riverine Chenopod Woodland	103	E	✓		✓	✓					✓	✓		✓	✓	✓		
Riverine Swampy Forest	814	D										✓				✓		✓
Sedgy Riverine Forest	816	D				✓						✓		✓	✓		✓	✓
Sedgy Riverine Forest/ Riverine Swamp Forest Complex	817	NL										✓				✓		
Spike-sedge Wetland	819	V										✓						
Tall Marsh	821	LC										✓				✓		
Victorian Riverina																		
Billabong Wetland Aggregate	335	V			✓		✓	✓	✓	✓	✓		✓	✓				
Black Box Wetland	369	E						✓		✓								
Floodplain Riparian Woodland	56	V	✓										✓					
Grassy Riverine Forest	106	D	✓															
Riverine Chenopod Woodland	103	V	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓				
Riverine Swampy Forest	814	D										✓						
Sedgy Riverine Forest	816	V		✓			✓				✓							
Sedgy Riverine Forest/ Riverine Chenopod Woodland	816/103	U							✓									
Spike-sedge Wetland	819	V										✓						
Tall Marsh	821	D	✓									✓						

Key:
Conservation Status: E- Endangered, V- Vulnerable, D- Depleted, LC- Least Concern, NT- Not Listed for bioregion ,U- Undescribed
Source[1:] DELWP (2015f)
Source[2:] Australian Ecosystems (2013)

Table 16. Significant water dependent flora species recorded in the Gunbower Creek System

Common Name	Scientific	R1									R2				3a		3b	Status		
		Creek	Heppell	Heart	Unreg	Splatt's	Turner	Phyland	Longmore	Upper	Creek	Gum	Cockatoo	Taylors	Creek	Safe	Creek	EPBC	FFG	DELWP
Bluish Raspwort	*Haloragis glauca f. glauca*	✓	✓			✓	✓													k
Bristly Love-grass	*Eragrostis setifolia*									✓										v
Dark Roly-poly	*Sclerolaena muricata var. semiglabra*														✓					k
Dwarf Brooklime	*Gratiola pumilo*														✓					r
Floodplain Fireweed	*Senecio campylocarpus*	✓	✓	✓		✓			✓		✓	✓								r
Hornwort	*Ceratophyllum demersum*	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓				k
Inland Verbena	*Verbena officinalis var. africana*				✓	✓														k
Native Peppercress	*Lepidium pseudohyssopifolium*	✓	✓			✓	✓			✓					✓					k
River Swamp Wallaby-grass	*Amphibromus fluitans*														✓			v		
Smooth Minuria	*Minuria integerrima*														✓					r
Tall Club-sedge	*Bolboschoenus fluviatilis*														✓	✓				k
Tough Scurf-pea	*Cullen tenax*	✓		✓	✓	✓														e
Twiggy Sida	*Sida intricata*														✓					v
Umbrella Grass	*Digitaria divaricatissima var. divaricatissima*										✓									v
Waterbush	*Myoporum montanum*	✓				✓	✓	✓	✓	✓	✓		✓							r
Wavy Marshwort	*Nymphoides crenata*														✓				L	v

Key:
EPBC Status: v- vulnerable
FFG Status: L= listed as threatened
DELWP Status: e- endangered, r- rare, v-vulnerable, k- poorly known

4.4. Habitat values

As well as providing high habitat value in the form of aquatic and riparian vegetation, the Gunbower Creek System also supports a significant load of IWH. IWH creates hydrodynamic diversity in the system through changes in the velocity and turbulence of water, providing shelter from predators, a spawning substrate, and nursery grounds for juveniles and habitat for feeding (Kitchingman et al., 2014).

In addition the Gunbower Creek System also includes a number of areas that are greater than four metres in depth, and would likely retain permanent water and provide critical refuge during very low flow events. In general, the greatest potential for refuge in the creek is within the Koondrook Weir pool as well as the areas immediately above other weirs in the system. A number of deep pools are also present above Hipwell Road and on a number of creek meanders as well as in five lagoons- Upper Gunbower, Phyland, Turner, Splatts and Longmore lagoons (Kitchingman et al., 2014; Ayers et all., 2013).

4.5. Ecosystem Functions

'Ecosystem function' is a term used to describe the biological, geochemical and physical processes and components that take place or occur within an ecosystem. These functions relate to the structural components of an ecosystem (e.g. vegetation, IWH, water, soil, atmosphere and biota) and how they interact with each other, within ecosystems and across ecosystems (Maynard et al., 2012). This include processes that are essential for maintaining life such as storage, transport and nutrient cycling as well as the provision of resources that support biodiversity such as habitat, food and shelter.

Critical ecosystem functions that support the primary water dependent environmental values of the Gunbower Creek System can be broken into local and regional functions. For example, the Gunbower Creek System locally supports a diversity of threatened flora and fauna species, with a number of these considered crucial for maintaining biodiversity in the region. In particular the presence of a genetically distinct Freshwater Catfish population, a sizeable Platypus breeding population and threatened native large-bodied fish species. These values contribute not only to the Murray River Catchment but the North Central CMA region as a whole. Ecosystems services critical to supporting the key environmental values of the Gunbower Creek System include (but are not limited to):

- **Food production**- Food web interactions are sustained by primary producers who fix carbon for uptake by consumers. A vital yet largely absent input of carbon into the Gunbower Creek system, is from the Gunbower Forest floodplain. The provision of hydrological connectivity between the two systems will promote an increase in the productivity of the Gunbower Creek System.
- **Reproduction**- recruitment of new individuals requires sufficient shelter from predators, food for growth, resources for nest building and cues for breeding (i.e. water level changes, temperature, rainfall etc.). Adequate resources to support larvae and juveniles are also required, including shelter, food and provision of water for consumption. This is particularly important in the Gunbower Creek System as it supports a fragmented age class distribution of key native fish species (i.e. Murray Cod) -the result of poor recruitment. Plants also require specific germination and growth conditions (including flood cues, follow up flooding, drying etc.) to ensure successful recruitment
- **Biological diversity**- the provision of a sufficient number and range of habitat types in the landscape supports a diversity of native species. This in turn assists to safe guard the region from the impacts of local catastrophic events (i.e. loss of habitat through fire and clearing) due to there being sufficient alternative habitats available. This supports the maintenance of genetic and species diversity in the region.
- **Movement/ dispersal-** movement of individuals is linked to the food web interactions and reproductive life cycle history of some species (i.e. migration). By providing hydrological connectivity, species are able to gain access to new resources, disperse to more favourable

habitats and avoid predators. The provision of high flows can also trigger the long distance movement of species such as Silver and Golden Perch in and out of the Gunbower Creek System. This supports biological diversity and reproduction functions described above. In addition, the dispersal of plant seeds/progapules in the landscape provides for colonisation support habitat diversity.

The Gunbower Creek System's ecosystem functions that meet the assessment indicators are described in Appendix 7.

4.6. Social Values

Although the primary purpose of environmental water entitlements is to achieve environmental benefits, a number of secondary benefits to social, cultural and economic values are also often achieved. These are considered complementary to the environmental values in environmental water management decisions.

To inform the development of this EWMP and to implement and evaluate other projects in the Gunbower Island locality, the North Central CMA commissioned Charles Sturt University (CSU) to undertake a social benchmarking study focusing on town residents and rural property owners in Gunbower, Leitchville, Cohuna and Koondrook. The study highlighted that Gunbower Island (forest, wetlands, creek, and lagoons) is highly valued by the local community with a high sense of ownership and commitment to be involved in the decision making and future management.

The survey respondents noted Gunbower Island supports a mix of recreation, economic (tourism and fire wood collection) and environmental values and '...*is part of what makes life here good*'. Although not all work undertaken by the North Central CMA and its partner agencies are supported by the community that participated in the survey, the assessment revealed common overarching goals of the North Central CMA and the values and attitudes of community members. This includes a desire to preserve the island for future generations and support biodiversity values. The study will be repeated at the end of 2017 to compare the social acceptability of the North Central CMA and it's projects in comparison to the benchmark set in 2014 (Mendham & Curtis, 2015).

4.6.1. Cultural Heritage

The traditional owner groups of the land encompassing the Gunbower Creek System is the Barapa Barapa (downstream of Cohuna) and Yorta Yorta Nation (upstream of Cohuna) Aboriginal Corporations. All of the lagoons as well as the entire length of the Gunbower Creek, with the exception of a 1.2 kilometre stretch of National Channel between the inlet and outlet of Splatts Lagoon, is listed as culturally sensitive as defined under the *Aboriginal Heritage Regulation 2007*. A number of Aboriginal Affairs Victoria (AAV) registered sites have also been recorded, including scar trees, burial mounds, artefact scatters, middens and hearths. The local indigenous communities are noted to have a strong connection to the biodiversity, ecological and commodity values of the system. For example, River Red Gums are considered the '*guardians of the river, stabilising the river banks while providing habitat both in and out of the water system*' (Interviewee 9 as per Mendham & Curtis, 2015). A number of plants and animals noted to occur within the system are also valued by aboriginal people for their medicinal and edible purposes (MDBA, 2012).

The Gunbower Creek System also contains a number of sites of local and or state European Heritage value. This includes the original Gunbower and Cohuna weirs constructed in the early 1900s and Condidorios Bridge (located in Reach 3b). All archaeological sites in Victoria that are more than 50 years old are protected under the *Heritage Act 1995* (Victoria) and through planning scheme heritage overlays (MDBA, 2012).

4.6.2. Recreation

The Gunbower Creek System is highly valued in the North Central CMA region for its recreational values. This includes recreational pursuits such as camping, boating, water-skiing, wakeboarding (recently banned by Gannawarra Shire), swimming, fishing (in season), hunting (game species as well foxes and rabbits), bird watching, nature walking, horse riding, kayaking and canoeing. A canoe trail has been established through a section of the Gunbower Island and includes Safe's Lagoon and

Gunbower Creek (MDBA, 2012; Mendham & Curtis, 2015). In additional, an eco-tourism boat named the '*Wetlander*' has recently been revitalised to allow tour groups to enjoy up to 34 kilometres of the Gunbower Creek near Koondrook. The creek also forms the centrepiece of the Cohuna Bridge to Bridge, an annual charity event which includes canoe, bike, run and swimming races centred on the township of Cohuna.

4.6.3. Economic values

The Gunbower Creek System supports a range of agricultural enterprises from irrigated pastures to grazing and dairying. The creek and lagoons are used for direct extraction of irrigation water and in the case of the creek, provides one of the major delivery conduits to other locations within the TIA. Annually this equates to approximately 500 GL of water to 120,000 hectares of irrigated land (Ecological Associates, 2014). According to Kaufman (2011), the TIA contains one of the largest irrigation systems in Victoria and is the most important irrigated region in Australia.

From a local economic perspective, the Gunbower Creek System is important for generating revenue through tourism opportunities. In particular, opportunities for eco-tourism (the creek, lagoons and forest) are noted in the development plans for Gannawarra Shire Council and Shire of Campaspe. These shires recognise the importance of natural assets for the future viability of their towns, and have clear action items documented for promoting and protecting the Gunbower Creek and Gunbower Forest into the future. In particular, the use of the forest over Easter, Christmas and Melbourne Cup weekends has historically resulted in up to an estimated 20,000 to 30,000 people camping in the forest area (SKM, 2015).

4.7. Conceptualisation of the Site

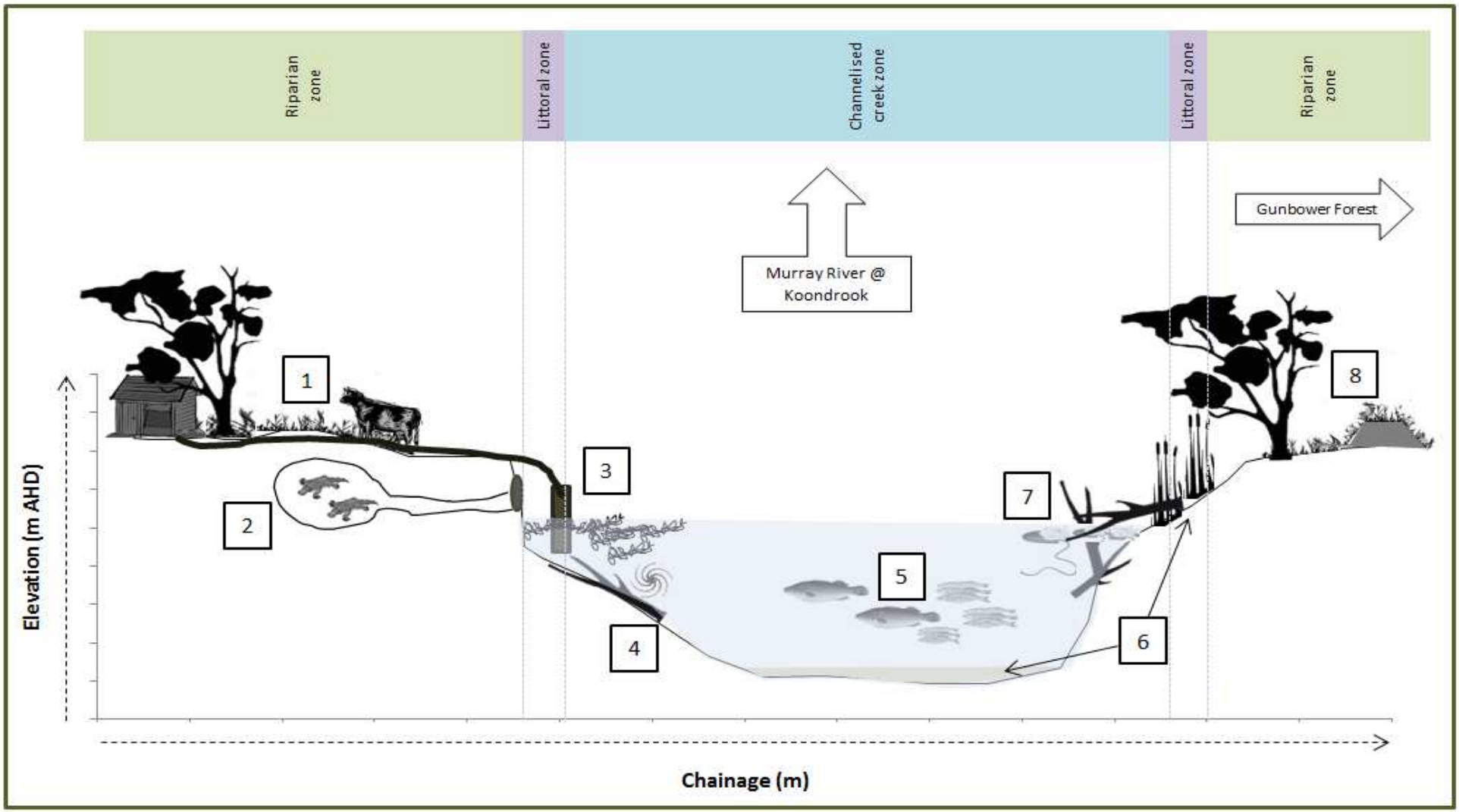

Figure 12. Conceptual undertstanding of the general characteristics of the Gunbower Creek

Gunbower Creek key:

1. The riparian zone primary comprises of an overstorey of River Red Gum and Black Box and a sparse understory of Tangled Lignum, salt bushes and native wattles. In the upper reaches, the riparian zone forms a continuous canopy with the Riverine Grassy Woodland and Riverine Swampy Forest vegetation of the Gunbower Forest. Stock access is widespread (particularly in the upper reaches of the system) contributing to a reduced cover and structural diversity of native species, bank erosion and nutrient enrichment.
2. To avoid drowning of juveniles during the spring-summer breeding and rearing period, Platypus establish their burrows above the late winter/ early spring waterline. During the months following nest establishment, nearby and ample resources are required to support the diet of the lactating female. This includes an adequate spring-summer water depth to ensure that females are not required to move over long distances in search of food.
3. High nutrient inputs and elevated summer water levels in the system has encouraged the growth of free-floating aquatic plants such as Hornwort. As Hornwort can block irrigation pumps causing capacity restrictions and mechanical breakdown, irrigators have fitted pump 'choppers' and mesh guards to protect Platypus, turtles and fish from the blades. However the guards are considered inadequate at passing debris and as such many irrigators are opting to either remove or not fit guards to their pumps.
4. IWH creates hydrodynamic diversity through changes in the velocity and turbulence of water. In the Gunbower Creek it provides a substrate for biofilms and macroinvertebrates to attach to, which in turn provides a food for a diversity of biota. In addition IWH creates habitat that is utilised as shelter from predators and a spawning substrate and nursery ground for larvae and juvenile fish. Variable flows will promote an increase in resource availability and productivity through exposing and re-wetting IWH.
5. Although the Gunbower Creek supports diversity of native fish species many are present in low abundance and exhibit fragmented age class distributions. Contributing factors include poor winter flow conditions which force juveniles to competing with adults for resources as well as a lack of connectivity between the floodplain and Murray River which prevents many species (i.e. migratory species) from completing essential life cycles histories.
6. Sustained water levels the result of irrigation delivery has contributed to poor soil structural stability, tree fall and bank erosion in the Gunbower Creek. As a result the littoral zone is narrow and of poor diversity and silt has built up in deep pools and meanders of the creek. This has reduced permanent refuges pools for fish and created islands for weed establishment.
7. Pale Yellow Water Lily is the most dominate aquatic weed species in the Gunbower Creek, thriving on high nutrient inputs and elevated summer water levels. The species forms a dense monoculture in the backwaters and slow flowing areas preventing foraging of Platypus and turtles and excludes the establishment of native plant species.
8. Levees and regulators prevent exchange of floodplain nutrients and organic matter between the Gunbower Creek and Gunbower Forest. This limits the productivity in the creek and its carrying capacity for biotic communities such as macroinvertebrates and native fish.

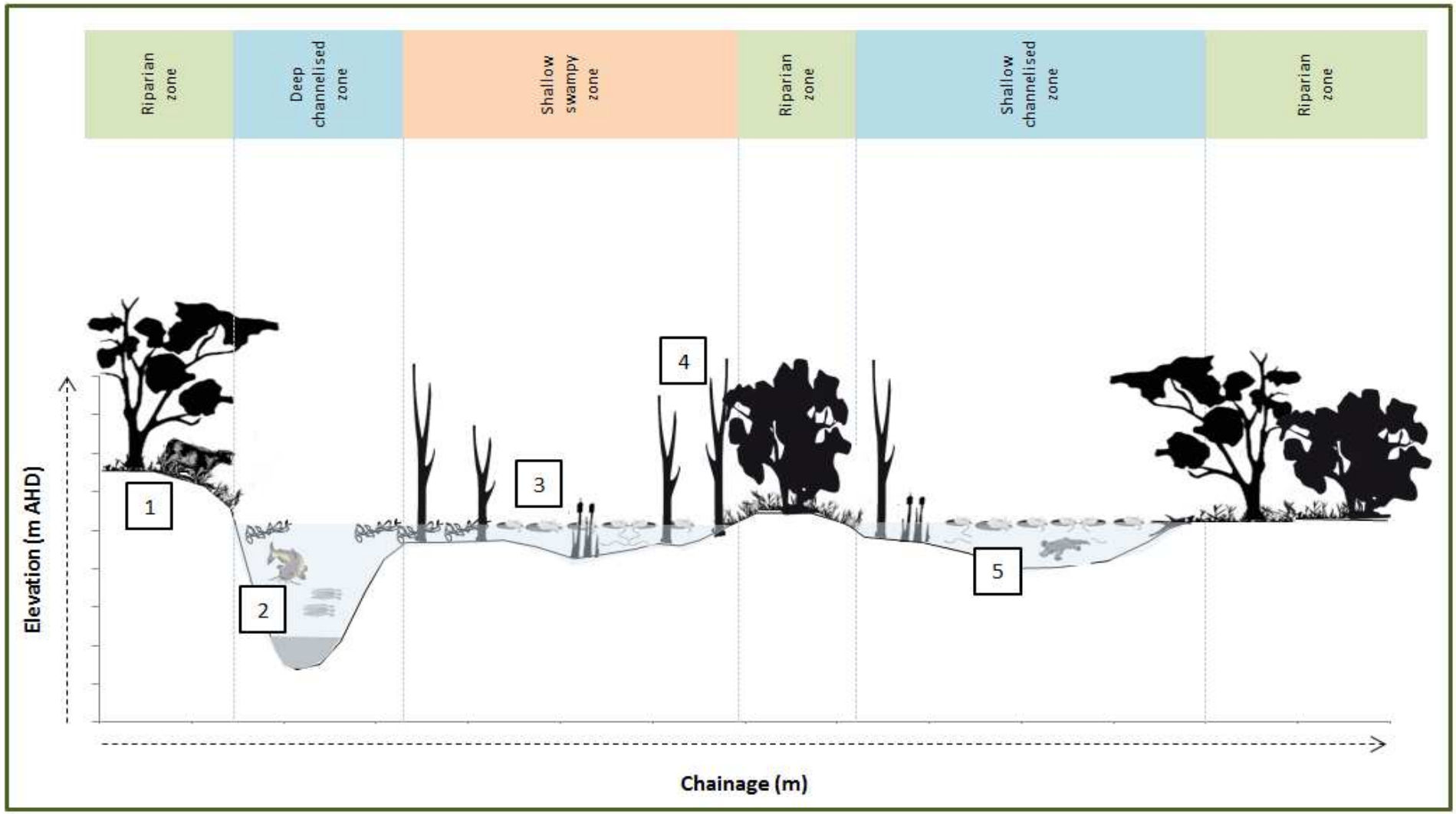

Figure 13. Conceptual understanding of the general characteristics of the Gunbower Lagoons

Gunbower Lagoons key:

1. Similar to the Gunbower Creek, stock access is widespread in many of the lagoons contributing to a reduced cover and structural diversity of native species, bank erosion and nutrient enrichment. The riparian zone is characterised predominately by Riverine Chenopod Woodland and Sedgy-Riverine Forest EVC types, whilst the littoral zone is characterised by narrow Tall Marsh zone that is low in species diversity due to the consistently high irrigation water levels.
2. A diversity of native fish species including small-bodies species and Freshwater Catfish has been recorded in the Gunbower Lagoons. In particular, Phyland, Turner, Gum, Cockatoo and Safe's lagoons support a genetically distinct Freshwater Catfish population. This species requires adequate water depth throughout the year to ensure provision of appropriate resources for growth, survival and reproduction. Siltation is considered a threat through infilling of deep pools which provide refuge during dry times and smothering of nests. The lagoons populations are isolated from one another due to road culverts and regulators.
3. As per Gunbower Creek, Pale Yellow Water Lily is prolific in the Gunbower Lagoons. See 'Gunbower Creek key No. 7' for impacts of Pale Yellow Water Lily on aquatic biota. Hornwort is also present as per 'Gunbower Creek key No. 3'.
4. A long history of elevated water levels throughout the irrigation season has resulted in the death of a large number of trees located in the littoral and swampy wetland zones of the lagoons. Although these trees provide habitat for a range of fauna species, they will eventually be lost to rot and will not be replaced due to the inappropriate water regime.
5. As per Gunbower Creek, Platypus are frequently observed in the lagoons associated with the upper reaches of the Gunbower Creek. See 'Gunbower Creek key No. 2.' for conceptual understanding of Platypus in the system.

4.8. Significance

The Gunbower Creek System is considered highly significant in the Murray Darling Basin representing an important anabranch of the Murray River and being intrinsically linked to the health of the neighbouring Gunbower Forest. Although highly regulated, the Gunbower Creek System supports a high diversity of native flora and fauna, a large proportion of which are listed as rare or threatened at an international, federal and state level. In particular the presence of EPBC and FFG listed species such as Murray Cod, Trout Cod, Freshwater Catfish and Growling Grass Frog as well as a regionally important Platypus population, makes the system important from a local perspective. In additional, the connectivity with the neighbouring Ramsar listed Gunbower Forest and close proximity to other wetlands within the region, makes the Gunbower Creek System a quintessential component of the mid Murray landscape.

The ecological values within the Gunbower Creek System are supported by the hydrodynamic diversity and by changes in the depth and width within the Gunbower Creek System. A diversity of habitat types, in particular those created by the presence of IWH, support a wide range of food webs and provides shelter, a substrate for feeding and breeding and refuge from predators. The diversity of fast and slow flowing creek reaches and still water habitats created within the lagoons and weirs further provide conditions to meet a wide range of species requirements.

Not only is the Gunbower Creek System important from an ecological perspective, it also supports a range of economic, recreational and cultural values. Some of these values are part of the wider Gunbower Forest system (i.e. nature observation, bird watching), whilst others are specific to the creek (i.e. recreational fishing) and lagoons (i.e. duck hunting). Appendix 7 addresses the importance of Gunbower Creek System against the Murray Darling Basin Plan criteria for identifying an environmental asset, as per schedule 8 of the Basin Plan.

5. Ecological Condition and Threats

5.1. Context

As described in Section 3.1, the Gunbower Creek System is a working river, reflected in its multiple uses for harvesting, storing and delivering consumptive and environmental water. For this reason, the system is characterised by seasonal inverted conditions which see low to no flows over the winter months and higher than natural flows during the warmer months. The system rarely experiences overbank flows or inputs from the Gunbower Forest floodplain and the water levels often exceed the natural rates of rise and fall over short time periods. In the lagoons, water is held at near maximum capacity for up to ten months of the year.

The most notable change caused by regulation within the Gunbower Creek System include a reduction in native species diversity and extent (i.e. a narrow band due to consistently high levels), the result of exotic species encroachment, tree death (i.e. sections of the creek, in weir pools and within lagoons) and habitat fragmentation (i.e. through the construction of fish barriers). In addition, clearing of native vegetation, livestock access and the input of nutrients from surrounding agricultural land use has degraded the condition of the system. As described in the following sections, these land and water management decisions, both historic and current, have contributed to a decline in condition of the Gunbower Creek System.

5.2. Current Condition

5.2.1. State Condition Monitoring

5.2.1.1. Sustainable Rivers Audit (SRA)

The SRA is a scientifically robust assessment of the ecological health of the Murray-Darling Basin's river valleys, based on assessments of fish, macroinvertebrates, vegetation, physical form and hydrology. These parameters are compared against a reference condition for each valley to determine an SRA condition score. The Gunbower Creek System sits within Murray Valley-Central management unit (Davies et al., 2012).

Two SRA assessments have been undertaken to date within the Murray Valley-Central. SRA 1 is based on data collected from 2004 – 2007 and assessed fish, macroinvertebrates and hydrology whilst SRA 2 is based on data collected from 2008 to 2010 and includes additional reports on physical form and vegetation. In some cases direct comparison between values is warranted (Davis et al., 2012) however, changes in methodology and additional information collated needs to be considered.

The SRA revealed that the Murray Valley-Central management unit is in relatively poor condition, with particular concern for native fish populations and hydrology. This included a lower than expected number of native fish species, low nativeness in comparison to introduced species and poor native recruitment. Hydrology was considerably altered with changes to the timing, duration and frequency of flows associated with a reduction in high flows and increased low flows. In addition a poor overall diversity of macroinvertebrate families as well as high sediment loads and the simplification of the physical channel form have altered the health of the system. However it should be noted that the Murray Valley-Central SRA assessment considers not only the Gunbower System, but also the entire area that extends from Lake Hume to Wentworth (at the Murray-Darling junction), including the Murrumbidgee, Darling, Kiewa, Ovens, Goulburn, Campaspe and Loddon rivers. The Gunbower Creek System sits within the mid-zone of this management unit which focuses on the area to the east and south-east of the Gunbower Forest area. Table 17 details the results of the two SRA reports. Please note that MDBA has issued a caveat against SRA 2 results, advising interpretation should be made in the context that prevailing climate conditions for the period in which the data were collected included the severe Millennium Drought (Davies et al., 2012).

Table 17. SRA indices ratings and trajectories for the Murray Valley-Central management unit which includes the Gunbower Creek locality

Parameter	Condition	
	SRA 1	SRA 2
Fish (SR-F1)	Poor	Very poor
Macroinvertebrates (SR-MI)	Poor	Poor
Vegetation (SR-VI)	-	Good
Physical Form (SR PI)	-	Poor
Hydrology	Moderate	Very Poor
Ecosystem health Rating	**Poor**	**Poor**
Source: Adapted from Davies et al., (2012); Davies et al., (2008)		

5.2.1.2. Index of Stream Condition (ISC) and Index of Wetland Condition (IWC)

The Index of Stream Condition (ISC) is a statewide assessment of river condition and measures the relative health against a reference condition for hydrology, physical form, stream side zone, water quality and aquatic life. ISC assessments were undertaken in 1999, 2004 and 2011 for the Gunbower Creek. Comparison across the sample period is however difficult to make, as the collection method changed for all five sub-indices (DEPI 2013e). In addition, the ISC reaches used are delineated differently to those used in environmental flows and this EWMP. For example, ISC reach 38 extends from the confluence of the Murray River upstream to Cohuna, whilst ISC reach 39 follows the natural creekline extending from Cohuna to the Murray River along Upper Gunbower, Turner and Splatts Lagoon. Two additional ISC reaches, 53 and 54, are the sections of National Channel that include Turners and Splatts lagoons respectively and were adopted in the 2011 ISC assessment. The most recent ISC assessment, which only included assessments of physical form, stream-side zone and water quality, reveals that the creek is generally in moderate condition. The results of all three assessments against each ISC reach (which is further aligned to the reaches identified in this EWMP) are shown in Table 18.

Table 18. Index of Stream Condition sub - indices scores and trajectories for the Gunbower Creek during 1999, 2004 and 2011 assessments

ISC Reach No.	E-flow No.[1]	Physical Form			Stream-side zone			Hydrology			Water Quality			Aquatic Life			Total Score			Condition			Change
		1999	2004	2011	1999	2004	2011	1999	2004	2011	1999	2004	2011	1999	2004	2011	1999	2004	2011	1999	2004	2011	
38	3a, 3b	5	5	9	6	3	7	3	-	-	8	6	6	6	4	-	24	20	34	P	M	M	+
39	1, 2	6	4	9	6	3	6	1	-	-	7	-	-	-	4	-	21	18	-	p	M	I	+
53	1	-	-	9	-	-	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	I	U
54	1	-	-	9	-	-	5	-	-	-		--	-		--	-	-	-	-	-	-	I	U

KEY:
VP- very poor; P- poor; Ma- marginal; M- moderate; G- Good, I- Insufficient data to assess
+ -Positive; 0 -no change; -- negative, U- unknown due to lack of data
[1] indicative environmental flows reaches used in this EWMP
Source: adapted from DEPI, 2014g; DSE, 2004; DSE, 1999.

The Index of Wetland Condition (IWC) is a statewide assessment that compares the current condition of a wetland against the presumed characteristics of the same wetland type prior to European settlement. The IWC defines wetland condition as a state of the biological, physical and chemical components of the wetland ecosystem and their interactions. Sub-indices measured to inform the overall IWC condition score include physical form, hydrology, water properties, soil and biota. The Gunbower Lagoons were assessed for the first time in 2013 by Australian Ecosystems as part of the GLMP.

In recognition that human induced changes have altered the vegetation composition of the Gunbower Lagoons, a modified IWC assessment was also undertaken. This assessment considered the

condition of replacement (extant) vegetation communities that have displaced the original pre-European vegetation and scored these against an extant vegetation benchmark.

The IWC assessments show that the general health of the Gunbower Lagoons is moderate (under both assessment methodologies). For both assessment methods, that is against the pre-European and extant vegetation benchmarks, physical form (i.e. area of wetland and form) is considered excellent; water quality (i.e. macronutrients, EC etc.) and soils (i.e. physical properties including texture and structure) are good; wetland catchment (i.e. land use and wetland buffer size) is poor; and hydrology (i.e. changes to water regime) is very poor. Biota is the only sub-indices in which the two assessment methods generated different overall system scores, with the pre-European benchmark assessing the system as poor and the extant benchmark scoring it as moderate. Table 18 and Table 19 show the IWC scores for the Gunbower Lagoons under the two IWC assessment methodologies.

Table 19. IWC assessment against pre-European Benchmark for the Gunbower Lagoons

Lagoon Name	Wetland catchment		Physical Form		Hydrology		Water properties		Soil		Biota		total	
	Score	Category	Score	Category	Score	Category	Score	Category	Score	Category	Score	Category	Score	Category
Heppell	8	Poor	17.4	Excellent	0	V. Poor	15	Good	17.25	Good	12.92	Poor	**70.57**	**Moderate**
Heart	18	Excellent	20	Excellent	0	V. Poor	15	Good	19.75	Excellent	13.85	Moderate	**86.6**	**Moderate**
Unregulated	14	Good	15	Good	0	V. Poor	17	Good	10	Moderate	11.31	Poor	**67.31**	**Moderate**
Splatts	12	Moderate	20	Excellent	0	V. Poor	15	Good	16	Good	13.78	Moderate	**76.78**	**Moderate**
Turner	3.5	V. Poor	20	Excellent	0	V. Poor	15	Good	14	Good	11.26	Poor	**63.76**	**Moderate**
Phyland	4	V. Poor	20	Excellent	0	V. Poor	15	Good	15.75	Good	9.86	Poor	**64.61**	**Moderate**
Longmore	*2.5*	V. Poor	19.95	Excellent	0	V. Poor	13.5	Good	10	Moderate	5.85	V. Poor	**51.8**	**Poor**
Upper	9	Poor	19.5	Excellent	0	V. Poor	15	Good	9	Moderate	1.45	V. Poor	**53.95**	**Poor**
Gum	6	Poor	19.9	Excellent	0	V. Poor	15	Good	5.5	Poor	12.55	Poor	**58.95**	**Moderate**
Cockatoo	9	Poor	19.5	Excellent	0	V. Poor	15	Good	10.5	Moderate	2.02	V. Poor	**56.02**	**Poor**
Taylors	6	Poor	19.5	Excellent	0	V. Poor	15	Good	10.5	Moderate	1.40	V. Poor	**52.39**	**Poor**
Safe's	11.5	Moderate	20	Excellent	0	V. Poor	15	Good	13.75	Good	14.57	Good	**74.82**	**Moderate**
System score	**8.62**	**Poor**	**19.23**	**Excellent**	**0**	**V. Poor**	**15**	**Good**	**12.67**	**Moderate**	**9.24**	**Poor**	64.80	Moderate

Source: Australian Ecosystems, 2013

Table 20. IWC assessment against extant vegetation benchmark for the Gunbower Lagoons

Lagoon Name	Wetland catchment		Physical Form		Hydrology		Water properties		Soil		Biota		total	
	Score	Category	Score	Category	Score	Category	Score	Category	Score	Category	Score	Category	Score	Category
Heppell	8	Poor	17.4	Excellent	0	V. Poor	15	Good	17.25	Good	13.49	Poor	**71.1**	**Moderate**
Heart	18	Excellent	20	Excellent	0	V. Poor	15	Good	19.75	Excellent	13.85	Moderate	**86.6**	**Moderate**
Unregulated	14	Good	15	Good	0	V. Poor	17	Good	10	Moderate	13.47	Moderate	**69.5**	**Moderate**
Splatts	12	Moderate	20	Excellent	0	V. Poor	15	Good	16	Good	17.15	Good	**80.15**	**Good**
Turner	3.5	V. Poor	20	Excellent	0	V. Poor	15	Good	14	Good	13.81	Moderate	**66.3**	**Moderate**
Phyland	4	V. Poor	20	Excellent	0	V. Poor	15	Good	15.75	Good	11.80	Poor	**66.5**	**Moderate**
Longmore	2.5	V. Poor	19.95	Excellent	0	V. Poor	13.5	Good	10	Moderate	15.55	Moderate	**61.5**	**Moderate**
Upper	9	Poor	19.5	Excellent	0	V. Poor	15	Good	9	Moderate	10.69	Poor	**53.19**	**Moderate**
Gum	6	Poor	19.9	Excellent	0	V. Poor	15	Good	5.5	Poor	15.65	Moderate	**62.05**	**Moderate**
Cockatoo	9	Poor	19.5	Excellent	0	V. Poor	15	Good	10.5	Moderate	10.80	Poor	**64.8**	**Moderate**
Taylors	6	Poor	19.5	Excellent	0	V. Poor	15	Good	10.5	Moderate	11.93	Poor	**62.93**	**Moderate**
Safe's	11.5	Moderate	20	Excellent	0	V. Poor	15	Good	13.75	Good	17.09	Good	**77.34**	**Moderate**
System score	**8.63**	**Poor**	**19.23**	**Excellent**	**0**	**V. Poor**	**15**	**Good**	**12.67**	**Moderate**	**13.77**	**Moderate**	68.50	Moderate

Source: Australian Ecosystems, 2013

5.2.2. Site Specific Condition

5.2.2.1. Vegetation

The SRA score and the ISC and IWC assessments indicate that the aquatic and riparian vegetation of the Gunbower Creek System is in poor to moderate condition. However the incompleteness of the previous ISC assessments (i.e. a number of parameters not measured in 1999 and 2004) and the change in assessment methodology, as well the lack of historical IWC assessments (i.e. 2013 being the first assessment for the system), makes it difficult to ascertain whether this condition has declined recently or has remained relatively static.

Regardless of this, observations from GMW, North Central CMA and community members suggest that the condition of vegetation communities in the system has been on a downward trajectory over at least the last 10-15 years. Sections of the creek are denude of riparian vegetation and exhibit degraded banks the result of stock access (Plate 8), whilst prolonged high water levels particularly in the low floodplain terraces of the lagoons and upstream of the weirs, have caused the tree death. In addition, changes to the floodplain immediately adjacent to the creek, including the construction of levees to protect farmland, has restricted the extent of seasonally waterlogged or flooded soils and has created a strong contrast between the riverine habitat and the relatively dry adjacent landscape (Australian Ecosystems 2013).

The fringing aquatic zones of the creek and lagoons are generally narrow in width (commonly only 1-2 meters wide) and of low diversity, the result of high and stabilized weir and creek levels that have eroded the banks. Dominant species include Hornwort, Pacific Azolla, Yellow Bladderwort (*Utricularia australis*) and Water Millfoil (*Myriophyllum spp*.). In particular Hornwort is noted to form extensive mats at the edges of the lagoons and the creek and is noted to clog and reduce the capacity of irrigation pumps (Plate 8). In areas deeper than two metres or fast-flowing (i.e. the main channel of the creek), the above species are generally absent (Anderson et al. 2007; Ecological Associates, 2015).

Plate 8. Left: Cow graving on rushes on banks of Gum Lagoon (photo courtsey of A. Dickens), Right: Hornwort on pump guard (photo courtsey of N. Rowlands)

5.2.2.2. Invasive flora species

A number of noxious and other significant submerged, emergent, floating and riparian weeds have been recorded along Gunbower Creek. High threat weeds currently established over large areas of the creek include Pale Yellow Water Lily (Plate 9), Parrots Feather and Willows (*Salix* spp.) (Plate 9). Arrowhead (*Sagittaria platyphylla*) is currently limited in extent along Gunbower Creek however has considerable potential to increase in range if not actively controlled (Ecological Associates, 2010).


Plate 9. Left- Pale Yellow Water Lily on Gunbower Creek, Right: Willows on banks of Gunbower Creek

Pale Yellow Water Lily is the most dominant aquatic weed species within the system, forming dense, continuous canopies of floating foliage in all lagoons and slower-flowing areas of the creek, particularly upstream of Cohuna. The species is particularly invasive and can cover as much as 50% of a lagoon's area (Rogers, 2013a cited in Ecological Associates, 2015). The species thrives in nutrient rich water (i.e. inputs from the agricultural landscape) and can exclude the growth and productivity of native aquatic in the water column (through shading) (Ecological Associates, 2015). This can reduce food and habitat availability for platypus and turtles, through disrupting surfacing behavior and preventing bank access for nesting (Serena & Williams, 2013).

As noted during the community engagement workshop undertaken for this EWMP (See Appendix 1), there is a strong perception by the community that winter plays a vital role in controlling the growth of Pale Yellow Water Lily. This is supported by an accelerated spread of the species during the Millennium Drought, when GMW maintained the creek height through winter as a means of conserving water. However observations of the spread of the species over the past decade shows that frosting alone has done little for the long term control of the species (Plate 10). The North Central CMA in partnership with GMW, have recently implemented a herbicide control program at a number of locations along the creek and lagoons. The program has facilitated a significant reduction in extent of the species, although long term funding is required to ensure follow-up treatment (Ecological Associates, 2015).

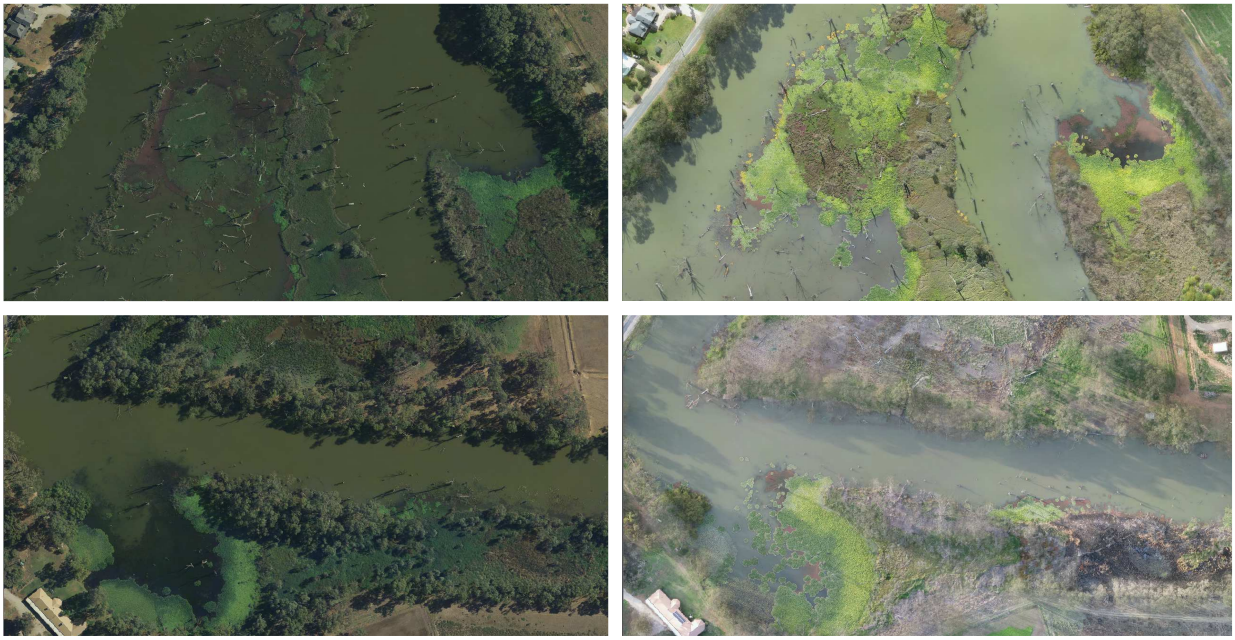

Plate 10. Aerial photograph comparision of Pale Yellow Water Lily infestation at three locations on the Gunbower Creek in 2009 (left) and 2014 (right)

Willow (*Salix spp*.) is also considered a major invasive weed in the Gunbower Creek System. In 2008, five species of Willow (*Salix cinerea spp. cinerea*, *Salix fragilis var. fragilis, Salix rubens, Salix pendulina and Salix sepulcralis var. sepulcralis*) were recorded along Gunbower Creek, some of which were noted to have been deliberately planted (G-MW, 2008 cited in Ecological Associates, 2010). The genus is regarded as one of south-east Australia's worst riparian and wetland weeds (Richardson, et al. 2007 cited in Ecological Associates, 2010), and is classified as both a weed of national significance and restricted under the 1994 *Catchment and Land Protection Act* (CaLP). Willows are high water users and can shade out and displace native vegetation and disrupt the flow and aeration of water through root spread. They spread vegetatively and form thickets that divert water outside the main watercourse or channel resulting in flooding and erosion of vulnerable banks. Willow can also drop leaves in autumn, creating a flush of organic matter that reduces water quality and oxygen availability (i.e. causing a blackwater event) directly threatening aquatic plants and animals (Ecological Associates, 2010). In the Gunbower Creek System a substantial willow removal program has been undertaken as part of the 'Enhancing the values of the Gunbower Ramsar Site' project.

Parrots Feather *(Myriophyllum aquaticum*), is ecologically similar to the Pale Yellow Water Lily in that it is a perennial aquatic herb that spreads vegetatively and favors summer wet habitat (Jeans, 1996b cited in Ecological Associates, 2010). Mapping along the Gunbower Creek in 2008 identified over 26 hectares of this species, the extent of which was apparently limited by the Pale Yellow Water Lily (G-MW, 2008 cited in Ecological Associates, 2010).

5.2.2.3. Physical habitat features

There are extensive high quality and diverse aquatic habitat opportunities in and immediately adjacent to Gunbower Creek and its lagoons including vegetated benches and riparian zone, instream habitats with fast and slow flowing channels of varying depth and width, areas with woody habitat, and adjoining sandy banks and nearby sand hills (North Central CMA 2014). In addition the close proximity of the Gunbower Forest floodplain provides a diversity of habitat opportunities including semi-permanent wetlands and River Red Gum forest. This diversity of habitats is important for promoting a range of fauna species including a diversity of fish species representing a range of size classes (Koehn et al., 2004).

IWH is considered essential for maintaining the health of the Gunbower System by providing critical physical habitat important for many aquatic species (Plate 11) (Crook & Robertson, 1999). In a survey by Arthur Rylah Institute (ARI) in 2014, current mapping of woody habitat was compared to modelled pre-European loads. Results suggested that some areas exhibit relatively healthy loads, but in comparison to predicted natural loads, all areas of the creek could benefit from additional woody habitat. The analysis revealed an average reduction of 74% in woody habitat across the system, with approximately 10% more loss in the upper reaches above Cohuna. In particular the study noted that winter draining of the creek, can result in the exposure of woody habitat (i.e. above the water line), making it unavailable to aquatic species to utilise. This was particularly evident below Hipwell Weir, where sites had higher densities of IWH, although much of it is above the water line. The limited availability of woody habitat during low flows in Gunbower Creek is likely to be a major limiting factor to fish populations reliant on this habitat (Kitchingman et al. 2014).

Gunbower Creek also exhibits variable depths along the system, with a number of sites that could be considered potential refuge areas during very low flow events. In particularly these are located in areas closer to the top of Koondrook Weir and Hipwell Weir as well as a number of deep creek bends that also support high IWH loads.

Although the system supports a diversity of physical habitat features, its productivity is limited by the low input of organic matter, nutrients and carbon from the floodplain. For this reason the creek is often referred to as a carbon starved system and is unlikely to support a significant increase in biotic communities unless its carrying capacity is increased. In addition the creek is also impacted by erosion which is associated with prolonged periods of extended high flows and rapid changes to water levels. The lack of riparian vegetation and access by stock has also increased the extent of notching, bank collapse and sediment immobilisation (Plate 11). This can result in mass bank failure, where the upper

section of the bank topples into the channel. Additional work is required to quantify the rate of productivity and bank erosion in the system and the impacts of rapid water level changes on structural stability.

Plate 11. Left- IWH exposed during the irrigation drawdown phase in June 2015, Right- bank erosion on Gunbower Creek from stock access, August 2007 (J. Spence)

5.2.2.4. Fish surveys

The fish component of the SRA score for the Murray Valley-Central locality, which includes Gunbower Creek, was considered very poor due to lower than expected native fish diversity, poor recruitment and low species nativeness (Davies et al., 2012). Although the SRA encompasses the larger Murray Valley- Central area, the poor assessment score for native fish community is substantiated at the local scale. Annual fish surveys have been conducted in the creek and nine of the lagoons (all but Unregulated, Heppell and Heart lagoons) since 2008 as part of the *Gunbower Island Annual Fish Monitoring Program* implemented through TLM Condition Monitoring Program, although comprehensive surveys have also been undertaken in the 1960s and in 1998, 2005 and 2007 (Douglas & Shirley, 1996; Rehwinkle & Sharpe, 2009 cited in Sharpe et al., 2014).

Long term monitoring has shown that populations of short-lived small bodied native fish species in the Gunbower Creek System has remained relatively stable in population structure, distribution and abundance (Sharpe & Stuart, 2015). This is supported by the recent 2014 fish surveys that noted high numbers of adult and young of year Carp Gudgeon, Un-Specked Hardyhead and Australian Smelt (Sharpe et al., 2014). However medium and large-bodied species including Freshwater Catfish, Golden Perch, Silver Perch and Murray Cod have persistently exhibited fragmented population structures with limited recruitment and an overall decline in abundance (Sharpe et al., 2013 cited in Sharpe & Stuart, 2015). In general these populations are made up of a limited age class distribution (with gaps in some age class sizes representing years where recruitment did not occur) as well as low number of juveniles and early recruits. Figure 14 shows a comparison of a healthy Murray Cod population age class distribution in the Darling River versus the Gunbower Creek. It is thought that the main factor limiting population health is low spawning success and/ or poor larval-juvenile recruitment/ survival (Sharpe & Stuart, 2014).

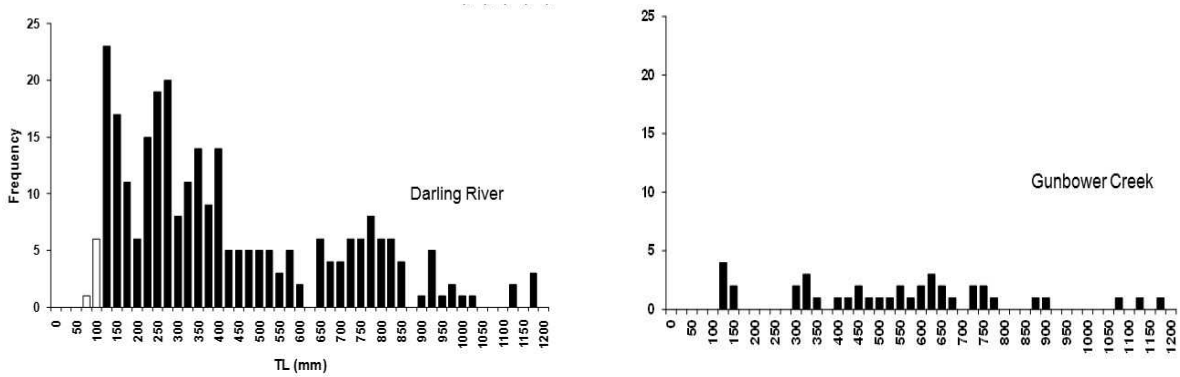

Figure 14. Abundance of Murray Cod age class distributions between 2008-2013 in Darling River and Gunbower Creek (Source: Sharpe et al., 2013 cited in Sharpe & Stuart, 2015)

Monitoring undertaken during the delivery of environmental water in spring 2013 to target spawning conditions for Murray Cod in Reach 3a (see Section 3.5), measured the distribution and abundance of Murray Cod larvae after spawning. A high abundance of young of year Murray Cod individuals were noted to be associated with the watering event. The study however noted that the ability for young of year individuals to survive their first winter was significantly reduced in the winter period due to the draining of the creek. These periods result in the formation of a series of pools that isolate individuals from one another and cause high juvenile mortality through predation. The study provided information on the preferred timing and tolerances to water level variability in the system as well as the location of key spawning and nursery habitats within Reach 3a (e.g. near Yarran Creek and Reedy Lagoon) (Sharpe & Stuart, 2015).

In addition, fish surveys undertaken in 2015 revealed the presence of five juvenile Freshwater Catfish caught in Phyland Lagoon (all of the catch) as well as one female in Turner's Lagoon during 2015 (Stuart & Sharpe, 2015). This supports previous observations that Phyland Lagoon is a Freshwater Catfish nursery site (Austral, 2013 cited in North Central CMA, 2013d). The long term persistence of the population is of particular concern due to the genetic distinction of this population from others in Northern Victoria (North Central CMA, 2013e; Mallen-Cooper et al., 2014; Ecological Associates, 2015).

As identified in *Gunbower and Lower Loddon Native Fish Recovery Plan* (Mallen-Cooper et al., 2014), the main threats to native fish populations in the Gunbower Creek System include habitat fragmentation, loss to irrigation channels, inappropriate flows and disconnection from the Murray River and Gunbower Forest (Mallen-Cooper et al., 2014). In particular, historical winter low flow periods have resulted in a series of pools forming which isolate individuals from one another. The consistently low number of juveniles for many native species indicates poor recruitment into the adult population, likely due to poor habitat and feeding opportunities and increased predation by larger fish species during the winter period (Mallen-Cooper et al., 2014; Stuart & Sharpe, 2015 cited in Ecological Associates, 2015).

5.2.2.5. Introduced Fauna species

Six introduced fish species are found in the Gunbower Creek System being Common Carp, Goldfish, Tench, Gambusia, Oriental Weatherloach and Redfin Perch. Recent fish surveys indicate that all of these species have a size distribution structure indicative of multiple seasons of successful recruitment with Eastern Gambusia, Common Carp and Goldfish the most frequently recorded species (Sharpe et al., 2014). Consecutive surveys show that the abundance of Common Carp and Goldfish has generally increased in the system, whilst Eastern Gambusia has generally decreased (Sharpe et al., 2014). In particular, inundation of the floodplain has the potential to trigger recruitment events, which upon floodplain water level recession, initiates a mass exodus of the species into Gunbower Creek System via the Hipwell Offtake regulator. This is considered a significant risk to the Gunbower Creek and requires a coordinated and strategic Common Carp management plan that is imbedded into the delivery of environmental water in the forest.

European Fox is also commonly found throughout the Gunbower Creek System with historical data indicating that the presence of high populations around camp sites, floodplain wetlands and the Gunbower Lagoons. Recent studies provide strong evidence that foxes are contributing significantly to the decline in a range of native fauna species, in particular the abundance of Platypus and all three freshwater turtles found in the Murray Darling Basin and Gunbower Creek System. Howard et al., (2013) noted that low recruitment through high levels of predation on nesting female turtles, their eggs and hatchings combined with an aging population, has limited the distribution and abundance of the species. In 2011 the North Central CMA in conjunction with Turtles Australia (Inc.) identified and successfully protected 70 turtle nests from fox predation in the Gunbower Forest using mesh fencing. More recently a fox baiting program targeting key turtle breeding hot spots in the Gunbower System has been implemented by the North Central CMA.

In addition European Rabbit is considered a key threat to native vegetation diversity in the Gunbower area and the North Central CMA undertakes regular monitoring, control and incentive programs in

the area (i.e. baiting, warren destruction etc.). Section 8.3 details the recommended complementary actions to be undertaken in the Gunbower Creek System.

5.3. Condition Trajectory - Do nothing

The Gunbower Creek System has been significantly impacted by regulation resulting in an irreversible change to the abundance and diversity of native flora and fauna. In particular the impact on native fish populations has been severe, through changes to the variability, duration and timing of flows as well as the fragmentation of habitat both within the creek and lagoon system and loss of connection with the Murray River and Gunbower Forest floodplain. In addition the proliferation of exotic species such as European Carp, Pale Yellow Water Lily and European Fox as well as water quality issues associated with an agricultural landscape has impacted on the health and food web interactions that occur in the anabranch system.

However in spite of these changes, the Gunbower Creek System still supports a range of physical habitat features considered vital for supporting a range of native species. This includes areas of still, slow and fast flowing water, shallow and deep pools, channelised and marsh environments, steep and gentle sloping banks, IWH and aquatic and littoral vegetation diversity. Without intervention however, many of these values and the species they support will continue to decline impacting on both the Gunbower Creek System and the wider Murray River Catchment. The following trajectory is anticipated without improved management of flows and long-term delivery of environmental water:

- Continued bank slumping, erosion and pool infilling the result of automated irrigation flow operation and rapid fluctuations in water level, particularly during the end of the irrigation season. This will result in a loss of native vegetation in the littoral and riparian zones and simplified the physical form of the creek.
- Reduced native species diversity and limited opportunities for rehabilitation of poorly represented and or threatened species due to low habitat availability and inappropriate flow regimes (i.e. as cues for movement, breeding etc.)
- Stable or reduced productivity in the creek the result of low organic matter and nutrient inputs from the Gunbower Forest floodplain
- Further decline in the number of native fish species present in the Gunbower Creek System, particularly large-bodied fish that have specific flow and habitat requirements that do not align with current regulated operations. Specifically this is likely to occur due to:
    - *Lack of spawning success:* Early spawning cues (the result of high irrigation variability) that are not preceded by appropriate conditions (i.e. exposure of nests, lack of food resources etc.) to ensure successful spawning or larvae survival.
    - *Lack of successful recruitment*: High juvenile mortality over the winter period the result of low habitat connectivity, which reduces the availability of resources and increases risk of predation by adult fish.
    - *Inappropriate life history cues*: sudden changes in flow can trigger long distance movement in search of permanent habitat. This can result in mortality through stranding of individuals on the floodplain and/ or by reducing the health and vigor (i.e. increase risk of disease) of individuals through the unnecessary expenditure of large amounts of energy.

In light of this, recent research and monitoring indicates that there is a real potential for recovery, particularly relating to native fish populations, through the use of environmental water delivery. As documented in *Gunbower and Lower Loddon Native Fish Recovery Plan*, this can be undertaken without impacting significantly on the system's role as major irrigation delivery conduit. In addition to the localized benefits of a more diverse, abundant and healthy fish assemblage, restoration in Gunbower Creek will aid in recovery of the larger Murray-Darling Basin fish assemblage, which is noted to be a key outcome in the *Basin-wide Environmental Watering Strategy* (MDBA, 2014).

6. Management Objectives

6.1. Management Goal

The long term management goal for the Gunbower Creek System has been derived from technical reports, *TLM Gunbower Forest EWMP*, the VWMS, *North Central Waterway Strategy 2013*, the environmental values documented in Section 4 and from expert advice and input (Section 1.4). The long term management goal seeks to address and respond to the current condition and condition trajectory discussed in Section 5.

Gunbower Creek System long term management goal
To rehabilitate the highly valued native fish populations of the Gunbower Creek System and facilitate connection between the Murray River, Gunbower Forest floodplain and associated wetlands through an appropriate water regime.

6.2. Ecological Objectives

Ecological objectives describe the intended outcomes of environmental water delivery. They contribute towards achieving the long term management goal. The ecological objectives for Gunbower Creek System are based on the key water dependent values of the system as informed by the previous Environmental Flows assessment (Anderson et al., 2007b), *TLM Gunbower Forest EWMP* (MDBA, 2012) and updated by Ecological Associates (2015) and North Central CMA staff. Where appropriate these are expressed as the target condition or functionality for each key value, using one of the following trajectories:

- Restore – recover a value that has been damaged, degraded or destroyed and return it to its original condition.
- Rehabilitate/ increase – repair a value that has been damaged, degraded or destroyed but not to the extent of its original condition.
- Maintain – maintain the current condition of a value.

Ecological objectives are presented as primary and secondary objectives. Primary objectives are related to the key values of Gunbower Creek System and summarise the overall objectives for those values. Secondary objectives are those that either support the achievement of the primary objectives (e.g. littoral vegetation provides shelter, food source etc. for native fish) or are indirectly supported thorough management that targets the primary objectives (i.e. flows that trigger fish movement also support Platypus). Each objective with its justification is shown in Table 21.

Ecological objectives have been developed to align closely with those identified in *TLM Gunbower Forest EWMP* (MDBA, 2012). Condition targets for the forest that are applicable to management of the creek are also noted in Table 21.

Table 21. Ecological objectives for the Gunbower Creek System

Objective	Justification
1. Primary objectives	
1.1 Increase the abundance and improve age class distribution of small and large-bodied *native fish species*	The Gunbower Creek System supports a diversity of small and large bodied native fish species including species listed as nationally threatened. The presence and abundance of these species is directly related to the availability of appropriate physical (i.e. flow, food and shelter resources) and spatial (i.e. connectivity) habitat characteristics that promote survival and reproductive success. Fish in turn provide a vital food source for other fauna including larger fish, waterbirds, turtles and aquatic mammals. The limited abundance and fragmented age class distribution of a number of species in the Gunbower Creek System has impacted on the food web interactions and balance of ecology. *Objective aligns with TLM EWMP target- by 2025, support a range of age/ size classes for each species present as well as a 10% increase in the current population size (MDBA, 2012)*

Objective	Justification
1.2 Increase connectivity to promote *movement/ migration* of native fish species within the lagoons, floodplain and Murray River	The growth, survival and reproductive success of many native fish species is promoted by the ability to move in response to changed environmental conditions. The scale and pattern of such movement varies between species, with some actively migrating over long distances (i.e. between Murray River and Gunbower Creek), others relying on larval drift (i.e. lateral or longitudinal movement between reaches, the floodplain and wetlands) and some moving locally within ecosystems (i.e. between open water and littoral zones). Connection between a range of habitat types improves the availability of resources (i.e. food, shelter, access to new individuals), facilitates the exchange of floodplain nutrients (increasing, organic carbon and minerals) and provides refuge during unfavourable conditions. Movement in the system is severely impaired by inappropriate or lack of cues and/ or physical barriers.
1.3 Rehabilitate populations of native fish species that are *poorly represented or absent* in the system	Species such as Trout Cod would have historically been abundant in the Gunbower Creek System. Rehabilitation of poorly represented or lost species depends on the presence of appropriate flows, a nearby source population for recolonisation (i.e. Murray River) or translocation and removal of barriers that prevent poorly represented species from recovering in the system (see Section 0). *Objective aligns with the TLM EWMP target – by 2030, presence of two native fish species currently considered extinct (MDBA, 2012)*
2. Secondary objectives	
2.1 Increase littoral and aquatic vegetation extent, diversity and productivity	Fringing and aquatic plants are an important component of the micro and macro habitats of the Gunbower Creek System. Plant matter provides shelter and a food source for a range of fauna species, a substrate for fish eggs, macroinvertebrates and biofilms to attach to, bank stability, as well as providing organic matter (including IWH) and nutrients important for system wide productivity. A high diversity of native species can assist with reducing the extent of exotic species and provide a source for downstream colonisation.
2.2 Increase the size of the resident breeding population of Platypus	Prior to regulation, Platypus would have been abundant in the Murray River Catchment. The upper reaches of the Gunbower Creek System (and a number of associated lagoons) now supports the only sizeable breeding population of the species downstream of Echuca. The Gunbower Creek System population has the potential to act as a source population for recolonisation of the Murray River.
2.3 Maintain feeding and breeding opportunities for turtles	The Gunbower Creek System supports a number of significant freshwater turtle species. Freshwater turtles contribute to nutrient cycling (i.e. plant nutrient recycling and breakdown of carrion) and retention in aquatic ecosystem and are an important component of the biodiversity of the region.
2.4 Maintain feeding and opportunistic breeding conditions for a diversity of waterbirds	A high diversity of feeding and breeding waterbirds is present in the Gunbower Creek system (in particular within the lagoon system). Waterbirds assist with cycling of nutrients and dispersal of seeds and progapules throughout the landscape. Resources in the Gunbower Creek System also assist with supporting waterbirds utilising the floodplain.
2.5 Maintain feeding and breeding opportunities for frogs	Frogs are integral part of the food web supporting an array of predators from waterbirds, fish, turtles, mammals and insects. They also serve as an important bioindicator of ecosystem health and assist with cycling nutrients and supporting water quality. *Objective aligns with the MDBA EWMP target – by 2030, presence of one native frog species currently considered locally threatened or extinct (MDBA, 2012).*
3. Aspirational objectives	
3.1 Restore connectivity between the creek, lagoons and their associated riparian zones	Riparian zones support an array of flora and fauna and assist with trapping sediments, nutrients, maintaining bank stability and groundwater levels. They are also an important source of organic matter, assist with maintaining water quality and water temperature (through shading) and can reduce wind erosion and evaporation. Under current operations, overbank flooding of the creek to inundate the riparian zone is not feasible.

6.3. Flow Recommendations

Flow recommendations describe the water regimes required for achieving ecological objectives. All values identified have components of their life-cycle or process that are dependent on particular flow components for success e.g. native fish require certain timing, duration and frequency of flooding to successfully breed and maintain their population. For the Gunbower Creek System, flow recommendations were developed by Ecological Associates (2015) and refined through a targeted workshop with Clayton Sharpe (fish ecologist) and North Central CMA staff on 3 June 2015.

The Gunbower Creek System EWMP acknowledges that the system is a working river, and as such environmental water will be utilised to 'make up the difference' between irrigation flows and flows required to achieve the key ecological values. The highly regulated nature of the system prohibits the achievement of a number of flow components which are commonly considered minimal environmental flow requirements in both unregulated and regulated systems (i.e. summer base flows, which cannot be achieved due to high irrigation demand). For this reason, only feasible flow components are discussed below.

To meet the hydrological requirements of the Gunbower Creek System EWMP, flow recommendations have been set considering the following factors:

- the preferred timing of watering events
- the recommended duration for watering events
- the tolerable intervals between events (condition tolerances)
- The volume required to provide these events – per event / per season.

6.3.1. Description of Flow components

Flow components for the Gunbower Creek System are described according to four seasons being spring (September -November), summer (December - February), autumn (March - May) and winter (June - August). As described in Section 3.2, the irrigation season runs from the 15 August to 15 May.

Please note that flow components which extend across multiple seasons will be described using the season in which the majority of the flow component occurs. For example, the flow component described as a 'winter base flow' begins in late autumn (May) and concludes in late winter (August).

6.3.1.1. Winter base flow

Winter base flows are recommended each year for the entire Gunbower Creek System to maintain aquatic habitat during the irrigation shut-down period. The flow aims to maintain more than 1.5 metres of depth in deeper pools and connect these with shallow zones of more than 30 centimetres of depth. A description of the links between the winter base flow and target values is provided below:

- *Native fish*: The winter period is considered essential for supporting survival of young of year fish and adults who are rapidly converting their muscle and body fat stores to gonads in anticipation of the spring breeding season. A winter low flow will ensure localised movement and facilitate the continued accumulation of biofilms and macroinvertebrates on submerged IWH which provide a food source for fish and other biota. The winter low flow will promote improved water quality through freshening of pools, minimise the effects of cold water on growth and development and reduce direct predation on juveniles by larger fish and waterbirds.
- *Vegetation:* A winter low flow will maintain soil moisture in the channel, to sustain a mosaic of aquatic and emergent plants which provide foraging opportunities for fauna. The flow will also maintain open water in the thalweg and limit colonisation of terrestrial plants in the lower sections of the creek and its benches.
- *Other fauna:* A winter low flow will maintain feeding habitat for Platypus, turtles and frogs in the creek and reduce risk of predation due to exposure. This is particularly important for female Platypus who are developing fat reserves prior to the breeding season as well as the long distance

dispersal of male juvenile platypus who are leaving their mother's territory and colonising elsewhere in the Gunbower, Loddon or Murray River systems.

Depending on the magnitude of the winter low, opportunities to facilitate throughflow through lagoons in reaches 1, 2 and 3 may be possible. This is aimed at reducing the impacts of the rapid drawdown that occurs at the end of the irrigation season by targeting:

- *Native Fish:* Phyland, Turner, Upper Gunbower, Gum and Cockatoo lagoons support Freshwater Catfish and can be operated in isolation of the Gunbower Creek. Freshwater Catfish is vulnerable to increased predation and reduced food resources when levels drop below one metre.
- *Other fauna*: maintenance of more than one metre of depth through the winter period will increase feeding habitat for water dependent fauna and reduce the risk of predation. This is particularly important for the development of fat reserve in female Platypus prior to the breeding season as well as the dispersal of males (especially during the Aug-Oct breeding season). Winter water levels will also provide refuge conditions for waterbirds, which during years when Gunbower Forest is not in flood, are generally limited in the region around Gunbower Island.

In years when the lower landscape wetlands are inundated, there are also opportunities to provide bi-directional flow through the regulators at Yarran and Little Gunbower creeks as well as Black and Reedy lagoons. Although opportunistic the occurrence of these events are likely between May and February when flows, and hence water levels, in the creek allow bi-direction flow between the creek and forest wetlands.

- *Connectivity:* the flow will facilitate movement of biota between the forest, wetland and creek habitats whilst also promoting exchange of nutrient rich floodwater, progapules, fish and macroinvertebrates. The flow is opportunistic and will be adaptively managed from year to year.

6.3.1.2. Winter-spring high flows

Winter-spring high flows will result in a three-fold increase in flows in the Gunbower Creek compared to the winter low flow volume. A description of the links between the winter base flow and target values is provided below:

- *Native fish:* The winter-spring high flow will provide a trigger for movement of native fish both in and out of the system and with the Gunbower Forest should Hipwell Road be in operation. The flow will assist with redistribution of bench sediments and assist with promoting productivity through scouring biofilms from IWH and inundate littoral zones located high on the banks. In addition the flow will be sufficient to create fast flowing habitat at key locations in the upper reaches (i.e. the Narrows in Reach 2) which is important for Murray Cod.
- *Other fauna:* The flow will increase feeding habitat for Platypus and turtles reducing the risk of predation due to exposure. The flow may also promote long distance movement of turtle and Platypus enabling recolonisation elsewhere in the Gunbower, Loddon or Murray River systems (Serena, 2013).

6.3.1.3. Spring-autumn base flow

A minimal base flow has been set for the Gunbower Creek System to ensure that connectivity is maintained through the spring to autumn period. Similar to the winter base flow, the spring-autumn flow aims to achieve at least 1.5 metres of depth in deeper pools and at least 30 centimetres of depth in the shallower connecting zones in all years. Due to the regulated nature of the system it is expected that the minimal base flow will be exceed in most years (with irrigation flows estimated at 600-800 ML/day). The flow is set to target the following values:

- *Native Fish:* base flow will ensure connectivity between habitats remain throughout the year and enhance larval survival. The future installation of a fishway at Koondrook Weir will facilitate connection between the Murray River and Gunbower Creek providing recolonisation opportunities.

- *Vegetation:* maintain a minimal level for native vegetation during the spring growth and recruitment period.
- *Other fauna:* maintain feeding habitat for Platypus, turtles and frogs in the creek and reduce risk of predation (due to exposure).

The spring-autumn base flow will also be used, as required, to dilute flows returning to the Gunbower Creek downstream of Cohuna Weir from the Gunbower Forest. This will assist with maintain habitable dissolved oxygen concentrations in Reach 3b of the creek during watering events in the Gunbower Forest.

As per the winter base flow, opportunities to manage the lower landscape regulators for bi-directional flow should also be considered when the lower landscape wetlands are inundated. This will promote exchange of nutrient rich floodwater, progapules, fish and macroinvertebrates important for promoting and increasing the productivity of the Gunbower Creek System (see description in Section 6.3.1.1).

6.3.1.4. Spring-summer modified fresh

A spring-summer modified fresh is recommended to provide flows targeting recruitment of large-bodied fish such as Murray Cod. This flow is targeted at reaches 2 and 3b (priority habitats for Murray Cod) and is designed to target critical life stages for breeding as well as larval and juvenile survival. Three main components, which must be delivered concurrently, are associated with this event:

- *Spring ramp-up*: designed to provide a controlled pulse over approximately 10-15 days in late winter- early spring. The flow component aims to initiate movement of fish in search of a mate (sufficient duration critical in ensuring maximum opportunities), access spawning sites (i.e. bank depression, inundated benches or woody habitat) and spawn.
- *Spring-summer hold*: maintain a sustained peak flow for approximately 3.5 months in spring-summer, with no more than 50 centimetres per day fall in water level per 24 hour period. The flow aims to stabilise water levels for egg incubation and dispersal of larvae. As many larvae disperse via drift this is particularly important for ensuring adequate habitat and food resources are available.
- *Summer ramp-down*: gradual recession in water level over approximately two weeks in mid-summer, to return to irrigated or spring-autumn base flows aimed at exposing new benches and promoting an increase in food resources for larvae.

In addition to targeting native fish objectives, the flow will also promote the following:

- *Vegetation:* most aquatic plants have a peak growth season between September and October which coincides with the spring ramp-up. This will assist with littoral and aquatic species establishment, distribution of seeds and progapules and provide moisture for riparian vegetation. It will also redistribute leaf litter and organic matter and scour biofilms accumulated on woody habitat over winter. The gradual exposure of banks during the summer ramp-down will provide ideal conditions for plants to establish and set seeds as well as promoting the breakdown of organic matter to provide food to a range of fauna species.
- *Other fauna:* Provides a surge of food for water dependent fauna as noted above. This is particularly important for Platypus who requires high amounts of food during the lactation period (December to January). The maintenance of consistent spring-summer water levels will ensure that females are not forced to travel long distances in search of food.

6.3.1.5. Autumn ramp down

A controlled autumn drawdown is recommended each year for the entire Gunbower Creek System to mitigate the impacts of a sudden drop in water level that occurs at the end of the irrigation season. The flow aims to gradually reduce water levels by approximately 25-50 ML/day to meet the winter base flow targets. This rate is based on the maximum rate of fall required to limit bank slumping in

the Gunbower Creek. A description of the links between the autumn ramp down and target values is provided below:

- *Native fish*: A gradual drawdown will reduce the 'flight' response from native fish (i.e. Golden Perch and Murray Cod) which often triggers individuals to seek out permanent habitat during sharp water level drops. This can result in individuals becoming stranded in areas that will dry during winter.
- *Vegetation*: a slow recession enables vegetation to respond to changes in water height without significant impacts on structural integrity and or condition. In addition the flow will allow a greater diversity of aquatic and littoral plants to colonise a broader area of the creek and lagoon edges. This provides habitat for frogs, small-bodied fish, waterbirds and turtles. A slow recession will also minimise bank slumping reducing deposition and infilling of deep pools ensuring that critical refuge habitat is maintained for native fish species.

6.3.1.6. Opportunistic recolonisation flow

Opportunities to mimic a pulse flow event in the Murray River System should be adopted to provide a trigger for fish to recolonise the Gunbower Creek System. Recolonisation flows may occur anytime between October and April and are linked to the target values by:

- *Native fish: f*low volume sufficient to encourage movement of native fish (i.e. Silver and Golden Perch) to move up through Reach 3b to colonise upper reaches. Please note: the ability for native fish to colonise the Gunbower Creek System upstream of Koondrook Weir is dependent on the installation of a fishway at Koondrook and Cohuna weirs.

6.3.1.7. Opportunistic winter fresh

Opportunistic winter freshes are proposed for the entire Gunbower Creek during periods when unregulated flows/ high flows occur in the Murray River. The flow will be adaptively managed depending on the duration and magnitude of the event in the Murray River and will aim to:

- *Fish and other fauna:* mimic natural high flow event in Murray River by providing a pulse that supports movement (both in and out of system), inundates benches, flushes water, provides food sources (through inundation of benches) and allows nutrient and carbon rich waters within the Murray River (as a result of upstream flooding of Barmah Forest, Goulburn and Campaspe Rivers) to be brought into Gunbower Creek. Flows over >15,000 ML/day can be diverted to Gunbower Creek via Yarran Regulator (Yarran Creek) allowing an exchange of nutrient rich water from the Gunbower Forest.

Depending on the flow volume in the Murray River, lagoon regulators in Reaches 1, 2 and 3 can also be opened to facilitate throughflow and maintain water quality (as per description in Section 6.3.1.1). This is aimed at reducing the rapid drawdown that occurs at the end of the irrigation season and to maintain depth targeting:

- *Fish:* Phyland, Turner, Upper Gunbower, Gum and Cockatoo lagoons support Freshwater Catfish and can be operated in isolation of the Gunbower Creek. Freshwater Catfish is vulnerable to increased predation and reduced food resources when levels drop below 1 metre.
- *Other fauna*: maintenance of more than 1 metre of depth through the winter period will increase feeding habitat for water dependent fauna and reduce the risk of predation. This is particularly important for the development of fat reserve in female Platypus prior to the breeding season as well as the dispersal of males (especially during the Aug-Oct breeding season). Winter water levels will also provide refuge conditions for waterbirds, which during years when Gunbower Forest is not in flood, are generally limited in the region around Gunbower Island.

6.3.2. Integration with Gunbower Forest flow recommendations

The delivery of environmental water through reaches 1 and 2 to inundate Gunbower Forest via the Hipwell Road infrastructure is likely to occur two in every three years between June and November (note flow volumes and durations vary depending on target objectives in the forest i.e. floodplain

inundation or just top-up of wetlands) (North Central CMA, 2013e; MDBA, 2012). These events, although not directly targeting ecological objectives in the creek will provide the following benefits:

- *Fish:* facilitate movement of fish through the system including movement onto the highly productive floodplain which is important for feeding and spawning of some species. When forest flows cease and water on the floodplain begins to recede, a significant migration of small-bodied fish into the Gunbower Creek is also expected to occur. This provides a surge in food for waterbirds and large-bodied fish during times when they have high energy requirements for breeding (i.e. late spring to early summer).
- C*onnectivity*: Provide a connection between the Murray River, Gunbower Creek and Gunbower Forest which will facilitate cycling of nutrients, dispersal of flora and fauna and movement of progapules through system.
- *Habitat diversity:* high flows will increase the velocity and turbulence in sections of the creek creating fast flowing habitat which is particularly important for species such as Murray Cod.
- *Other fauna:* high flow events such as this will coincide with the peak breeding season (August to October) of species such as Platypus encouraging females to establish nests above the waterline. This is important for ensuring that consecutive high flows do not drown out young.

These events are likely to impact on the delivery of the spring-summer modified fresh aimed at cueing spawning conditions for large-bodied fish. For this reason fish spawning conditions will be targeted in alternative years to ensure sufficient channel capacity is available. This will prioritize maintenance of existing fish populations in the creek (i.e. provision of base flows) during years when the Gunbower Forest is being watered (see Section 6.4).

6.3.3. Environmental flow recommendations

Table 22 documents the flow recommendations applicable to the Gunbower Creek System on a reach by reach basis, as per the information presented in Sections 6.3.1 and 6.3.2.

Table 22. Flow recommendations for the Gunbower Creek System

Flow component	Flow magnitude[2] at target location				Duration	Timing	Frequency	Daily flow variability	Additional info including critical tolerances	Ecological objectives
	Reach 1 Headworks	Reach 2 Gunbower Weir	Reach 3a Cohuna Weir	Reach 3b Koondrook Weir[3]						
Winter base flow	No prescribed flow as targeting flows in lower reaches If flows are >300 ML/day open lagoon regulators to facilitate throughflow	>250-300 ML/day[4] If flows are >300 ML/day open lagoon regulators to facilitate throughflow	250-500 ML/day If forest inundated, open lower landscape regulators to facilitate bi-directional flow[5]	>150 ML/day	Approx. 3 months	Between 15 May to 15 Aug	1 event per year each year (opening of lower landscape regulators is opportunistic) Max. 2 in 3 years for opening lagoon regulators (to maintain aquatic community structure)	(+/-) 50-100 ML/day including ramp up at start of Aug to integrate with spring-autumn low flow/ irrigation demand 15 ML/day bi-directional flow per lower landscape regulator	Magnitude to vary depending on conditions (i.e. lower end of range if delivering to forest) however flows to occur in all years. Close lagoon regulators if levels in the creek begin to drop to maintain >1 metre depth in critical lagoons[6]	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.8
Winter-spring high flow	No prescribed flow as targeting flows in lower reaches	1,200 ML/day N.B. during forest water years majority of flow may be diverted @ Hipwell Road	Pass flow through reach to return to Murray River or if watering forest maintain winter base flow conditions D/S Hipwell Road (see *winter base flow* for Reach 3a and Reach 3b)		Up to 3 months	Between June and Nov	1 event per year every 2 in 3 years	(+/-) 50-100 ML/day Including ramp up and down to integrate with preceding and proceeding flows		1.1, 1.2, 1.5, 1.6
Spring-autumn base flow	No prescribed flow as targeting flows in lower reaches		>400 ML/day If forest inundated, open lower landscape regulators to facilitate bi-directional flow[4]	>150 ML/day	Up to 8 months	Between 15 Aug to 15 May	1 event per year each year Opportunistic opening of regulators depending on conditions	(+/-) 50-100 ML/day where possible ~15 ML/day bi-directional flow per regulator	Flow likely to be exceeded due to irrigation demand. Flow can be adjusted to dilute water entering creek from a forest watering event (i.e. to maintain habitable DO in creek D/S Cohuna Weir)	1.2, 1.4

[2] Variability in the magnitude of the flow within the prescribed range and time period to match natural conditions should be adopted (i.e. steady increase and decrease within the flow range throughout the period instead of a constant level with no variability).
[3] Assumes installation of a fishway that requires approx. 50 ML/day required to operate. To be refined during the concept design phase of the Koondrook Fishway Project.
[4] Volume is minimum passing flow required when delivering water to the forest via Hipwell Road. During non-forest watering years, the regulator at Hipwell should be opened with flows targeted at Reach 3a.
[5] Flow component is opportunistic and opportunities to undertake this action will depend on the head difference between the creek and lagoons (i.e. eequilibrium required between levels in creek and lower landscape wetlands for bi-directional flow)
[6] Critical Lagoons include Phyland, Turner, Upper Gunbower, Gum and Cockatoo Lagoons which support or have the potential to support Freshwater Catfish.

Flow component	Flow magnitude[2] at target location				Duration	Timing	Frequency	Daily flow variability	Additional info including critical tolerances	Ecological objectives
	Reach 1 Headworks	Reach 2 Gunbower Weir	Reach 3a Cohuna Weir	Reach 3b Koondrook Weir[3]						
Spring-summer modified fresh	No prescribed flow as targeting flows in lower reaches	400-700 ML/day	400-500 ML/day[7]	Pass entire flow through reach	10-15 days to ramp up --- 3.5 months hold phase --- <1 month to ramp down	Aug-Oct to ramp up --- Oct-Jan for hold phase --- Jan-Feb to ramp down	1 event per year every 2 in 3 years	<100 ML/day rate during ramp up and down to integrate with preceding and proceeding flows. Ramp up needs to provide a pulse larger than that of the preceding flow (i.e. if base flows is 250 ML/day pulse may be >450 ML/day) to trigger objective --- Hold to not exceed 50 cm/day fall D/S Cohuna Weir	Flow to occur in alternative watering years to forest due to flow volume required D/S of Hipwell Road.	1.1, 1.2, 1.3, 1.4, 1.5, 1.6, 1.7, 1.8
Autumn ramp down	Slow recession in flow rate to meet winter base flow targets (see *winter base flow*)				Approx. 2 week	Start early May	1 event per year each year	Recommended to not exceed 25-50 ML/day rate of fall	Integrate with winter low flow	1.1, 1.2, 1.3, 1.4
Opportunistic flow components[8]										
Recolonisation flow *Triggered by pulse @ Torrumbarry*	No prescribed flow as targeting flows in lower reaches		~600-800 ML/day	~600-800 ML/day	5-15 days	Between late October and April	Opportunistic events	100 ML/day rate during ramp up and down to integrate with preceding and proceeding flows	Flow in response to Murray River pulse (i.e. piggy back on rain rejection event)	1.1, 1.2, 1.3
Winter fresh *Triggered by <15,000 ML/day unregulated flow @ Torrumbarry*	No prescribed flow as targeting flows in lower reaches. However if flows are >300 ML/day open Gunbower Lagoon regulators to allow freshening flows and facilitate throughflow. Maintain at least 1 metre of depth at Phyland, Turner, Upper Gunbower, Gum and Cockatoo lagoons			50-750 ML/day	Estimated to be approx. 30 days	Between 15 May and 25 Aug	Opportunistic events. Max of 2 in 3 years for opening of lagoon regulators (to maintain aquatic community structure)	(+/-) 50-100 ML/day including ramp up and down to integrate with preceding and proceeding flows	Close regulators if levels in the creek begin to drop to maintain >1 metre depth in critical lagoons	1.1, 1.2, 1.3, 1.4, 1.5, 1.6

[7] Delivery of volume and maintenance of level may require use of the 6/1 Channel (total capacity of 150 ML/day)
[8] Parameters that may impact on the opportunity to deliver these flow components include GMW maintenance works, delivery forest, source water quality, environmental water allocations and unregulated flow conditions.

Flow component	Flow magnitude[2] at target location				Duration	Timing	Frequency	Daily flow variability	Additional info including critical tolerances	Ecological objectives
	Reach 1 Headworks	Reach 2 Gunbower Weir	Reach 3a Cohuna Weir	Reach 3b Koondrook Weir[3]						
Winter fresh *Triggered by >15,000 ML/day unregulated flows @ Torrumbarry*	~250 ML/day	No prescribed flow as targeting flows in lower reaches	Approximately 20-50 ML/ day release from forest through Yarran Regulator	Pass entire flow through reach	Estimated to be approx. 30 days	Between 15 May and 25 Aug	Opportunistic events	(+/-) 50-100 ML/day including ramp up and down to integrate with preceding and proceeding flows	Management under this scenario needs to take into consideration the watering regime of forest	1.1, 1.2, 1.3, 1.4, 1.5, 1.6

6.4. Ten year water regime and hydrological objectives

Historically river systems have been managed according to annual flow recommendations. However, to achieve long term objectives flow regimes need to be adaptable and variable from one year to the next. To meet the 'long-term' requirements of the Gunbower Creek System EWMP, a ten year flow regime has been established considering the following factors and is shown in Table 23:

- the recommended number of watering events over a ten year period
- the tolerable intervals between events (condition tolerances); and
- the use of Gunbower Creek as an environmental water delivery conduit for the Gunbower Forest (estimated to occur approximately two in every three years).

It should be noted that the ten year watering regime is assuming water availability and channel capacity and will need to be adaptively managed and be based on outcomes achieved in the previous year. Adaptive management principles should consider the condition tolerances shown in Table 22.

Table 23. Potential ten year water regime for the Gunbower Creek System (assuming water availability)

Environmental watering focus		Year									
		1	2	3	4	5	6	7	8	9	10
Gunbower Forest		Large scale forest watering	Moderate to small scale forest watering	Dry	Large scale forest watering	Moderate to small scale forest watering	Dry	Large scale forest watering	Moderate to small scale forest watering	Dry	Large scale forest watering
Gunbower Creek System		Maintain fish populations	Maintain fish populations	Promote fish populations	Maintain fish populations	Maintain fish populations	Promote fish populations	Maintain fish populations	Maintain fish populations	Promote fish populations	Maintain fish populations
Gunbower Creek System flow component	Winter base flow	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Winter-spring high flow	✓	✓		✓	✓		✓	✓		✓
	Spring-autumn base flow	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Spring-summer modified fresh		If feasible[9]	✓		If feasible[8]	✓		If feasible[8]	✓	
	Autumn ramp down	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Opportunistic recolonisation flow	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*
	Opportunistic winter fresh	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*	✓*

*Component is opportunistic and delivered when conditions permit (see Table 22)

[9] Feasibility of undertaking 'spring-summer modified fresh' is dependent on channel capacity which may be impacted by the duration and flow volume being delivered to the forest as part of the 'winter-spring high flow'.

7. Risk Assessment

A qualitative risk assessment has been undertaken for the Gunbower Creek System to assign the level of long-term risk associated with:

- achieving set ecological objectives (i.e. factors outside delivery of environmental water inhibiting ability to achieve objective); and
- delivery of environmental water.

As shown in Table 24 the relationship between likelihood (probability of occurrence) and the severity (severity of the impact) provide the basis for evaluating the level of risk.

Table 24. Risk Matrix

		Severity		
		Major	Moderate	Minor
Likelihood	Probable	High	High	Moderate
	Possible	High	Moderate	Low
	Improbable	Moderate	Low	Low

The results from the site risk assessment are presented in Table 25. Management measures relevant for the moderate to high level risks are recommended and the residual risk is then recalculated using the same risk matrix assuming all management measures are fully implemented. Please note that short-term operational risks will be assessed as part of the development of the Gunbower Forest and Gunbower Creek Seasonal Watering Proposal.

Table 25. Possible risks and mitigation measures associated with environmental water delivery

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
1	**Threats to ecological values**							
1.1	Artificial instream structures	Barriers to upstream, downstream and lateral movement between the reaches, lagoons and forest floodplain, can cause genetic and resource (i.e. food, shelter) isolation and restricted spawning opportunities for migratory fish species (i.e. Golden Perch and Silver Perch), turtles and Platypus. High mortality rate associated with individuals forced to travel overland (i.e. Platypus) and for fish who pass through regulating structures (i.e. those with undershot gates)	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4	Probable	Major	High	• Fish passage is required at the National Channel, Koondrook Spillway, Cohuna Weir and lagoon regulators and culverts to allow fish to move throughout the system (see Section 8). • Consider opening regulators during periods when the wetland, lagoon and creek head levels are similar. This will reduce velocities and allow bi-directional movement between habitat types • Residual risk based on full adoption of all management measures (adjusted score of L: possible/ S: moderate) N.B. Significant funding needs to be secured to achieve these management measures.	Low

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
1.2	Bank erosion	Irrigation delivery, stock access and riparian clearing has resulted in the degradation of the banks of the Gunbower Creek. In addition bank full deliveries in Reaches 1 and 2 will occur in most years under the prescribed watering regime (both targeting creek objectives and watering of the forest during normal irrigation operation). Consistently high levels may impact on the structural stability of the banks resulting in bank slumping during periods when the flow level is returned to normal operations. This has potential to reduce the capacity of the creek through input of IWH, bank structural changes and siltation (i.e. fills deep pools and meanders, inundate IWH, alter hydrodynamics and reduce the capacity of regulators).	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.5	Probable	Moderate to major	High	• Quantification of impact of high flow is yet to be undertaken. Therefore monitoring of bank structure and siltation rates through regular cross sectional profiles of the creek and lagoons. • Ensure gradual ramp up and down occur during watering events to reduce bank slumping associated with rapidly falling water levels • Undertake revegetation program to support integrity of banks during high flow events • Reinstate deep pools and riffles through excavation as per the *Gunbower and Lower Loddon Native Fish Recovery Plan* • Fencing of riparian areas to exclude livestock • Implement Native Fish Recovery Plan which includes working with GMW to reduce the rates of rise and fall in the system • Residual risk reduced to reflect full adoption of all management measures (L: possible/ S: Moderate). N.B. It should be noted that delivery to Gunbower Forest is considered the highest priority watering action in the larger system while the upper reaches (in particular Reach 1) are considered the lowest priority reach from an environmental perspective.	Moderate
1.3	Pumps	A high number of irrigation pumps are located on the Gunbower Creek System. In the system it is commonplace for pumps to be fitted with 'choppers' to assist with breaking down debris that can clog the pump. Many pumps are also fitted with a pump guard to prevent Platypus and turtles from being drawn into the blades. The accumulation of debris on the pump guards can reduce the pumping capacity dramatically, and as a result many irrigators are opting to remove the guard completely.	1.1, 2.2, 2.3	Possible	Moderate	Moderate	• Investigate design options to allow pump guards to effectively pass debris without becoming clog (i.e. further out in water column, larger cage area, larger mesh size, design to reduce accumulation etc.). There is risk inadequate landholder uptake will occur, particularly if a significant personal cost associated with implementation. Investigate potential for an incentive program to assist with out of pocket costs associated with implementation. • Education program to promote importance of pump guards • Residual risk reduced to reflect likelihood of an effective method being developed and uptake by landholders (L: possible /S: minor)	Low

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
1.4	Irrigation delivery management on water levels	*Large fluctuations in water level driven by irrigation demand*- irrigation operations see the water level in Gunbower Creek fluctuate widely through the irrigation season, in response to demand along its length. Large fluctuations can drown/ expose nests (fish and platypus), isolate and strand fish and impact on the growth of aquatic plants. This can also reduce hydrodynamic diversity (associated with natural fluctuations). *Scheduled maintenance work to Infrastructure during off-irrigation period* - The flow recommendations documented in this EWMP include a winter base flow. This will require use of infrastructure outside the irrigation season, which is also when maintenance works are scheduled. Management of water levels during this period is particularly important to support native fish recruited in the previous spring/summer period. *Seasonal inversion of watering regime*- The Gunbower Creek system is seasonally inversed due to irrigation demand. The flow regime is characteristic of extended high levels thorough spring and summer which can reduce aquatic and riparian growth (to a narrow band), reduce triggers for fish movement and migration and food.	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.5	Probable	Moderate	High	Work with GMW to: • Implement a smooth hydrograph (i.e. filling in gaps formed during the anticipated peaks and troughs to ensure levels remain relatively stable during critical times of the year). It should be noted that although this has been effective in the past, the process requires significant resource investment (both from GMW and North Central CMA staff). Secure funding for additional resources (both GMW and North Central CMA) to implement smooth hydrograph. • Determine scheduled maintenance works early in season. Where possible negotiate time to coincide with environmental watering objectives. Adaptively manage delivery to provide the highest benefit whilst maintenance works progress • Residual risk reduced to reflect potential for effective management although its feasibility is dependent on resourcing (adjusted score of L: possible/ S: moderate)	Moderate
1.5	Recreational fishing	Recreational fishing can reduce numbers of target species, such as Murray Cod and Trout Cod. Severity of the threat to native fish	1.1, 1.3	Probable	Moderate	High	• Implement a catch and release education program for native fish, while promoting catch and keep for introduced species such as European Carp • Develop a fish app aimed at highlight the importance of	Moderate

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
		communities is uncertain.					native fish conservation in the system • Residual risk is calculated based on assumed likelihood that local angler groups would partake in a fish monitoring program (adjusted score of L: possible/ S: moderate).	
1.6	Removal of IWH	IWH within the Gunbower Creek system provide important habitat for fish and platypus, however they can impede navigation of waterways (i.e. large IWH traversing length of creek) and as such de-snagging activities have been proposed.	1.1, 1.3, 2.2, 2.3	Possible	Moderate	Moderate	• Educate community on importance of snags in the Gunbower Creek System • If snags are to be removed, undertake a selective program that prioritise snag based on habitat values. If possible cut snags to maintain bulk of IWH within the channel • Residual risk reduced to reflect full adoption of mitigation actions and likelihood of action being undertaken (L: improbable-possible/ S: moderate)	Moderate to low
1.7	Introduced species - Fish	High abundance of exotic fish species such as Common Carp, Oriental Weather loach and Eastern Gambusia limits the establishment and subsequent maintenance of in-stream (submerged) vegetation and contributes to the decline in distribution and/or abundance of native fish with similar resource requirements.	1.1, 1.3, 2.1	Probable	Moderate	High	• There is yet to be a broad scale successful method for controlling Common Carp biomass. This is a knowledge gap across the Murray-Darling Basin. The following mitigation actions are currently adopted in the state: - Fit carp traps/ screens on regulating structures to prevent carp access - Implement a catch and release education program for native fish, while promoting catch and keep for introduced species such as European Carp • Develop a Common Carp management strategy for the Gunbower Island system that is integrated with environmental flow management • Residual risk reduced to reflect full adoption of mitigation actions (L: possible/ S: moderate) N.B. It should be noted that the proposed flow regime may continue to provide favourable conditions for Common Carp as the species is successful under a number of niches. The CSIRO are currently investigation a carp virus to assist with large-scale management of the species.	Moderate
1.8	Introduced species - Foxes	Predation on Platypus and other aquatic fauna such as freshwater turtles is a major issue in the Gunbower Island area.	2.2, 2.3, 2.4	Probable	Moderate	High	• Managing this risk relates to improving riparian cover and longitudinal aquatic connectivity as well as fox control programs. • Residual risk is assessed assuming full implementation of above management actions (adjusted score of L: possible/ S: moderate)	Moderate

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
1.9	Stocking of Murray Cod	Murray Cod is currently stocked in Reach 2 of the Gunbower Creek. Hatchery stocking can mask broader problems with fish abundance and richness. The actual severity of the threat to native fish communities is uncertain (therefore moderate was selected).	1.1,1.3	Possible	Moderate	Moderate	• Investigate contribution of stock fish to overall abundance • Consider removing stocking program. • Residual risk remains the same as further investigation required.	Moderate
1.10	Stock access	Sections of Gunbower Creek and the lagoons are not fenced, allowing direct access to riparian land. This can result in soil erosion and reduction in vegetation coverage causing issues with water quality, in particular turbidity and nutrient enrichment (i.e. algae blooms).	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.5	Probable	Moderate	High	• Implement program to fence entire length of Gunbower Creek and provide off-stream watering points. This would require an educational program to promote need for maintained stock exclusion. In addition better enforcement of riparian stock access is required from land managers. • Residual risk based on full adoption of above actions (adjusted score of L: possible/ S: moderate to minor)	Low to moderate
1.11	Water quality	Water quality in the Gunbower Creek System is impacted by stock access and nutrient inputs (i.e. from surrounding piggeries, dairies etc.). This can result in reduced DO levels in the system, proliferation of weed species (i.e. Pale Yellow Water Lily), increased turbidity as well as siltation.	1.1, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5	Probable	Major	High	• Implement fencing program to protect riparian zone from stock access • Work with GMW to implement periodic flushing of lagoons to enhance water quality • Revegetation of riparian zone to improve buffer width • Undertake an education and incentive program to increase the uptake of activities aimed at reducing nutrient loads (i.e. installation of re-use systems etc.). • Residual risk based on full adoption of above actions (adjusted score of a L: possible/ S: moderate)	Moderate
1.12	Chytrid-iomycosis (amphibian chytrid fungus disease)	Chytridiomycosis is an infectious disease of amphibians, caused by the chytrid fungus (*Batrachochytrium dendrobatidis*) that impairs osmoregulation. Although there has been no long term monitoring of the disease within the Gunbower Creek System, it is considered widespread in Victoria. Mortality rates of up to 100% are common, with adults more vulnerable than tadpoles.	2.6	Possible	Moderate	Moderate	• undertake zoospore counts to identify presence of disease- N.B. the disease is not as prevalent in semi-arid regions (vivacity linked to wet and cold conditions) • There has been some success with early stage of the infection, with sodium chloride and thermal manipulation found to reduce growth. However no current treatment available to wild population • No change to residual risk due to limited control measures available.	Moderate

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
1.13	Loss of native fish to irrigation system	*Gunbower and Lower Loddon Native Fish Recovery Plan* notes the loss of native fish (all life history phases) to irrigation channels as a significant risk to native fish populations.	1.1, 1.2, 1.3	Probable	Moderate	Moderate	• Screening of irrigation offtakes is required to prevent downstream fish passage into irrigation channels • Residual risk based on full adoption of irrigation offtake screening • full adoption of above actions (adjusted score of L: possible/ S: minor)	Low
2	**Threats from environmental water**							
2.1	Winter base flow	Exotic species such as Willow, Parrot's Feather and Pale Yellow Water Lily can reduce the abundance and diversity of native vegetation, limit habitat availability for native fauna, reduce channel capacity and clog pumps. Although no long term data is available, frosting through reducing water levels in winter, is perceived by the community to assist with control of aquatic species such as Pale Yellow Water Lily. However preliminary observations during the 2014-15 winter base flow delivery showed that large areas of Pale Yellow Water Lily was still stranded under winter base flow levels.	1.1, 1.2, 1.3, 2.1, 2.2, 2.3, 2.4, 2.5	Possible	Moderate to major	Moderate to high	• Operate at the lower end of the winter base flow threshold to strand large areas of Pale Yellow Water Lily on the benches during winter • Continue to undertake targeted weed control program in partnership with GMW • Undertake trials and research best practice/ most cost effective way to manage the species into the future • Undertake educational program to educate landholders on their role in future management • Reduce nutrient inputs into the system through enforcement and improved on farm waste systems and riparian revegetation works • Implement appropriate buffer zone or remove high intensity agriculture (i.e. piggeries) from vicinity of Gunbower Creek and lagoons • Residual risk reduced to reflect effectiveness of recent control treatment. In addition the benefit of undertaking a winter low flow (i.e. to support fish) outweighs the risk of potential future spread (adjusted score of L: possible/ S: moderate) N.B. Ability to manage the species relies on significant long term funding. This has not yet been secured.	Moderate

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
2.2	Maintenance of winter water levels in lagoons	Under current operations, the lagoon regulators are opened at the end of the irrigation season to facilitate rapid drawdown. This releases suspended matter and nutrients from the system to be discharged back into the creek. Closing of lagoon regulator to allow natural drawdown as proposed in this EWMP could result in deterioration of water quality (i.e. low dissolved oxygen and concentration of nutrients).	1.1, 1.3, 2.1, 2.3, 2.4	Possible	Moderate	Moderate	• Maintenance of lagoon water levels is proposed to occur during the winter period where DO, evaporation and seepage is low. Water quality will however be monitored throughout the event to inform the need to open regulators and flush suspended matter from the system. • Residual risk reduced to reflect mitigation actions and ability to respond to water quality issues (adjusted score of L: improbable/ S: moderate)	Low
2.3	Discharge of water from the forest into the creek	During managed watering events within the forest, organic carbon and nutrients are immobilised and broken down by invertebrates and microbes. This can reduce the dissolved oxygen concentrations in the water which is discharged out of the system through the lower landscape regulators (when operated).	1.1, 1.3, 2.1, 2.3, 2.4	Possible	Moderate	Moderate	• During managed forest watering events dilution/ freshening flows can be released over Cohuna and Koondrook Weir to reduce potential water quality issues associated with forest water entering the creek • Residual risk reduced to reflect mitigation actions and ability to respond to water quality issues (adjusted score of L: possible/ S: minor)	Low
2.4	Stable high winter/ spring flows	Inundation of the forest via Hipwell Road infrastructure will create stable high winter/spring water levels of the creek and lagoons above Hipwell Road. This may restrict the expansion of the littoral zone.	2.1	Possible	Minor to moderate	Moderate to low	• Continue to monitor vegetation response in lagoons to determine impacts of consistently high, stable water levels. • If required close regulators on regulated lagoons during periods when winter/spring high flow conditions will be delivered • Residual risk reduced to reflect full adoption of mitigation actions (L: Possible/S: minor)	low

Risk No.	Threat	Outcome	Relevant objectives	Likelihood (L)	Severity (S)	Risk rating	Management Measure	Residual risk rating
2.5	Forest watering events	Common Carp is considered a major threat to the abundance, health and diversity of native instream vegetation, to water quality and to the availability of resources utilised by native fish species. Flow components targeting native fish may provide conditions conducive to breeding of introduced species such as Common Carp, Redfin and Weatherloach.	1.1, 1.3, 2.1	Possible	Moderate	Moderate	• Mitigation for management of carp is limited • Flow components involve in channel rises which do not dramatically increase spawning habitat for Common Carp • Residual risk remains the same.	Moderate

8. Environmental Water Delivery Infrastructure

8.1. Constraints

The following section outlines the constraints to delivering environmental water in the Gunbower Creek System.

8.1.1. Infrastructure constraints

As noted throughout this EWMP, there are a number of significant barriers to fish passage in the Gunbower Creek System. Improving fish passage along the creek and into the lagoons as well as reinstating connectivity between the Gunbower Creek and Murray River will improve breeding opportunities for native fish species and increase connectivity and access to resources. The major barriers to fish passage are summarised in Table 26.

Table 26. Barriers to fish passage in the Gunbower Creek System

Site	Fishway	Fish passage limitations
National Channel Offtake	None	- Downstream fish passage is possible through the existing undershot gates when the gates are fully open. If the gates are only partly open, the high velocities under the gate result in a high mortality rate for fish passing through the structure. - Upstream fish passage through the gates is minimal due to the high velocities and turbulence.
Gunbower Weir	Vertical-slot fish (built 2009)	- Present hydraulic specifications of the vertical-slot fishway is effective for medium and large-bodied fish (>120 mm length) but not for smaller fish. - Latest research suggests that minor modifications to the baffles can reduce turbulence and enable passage of smaller fish.
Thompsons Weir	Rock-ramp (built 2010)	- Rock-ramp fishway was modified by GMW as original design resulted in raised upstream water levels. The current modified design is considered to be of poor design and has significantly reduced capabilities to pass fish.
Cohuna Weir	None	- A concept design for Cohuna Weir fishway is in development by GMW. - The current undershot gate configuration does not facilitate downstream passage. Gates can however be operated as overshot through agreement with GMW.
Koondrook Weir	None	- A concept design for Koondrook fishway is in development by North Central CMA - The provision of fish passage at this site is considered the highest priority in the Gunbower Creek system to facilitate connectivity with the Murray River.
Splatts Lagoon	None	- The road culverts and existing regulators are considered unsuitable for fish passage except when in the fully opened position.
Turner and Phyland Lagoons	None	- The existing pipe structure under the road provides limits access for fish and other aquatic biota. - Through flows at the upstream end of Turner Lagoons is limited due to access/operational constraints associated with the regulating structure.
Longmore Lagoon	None	- The road culverts and existing regulators are considered unsuitable for fish passage except when in the fully opened position.
Upper Gunbower Lagoon	None	- The road culverts and existing regulators are considered unsuitable for fish passage except when in the fully opened position.
Gum Lagoon	None	- The undershot gates at the inlet limit the movement of aquatic species into the lagoon. - Current operation of the outfall regulator limits through flow potential.
Cockatoo Lagoon	None	- The existing structures restrict throughflow of water through the system
Taylor's Creek Weir	None	- The lack of fish passage limits recolonisation opportunities between the Gunbower Creek and Lower Loddon River systems.
Source: North Central CMA (2014a; 2014b; 2014c; 2014e; 2014f; 2014g; 2013a; 2013b; 2013c; 2013d), Stuart & Sharpe (2012) cited in Mallen-Cooper et al., (2014).		

8.1.2. Operational constraints

Stabilising flow variability

During the spring 2013 delivery of environmental water to Reach 3a, GMW noted the difficulties associated with creating stable flows below Cohuna Weir. This was associated with short order and extract times for irrigation customers (i.e. 24 hours period) versus the travel time for water in the system i.e. 3 days are required for water to travel from Gunbower Weir to Cohuna Weir. There is potential to mitigate this by utilising the 6/1 Channel (150 ML/day capacity) which reduces travel time to 12 hours from Taylor's Creek (Sharpe & Stuart, 2015). GMW and North Central CMA staff resources required to manage and implement stable flows is considered significant.

Access to Gunbower Creek capacity

To deliver environmental water to Gunbower Forest, capacity in reaches 1 and 2 is required. Outside the irrigation season, access to the entire capacity of Gunbower Creek is available for environmental water deliveries. This is however subject to any maintenance works scheduled by GMW during this period, which are likely to occur in most years.

Under most circumstances within the irrigation season, it is predicted that there will be sufficient capacity to deliver the required environmental volumes. However at times there is the risk that flow recommendations may not be met, in particular during shortfalls in capacity that may occur in the summer months during peak irrigation demand. When orders for water exceed the capacity of Gunbower Creek or the National Channel, delivery is proportioned to customers that hold a delivery share or delivery entitlement. There is however ecological risks associated with prolonged elevated water levels (as discussed in Section 7) particularly in reaches 1 and 2, the result of dual delivery of irrigation and environmental water in the system.

Ability to achieve low flows during the irrigation season

Irrigation delivery maintains water levels in the Gunbower Creek and lagoons above the natural spring and summer levels expected. However due to the creek acting as one of the major delivery conduits in the Torrumbarry Irrigation Area, there is no capacity to operate the creek outside these conditions.

Flooding of private and public land

The delivery of high flow events in the Gunbower Creek is constrained by locations such as the 'Narrows', the Cohuna swimming pool and Cohuna Golf Course. During the spring 2013 delivery of environmental water targeting Murray Cod, risk of flooding private land reduced the peak volume from 800 ML/day (bankfull) to 600 ML/day. There is currently no agreement for inundation of private and/or public land to achieve environmental objectives in the system.

Bulk entitlement accounting

For GMW bulk accounting purpose, gauging of returned flows to the Murray River is undertaken at the "knife edge' which is a fixed crest weir located 50 meters downstream of the Koondrook Weir (see Table 7). Due to the complexity and multiple uses of the system calculation of loses in the creek and determination of water volumes used is problematic. A defined process to account for the bi-directional exchange of water between the lower landscape wetlands (when inundated) and the creek (during periods when levels permit) is yet to be undertaken. A nominal volume of 1.5 ML was agreed to between the North Central CMA and GMW to undertake this flow component in the 2015-16 watering season. In addition, the volume expected to be maintained within the system through the closure of lagoon regulators during the winter period, is also required.

8.2. Infrastructure recommendations

A key objective for the delivery of environmental water in the Gunbower Creek System is based on promoting native fish populations through improved connectivity. Table 27 summarises the infrastructure recommendations aimed at improving the delivery of environmental water or enhancing the benefit to target ecological values. Further information on the recommendations for the infrastructure in the wider Gunbower and Lower Loddon system can be sourced from Mallen-Cooper et al., (2014).

Table 27. Infastructure requirements for the Gunbower Creek System

Site	Description	Requirements
National Channel Offtake	Fish passage	- Design and construct fishway (including provision of downstream passage)
Gunbower Weir	Fish passage	- Minor rectification to existing fishway
Thompsons Weir	Fish passage	- Significant rectification/ redesign to existing fishway
Cohuna Weir	Fish passage	- Design and construct fishway (currently in design phase) - Repositioning of gates to overshot arrangement (to facilitate downstream passage
Koondrook Weir	Fish passage	- Design and construct fishway (Currently in design phase)
Splatts Lagoon	Fish passage	- Modifications to road culverts and existing regulators
Turner Lagoon	Fish passage and throughflow	- Modifications to road culverts, pipe structures and regulators - Work to mediate access/ operational constraints associated with operation of upstream regulating structure
Phyland Lagoons	Fish passage	- Modifications to road culverts, pipe structures and regulators
Longmore Lagoon	Fish passage	- Modifications to road culverts and regulators
Upper Gunbower Lagoon	Fish passage	- Modifications to road culverts and regulators
Gum Lagoon	Fish passage and throughflow	- Modifications to road culverts and regulators - Work to mediate operational constraints associated with operation of the outfall regulator
Cockatoo Lagoon	Fish passage and throughflow	- Modifications to existing structures to
Taylor's Creek Weir	Fish passage	- Modifications to existing structures
All irrigation channels connected to the system	Irrigation channel screens	- Fit irrigation screens on all channels to prevent loss of native fish species from the system
Source: North Central CMA (2014a; 2014b; 2014c; 2014e; 2014f; 2014g; 2013a; 2013b; 2013c; 2013d), Stuart & Sharpe (2012) cited in Mallen-Cooper et al., (2014).		

8.3. Complementary actions

Implementation of the watering regime detailed in this EWMP will generate a range of environmental benefits in the Gunbower Creek System. However a number of these objectives, some of which are directly related to the risk section of this EWMP (i.e. risk of not achieving objectives- see Section 7), require complementary actions to be fully realised. Table 28 documents the key complementary actions required in the system.

Table 28. Complementary actions to enchance the outcomes of environmental water

Activity	Rationale	Recommendation	Priority
Fish passage	Removing instream barriers would facilitate fish passage throughout system (including Murray River), enhancing native fish genetic interaction and facilitate recolonisation.	Secure funding to address instream barriers (as per Section 8.1.1).	High
Reduce nutrient inputs	Limit input of high-nutrient discharge into the creek and lagoons to reduce the risk of eutrophication, nuisance algal growth (i.e. Blue-green algae) or weed infestations (i.e. Pale Yellow Water Lily).	Riparian vegetation buffers to assist with reducing nutrient concentrations and turbidity. Also implement an education programs and/or consult with adjacent landholders to assist with identifying ways to reduce nutrient concentration in runoff (i.e. modified fertiliser practices or modified stock management). Implement whole farm plans to include improved farm drainage. Work with land managers and EPA to educate and where required enforce compliance.	Moderate to high
Fencing	Exclusion of stock to reduce trampling and increase recruitment of native vegetation. This would also reduce the direct input of nutrients into the water.	Provide additional fencing to ensure riparian zones are protected. Work with land managers to educate and where required enforce compliance.	High
Carp control	Common carp out compete native species, limit the establishment and maintenance of in-stream vegetation and increase water turbidity. They also tie up nutrients that would otherwise be available to native species, through their long life span and tendency to feed at low trophic levels.	Develop carp management strategy for Gunbower Island system. Fit carp screens and/or cages on fishways and undertake education activities such as “catch a carp” day. In addition manipulation of return flows from the Gunbower Forest into the Gunbower Creek is a key strategy for future management. Additional work required to identified process (see Section 11)	High
Fox control	Reduce predation on juvenile waterbirds, turtles, mammals and terrestrial birds (particularly important during periods when waterbirds and turtles are breeding/ nesting).	Undertake fox control measures such as baiting, fox drives and education activities to encourage compliance by surrounding landholders.	High
Weed management	Reduction of aquatic and riparian weeds (i.e. Pale Yellow Water Lily, Willow etc.) will assist growth of native vegetation.	Large scale weed control program required for targeted high threat species (continuation of currently funded programs). Follow up management required to ensure species remain under control. Consider undertaking trials and research best practice for future management. Program to be operated in collaboration with farm drainage improvement.	High
Riparian revegetation	Reduces bank erosion, downstream sedimentation, provides native fauna habitat, habitat connectivity and an input of IWH into the system.	Revegetation of at-risk sections of riparian zone with native flora species to a composition and placement that is appropriate for the host EVC.	Moderate
Lagoon operating plan	There are opportunities to better manage irrigation storages to provide a secondary benefit to the environment. This includes working to provide throughflow as well as improving seasonality in water levels.	Work with GMW to develop an operation plan for irrigation water management in the lagoons to improve water quality and improve seasonality of water level (as appropriate to still maintain supply to customers).	Moderate
Turtle nest protection	Protection of nests will help to reduce predation by foxes and improve survival rate of juvenile turtles. Also scope to improve road signage around areas where turtles are known to	Actively survey for turtle nests during nesting season to identify nest locations before predation. Cover with netting or other protective screens. Install road signs and undertake education program to inform motorists of turtles moving in	Moderate to high

Activity	Rationale	Recommendation	Priority
	move.	landscape.	
Re-snagging	Improve habitat quality for native fish by returning IWH to system.	Introduce complex IWH such as large branches and logs to key areas.	Moderate
Pump guards	Prevent mortality of native aquatic fauna (i.e. fish, platypus and turtle).	Investigate design options to improve effectiveness of pump guards and undertake educational program to promote use.	Moderate
Community education	Educate community members to promote environmental watering, outline key threats and values and encourage stewardship and trust in the North Central CMA projects.	Undertaken community education program through rotary clubs, schools and other interest groups. Additional tasks aimed at community education include the development of a Fish app aimed at highlighting the importance of native fish conservation.	Moderate

9. Demonstrating Outcomes

Monitoring is required to enable the North Central CMA and VEWH to justify the application of environmental water by demonstrating that watering is achieving environmental outcomes. Monitoring is undertaken to assist with determining the success of the hydrological outcome, in consideration of other limiting factors that may inhibit full realisation.

Two types of monitoring are recommended to assess the effectiveness of the proposed water regime on objectives and to facilitate adaptive management:

- Long-term condition monitoring
- Intervention monitoring

Currently the principle monitoring program for the release of environmental water to Victorian rivers is the Victorian Environmental Flow Monitoring Assessment Program (VEFMAP). This program does not however include the Gunbower Creek system, and as such the majority of monitoring undertaken to date has been commissioned through the TLM Project.

For wetland systems, DELWP is currently developing WetMAP (Wetlands Monitoring and Assessment Program), which will be a long-term monitoring program aimed at assessing the effect of environmental water on Victorian wetlands. However as the program is in its early stages of development and the lagoon system has not been previously managed for environmental outcomes, there is no long-term monitoring records.

A monitoring program has therefore been developed specifically for the Gunbower Creek System to demonstrate the achievement of the short and long-term objectives documented in this EWMP.

9.1. Long term condition monitoring

Long-term condition monitoring will provide information on whether the flow regime (and other factors) is causing a change in, or maintaining, the overall condition of the wetland (trend over time). Requirements in the Gunbower Creek System to demonstrate long-term outcomes of environmental water management are shown in Table 29.

Table 29. Required long-term condition monitoring for the Gunbower Creek System

Ecological Objective	Method	When
Specifically relating to ecological objectives		
Increase the abundance and improve age class distribution of small and large-bodied native fish species	Comprehensive fish surveys (including distribution, abundance, age classes etc.) using targeted electrofishing (large-bodied) and small mesh gauge fyke nets (small-bodied)	Ideally annually with no more than two years between surveys
Restore/ rehabilitate populations of native fish species that are poorly represented or absent in the system	Intensive fish surveys using above methods	Ideally annually with no more than two years between surveys
Increase littoral and aquatic vegetation extent, diversity and productivity	Comprehensive vegetation condition surveys, including tree health, EVC condition, species presence, weediness and evidence of recruitment	Ideally annually with no more than two years between surveys
Maintain/ increase resident breeding population of Platypus	Qualitative surveys including community based surveys	Every two to three years

9.2. Intervention monitoring

Intervention monitoring will assess the responses of key environmental values to the changes in the water regime (intervention) and the achievement of ecological objectives e.g. recruitment of Murray Cod. Intervention monitoring may include monitoring of water quality, vegetation and biota (i.e. native fish).

Monitoring the response to a watering event will be important to provide feedback on how the system is responding and whether any amendments need to be made to the operational management or determine if any risk management actions need to be enacted.

Current intervention monitoring

The North Central CMA conducts an ongoing environmental water resource planning program for the Gunbower Creek System, and Gunbower Forest, which is undertaken as part of the implementation of the SWP. Each year environmental flows are released based on an assessment of the monitoring data as well as the water availability and requirements of the forest.

As part of TLM program, annual condition monitoring is undertaken within the Gunbower System. The majority of monitoring has however focused on the forest, with only annual fish surveys undertaken in the creek and lagoons. These surveys were undertaken annually between 2007 and 2013, although no surveys were undertaken in 2014 due to limited funding. The future of the program is therefore subject to funding. Monitoring of other ecological values is limited to once off project based surveys (i.e. baseline surveys) or event based monitoring (i.e. during large scale events).

Required intervention monitoring

Further intervention monitoring is required so that the CMA is able to adaptively manage the Gunbower Creek System over the next ten years to ensure that the delivery of environmental water is achieving objectives. The proposed intervention monitoring program and the objective that is being monitored is shown in Table 30.

Table 30. Required intervention monitoring for the implementation of the Gunbower Creek System EWMP

Ecological objective	Monitoring question	When	Method
Increase the abundance and improve age class distribution of native fish species	Is poor spawning and or recruitment the limiting factor in increasing the abundance of native fish species?	Annually to biannually (short term to identify condition)	Targeted fish surveys with electrofishing and fyke nets Pit-tag readers for fish movement at fishways
Increase movement/ migration of native fish species	Are native fish moving in response to environmental flows?		
Increase connectivity with the lagoons, Gunbower Forest (including wetlands) and Murray River	Are key species (i.e. fish) moving through the system? Are floodplain nutrients entering the system and how is this contributing to organic carbon levels in the creek?	As per fish monitoring (see above) as well as throughout watering events	Targeted fish surveys as well as measurement of nutrient inputs and changes in dissolved organic carbon levels in the creek system
Increase littoral and aquatic vegetation extent, diversity and productivity	Is the extent, diversity and productivity of native vegetation responding to environmental flows?	Annually	Spring vegetation surveys
Increase hydrodynamic variability	Is there a diversity of hydrodynamic conditions within the system? How does hydrodynamic diversity relate to flow (i.e. how to create specific hydrodynamic conditions and where)?	Annually under a range of flows	Cross section assessments and installation of continuous probes to undertake Velocity profile mapping (hydrodynamic diversity)
Maintain/ increase resident breeding population of Platypus	Are juveniles joining the resident Platypus population? Are platypus colonising new habitats?	Annually (during breeding season)	Platypus tracking
Maintain feeding and breeding opportunities for turtles	Are turtles able to feed during the winter drawdown period and is nesting occurring?	Annually (during breeding season)	Turtle tracking

Ecological objective	Monitoring question	When	Method
Maintain feeding and opportunistic breeding conditions for a diversity of waterbirds	Is waterbird abundance and species composition changing in the system? For what purpose are waterbirds utilising particular habitats in the system?	Periodically through year	Waterbird surveys
Maintain feeding and breeding opportunities for frogs	Is frog breeding triggered by the delivery of environmental flow components?	Annually	Frog surveys (Wildlife Acoustic Song Metre)
Risks	**Monitoring question**	**When**	**Method**
Increased aquatic plant growth	What is the response of Pale Yellow Water Lily and Hornwort to flow? Is density and extent (i.e. new populations) changing?	Annually	Density mapping
Poor water quality, bank erosion and siltation	What are the major water quality issues and for what reason are they occurring? How does water quality change in response to the flow regime and are they acceptable?	Throughout year (particularly during watering events where the forest is discharging water into the creek)	Continous probe (to directly inform adaptive management)
Introduced species- Fish	Are specific flow components contributing to the dominance and movement of exotic fish species?	Annually	Targeted fish surveys with electrofishing and fyke nets
Irrigation management on water levels	How do water levels respond to changes in flow? What volume of environmental water is required to mitigate these effects?	Throughout year	Continous probe

10. Consultation

Table 31 summarises the consultation that has been undertaken as part of the Gunbower Creek System EWMP development.

Table 31. Consultation for development of Gunbower Creek System EWMP

Date	Description	Purpose	Who
13 January 2015	Project Working Group (PWG) workshop No. 1	Inception meeting to explain project scope and requirements from PWG members.	PWG members (DELWP, Parks Victoria, VEWH, GMW, North Central CMA, Ecological Associates, Shire of Campaspe, Gannawarra Shire)
21 January 2015	PWG workshop No. 2	A workshop was run by Ecological Associates to assist with understanding the current system operations and constraints.	
22 January 2015	Community Advisory Group (CAG) workshop No. 1	Workshop aimed at developing an understanding of the history, environmental, social, cultural and economic values, threats, risks and management objectives for the Gunbower Creek system from a community perspective.	Community and interest groups- see Appendix 1
22-23 January 2015	Site visits	Site visits to assist SRP with refining ecological objectives and flow requirements	PWG members, CAG, North Central CMA and SRP
11 February 2015	Technical ecological objectives and flow requirements workshop	Workshop run by Ecological Associates with SRP to refine the ecological objectives and flows requirements based on previous work, site visits and community meeting.	PWG members, North Central CMA and SRP
27 February 2015	CAG workshop No. 2	Briefing on the work undertaken by Ecological Associates including workshop on the broad ecological and hydrological requirements of the system.	Community and interest groups- see Appendix 1
28 May 2015	CAG workshop No. 3	Review final management goals and ecological objectives from the draft EWMP. Participants were supplied with a copy of the draft EWMP one week prior to the meeting. Final comments and recommendations from the workshop were incorporated into the final EWMP.	Community and interest groups- see Appendix 1

11. Knowledge Gaps and Recommendations

The Gunbower Creek System EWMP has been developed using the best available information. However, a number of information and knowledge gaps exist which may impact on recommendations and/or information presented in the EWMP. The priority status of these are summarised in Table 32.

Table 32. Knowledge gaps and recommendations for Gunbower Creek and Lagoons

Knowledge Gap	Objective	Risk	Recommendation	Who	Priority
Understand impact of Pale Yellow Water Lily on water quality, habitat quality, as well as the time lag required to establish new populations and effective control methods. Also investigate impacts of winter base flow on growth of the species.	All	1.11, 2.1, 2.2,	Conduct investigation into biology and control of Pale Yellow Water Lily as well as impacts on water quality and native vegetation. Conduct a trial of different control methods.	North Central CMA, GMW, DELWP	High
Understand rate of bank erosion in creek and exacerbating factors (i.e. tolerances)	2.1	1.2, 1,10, 1.11, 2.4	Undertake repeat cross sectional surveys to understand changes occurring. Information to inform hydraulic model and future environmental and irrigation delivery	North Central CMA, GMW	High
Investigate small-bodied fish population and its ability to self-sustain	1.1, 1.2 and 1.3	-	Ongoing fish monitoring to determine the survival rates of small bodied fish entering the creek from the forest and lagoons. Investigate recruitment and population dynamics	North Central CMA	Moderate
Identify whether Gunbower Creek is actually carbon poor as previously theorized	All	-	Research into the availability of opportunities for carbon cycling in the forest	North Central CMA	Moderate
Investigate relationship between water quality parameters (i.e. DO, salinity, nutrients) and flow	All	1.11, 2.2, 2.3	Investigate relationships between flow rates, temperature and water quality. Understanding of the impact of nutrient flushing from lagoons on the system. Ongoing water quality monitoring during watering events.	North Central CMA	Moderate
Assess the impact of forest watering on exotic fish species entering creek	1.1, 1.2, 1.3, 2.1	1.7, 2.3, 2.5	Ongoing monitoring of fish populations in Gunbower Creek and Lagoons to determine survival rates and impact of carp on population dynamics	North Central CMA	High
Quantify fish leaving system through irrigation network	1.1, 1.2, 1.3	1.13	To be implemented as part of the fish recovery program	North Central CMA	Moderate
Understand impact of future modernisation	All	1.4	Investigate level of potential interruptions to flows due to future modernisation of system	North Central CMA, GMW	Moderate
Improve the hydraulic model to better estimate flow requirements	All	-	Additional cross sections required (i.e. particularly downstream of Cohuna) to further understand the relationship between flow and level	North Central CMA	Moderate
Better understanding of the relationship between depth and flow to tighten flow recommendations	All	-	Install continuous probes to understand relationship between depth and flow at different locations in the creek systems (i.e. Deep Creek junction, Narrows). Also undertake additional cross sections	North Central CMA	High

Knowledge Gap	Objective	Risk	Recommendation	Who	Priority
			below Cohuna Weir and at selected lagoons (considered inadequate in current model).		

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13. Abbreviations and Acronyms

AVIRA	Aquatic Value Identification and Risk Assessment
BE	Bulk Entitlement
Bonn	The Convention on the Conservation of Migratory Species of Wild Animals (also known as the Bonn Convention or CMS)
CAG	Community Advisory Group
CAMBA	China-Australia Migratory Bird Agreement
CEWH	Commonwealth Environmental Water Holder
CMA	Catchment Management Authority
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary Industries (Now an amalgamation of DELWP as of 2015)
DPI	Department of Primary Industries (Now an amalgamation DELWP in 2015)
D/S	Downstream
DSE	Department of Sustainability and Environment (Now DELWP in 2015)
EPA	Environmental Protection Authority
EPBC	*Environment Protection and Biodiversity Conservation Act 1999* (Cth)
EVC	Ecological Vegetation Class
EWMP	Environmental Water Management Plan
FFG	*Flora and Fauna Guarantee Act 1988* (Vic)
GL	Gigalitre (one billion litres)
GLMP	Gunbower Lagoons Modernisation Project
GIS	Geographical Information System
GMW	Goulburn Murray Water
HRWS	HRWS
ISC	Index of Stream Condition
IWC	Index of Wetland Condition
IWH	Instream Woody Habitat
JAMBA	Japan-Australia Migratory Bird Agreement
LRWS	LRWS
MDBA	Murray-Darling Basin Authority (formerly Murray-Darling Basin Commission, MDBC)
ML	Megalitre (one million litres)
ML/d	Megalitres per day
NCWS	North Central Waterway Strategy
PWG	Project Working Group
ROKAMBA	Republic of Korea-Australia Migratory Bird Agreement
RCS	Regional Catchment Strategy
RWS	Regional Waterway Strategy
SRA	Sustainable Rivers Audit
SRP	Scientific Review Panel
SWP	Seasonal Watering Proposal
TIA	Torrumbarry Irrigation Area
TLM	The Living Murray Initiative
U/S	Upstream
VEFMAP	Victorian Environmental Flows Monitoring and Assessment Program
VEWH	Victorian Environmental Water Holder
VWMS	Victorian Waterway Management Strategy
VWQN	Victorian Water Quality Network
WAP	Waterway Action Plan

Appendix 1. Community engagement

The North Central CMA assembled a Community Advisory Group (CAG) for the Gunbower Creek System which included the following representatives:

Name	Representative
Dianne Bowles	Chair and North Central CMA Board member
Charlie Gillingham	North Central CMA NRMC member
Thomas Chick	Field and Game
Audrey Dickens	Gunbower Landcare Group
Wendy Duckworth-Veitch	Community member
Jason Hare	Community member
Lorraine Learmonth	Community member
Debra Munzel	Gunbower Landcare Group
Trevor Powis	Community member
Glenn Rogers	Waterwatch volunteer
Nicholas Rowlands	Community member
Betty Waterson	Community member and Birdlife Australia
Douglas McGillivray	Community member
Andrew Brown	Community member

A summary of the feedback and discussions points from the three workshops held with the group (as detailed in Section 10) is provided below:

History:

- Areas of Gunbower Creek (i.e. near Cohuna Golf Course) dried to mudflats during the 1970-1980s.
- During the Millennium drought, water levels were held during winter to conserve water. This coincided with an increase in the abundance of Pale Yellow Water Lily. Winter frosting (i.e. lowering winter water levels) is therefore considered an important control mechanism for Pale Yellow Water Lily by the community.
- Pale Yellow Water Lily has been historically planted around pump sites to shade out other aquatics such as Hornwort which are known to clog pumps.
- Historically a series of lagoon drainage channels were cut to assist with draining water for timber harvesting. It is likely that these channels contribute to the rapid water level reduction that occurs at the end of the irrigation season.
- Chemical treatment was undertaken some 20 years ago to strip the Gunbower Creek of aquatic plants. It also resulted in a fish kill. DDT has also been used historically in the system to control mosquitos.

Values:

- Seven years of waterbird monitoring at Cockatoo Lagoon has shown that Black Swan numbers have dropped.
- 15-20 years ago, Taylor's Lagoon supports thousands of nesting waterbirds including Darters and Black Swans; however silt built up the result of minimal throughflow has seen this number decrease considerably. The most recent observation includes only two cormorants and three darter nests. River Red Gums have also started to grow in the lagoon.
- White ibis are often associated lagoons that are located near piggeries i.e. Gum Lagoon. This association is likely to be based on the abundance of food (i.e. pig pellets) and not the nutrient levels associated with the lagoons.
- Recent angler's records of Murray Cod include a 37 pound individual caught and released back to creek near Koondrook and a large individual (weight not specified) near Tree Tops Scout Camp.
- Golden Perch are often observed cuing up at Taylor's Creek.

- Group would like to see a program like 'tell us about your catch', 'angler's diary' or a 'fish app' to promote catch and release of threatened species
- Many of the lagoons were historically used for swimming. The high abundance of Pale Yellow Water Lily means that this recreational pursuit is no longer possible.

Threats- erosion:

- When the creek is operated at high levels for prolonged periods of time, the banks become susceptible to erosion and trees are more liable to fall in (reducing availability of nesting habitat for waterbirds such as Darters and White Ibis). This has been occurring over a long period of time (with some areas noted to have retreated by up to 12 metres from their original position) however the recent 2014-15 Gunbower Forest watering event is noted to have coincided with an increase in erosion and tree fall particularly around the Narrows.
- Stock grazing up to the creek edge degrades riparian vegetation and makes banks less stable. Fencing stock is only effective in protecting riparian zones if fences are maintained and gates are kept closed. Grazing restrictions are not being enforced. This is a DEPI issue that the CMA will continue to follow up.
- Wave action from wakeboarding was noted to contribute to bank erosion (i.e. particularly between Daltons Bridge to the Caravan Park). These activities were recently banned by Gannawarra Shire.
- Although not previously monitored, silt build up is noted to occur on the inside bends of the creek and lagoons channels. Fixing the issue is problematic and likely to require significant future investment.
- Stable levels have reduced the growth zone for aquatic plants and have reduced the structural stability of the soil.

Threats- water quality:

- Whole farm planning has greatly reduced runoff through farmers now recycle their water. However agricultural runoff is still considered a key threat to the Gunbower Creek System, in particularly in the lagoons where there is poor throughflow. It contributes to poor water quality (noted as terrible over the past 10-15 years) and produces an offensive smell.
- Blue Green Algae (BGA) is an issue in Gum Lagoon with pig effluent (from the neighbouring piggery) noted as the cause of the high nutrient loads. At one point the lagoon has the highest BGA record in Australia. When BGA levels are high Pale Yellow Water Lily is absent or scarce.
- Pumps contribute to poor water quality through diesel and lubricant spills.
- During winter when there is no flow in the creek, the water is known to turn red upstream of Holmes Bridge. Dilution flows have been provided in the past to mitigate this.
- Community would like to see as much of the creek flows diverted through the lagoons to improve water quality. There has been a proposal to channel water from Gum Lagoon to Cockatoo Lagoon to assist with this.

Threats- invasive species:

- At the end of the 2014-15 Gunbower Forest watering event, a large abundance of Common Carp were observed at the Hipwell Road fishway. This present a major threat to the Gunbower Creek System.
- Willows have recently been controlled in the system but some are starting to return. In some areas where willow management has been effective Pale Yellow Water Lily is starting to invade.
- Blackberries are spreading in the riparian zone from Daltons Bridge to Cohuna and opposite the caravan park.

Weeds including Pale Yellow Water Lily affect water quality and flow in the system. In the last 10 years water quality has deteriorated significantly due to poor flow.

- PYWL is currently managed in the Gunbower Creek System as a trial program. It has previously been managed in Goulburn Weir through helicopter and boat spraying. Additional infestations noted include site in Western Australia, Murray River (noted in a lagoon approximately 5 kilometres upstream from Torrumbarry Weir Pool) and Kow Swamp (recently occurring but have been sprayed as part of this program).
- Pale Yellow Water Lily restricts bank access for Platypus and turtles forcing them to forage in the open channelised areas.
- Backwaters and shallow areas are the hardest to manage for Pale Yellow Water Lily although the spread of the species from these areas is less likely (i.e. less likely for pieces to break off). In contrast the species is noted to be less abundant in flowing areas (i.e. channelised sections) due to both the depth and flow velocity.
- The Pale Yellow Water Lily spray program is undertaken in close partnership with Coliban Water to ensure that town water supply is not impacted. The program has been successful, with the community noting the return of foraging waterbirds to areas previously infested.
- Torrumbarry Water Services Committee has negotiated that GMW will continue monitor and manage the spread Pale Yellow Water Lily if the extent can be reduced by 10% of its current coverage.
- Cumbungi may prevent rhizomes of Pale Yellow Water Lily from establishing.
- Hornwort is abundant in the Upper Gunbower Creek and lagoons and is considered by some to be an even bigger threat to the system then Pale Yellow Water Lily. Areas which have been sprayed for Pale Yellow Water Lily are often replaced by Hornwort infestations.
- Water releases from full storages might assist with reducing Hornwort, which is a summer loving plant. However real issue that needs to be dealt with is nutrient concentrations in the water.
- Nutrient management is required to ensure that the control of Pale Yellow Water Lily and other aquatic weeds does not result in the opening up of habitat for new weeds to invade. Spraying should be seen as a band aid and not the cure.

Threats- infrastructure:

- Fish, Platypus and turtle movement is restricted by regulators and pipe culverts in the creek and lagoons. For example Stoney Crossing restricts turtle movement to Gum Lagoon. Turtles are often killed on the road.
- Mesh guards have been used on pumps to protect animals such as Platypus, fish and turtles. As debris (Hornwort) in the creek and lagoons increases, maintenance of the guards has been too high. Farmers are now opting to remove mesh guards and install choppers which threaten platypus, water rats and turtles. Diary Australia is doing some trials on pump mesh guards to remove threat to biota.

Water management:

- In Easter 2015, Spur Creek was inundated due to the padlock on the fish ladder being vandalised.
- Future management of lagoons levels should take into consideration wether levels will expose irrigation pumps reducing supply to customers (i.e. Upper Gunbower Lagoon).
- Falling water levels can cause waterbirds to abandon their nests, for example white ibis. Water levels in lagoons can fall quickly when farmers are not irrigating. In contrast levels can rise quickly in respond to demand (i.e. nests have been flooded in the past at the Gum Lagoon ibis rookery).
- Concerns that the lagoons will turn into salt pans if the levels are lowered as proposed in the GLMP.

- Upper Gunbower Lagoon should be considered as an alternative passage for fish as opposed to Gunbower Weir.
- Modernisation may cause the removal of other irrigation channels putting more irrigators back to the backbone increasing demand in the creek. This should be considered in the future management of the system.
- The public should be educated on all the different benefits of the Hipwell Road infrastructure, not just environmental outcomes.
- Barr Creek should be investigated for environmental watering in the future.

Other points raised:

- Rubbish dumping occurs widely in the riparian zone.
- Crows are known to eat turtle eggs.

Appendix 2. Summary of key technical work undertaken to date for the Gunbower Creek System

Name	Author	Date	Summary
Gunbower Creek Capacity Study	SKM	2002	Quantifies the potential capacity of Gunbower Creek and upstream supply channels to carry environmental flows for delivery to Gunbower Forest during the irrigation season and environmental water allocation events in the Murray River.
Gunbower Creek Waterway Action Plan (WAP)	North Central CMA	2007	Details a ten year works program that aims to enhance the environmental values of Gunbower Creek, while taking into account the economic and social values of the area. In implementing the Gunbower Creek WAP, the following objectives were targeted: • Increased community and stakeholder integration participation in natural resource management • Improved understanding of key threats and values within the project area; and • Increased integration between natural resource management programs.
Gunbower Creek Environmental Flows Study – Site Paper, Issues Paper and Flow Recommendations	Anderson & Anderson *et al.*	2007	Describes the condition of Gunbower Creek and determined an appropriate flow regime which supported and/ or sustained the key environmental and physical (geomorphic and water quality) values, whilst minimising threats. The Flow Study was undertaken as per the FLOWS Method detailed in DEPI (2013b).
Gunbower Creek and Lagoons Fish Passage- Concept Design Report	SKM	2008	Investigates fish passage options at priority sites in Gunbower Creek and associated lagoons (an adopted action from the WAP) and documented the current and expected fish assemblages and species requirements. The report also scoped design options for fish passage at a number of locations.
Gunbower Forest- Lower Landscape Regulators Interim Operating Plan	North Central CMA	2012	The Gunbower Forest Lower Landscape Regulators Interim Operating Plan documents the processes to plan and implement the delivery of environmental water to the lower area of Gunbower forest via Gunbower Creek as part of the commissioning of Hipwell Road. Once the Gunbower Forest Flooding Enhancement Operating Plan (in prep.) has been approved this Interim Plan will become obsolete.
Gunbower Forest Environmental Water Management Plan	MDBA	2012	The Gunbower Forest Environmental Water Management Plan established a series of priorities, environmental objectives and associated watering actions for the use of TLM water within the icon site which includes the use of Gunbower Creek as a delivery conduit. Outcomes relating to the maintenance of healthy fish populations in the wetlands and on the floodplain are directly linked with the creek and lagoon habitat values.
Gunbower Lagoons Modernisation Project- Technical Workshop reports 1-4	North Central CMA	2013	A series of five Technical Reports developed for the Gunbower Lagoons Modernisation Project (GLMP) Technical Workshops (held between May to October 2013) which summarised the water history, values, threats, proposed environmental objectives, water regime, knowledge gaps, constraints and complementary actions required for each of the Gunbower Lagoons. The reports preceded the Environmental Watering Investigations (EWI) (see below) and aimed to establish the potential water requirements for each lagoon, should irrigation customers be removed.
Environmental Watering Investigations (EWI) for Gunbower Lagoons Modernisation Project	North Central CMA	2014	Environmental Watering Investigations' (EWI) were prepared for six of the Gunbower Lagoons (Cockatoo, Taylor's, Unregulated, Gum, Heart and Heppell Lagoons) which were deemed potentially suitable for modernisation under the GLMP. The EWIs provided an in-depth detail including ecological justified environmental and hydrological objectives and an associated water regime for each of the lagoons. See Section 1.3 for more information on the project.
Native Fish Recovery Plan – Gunbower and Lower Loddon	Mallen-Cooper *et al.*	2014	The Plan recognises irrigation systems as components of aquatic ecosystems and details an approach which utilise irrigation water and infrastructure as well as environmental water and complementary actions to build native fish resilience in the Gunbower and Lower Loddon System. The Plan addresses three key factors being loss of connectivity for fish movement and migration, alteration of natural flows regimes and loss of habitat as significant in the decline of native fish populations. The plan further proposes a series of fishway infrastructure (including upgrades to current fishways deemed inadequate) works which are required to facilitate movement of native fish throughout the larger system.

Name	Author	Date	Summary
Gunbower Creek Instream Habitat Assessment	Kitchingman *et al*.	2014	An Instream Woody Habitat (IWH) survey of the Gunbower Creek was conducted to assist with habitat rehabilitation and aid in decision making, particularly around removal of IWH for boating access. The survey developed IWH density maps, modelled IWH loads for different reaches and provide depth estimates along the Gunbower Creek.
Optomising Flows in Gunbower Creek to Enhance Spawning Opportunities for Murray Cod	Sharpe & Stuart	2015	A report that documents the flow requirements of Murray Cod in the Gunbower Creek System, particularly relating to spawning as well as larval and juvenile survival. The report summarises the results from environmental water delivery in 2013-14 which aimed to suppress short-term (i.e. daily) variation in irrigation water level and flows for Murray Cod. Key components of this report have been utilised in the development of the Gunbower Creek System EWMP.
Refinement of Ecological Objectives and Flow Requirementws for Gunbower Creek- Draft	Ecological Associates Pty Ltd	2015	Ecological Associates was engaged to refine the ecological and hydrological objectives and associated flow regime based on the full suite of environmental values and threats identified in Gunbower Creek. Where appropriate, the project was also required to incorporate ecological and hydrological objectives for the Gunbower Lagoons into the Gunbower Creek flow regime. The project was undertaken to support the development of the Gunbower Creek and Lagoons EWMP.

Appendix 3. Legislative Framework

International agreements and conventions

Ramsar Convention on Wetlands (Ramsar)

The Australian Government is a Contracting Party to the convention, which is an inter-governmental treaty whose mission is “the conservation and wise use of all wetlands through local, regional and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world".

World Heritage Sites

Heritage includes places, values, traditions, events and experiences that capture where we've come from, where we are now and gives context to where we are headed as a community. The World Heritage Convention aims to promote cooperation among nations to protect heritage from around the world that is of such outstanding universal value that its conservation is important for current and future generations. It is intended that, unlike the seven wonders of the ancient world, properties on the World Heritage List will be conserved for all time (DEWHA, 2008a).

East Asian-Australasian Flyway Sites

Australia provides critical non-breeding habitat for millions of migratory waterbirds each year. Migratory waterbirds include species such as plovers, sandpipers, stints and curlews. The corridor through which these waterbirds migrate is known as the East Asian-Australasian Flyway.

To ensure their conservation, the Australian Government has fostered international cooperation through the recently launched East Asian-Australasian Flyway Partnership. Under the Flyway Partnership, the site network for shorebirds has been combined into a single network, referred to as the East Asian–Australasian Flyway Site Network.

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.

Nationally Important Wetlands

Victoria has a number of waterways of National importance as described in A Directory of Important Wetlands in Australia (Environment Australia, 2001).

There are 159 wetlands in Victoria listed in the Directory.

Living Murray Icon Sites

TLM was established in 2002 in response to evidence that the health of the River Murray system is in decline. TLM's first stage focuses on improving the environment at six 'icon sites' along the River:

- Barmah-Millewa Forest;
- Gunbower-Koondrook-Perricoota Forest;
- Hattah Lakes;
- Chowilla Floodplain and Lindsay-Wallpolla Islands;
- Lower Lakes, Coorong and Murray Mouth; and
- River Murray Channel.

The sites were chosen for their high ecological value—most are listed as internationally significant wetlands under the Ramsar convention—and also their cultural significance to Indigenous people and the broader community (MDBC, 2006).

HEVAE

Through National Water Initiative (NWI) commitments, a toolkit for identifying high ecological value aquatic ecosystems (HEVAE) has been developed so that national consistency may be applied. Five core criteria are used to develop HEVAE sites across a range of scales and ecosystems:

- Diversity
- Distinctiveness
- Vital habitat
- Naturalness
- Representativeness.

The HEVAE toolkit is saved at http://www.environment.gov.au/resource/aquatic-ecosystems-toolkit-module-3-guidelines-identifying-high-ecological-value-aquatic

National Heritage Sites

The National Heritage List has been established to list places of outstanding heritage significance to Australia. It includes natural, historic and Indigenous places that are of outstanding national heritage value to the Australian nation (DEWHA ~2008).

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.

Advisory lists of rare or threatened species in Victoria (DSE)

Three advisory lists are maintained by DSE for use in a range of planning process and in setting priorities for actions to conserve biodiversity. Unlike other threatened species lists, there are no legal requirements or consequences that flow from inclusion of a species on an advisory list. The advisory lists comprise:

- Advisory List of Rare or Threatened Plants In Victoria – 2014
- Advisory List of Threatened Vertebrate Fauna in Victoria - 2013
- Advisory List of Threatened Invertebrate Fauna in Victoria - 2009

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 4. Fauna species list

Reach	Location	Common Name	Scientific Name	Most recent record	Source
Amphibians					
1	Heart	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral; Solum; VBA
1	Heppell	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral; Australian Ecosystems; VBA
1	Longmore	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral
1	Phyland	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral
1	Splatts	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral; Australian Ecosystems; VBA
1	Turner	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Australian Ecosystems; Austral; VBA
1	Unregulated	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral; Solum; VBA
1	Upper	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	VBA; Solum; Austral
2	Cockatoo	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral; VBA; Solum
2	Gum	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral; Solum; VBA
2	Taylors	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral
3a	Safe's	Barking Marsh Frog	*Limnodynastes fletcheri*	2013	Austral
1	Creek	Barking Marsh Frog	*Limnodynastes fletcheri*	2012	Australian Ecosystems
2	Creek	Barking Marsh Frog	*Limnodynastes fletcheri*	2012	VBA
1	Heart	Common Froglet	*Crinia signifera*	2013	Solum; VBA
1	Heppell	Common Froglet	*Crinia signifera*	1994	VBA
1	Phyland	Common Froglet	*Crinia signifera*	2013	Austral
1	Splatts	Common Froglet	*Crinia signifera*	1991	VBA
1	Turner	Common Froglet	*Crinia signifera*	2013	VBA; Austral
1	Unregulated	Common Froglet	*Crinia signifera*	2013	Solum; VBA
1	Upper	Common Froglet	*Crinia signifera*	2013	VBA
2	Cockatoo	Common Froglet	*Crinia signifera*	1991	VBA
2	Taylors	Common Froglet	*Crinia signifera*	2013	Solum
3a	Safe's	Common Froglet	*Crinia signifera*	1982	VBA
1	Creek	Common Froglet	*Crinia signifera*	1994	VBA
2	Creek	Common Froglet	*Crinia signifera*	1982	VBA
3a	Creek	Common Froglet	*Crinia signifera*	2008	VBA
3b	Creek	Common Froglet	*Crinia signifera*	1961	VBA
1	Upper	Growling Grass Frog	*Litoria raniformis*	1982	VBA
1	Heart	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Australian Ecosystems; Solum
1	Heppell	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Australian Ecosystems
1	Longmore	Peron's Tree Frog	*Litoria peronii*	2013	Austral
1	Phyland	Peron's Tree Frog	*Litoria peronii*	2013	Australian Ecosystems; Austral
1	Splatts	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Australian Ecosystems; VBA
1	Turner	Peron's Tree Frog	*Litoria peronii*	2013	Australian Ecosystems
1	Unregulated	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Solum
1	Upper	Peron's Tree Frog	*Litoria peronii*	1991	VBA; Solum; Austral
2	Cockatoo	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Australian Ecosystems; Solum
2	Gum	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Solum; VBA
2	Taylors	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Australian Ecosystems
3a	Safe's	Peron's Tree Frog	*Litoria peronii*	2013	Austral; Australian Ecosystems
1	Creek	Peron's Tree Frog	*Litoria peronii*	2012	Australian Ecosystems
2	Creek	Peron's Tree Frog	*Litoria peronii*	2012	Australian Ecosystems
3a	Creek	Peron's Tree Frog	*Litoria peronii*	2012	Australian Ecosystems
1	Heart	Plains Froglet	*Crinia parinsisnifera*	2013	Solum
1	Splatts	Plains Froglet	*Crinia parinsignifera*	1992	VBA
1	Turner	Plains Froglet	*Crinia parinsisnifera*	1992	VBA
1	Unregulated	Plains Froglet	*Crinia parinsisnifera*	2013	Solum
1	Upper	Plains Froglet	*Crinia parinsignifera*	2013	VBA; Solum
2	Cockatoo	Plains Froglet	*Crinia parinsignifera*	2013	Solum
2	Gum	Plains Froglet	*Crinia parinsisnifera*	2013	Solum
2	Taylors	Plains Froglet	*Crinia parinsisnifera*	2013	Solum
1	Creek	Plains Froglet	*Crinia parinsignifera*	1994	VBA
2	Creek	Plains Froglet	*Crinia parinsignifera*	1982	VBA
3a	Creek	Plains Froglet	*Crinia parinsignifera*	2008	VBA
1	Heart	Pobblebonk	*Limnodynastes dumerilii*	2013	Solum
1	Unregulated	Pobblebonk	*Limnodynastes dumerilii*	2013	Solum
1	Upper	Pobblebonk	*Limnodynastes dumerilii*	2013	Solum
2	Gum	Pobblebonk	*Limnodynastes dumerilii*	2013	Solum
2	Taylors	Pobblebonk	*Limnodynastes dumerilii*	2013	Solum
1	Splatts	Sloane's Froglet	*Crinia sloanei*	1993	VBA
1	Creek	Sloane's Froglet	*Crinia sloanei*	1993	VBA
1	Heart	Southern Bullfrog	*Limnodynastes dumerilii*	1993	VBA

Reach	Location	Common Name	Scientific Name	Most recent record	Source
1	Heppell	Southern Bullfrog	*Limnodynastes dumerilii*	1994	VBA
1	Splatts	Southern Bullfrog	*Limnodynastes dumerilii*	1991	VBA
1	Turner	Southern Bullfrog	*Limnodynastes dumerilii*	1991	VBA
1	Unregulated	Southern Bullfrog	*Limnodynastes dumerilii*	1993	VBA
1	Creek	Southern Bullfrog	*Limnodynastes dumerilii*	1994	VBA
3a	Creek	Southern Bullfrog	*Limnodynastes dumerilii*	2008	VBA
1	Heart	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Solum; VBA
1	Heppell	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Australian Ecosystems; VBA
1	Longmore	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Austral
1	Phyland	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Austral
1	Splatts	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	1994	VBA
1	Turner	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	VBA; Austral
1	Unregulated	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Solum; VBA
2	Cockatoo	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Austral; Solum
2	Gum	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Austral; Solum
2	Taylors	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	Solum
1	Upper	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2013	VBA; Solum
1	Creek	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	1994	VBA
3a	Creek	Spotted Marsh Frog	*Limnodynastes tasmaniensis*	2008	VBA
Fish					
1	Creek	Australian Smelt	*Retropinna semoni*	2013	Sharpe et al.,
1	Heart	Australian Smelt	*Retropinna semoni*	2013	Austral
1	Longmore	Australian Smelt	*Retropinna semoni*	2014	Austral
1	Phyland	Australian Smelt	*Retropinna semoni*	2008	Rehwinkel & Sharpe
1	Splatts	Australian Smelt	*Retropinna semoni*	2013	Austral
1	Turner	Australian Smelt	*Retropinna semoni*	2014	Sharpe et al
1	Upper	Australian Smelt	*Retropinna semoni*	2014	Sharpe et al
2	Cockatoo	Australian Smelt	*Retropinna semoni*	2012	Rehwinkel & Sharpe
2	Creek	Australian Smelt	*Retropinna semoni*	2014	Sharpe et al.,
2	Creek	Australian Smelt	*Retropinna semoni*	2014	Sharpe et al.,
2	Taylors	Australian Smelt	*Retropinna semoni*	2007	PIRVic
3a	Creek	Australian Smelt	*Retropinna semoni*	2014	Sharpe et al.,
3a	Safe's	Australian Smelt	*Retropinna semoni*	2014	Austral
3b	Creek	Australian Smelt	*Retropinna semoni*	2014	Sharpe et al.,
1	Longmore	Bony Herring	*Nematalosa erebi*	2013	Sharpe et al.,
1	Splatts	Bony Herring	*Nematalosa erebi*	2014	Sharpe et al.,
2	Gum	Bony Herring	*Nematalosa erebi*	2008	Rehwinkel & Sharpe
2	Crreek	Bony Herring	*Nematalosa erebi*	2014	Sharpe et al.,
2	Creek	Bony Herring	*Nematalosa erebi*	2010	Sharpe et al.,
1	Creek	Murray Darling Rainbowfish	*Melanotaenia fluviatilis*	2014	Sharpe et al.,
1	Splatts	Murray Darling Rainbowfish	*Melanotaenia fluviatilis*	2014	Sharpe et al.,
2	Creek	Murray Darling Rainbowfish	*Melanotaenia fluviatilis*	2014	Sharpe et al.,
2	Creek	Murray Darling Rainbowfish	*Melanotaenia fluviatilis*	2014	Sharpe et al.,
3a	Creek	Murray Darling Rainbowfish	*Melanotaenia fluviatilis*	2014	Sharpe et al.,
1	Creek	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2014	Sharpe et al.,
2	Creek	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2010	Sharpe et al.,
2	Creek	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2011	Sharpe et al.,
3a	Creek	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2012	Sharpe et al.,
1	Phyland	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2014	Sharpe et al.,
1	Splatts	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2011	Rehwinkel et al.,
1	Turner	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2012	Rehwinkel & Sharpe,
1	Upper	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2012	Rehwinkel & Sharpe,
2	Cockatoo	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2009	Rehwinkel & Sharpe,
2	Gum	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2010	Rehwinkel et al.,
2	Taylors	Dwarf Flat-headed Gudgeon	*Philypnodon macrostomus*	2010	Rehwinkel & Sharpe,
3a	Safe's	Dwarf Flat-headed	*Philypnodon macrostomus*	2012	Rehwinkel & Sharpe,

Reach	Location	Common Name	Scientific Name	Most recent record	Source
		Gudgeon			
1	Creek	Eastern Gambusia	*Gambusia holbrooki*	2013	Sharpe et al.,
2	Creek	Eastern Gambusia	*Gambusia holbrooki*	2013	Sharpe et al.,
2	Creek	Eastern Gambusia	*Gambusia holbrooki*	2013	Sharpe et al.,
3a	Creek	Eastern Gambusia	*Gambusia holbrooki*	2013	Sharpe et al.,
3b	Creek	Eastern Gambusia	*Gambusia holbrooki*	2013	Sharpe et al.,
1	Creek	Common Carp	*Cyprinus carpio*	2013	Sharpe et al.,
2	Creek	Common Carp	*Cyprinus carpio*	2013	Sharpe et al.,
2	Creek	Common Carp	*Cyprinus carpio*	2013	Sharpe et al.,
3a	Creek	Common Carp	*Cyprinus carpio*	2013	Sharpe et al.,
3b	Creek	Common Carp	*Cyprinus carpio*	2013	Sharpe et al.,
1	Heart	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral
1	Longmore	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral
1	Phyland	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral
1	Splatts	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral
1	Turner	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral
1	Unregulated	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral; VBA
1	Upper	Flathead Gudgeon	*Philypnodon grandiceps*	2010	Rehwinkel & Sharpe
2	Cockatoo	Flathead Gudgeon	*Philypnodon grandiceps*	2009	Rehwinkel & Sharpe
2	Gum	Flathead Gudgeon	*Philypnodon grandiceps*	2012	Rehwinkel & Sharpe
2	Taylors	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral
3a	Safe's	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Austral
1	Creek	Flathead Gudgeon	*Philypnodon grandiceps*	2012	Austral
2	Creek	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Sharpe et al.,
2	Creek	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Sharpe et al.,
3a	Creek	Flathead Gudgeon	*Philypnodon grandiceps*	2013	Sharpe et al.,
1	Phyland	Freshwater Catfish	*Tandanus tandanus*	2013	Austral
1	Turner	Freshwater Catfish	*Tandanus tandanus*	2013	Austral
2	Cockatoo	Freshwater Catfish	*Tandanus tandanus*	2009	Rehwinkel & Sharpe
2	Gum	Freshwater Catfish	*Tandanus tandanus*	2013	Austral;
3a	Safe's	Freshwater Catfish	*Tandanus tandanus*	2013	Austral
1	Creek	Golden Perch	*Macquaria ambigua*	2013	Sharpe et al.,
1	Heart	Golden Perch	*Macquaria ambigua*	2013	Austral
1	Longmore	Golden Perch	*Macquaria ambigua*	2011	Rehwinkel et al.,
1	Splatts	Golden Perch	*Macquaria ambigua*	2012	Sharpe et al.,
1	Upper	Golden Perch	*Macquaria ambigua*	2012	Sharpe et al.,
2	Creek	Golden Perch	*Macquaria ambigua*	2013	Sharpe et al.,
3a	Creek	Golden Perch	*Macquaria ambigua*	2013	Sharpe et al.,
3b	Creek	Golden Perch	*Macquaria ambigua*	2013	Sharpe et al.,
1	Creek	Goldfish	*Carassius auratus*	2012	Sharpe et al.,
2	Creek	Goldfish	*Carassius auratus*	2012	Sharpe et al.,
2	Creek	Goldfish	*Carassius auratus*	2013	Sharpe et al.,
3a	Creek	Goldfish	*Carassius auratus*	2013	Sharpe et al.,
3b	Creek	Goldfish	*Carassius auratus*	2012	Sharpe et al.,
1	Creek	Gudgeon spp.	*Fam. Eleotrididae Gen. Hypseleotris*	2013	Sharpe et al.,
2	Creek	Gudgeon spp.	*Fam. Eleotrididae Gen. Hypseleotris*	2013	Sharpe et al.,
2	Creek	Gudgeon spp.	*Fam. Eleotrididae Gen. Hypseleotris*	2013	Sharpe et al.,
3a	Creek	Gudgeon spp.	*Fam. Eleotrididae Gen. Hypseleotris*	2013	Sharpe et al.,
3b	Creek	Gudgeon spp.	*Fam. Eleotrididae Gen. Hypseleotris*	2013	Sharpe et al.,
1	Creek	Murray Cod	*Maccullochella peelii*	2009	Sharpe et al.,
2	Creek	Murray Cod	*Maccullochella peelii*	2013	Sharpe et al.,
3a	Creek	Murray Cod	*Maccullochella peelii*	2013	Sharpe et al.,
3b	Creek	Murray Cod	*Maccullochella peelii*	2013	Sharpe et al.,
2	Creek	Murray Cod	*Maccullochella peelii*	1970	VBA
1	Longmore	Murray-Darling Rainbow Fish	*Melanotaenia fluviatilis*	2013	Rehwinkel & Sharpe
1	Splatts	Murray-Darling Rainbow Fish	*Melanotaenia fluviatilis*	2013	Austral
1	Turner	Murray-Darling Rainbow Fish	*Melanotaenia fluviatilis*	2012	Rehwinkel & Sharpe
2	Cockatoo	Murray-Darling Rainbow Fish	*Melanotaenia fluviatilis*	2008	Rehwinkel & Sharpe

Reach	Location	Common Name	Scientific Name	Most recent record	Source
3a	Safe's	Murray-Darling Rainbow Fish	*Melanotaenia fluviatilis*	2013	Austral
1	Creek	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2011	Sharpe et al.,
2	Creek	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2011	Sharpe et al.,
2	Creek	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2013	Sharpe et al.,
3a	Creek	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2010	Sharpe et al.,
2	Creek	Redfin	*Perca fluviatilis*	2011	Sharpe et al.,
3a	Creek	Redfin	*Perca fluviatilis*	2011	Sharpe et al.,
1	Creek	Silver Perch	*Bidyanus bidyanus*	2013	Sharpe et al.,
1	Upper	Silver Perch	*Bidyanus bidyanus*	2013	Austral
2	Creek	Silver Perch	*Bidyanus bidyanus*	2013	Sharpe et al.,
3a	Creek	Silver Perch	*Bidyanus bidyanus*	2013	Sharpe et al.,
3a	Safe's	Silver Perch	*Bidyanus bidyanus*	2007	PIRVic
3b	Creek	Silver Perch	*Bidyanus bidyanus*	2013	Sharpe et al.,
3a	Creek	Trout Cod	*Maccullochella macquariensis*	2008	Sharpe et al.,
1	Creek	Unspecked Hardyhead	*Craterocephalus fulvus*	2013	Sharpe et al.,
2	Creek	Unspecked Hardyhead	*Craterocephalus fulvus*	2013	Sharpe et al.,
2	Creek	Unspecked Hardyhead	*Craterocephalus fulvus*	2013	Sharpe et al.,
3a	Creek	Unspecked Hardyhead	*Craterocephalus fulvus*	2013	Sharpe et al.,
3b	Creek	Unspecked Hardyhead	*Craterocephalus fulvus*	2013	Sharpe et al.,
1	Longmore	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2013	Austral
1	Phyland	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2013	Austral
1	Splatts	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2013	Austral
1	Turner	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2013	Austral
1	Upper	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2010	Rehwinkel & Sharpe
2	Cockatoo	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2012	Rehwinkel & Sharpe
2	Gum	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2013	Rehwinkel & Sharpe
2	Taylors	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2013	Austral
3a	Safe's	Unspecked Hardyhead	*Craterocephalus stercusmuscarum fulvus*	2013	Austral
Water dependent mammals					
1	Creek	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
1	Longmore	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
1	Phyland	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
1	Splatts	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
1	Turner	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
1	Upper	Platypus	*Ornithorhynchus anatinus*	2013	Australian Ecosystems
2	Creek	Platypus	*Ornithorhynchus anatinus*	2005	Serena & Williams
2	Cockatoo	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
2	Gum	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
2	Taylors	Platypus	*Ornithorhynchus anatinus*	2011	Serena & Williams
3a	Creek	Water Rat	*Hydromys chrysogaster*	1994	VBA
Waterbirds					
2	Creek	Australasian Bittern	*Botaurus poiciloptilus*	1999	Birds Australia
2	Creek	Australasian Bittern	*Botaurus poiciloptilus*	1999	Birds Australia
1	Heart	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems
1	Longmore	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems; VBA
1	Phyland	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Splatts	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Ayres et al.,
1	Turner	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems; Austral; VBA; Ayres et al.,
1	Unregulated	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems
1	Upper	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems; VBA
2	Cockatoo	Australasian Darter	*Arhinga melanogaster*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VFRI, 1996; Australian Ecosystems; VBA
2	Gum	Australasian Darter	*Arhinga melanogaster*	2013	VFRI, 1996; VBA; Ayres et al.,
2	Taylors	Australasian Darter	*Arhinga melanogaster*	2013	Birdlife Echuca, 2008; Australian

Reach	Location	Common Name	Scientific Name	Most recent record	Source
					Ecosystems; VBA
3a	Safe's	Australasian Darter	*Arhinga melanogaster*	2013	Australian Ecosystems; Birdlife Echuca, 2008; Ayres et al.,
1	Longmore	Australasian Grebe	*Tachybaptus novaehollandiae*	1989	VBA
1	Splatts	Australasian Grebe	*Tachybaptus novaehollandiae*	2011	Birdlife Echuca, 2011
1	Turner	Australasian Grebe	*Tachybaptus novaehollandiae*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Upper	Australasian Grebe	*Tachybaptus novaehollandiae*	1999	VBA
2	Cockatoo	Australasian Grebe	*Tachybaptus novaehollandiae*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Australian Ecosystems
2	Taylors	Australasian Grebe	*Tachybaptus novaehollandiae*	2008	Birdlife Echuca, 2008; VBA
3a	Safe's	Australasian Grebe	*Tachybaptus novaehollandiae*	2013	Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Australasian Grebe	*Tachybaptus novaehollandiae*	2012	Australian Ecosystems
2	Creek	Australasian Grebe	*Tachybaptus novaehollandiae*	2012	Birds Australia
2	Creek	Australasian Grebe	*Tachybaptus novaehollandiae*	2002	Birds Australia
3a	Creek	Australasian Grebe	*Tachybaptus novaehollandiae*	2008	Birds Australia
1	Splatts	Australasian Shoveler	*Anas rhynchotis*	2010	Birdlife Echuca, 2010
1	Turner	Australasian Shoveler	*Anas rhynchotis*	2013	Australian Ecosystems
2	Cockatoo	Australasian Shoveler	*Anas rhynchotis*	prior to 2009	Birdlife Echuca, pre 2009
1	Creek	Australasian Shoveler	*Anas rhynchotis*	2012	Australian Ecosystems
1	Longmore	Australian Pelican	*Pelecanus conspicillatus*	2013	Austral; Australian Ecosystems; VBA; Ayres et al.,
1	Splatts	Australian Pelican	*Pelecanus conspicillatus*	2013	Austral; Australian Ecosystems; Birdlife Echuca, 2009, 2012
1	Turner	Australian Pelican	*Pelicanus conspicillatus*	2013	Australian Ecosystems; Ayres et al.,
1	Unregulated	Australian Pelican	*Pelecanus conspicillatus*	2013	Australian Ecosystems
1	Upper	Australian Pelican	*Pelecanus conspicillatus*	2013	VBA; Austral
2	Cockatoo	Australian Pelican	*Pelicanus conspicillatus*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Australian Ecosystems; Ayres et al.,
2	Gum	Australian Pelican	*Pelecanus conspicillatus*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Taylors	Australian Pelican	*Pelicanus conspicillatus*	2013	Birdlife Echuca, 2008; Australian Ecosystems; VBA
3a	Safe's	Australian Pelican	*Pelecanus conspicillatus*	2013	Austral; Birdlife Echuca, 2008
1	Creek	Australian Pelican	*Pelecanus conspicillatus*	2012	Austral Research
2	Creek	Australian Pelican	*Pelecanus conspicillatus*	2012	Australian Ecosystems
2	Creek	Australian Pelican	*Pelecanus conspicillatus*	2008	Birds Australia
3a	Creek	Australian Pelican	*Pelecanus conspicillatus*	2012	Birds Australia
1	Heppell	Australian Shelduck	*Tadorna tadornoides*	1972	VBA
1	Longmore	Australian Shelduck	*Tadorna tadornoides*	2013	Australian Ecosystems; VBA
1	Splatts	Australian Shelduck	*Tadorna tadornoides*	2013	Australian Ecosystems; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013
1	Turner	Australian Shelduck	*Tadorna tadornoides*	2013	Australian Ecosystems
1	Upper	Australian Shelduck	*Tadorna tadornoides*	1993	VBA; Ayres et al.,
2	Cockatoo	Australian Shelduck	*Tadorna tadornoides*	2012	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA
2	Gum	Australian Shelduck	*Tadorna tadornoides*	2013	Australian Ecosystems; VBA
2	Taylors	Australian Shelduck	*Tadorna tadornoides*	1998	VBA
3a	Safe's	Australian Shelduck	*Tadorna tadornoides*	2008	Birdlife Echuca, 2008
1	Creek	Australian Shelduck	*Tadorna tadornoides*	2012	Australian Ecosystems
2	Creek	Australian Shelduck	*Tadorna tadornoides*	2012	Australian Ecosystems
2	Creek	Australian Shelduck	*Tadorna tadornoides*	2005	Birds Australia
3a	Creek	Australian Shelduck	*Tadorna tadornoides*	2008	Birds Australia
1	Heppell	Australian White Ibis	*Threskiornis molucca*	1972	VBA
1	Longmore	Australian White Ibis	*Threskiornis molucca*	2013	Austral; Australian Ecosystems; VBA; Ayres et al.,
1	Splatts	Australian White Ibis	*Threskiornis molucca*	2013	Australian Ecosystems; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Ayres et al.,

Reach	Location	Common Name	Scientific Name	Most recent record	Source
1	Turner	Australian White Ibis	*Threskiornis molucca*	2013	Australian Ecosystems; Ayres et al.,
1	Upper	Australian White Ibis	*Threskiornis molucca*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Cockatoo	Australian White Ibis	*Threskiornis molucca*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Australian Ecosystems; Ayres et al.,
2	Gum	Australian White Ibis	*Threskiornis molucca*	2013	Austral; VFRI, 1996; Australian Ecosystems; VBA; Ayres et al.,
2	Taylors	Australian White Ibis	*Threskiornis molucca*	2013	Birdlife Echuca, 2008; Australian Ecosystems; VBA
3a	Safe's	Australian White Ibis	*Threskiornis molucca*	2008	Birdlife Echuca, 2008
1	Creek	Australian White Ibis	*Threskiornis molucca*	2012	Birds Australia
2	Creek	Australian White Ibis	*Threskiornis molucca*	2012	Birds Australia
2	Creek	Australian White Ibis	*Threskiornis molucca*	2005	Birds Australia
3a	Creek	Australian White Ibis	*Threskiornis molucca*	2012	Birds Australia
1	Heart	Australian Wood Duck	*Chenonetta jubata*	2013	Australian Ecosystems
1	Heppell	Australian Wood Duck	*Chenonetta jubata*	2013	Austral; Australian Ecosystems; Ayres et al.,; VBA
1	Longmore	Australian Wood Duck	*Chenonetta jubata*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	Australian Wood Duck	*Chenonetta jubata*	2013	Ayres et al.,
1	Splatts	Australian Wood Duck	*Chenonetta jubata*	2013	Austral; Australian Ecosystems; Birdlife Echuca, 2009, 2010, 2012, 2013; Ayres et al.,
1	Turner	Australian Wood Duck	*Chenonetta jubata*	2013	Australian Ecosystems; Ayres et al.,
1	Upper	Australian Wood Duck	*Chenonetta jubata*	2013	Australian Ecosystems
2	Cockatoo	Australian Wood Duck	*Chenonetta jubata*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA
2	Taylors	Australian Wood Duck	*Chenonetta jubata*	2013	Austral; VBA
3a	Safe's	Australian Wood Duck	*Chenonetta jubata*	2013	Ayres et al.,
1	Creek	Australian Wood Duck	*Chenonetta jubata*	2012	Australian Ecosystems
2	Creek	Australian Wood Duck	*Chenonetta jubata*	1999	VBA
2	Creek	Australian Wood Duck	*Chenonetta jubata*	2002	Birds Australia
3a	Creek	Australian Wood Duck	*Chenonetta jubata*	2012	Birds Australia
3b	Creek	Australian Wood Duck	*Chenonetta jubata*	2012	Birds Australia
1	Heart	Azure Kingfisher	*Alcedo azurea*	2013	Austral; VBA
1	Heppell	Azure Kingfisher	*Ceyxazurea*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Longmore	Azure Kingfisher	*Alcedo azurea*	2013	Australian Ecosystems
1	Splatts	Azure Kingfisher	*Alcedo azurea*	2011	VBA; Birdlife Echuca, 2010, 2011
1	Unregulated	Azure Kingfisher	*Ceyx azurea*	2013	Ayres et al.,; VBA
1	Upper	Azure Kingfisher	*Alcedo azurea*	2013	VBA; Ayres et al.,
2	Cockatoo	Azure Kingfisher	*Alcedo azurea*	2012	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Ayres et al.,
2	Gum	Azure Kingfisher	*Alcedo azurea*	1996	VFRI, 1996
2	Taylors	Azure Kingfisher	*Alcedo azurea*	1999	VBA
1	Creek	Azure Kingfisher	*Alcedo azurea*	2012	Birds Australia
2	Creek	Azure Kingfisher	*Alcedo azurea*	2012	Birds Australia
2	Creek	Azure Kingfisher	*Alcedo azurea*	2002	Birds Australia
3a	Creek	Azure Kingfisher	*Alcedo azurea*	2005	Birds Australia
3b	Creek	Azure Kingfisher	*Alcedo azurea*	2010	Birds Australia
2	Creek	Baillon's Crake	*Porzana pusilla palustris*	2001	Birds Australia
1	Splatts	Banded Lapwing	*Vanellus tricolor*	2010	Birdlife Echuca, 2010
1	Heppell	Black Swan	*Cygnus atratus*	1969	VBA
1	Longmore	Black Swan	*Cygnus atratus*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	Black Swan	*Cygnus atratus*	1989	VBA
1	Splatts	Black Swan	*Cygnus atratus*	2013	Austral; VBA; Birdlife Echuca, 2009, 2010
1	Turner	Black Swan	*Cygnus atratus*	2013	Australian Ecosystems; Austral; VBA; Ayres et al.,
1	Upper	Black Swan	*Cygnus atratus*	2013	Australian Ecosystems; VBA; Ayres et al.,; Austral
2	Cockatoo	Black Swan	*Cygnus atratus*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VFRI, 1996; VBA; Australian Ecosystems; Ayres et al.,
2	Gum	Black Swan	*Cygnus atratus*	2013	Austral; VFRI, 1996; VBA; Ayres et al.,
2	Taylors	Black Swan	*Cygnus atratus*	2013	Birdlife Echuca, 2008; Australian Ecosystems; Ayres et al.,; VBA
3a	Safe's	Black Swan	*Cygnus atratus*	2013	Australian Ecosystems; Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Black Swan	*Cygnus atratus*	2012	Australian Ecosystems
2	Creek	Black Swan	*Cygnus atratus*	2012	Australian Ecosystems
2	Creek	Black Swan	*Cygnus atratus*	2002	Birds Australia

Reach	Location	Common Name	Scientific Name	Most recent record	Source
3a	Creek	Black Swan	*Cygnus atratus*	2012	Australian Ecosystems
1	Splatts	Black-fronted Dotterel	*Elseyornis melanops*	2011	Birdlife Echuca, 2009, 2010, 2011
1	Creek	Black-fronted Dotterel	*Elseyornis melanops*	2008	Birds Australia
1	Heppell	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Australian Ecosystems
1	Longmore	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Austral; Australian Ecosystems; Ayres et al.,
1	Splatts	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Austral; Birdlife Echuca, 2011, 2012, 2013; Ayres et al.,
1	Turner	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Australian Ecosystems; Ayres et al.,
1	Upper	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Australian Ecosystems; Ayres et al.,; Austral
2	Cockatoo	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Birdlife Echuca, pre 2009; Australian Ecosystems
2	Gum	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Australian Ecosystems
2	Taylors	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Australian Ecosystems
3a	Safe's	Black-tailed Native Hen	*Tribonyx ventralis*	2013	Austral; Australian Ecosystems; Ayres et al.,
1	Creek	Black-tailed Native Hen	*Tribonyx ventralis*	2012	Austral Research
2	Creek	Black-tailed Native Hen	*Tribonyx ventralis*	2012	Australian Ecosystems
2	Creek	Black-tailed Native Hen	*Tribonyx ventralis*	2002	Birds Australia
3a	Creek	Black-tailed Native Hen	*Tribonyx ventralis*	2012	Australian Ecosystems
2	Cockatoo	Black-winged Stilt	*Himantopus himantopus*	2012	Birdlife Echuca, pre 2009, 2012; VBA
2	Creek	Black-winged Stilt	*Himantopus himantopus*	1999	Birds Australia
1	Longmore	Brolga	*Grus rubicunda*	1999	VBA
1	Phyland	Brolga	*Grus rubicunda*	1999	VBA
1	Splatts	Brolga	*Grus rubicunda*	2005	VBA
2	Creek	Brolga	*Grus rubicunda*	1982	VBA
2	Cockatoo	Caspian Tern	*Sterna caspia*	2012	Birdlife Echuca, pre 2009, 2012
2	Creek	Caspian Tern	*Hydroprogne caspia*	2002	Birds Australia
1	Heppell	Cattle Egret	*Ardea ibis*	1974	VBA
2	Cockatoo	Cattle Egret	*Ardea ibis*	prior to 2009	Birdlife Echuca, pre 2009
2	Taylors	Cattle Egret	*Ardea ibis*	1998	VBA
2	Creek	Cattle Egret	*Ardea ibis*	2002	Birds Australia
2	Creek	Chestnut Teal	*Anas castanea*	1999	Birds Australia
3a	Creek	Chestnut Teal	*Anas castanea*	2012	Birds Australia
2	Creek	Common Greenshank	*Tringa nebularia*	1999	Birds Australia
1	Creek	Darter	*Anhinga novaehollandiae*	2012	Birds Australia
2	Creek	Darter	*Anhinga novaehollandiae*	2012	Birds Australia
2	Creek	Darter	*Anhinga novaehollandiae*	2002	Birds Australia
3a	Creek	Darter	*Anhinga novaehollandiae*	2012	Birds Australia
1	Heppell	Dusky Moorhen	*Gallinula tenebrosa*	2013	Austral; Australian Ecosystems
1	Longmore	Dusky Moorhen	*Gallinula tenebrosa*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	Dusky Moorhen	*Gallinula tenebrosa*	1988	VBA
1	Splatts	Dusky Moorhen	*Gallinula tenebrosa*	2013	Austral; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013
1	Turner	Dusky Moorhen	*Gallinula tenebrosa*	1988	VBA
1	Upper	Dusky Moorhen	*Gallinula tenebrosa*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Cockatoo	Dusky Moorhen	*Gallinula tenebrosa*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VFRI, 1996; VBA; Australian Ecosystems
2	Gum	Dusky Moorhen	*Gallinula tenebrosa*	2013	VFRI, 1996; Australian Ecosystems; VBA
2	Taylors	Dusky Moorhen	*Gallinula tenebrosa*	2013	Birdlife Echuca, 2008; Australian Ecosystems; VBA
3a	Safe's	Dusky Moorhen	*Gallinula tenebrosa*	2013	Australian Ecosystems; Birdlife Echuca, 2008
1	Creek	Dusky Moorhen	*Gallinula tenebrosa*	2012	Birds Australia
2	Creek	Dusky Moorhen	*Gallinula tenebrosa*	2012	Birds Australia
2	Creek	Dusky Moorhen	*Gallinula tenebrosa*	2005	Birds Australia
3a	Creek	Dusky Moorhen	*Gallinula tenebrosa*	2012	Birds Australia
3b	Creek	Dusky Moorhen	*Gallinula tenebrosa*	2012	Birds Australia
1	Heart	Eastern Great Egret	*Ardea alba*	2013	Australian Ecosystems
1	Heppell	Eastern Great Egret	*Ardea alba*	2013	Australian Ecosystems
1	Longmore	Eastern Great Egret	*Ardea alba*	2013	Australian Ecosystems
1	Splatts	Eastern Great Egret	*Ardea modesta*	1991	VBA; Birdlife Echuca, 2010, 2011, 2012, 2013; Ayres et al.,
1	Turner	Eastern Great Egret	*Ardea alba*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Upper	Eastern Great Egret	*Ardea alba*	2013	Australian Ecosystems; VBA
2	Cockatoo	Eastern Great Egret	*Ardea alba*	2013	Birdlife Echuca, 2010, 2011; Australian Ecosystems; VBA
2	Gum	Eastern Great Egret	*Ardea alba*	1989	VBA

Reach	Location	Common Name	Scientific Name	Most recent record	Source
2	Taylors	Eastern Great Egret	*Ardea alba*	2013	Australian Ecosystems; VBA
3a	Safe's	Eastern Great Egret	*Ardea alba*	2013	Australian Ecosystems; Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Eastern Great Egret	*Ardea modesta*	2012	Australian Ecosystems
2	Creek	Eastern Great Egret	*Ardea modesta*	2012	Australian Ecosystems
2	Creek	Eastern Great Egret	*Ardea modesta*	2005	Birds Australia
3a	Creek	Eastern Great Egret	*Ardea modesta*	2012	Birds Australia
3b	Creek	Eastern Great Egret	*Ardea modesta*	2001	Birds Australia
1	Heart	Egret sp.		2013	Ayres et al.,
1	Splatts	Egret sp.		2013	Ayres et al.,
1	Turner	Egret sp.		2013	Ayres et al.,
2	Gum	Egret sp.		2013	Ayres et al.,
2	Taylors	Egret sp.		2013	Ayres et al.,
3a	Safe's	Egret sp.			Ayres et al.,
1	Heart	Eurasian Coot	*Fulica atra*	2013	Ayres et al.,
1	Heppell	Eurasian Coot	*Fulica atra*	1967	VBA
1	Longmore	Eurasian Coot	*Fulica atra*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	Eurasian Coot	*Fulica atra*	1989	VBA
1	Splatts	Eurasian Coot	*Fulica atra*	2013	Australian Ecosystems; Birdlife Echuca, 2013; Ayres et al.,
1	Turner	Eurasian Coot	*Fulica atra*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Upper	Eurasian Coot	*Fulica atra*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Cockatoo	Eurasian Coot	*Fulica atra*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Australian Ecosystems; Ayres et al.,
2	Gum	Eurasian Coot	*Fulica atra*	2013	VBA; Ayres et al.,
2	Taylors	Eurasian Coot	*Fulica atra*	2013	Birdlife Echuca, 2008; Australian Ecosystems; Ayres et al.,
3a	Safe's	Eurasian Coot	*Fulica atra*	2013	Australian Ecosystems; Ayres et al.,
1	Creek	Eurasian Coot	*Fulica atra*	2012	Australian Ecosystems
2	Creek	Eurasian Coot	*Fulica atra*	2012	Australian Ecosystems
2	Creek	Eurasian Coot	*Fulica atra*	2000	Birds Australia
3a	Creek	Eurasian Coot	*Fulica atra*	2012	Australian Ecosystems
1	Turner	Glossy Ibis	*Plegadis falcinellus*	1992	VBA
2	Gum	Glossy Ibis	*Plegadis falcinellus*	2013	Australian Ecosystems
2	Creek	Glossy Ibis	*Plegadis falcinellus*	2012	Australian Ecosystems
1	Longmore	Great Cormorant	*Phalacrocorax carbo*	1989	VBA
1	Splatts	Great cormorant	*Phalacrocorax carbo*	1992	VBA; Birdlife Echuca, 2009, 2012, 2013
1	Turner	Great Cormorant	*Phalacrocorax carbo*	2013	Australian Ecosystems
1	Upper	Great Cormorant	*Phalacrocorax carbo*	1993	VBA
2	Cockatoo	Great Cormorant	*Phalacrocorax carbo*	2012	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA
2	Gum	Great Cormorant	*Phalacrocorax carbo*	1993	VBA
2	Taylors	Great Cormorant	*Phalacrocorax carbo*	2013	Australian Ecosystems; VBA
3a	Safe's	Great Cormorant	*Phalacrocorax carbo*	2013	Australian Ecosystems; Birdlife Echuca, 2008
1	Creek	Great Cormorant	*Phalacrocorax carbo*	2012	Australian Ecosystems
2	Creek	Great Cormorant	*Phalacrocorax carbo*	2002	Birds Australia
3a	Creek	Great Cormorant	*Phalacrocorax carbo*	2012	Birds Australia
1	Upper	Great Crested Grebe	*Podiceos cristatus*	1993	VBA
2	Creek	Great Crested Grebe	*Podiceps cristatus*	1995	VBA
3a	Safe's	Great Egret	*Ardea modesta*	2013	Ayres et al.,
2	Cockatoo	Great-crested Grebe	*Podiceps cristatus*	2012	Birdlife Echuca, 2010, 2012; VBA
1	Heppell	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems
1	Longmore	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems
1	Splatts	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013
1	Turner	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems
1	Unregulated	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems
1	Upper	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems; VBA
2	Cockatoo	Grey Teal	*Anas gracilis*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Australian Ecosystems
2	Gum	Grey Teal	*Anas gracilis*	2013	Australian Ecosystems
2	Taylors	Grey Teal	*Anas gracilis*	2013	Birdlife Echuca, 2008; Australian Ecosystems; VBA
1	Creek	Grey Teal	*Anas gracilis*	2012	Australian Ecosystems
2	Creek	Grey Teal	*Anas gracilis*	2012	Australian Ecosystems

Reach	Location	Common Name	Scientific Name	Most recent record	Source
2	Creek	Grey Teal	*Anas gracilis*	2005	Birds Australia
3a	Creek	Grey Teal	*Anas gracilis*	2012	Birds Australia
1	Longmore	Gull-billed Tern	*Gelochelidon nilotica*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Longmore	Hardhead	*Aythya australis*	2013	Ayres et al.,; Australian Ecosystems
1	Turner	Hardhead	*Aythya australis*	2013	Ayres et al.,
2	Cockatoo	Hardhead	*Aythya australis*	2013	Birdlife Echuca, 2011; Australian Ecosystems
2	Creek	Hardhead	*Aythya australis*	2012	Australian Ecosystems
2	Cockatoo	Hoary-headed Grebe	*Poliocephalus poliocephalus*	2012	Birdlife Echuca, 2009, 2012; VBA
2	Creek	Hoary-headed Grebe	*Poliocephalus poliocephalus*	2001	Birds Australia
3a	Creek	Hoary-headed Grebe	*Poliocephalus poliocephalus*	2005	Birds Australia
1	Splatts	Inland Dotterel	*Charadrius australis*	2007	VBA
1	Heppell	Intermediate Egret	*Ardea intermedia*	1974	VBA
1	Longmore	Intermediate Egret	*Ardea intermedia*	1989	VBA
2	Cockatoo	Intermediate Egret	*Ardea intermedia*	2012	Birdlife Echuca, 2012
2	Creek	Intermediate Egret	*Ardea intermedia*	2001	Birds Australia
3a	Creek	Intermediate Egret	*Ardea intermedia*	2011	Birds Australia
2	Taylors	Latham's Snipe	*Gallinago hardwickii*	1998	VBA
3a	Creek	Little Bittern	*Ixobrychus dubius*	2000	Birds Australia
1	Heppell	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Australian Ecosystems
1	Longmore	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Ayres et al.,
1	Splatts	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Australian Ecosystems; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Ayres et al.,
1	Turner	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Australian Ecosystems; Ayres et al.,
1	Unregulated	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Ayres et al.,
1	Upper	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Cockatoo	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Australian Ecosystems; VBA; Ayres et al.,
2	Gum	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Taylors	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Ayres et al.,; VBA
3a	Safe's	Little Black Cormorant	*Phalacrocorax sulcirostris*	2013	Australian Ecosystems; Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Little Black Cormorant	*Phalacrocorax sulcirostris*	2012	Birds Australia
2	Creek	Little Black Cormorant	*Phalacrocorax sulcirostris*	2012	Birds Australia
2	Creek	Little Black Cormorant	*Phalacrocorax sulcirostris*	2005	Birds Australia
3a	Creek	Little Black Cormorant	*Phalacrocorax sulcirostris*	2012	Birds Australia
3b	Creek	Little Black Cormorant	*Phalacrocorax sulcirostris*	2012	Birds Australia
1	Heart	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Australian Ecosystems
1	Heppell	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Australian Ecosystems
1	Longmore	Little Pied Cormorant	*Microcarbo melanoleucos*	2013	VBA; Ayres et al.,
1	Phyland	Little Pied Cormorant	*Phalacrocorax melanoleucos*	1989	VBA
1	Splatts	Little Pied Cormorant	*Microcarbo melanoleucos*	2013	VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Ayres et al.,
1	Turner	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Unregulated	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Ayres et al.,
1	Upper	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Cockatoo	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Birdlife Echuca, 2009, 2010 , 2011, 2012; Australian Ecosystems; VBA; Ayres et al.,
2	Gum	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Australian Ecosystems; VBA
2	Taylors	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2008	Birdlife Echuca, 2008
3a	Safe's	Little Pied Cormorant	*Phalacrocorax melanoleucos*	2013	Australian Ecosystems; Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Little Pied Cormorant	*Microcarbo melanoleucos*	2012	Birds Australia
2	Creek	Little Pied Cormorant	*Microcarbo melanoleucos*	2012	Birds Australia
2	Creek	Little Pied Cormorant	*Microcarbo melanoleucos*	2009	Birds Australia
3a	Creek	Little Pied Cormorant	*Microcarbo melanoleucos*	2012	Birds Australia
3b	Creek	Little Pied Cormorant	*Microcarbo melanoleucos*	2010	Birds Australia
1	Heppell	Masked lapwing	*Vanellus miles*	1950	VBA
1	Longmore	Masked Lapwing	*Vanellus miles*	2013	VBA; Ayres et al.,
1	Splatts	Masked lapwing	*Vanellus miles*	1992	VBA; Birdlife Echuca, 2009, 2010, 2011, 2012
1	Turner	Masked Lapwing	*Vanellus miles*	1992	VBA
1	Upper	Masked Lapwing	*Vanellus miles*	2013	Ayres et al.,
2	Cockatoo	Masked Lapwing	*Vanellus miles*	2013	Birdlife Echuca, 2009, 2010, 2012, 2013; VBA
2	Taylors	Masked lapwing	*Vanellus miles*	2013	Australian Ecosystems; VBA

Reach	Location	Common Name	Scientific Name	Most recent record	Source
1	Creek	Masked Lapwing	*Vanellus miles*	2012	Birds Australia
2	Creek	Masked Lapwing	*Vanellus miles*	2002	Birds Australia
3a	Creek	Masked Lapwing	*Vanellus miles*	2009	Birds Australia
2	Creek	Muscovy Duck	*Cairina moschata*	2012	Australian Ecosystems
2	Creek	Musk Duck	*Biziura lobata*	2001	Birds Australia
1	Heppell	Nankeen Night Heron	*Nycticorax caledonicus hillii*	1968	VBA
1	Longmore	Nankeen Night Heron	*Nycticorax caledonicus*	2013	Ayres et al.,
1	Splatts	Nankeen Night Heron	*Nycticorax caledonicus hillii*	2013	Austral; Australian Ecosystems; Birdlife Echuca, 2010, 2011, 2012; Ayres et al.,
1	Turner	Nankeen Night Heron	*Nycticorax caledonicus hillii*	2013	Australian Ecosystems; Ayres et al.,
1	Unregulated	Nankeen Night Heron	*Nycticorax caledonicus hillii*	2013	Australian Ecosystems; Ayres et al.,
1	Upper	Nankeen Night Heron	*Nycticorax caledonicus hillii*	2013	Australian Ecosystems; Ayres et al.,
2	Cockatoo	Nankeen Night Heron	*Nycticorax caledonicus hillii*	2013	Birdlife Echuca, 2011; Australian Ecosystems; VBA; Ayres et al.,
3a	Safe's	Nankeen Night Heron	*Nycticorax caledonicus hillii*	2013	Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Nankeen Night Heron	*Nycticorax caledonicus australasiae*	2012	Australian Ecosystems
2	Creek	Nankeen Night Heron	*Nycticorax caledonicus australasiae*	1999	VBA
2	Creek	Nankeen Night Heron	*Nycticorax caledonicus australasiae*	2001	Birds Australia
3a	Creek	Nankeen Night Heron	*Nycticorax caledonicus australasiae*	2007	Birds Australia
2	Taylors	Nankeen Night Herron	*Nycticorax caledonicus hillii*	2013	Australian Ecosystems
2	Creek	Northern Mallard	*Anas platyrhynchos*	2012	Australian Ecosystems
2	Creek	Northern Mallard	*Anas platyrhynchos*	2002	Birds Australia
1	Heart	Pacific Black Duck	*Anas superciliosa*	2013	Australian Ecosystems; VBA
1	Heppell	Pacific Black Duck	*Anas superciliosa*	2013	Australian Ecosystems; VBA
1	Longmore	Pacific Black Duck	*Anas superciliosa*	2013	Austral; Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	Pacific Black Duck	*Anas superciliosa*	2013	Australian Ecosystems; VBA
1	Splatts	Pacific Black Duck	*Anas superciliosa*	2013	Austral; Australian Ecosystems; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Ayres et al.,
1	Turner	Pacific Black Duck	*Anas superciliosa*	*2013*	Australian Ecosystems; VBA; Ayres et al.,
1	Unregulated	Pacific Black Duck	*Anas superciliosa*	2013	Australian Ecosystems; VBA
1	Upper	Pacific Black Duck	*Anas superciliosa*	2013	Australian Ecosystems; VBA; Ayres et al.,; Austral
2	Cockatoo	Pacific Black Duck	*Anas superciliosa*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Australian Ecosystems; VBA
2	Gum	Pacific Black Duck	*Anas superciliosa*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Taylors	Pacific Black Duck	*Anas superciliosa*	2013	Birdlife Echuca, 2008; Australian Ecosystems; Ayres et al.,; VBA
3a	Safe's	Pacific Black Duck	*Anas superciliosa*	2013	Australian Ecosystems; Ayres et al.,
1	Creek	Pacific Black Duck	*Anas superciliosa*	2012	Birds Australia
2	Creek	Pacific Black Duck	*Anas superciliosa*	2012	Birds Australia
2	Creek	Pacific Black Duck	*Anas superciliosa*	2005	Birds Australia
3a	Creek	Pacific Black Duck	*Anas superciliosa*	2012	Birds Australia
3b	Creek	Pacific Black Duck	*Anas superciliosa*	2012	Birds Australia
1	Longmore	Pied Cormorant	*Phalacrocorax varius*	2013	Austral
1	Splatts	Pied Cormorant	*Phalacrocorax varius*	2013	Austral; Ayres et al.,
1	Turner	Pied Cormorant	*Phalacrocorax varius*	2013	VBA; Ayres et al.,
1	Unregulated	Pied Cormorant	*Phalacrocorax varius*	2013	Ayres et al.,
1	Upper	Pied Cormorant	*Phalacrocorax varius*	2013	VBA; Austral
2	Cockatoo	Pied Cormorant	*Phalacrocorax varius*	2013	Australian Ecosystems
2	Taylors	Pied Cormorant	*Phalacrocorax varius*	2013	Australian Ecosystems
3a	Safe's	Pied Cormorant	*Phalacrocorax varius*	2013	Austral; Ayres et al.,
1	Creek	Pied Cormorant	*Phalacrocorax varius*	2012	Austral Research
2	Creek	Pied Cormorant	*Phalacrocorax varius*	2012	Australian Ecosystems
2	Creek	Pied Cormorant	*Phalacrocorax varius*	2001	Birds Australia
3a	Creek	Pied Cormorant	*Phalacrocorax varius*	2007	Birds Australia
1	Creek	Pink-eared Duck	*Malacorhynchus membranaceus*	2013	Australian Ecosystems
1	Longmore	Plumed Whistling-duck	*Dendrocygna eytoni*	2013	Australian Ecosystems; Ayres et al.,
1	Heart	Purple Swamphen	*Porphyrio porphyrio*	2013	Australian Ecosystems; Ayres et al.,
1	Heppell	Purple Swamphen	*Porphyrio porphyrio*	2013	Australian Ecosystems; Ayres et al.,; VBA
1	Longmore	Purple Swamphen	*Porphyrio porphyrio*	2013	Austral; Australian Ecosystems; VBA; Ayres et al.,

Reach	Location	Common Name	Scientific Name	Most recent record	Source
1	Phyland	Purple Swamphen	*Porphyrio porphyrio*	2013	Austral; Australian Ecosystems; VBA; Ayres et al.,
1	Splatts	Purple Swamphen	*Porphyrio porphyrio*	2013	Australian Ecosystems; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013
1	Turner	Purple Swamphen	*Porphyrio porphyrio*	2013	Australian Ecosystems; Ayres et al.,
1	Unregulated	Purple Swamphen	*Porphyrio porphyrio*	2013	Ayres et al.,
1	Upper	Purple Swamphen	*Porphyrio porphyrio*	2013	Australian Ecosystems; VBA; Ayres et al.,; Austral
2	Cockatoo	Purple Swamphen	*Porphyrio porphyrio*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VFRI, 1996; Australian Ecosystems; VBA; Ayres et al.,
2	Gum	Purple Swamphen	*Porphyrio porphyrio*	2013	VFRI, 1996; VBA; Ayres et al.,
2	Taylors	Purple Swamphen	*Porphyrio porphyrio*	2013	Birdlife Echuca, 2008; Australian Ecosystems; Ayres et al.,; VBA
3a	Safe's	Purple Swamphen	*Porphyrio porphyrio*	2013	Australian Ecosystems; Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Purple Swamphen	*Porphyrio porphyrio*	2012	Birds Australia
2	Creek	Purple Swamphen	*Porphyrio porphyrio*	2012	Birds Australia
2	Creek	Purple Swamphen	*Porphyrio porphyrio*	2002	Birds Australia
3a	Creek	Purple Swamphen	*Porphyrio porphyrio*	2012	Birds Australia
3b	Creek	Purple Swamphen	*Porphyrio porphyrio*	2010	Birds Australia
1	Splatts	Royal Spoonbill	*Platalea regia*	2013	VBA; Birdlife Echuca, 2009, 2012, 2013
1	Upper	Royal Spoonbill	*Platalea regia*	1982	VBA
2	Cockatoo	Royal Spoonbill	*Platalea regia*	prior to 2009	Birdlife Echuca, pre 2009
2	Taylors	Royal Spoonbill	*Platalea regia*	1998	VBA
1	Creek	Royal Spoonbill	*Platalea regia*	2011	Birds Australia
2	Creek	Royal Spoonbill	*Platalea regia*	2002	Birds Australia
3a	Creek	Royal Spoonbill	*Platalea regia*	2008	Birds Australia
1	Heart	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; VBA
1	Heppell	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; VBA
1	Longmore	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems
1	Splatts	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; VBA; Birdlife Echuca, 2010, 2011
1	Turner	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems
1	Unregulated	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; Ayres et al.,; VBA
1	Upper	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; VBA
2	Cockatoo	Sacred Kingfisher	*Todiramphus sanctus*	2013	Birdlife Echuca, 2010, 2011, 2012; Australian Ecosystems; VBA
2	Gum	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; VBA
2	Taylors	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; VBA
3a	Safe's	Sacred Kingfisher	*Todiramphus sanctus*	2013	Australian Ecosystems; Ayres et al.,
1	Creek	Sacred Kingfisher	*Todiramphus sanctus*	2012	Australian Ecosystems
2	Creek	Sacred Kingfisher	*Todiramphus sanctus*	2012	Australian Ecosystems
2	Creek	Sacred Kingfisher	*Todiramphus sanctus*	2012	Birds Australia
3a	Creek	Sacred Kingfisher	*Todiramphus sanctus*	2012	Birds Australia
3b	Creek	Sacred Kingfisher	*Todiramphus sanctus*	2012	Birds Australia
2	Creek	Silver Gull	*Chroicocephalus novaehollandiae*	2000	Birds Australia
3a	Creek	Silver Gull	*Chroicocephalus novaehollandiae*	2000	Birds Australia
2	Taylors	Spotted Harrier	*Circus assimilis*	2001	VBA
2	Creek	Spotted Harrier	*Circus assimilis*	2001	Birds Australia
1	Heart	Straw-necked Ibis	*Threskiornis spinicollis*	1992	VBA
1	Heppell	Straw-necked Ibis	*Threskiornis spinicollis*	2013	Australian Ecosystems; Ayres et al.,; VBA
1	Longmore	Straw-necked Ibis	*Threskiornis spinicollis*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Splatts	Straw-necked Ibis	*Threskiornis spinicollis*	2013	Austral; Australian Ecosystems; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013
1	Turner	Straw-necked Ibis	*Threskiornis spinicollis*	2013	Australian Ecosystems; Ayres et al.,
1	Unregulated	Straw-necked Ibis	*Threskiornis spinicollis*	2013	Australian Ecosystems; VBA
1	Upper	Straw-necked Ibis	*Threskiornis spinicollis*	2013	VBA; Ayres et al.,
2	Cockatoo	Straw-necked Ibis	*Threskiornis spinicollis*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Ayres et al.,
2	Taylors	Straw-necked Ibis	*Threskiornis spinicollis*	1998	VBA
3a	Safe's	Straw-necked Ibis	*Threskiornis spinicollis*	2013	Birdlife Echuca, 2008; Ayres et al.,
1	Creek	Straw-necked Ibis	*Threskiornis spinicollis*	2012	Birds Australia
2	Creek	Straw-necked Ibis	*Threskiornis spinicollis*	2012	Birds Australia

Reach	Location	Common Name	Scientific Name	Most recent record	Source
2	Creek	Straw-necked Ibis	*Threskiornis spinicollis*	2005	Birds Australia
3a	Creek	Straw-necked Ibis	*Threskiornis spinicollis*	2012	Birds Australia
3b	Creek	Straw-necked Ibis	*Threskiornis spinicollis*	2008	Birds Australia
1	Longmore	Swamp Harrier	*Circus approximans*	2013	Australian Ecosystems
1	Splatts	Swamp Harrier	*Circus approximans*	2013	Austral; Australian Ecosystems; VBA
1	Turner	Swamp Harrier	*Circus approximans*	2013	Austral
2	Cockatoo	Swamp Harrier	*Circus approximans*	2013	Birdlife Echuca, 2010, 2011, 2012, 2013; VBA
2	Taylors	Swamp Harrier	*Circus approximans*	1998	VBA
3a	Safe's	Swamp Harrier	*Circus approximans*	2008	Birdlife Echuca, 2008
1	Creek	Swamp Harrier	*Circus approximans*	2012	Australian Ecosystems
2	Creek	Swamp Harrier	*Circus approximans*	2008	Birds Australia
2	Creek	Swamp Harrier	*Circus approximans*	2002	Birds Australia
3a	Creek	Swamp Harrier	*Circus approximans*	2012	Birds Australia
2	Cockatoo	Whiskered Tern	*Childonias hybridus*	2012	Birdlife Echuca, 2012; VBA
2	Creek	Whiskered Tern	*Chlidonias hybridus javanicus*	2008	Birds Australia
2	Creek	Whiskered Tern	*Chlidonias hybridus javanicus*	1995	Birds Australia
3a	Creek	Whiskered Tern	*Chlidonias hybridus javanicus*	2008	Birds Australia
1	Heppell	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	1950	VBA
1	Splatts	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2010	Birdlife Echuca, 2010
1	Turner	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2013	Austral
2	Cockatoo	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	prior to 2009	Birdlife Echuca, pre 2009
3a	Safe's	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2008	Birdlife Echuca, 2008
1	Creek	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2008	Birds Australia
2	Creek	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2000	Birds Australia
3a	Creek	White-bellied Sea-Eagle	*Haliaeetus leucogaster*	2012	Birds Australia
3a	Safe's	White-face Heron	*Egretta novahollandiae*	2013	Ayres et al.,
1	Heppell	White-faced Heron	*Egretta novaehollandiae*	2013	Austral; Australian Ecosystems
1	Longmore	White-faced Heron	*Egretta novaehollandiae*	2013	Australian Ecosystems; VBA; Ayres et al.,
1	Phyland	White-faced Heron	*Egretta novaehollandiae*	2013	Ayres et al.,
1	Splatts	White-faced Heron	*Egretta novaehollandiae*	2013	Australian Ecosystems; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; Ayres et al.,
1	Turner	White-faced Heron	*Egretta novaehollandiae*	2013	Australian Ecosystems; Ayres et al.,
1	Unregulated	White-faced Heron	*Egretta novaehollandiae*	2013	Australian Ecosystems;
1	Upper	White-faced Heron	*Egretta novaehollandiae*	2013	Australian Ecosystems; VBA; Ayres et al.,
2	Cockatoo	White-faced Heron	*Egretta novaehollandiae*	2013	Birdlife Echuca, 2009, 2010, 2011, 2012, 2013; VBA; Ayres et al.,
2	Gum	White-faced Heron	*Egretta novaehollandiae*	2013	Ayres et al.,
2	Taylors	White-faced Heron	*Egretta novaehollandiae*	2013	Australian Ecosystems; Ayres et al.,; VBA
1	Creek	White-faced Heron	*Egretta novaehollandiae*	2012	Birds Australia
2	Creek	White-faced Heron	*Egretta novaehollandiae*	2012	Birds Australia
2	Creek	White-faced Heron	*Egretta novaehollandiae*	2002	Birds Australia
3a	Creek	White-faced Heron	*Egretta novaehollandiae*	2009	Birds Australia
3b	Creek	White-faced Heron	*Egretta novaehollandiae*	2010	Birds Australia
1	Heppell	White-necked Heron	*Ardea pacifica*	1969	VBA
1	Longmore	White-necked Heron	*Ardea pacifica*	2013	Australian Ecosystems; Ayres et al.,
1	Splatts	White-necked Heron	*Ardea pacifica*	2012	Birdlife Echuca, 2008
1	Turner	White-necked Heron	*Ardea pacifica*	2013	Ayres et al.,
1	Upper	White-necked Heron	*Ardea pacifica*	2013	Australian Ecosystems; VBA
2	Cockatoo	White-necked Heron	*Ardea pacifica*	2011	Birdlife Echuca, 2011
2	Gum	White-necked Heron	*Ardea pacifica*	2013	Australian Ecosystems
2	Taylors	White-necked Heron	*Ardea pacifica*	2013	Australian Ecosystems
3a	Safe's	White-necked Heron	*Ardea pacifica*	2013	Birdlife Echuca, 2008; Ayres et al.,
1	Creek	White-necked Heron	*Ardea pacifica*	2011	Birds Australia
2	Creek	White-necked Heron	*Ardea pacifica*	2012	Australian Ecosystems
2	Creek	White-necked Heron	*Ardea pacifica*	2002	Birds Australia
3a	Creek	White-necked Heron	*Ardea pacifica*	2008	Birds Australia
1	Longmore	Yellow-billed Spoonbill	*Pltalea flavipes*	1989	VBA; Ayres et al.,
1	Splatts	Yellow-billed Spoonbill	*Platalea flavipes*	2013	Austral; VBA; Birdlife Echuca, 2009, 2010, 2011, 2012, 2013
1	Turner	Yellow-billed Spoonbill	*Platalea flavipes*	2013	Australian Ecosystems
1	Upper	Yellow-billed Spoonbill	*Platalea flavipes*	2013	VBA; Ayres et al.,; Austral
2	Cockatoo	Yellow-billed Spoonbill	*Platalea flavipes*	2012	Birdlife Echuca, 2010, 2011, 2012; VBA
2	Taylors	Yellow-billed Spoonbill	*Platalea flavipes*	1998	VBA
1	Creek	Yellow-billed Spoonbill	*Platalea flavipes*	2012	Birds Australia
2	Creek	Yellow-billed Spoonbill	*Platalea flavipes*	2012	Australian Ecosystems

Reach	Location	Common Name	Scientific Name	Most recent record	Source
2	Creek	Yellow-billed Spoonbill	*Platalea flavipes*	2002	Birds Australia
3a	Creek	Yellow-billed Spoonbill	*Platalea flavipes*	2000	VBA
Water dependent reptiles					
1	Heart	Broad-shelled Turtle	*Chelodina expansa*	2013	Austral
1	Heppell	Broad-shelled Turtle	*Chelodina expansa*	2013	Austral
1	Longmore	Broad-shelled Turtle	*Chelodina expansa*	2013	Austral; Howard et al., 2013
1	Phyland	Broad-shelled Turtle	*Chelodina expansa*	2014	Sharpe et al.,
1	Splatts	Broad-shelled Turtle	*Chelodina expansa*	2013	Austral; VBA; Howard et al., 2013
1	Turner	Broad-shelled Turtle	*Chelodina expansa*	2013	Austral; Howard et al., 2013
1	Upper	Broad-shelled Turtle	*Chelodina expansa*	2014	Sharpe et al.,
2	Cockatoo	Broad-shelled Turtle	*Chelodina expansa*	2014	Sharpe et al.,
2	Gum	Broad-shelled Turtle	*Chelodina expansa*	2014	Sharpe et al.,
2	Taylors	Broad-shelled Turtle	*Chelodina expansa*	2013	Austral
3a	Safe's	Broad-shelled Turtle	*Chelodina expansa*	2013	Austral
3a	Creek	Broad-shelled Turtle	*Chelodina expansa*	1991	VBA
3b	Creek	Broad-shelled Turtle	*Chelodina expansa*	2014	Sharpe et al.,
1	Heart	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral
1	Heppell	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral
1	Longmore	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral; Howard et al., 2013
1	Phyland	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral; Howard et al., 2013
1	Splatts	Eastern Long-necked Turtle	*Chelodina longicollis*	2014	Sharpe et al.,
1	Turner	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral; Howard et al., 2013
1	Unregulated	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral; VBA
1	Upper	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral; VBA
2	Cockatoo	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral 2013; VBA; Howard et al., 2013
2	Gum	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral; VBA
2	Taylors	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral; VBA
3a	Safe's	Eastern Long-necked Turtle	*Chelodina longicollis*	2013	Austral
1	Creek	Eastern Long-necked Turtle	*Chelodina longicollis*	2012	Austral Research
2	Creek	Eastern Long-necked Turtle	*Chelodina longicollis*	2012	Australian Ecosystems
3a	Creek	Eastern Long-necked Turtle	*Chelodina longicollis*	1993	VBA
1	Heppell	Murray River Turtle	*Emydura macquarii*	2013	Austral
1	Longmore	Murray River Turtle	*Emydura macquarii*	2013	Austral; Howard et al., 2013
1	Phyland	Murray River Turtle	*Emydura macquarii*	2013	Austral; Australian Ecosystems; Howard et al., 2013
1	Splatts	Murray River Turtle	*Emydura macquarii*	2014	Sharpe, et al.,
1	Turner	Murray River Turtle	*Emydura macquarii*	2013	Austral; Howard et al., 2013
1	Upper	Murray River Turtle	*Emydura macquarii*	2014	Sharpe, et al.,
2	Cockatoo	Murray River Turtle	*Emydura macquarii*	1996	VBA; Howard et al., 2013
2	Gum	Murray River Turtle	*Emydura macquarii*	2013	Austral; VBA
2	Taylors	Murray River Turtle	*Emydura macquarii*	2013	Austral
3a	Safe's	Murray River Turtle	*Emydura macquarii*	2013	Austral
1	Creek	Murray River Turtle	*Emydura macquarii*	2012	Austral Research
3a	Creek	Murray River Turtle	*Emydura macquarii*	2014	Sharpe, et al.,
Invertebrates					
2	Creek	Murray River Spiny Crayfish	*Euastacus armatus*	U	C. Sharpe pers comm., 11 February 2015
Water dependent fauna exotic species					
1	Heart	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral
1	Heppell	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral
1	Longmore	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Phyland	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Splatts	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; Sharpe, Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; VBA; PIRVic, 2007
1	Turner	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Unregulated	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; VBA
1	Upper	Carp Gudgeon	*Hypseleotris spp.*	2013	Rehwinkel & Sharpe, 2008; Rehwinkel &

Reach	Location	Common Name	Scientific Name	Most recent record	Source
					Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; Austral
2	Cockatoo	Carp Gudgeon	*Hypseleotris spp.*	2012	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
2	Gum	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; Atlas Victorian Wildlife
2	Taylors	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
3a	Safe's	Carp Gudgeon	*Hypseleotris spp.*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Heart	Common Carp	*Cyprinus carpio*	2013	Austral
1	Heppell	Common Carp	*Cyprinus carpio*	2013	Austral
1	Longmore	Common Carp	*Cyprinus carpio*	2013	Austral; Australian Ecosystems; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Phyland	Common Carp	*Cyprinus carpio*		Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Splatts	Common Carp	*Cyprinus carpio*	2013	Austral; Australian Ecosystems; Rehwinkel & Sharpe, 2009a; Rehwinkel & Sharpe, 2009b; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Splatts	Common Carp	*Cyprinus carpio*	2013	Austral; Australian Ecosystems; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Turner	Common Carp	*Cyprinus carpio*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Unregulated	Common Carp	*Cyprinus carpio*	2013	Austral; Australian Ecosystems
1	Upper	Common Carp	*Cyprinus carpio*	2013	Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; Australian Ecosystems; Austral
2	Cockatoo	Common Carp	*Cyprinus carpio*	2013	Austral; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
2	Gum	Common Carp	*Cyprinus carpio*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
2	Taylors	Common Carp	*Cyprinus carpio*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2012; Australian Ecosystems; VBA; PIRVic, 2007
3a	Safe's	Common Carp	*Cyprinus carpio*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Creek	Common Carp	*Cyprinus carpio*	2012	Austral Research
2	Creek	Common Carp	*Cyprinus carpio*	2012	Australian Ecosystems
2	Creek	Common Carp	*Cyprinus carpio*	1993	VBA
3b	Creek	Common Carp	*Cyprinus carpio*	1993	VBA
1	Heart	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral
1	Heppell	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral
1	Longmore	Eastern Gambusia	*Gambusia holbrooki*	2011	Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011
1	Phyland	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Splatts	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral; Rehwinkel & Sharpe, 2009;

Reach	Location	Common Name	Scientific Name	Most recent record	Source
					Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Turner	Eastern Gambusia	*Gambusia holbrooki*	2012	Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Unregulated	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral; VBA
1	Upper	Eastern Gambusia	*Gambusia holbrooki*	2013	Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; Austral
2	Cockatoo	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
2	Gum	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
2	Taylors	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
3a	Safe's	Eastern Gambusia	*Gambusia holbrooki*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Creek	Eastern Gambusia	*Gambusia holbrooki*	2012	Austral Research
2	Creek	Eastern Gambusia	*Gambusia holbrooki*	1989	VBA
3a	Creek	Eastern Gambusia	*Gambusia holbrooki*	1990	VBA
2	Creek	European Goldfinch	*Carduelis carduelis*	2002	Birds Australia
1	Heart	Goldfish	*Carasius auratus auratus*	2013	Austral
1	Heppell	Goldfish	*Carasius auratus auratus*	2013	Austral
1	Longmore	Goldfish	*Carasius auratus auratus*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Phyland	Goldfish	*Carasius auratus auratus*	2012	Austral; Rehwinkel & Sharpe, 2008; Sharpe et al., 2012
1	Splatts	Goldfish	*Carasius auratus auratus*	2013	Austral; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2012
1	Turner	Goldfish	*Carasius auratus auratus*	2013	Austral; Rehwinkel & Sharpe, 2008; Sharpe et al., 2011; Sharpe et al., 2012
1	Upper	Goldfish	*Carasius auratus auratus*	2011	Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Austral
2	Cockatoo	Goldfish	*Carasius auratus auratus*	2011	Rehwinkel & Sharpe, 2009; Sharpe et al., 2011
2	Gum	Goldfish	*Carasius auratus auratus*	2012	Rehwinkel & Sharpe, 2008; Rehwinkel et al., 2010; Sharpe et al., 2012
2	Taylors	Goldfish	*Carasius auratus auratus*	2013	Rehwinkel & Sharpe, 2009; Sharpe et al., 2011; Austral; VBA; PIRVic, 2007
3a	Safe's	Goldfish	*Carasius auratus auratus*	2013	Austral; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
1	Creek	Goldfish	*Carassius auratus*	2012	Austral Research
2	Creek	Goldfish	*Carassius auratus*	1993	VBA
3a	Creek	Goldfish	*Carassius auratus*	1990	VBA
3b	Creek	Goldfish	*Carassius auratus*	1993	VBA
3a	Safe's	Goldfish/Carp Hybrid		2007	PIRVic, 2007
1	Heart	Oriental Weatherloach	*M. anguillicaudatus*	2013	Austral
1	Heppell	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2013	Austral, 2013
1	Longmore	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2007	PIRVic, 2007
1	Phyland	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2012	Rehwinkel & Sharpe, 2008; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012
1	Splatts	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2013	Austral; Sharpe et al., 2011; Sharpe et al., 2012
1	Turner	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2008	Rehwinkel & Sharpe, 2008
1	Unregulated	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2013	Austral
1	Upper	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2011	Rehwinkel & Sharpe, 2008; Rehwinkel et al., 2010; Sharpe et al., 2011; Austral

Reach	Location	Common Name	Scientific Name	Most recent record	Source
2	Cockatoo	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2013	Austral; PIRVic, 2007
2	Gum	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2011	Sharpe et al., 2011
2	Taylors	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011; Sharpe et al., 2012; PIRVic, 2007
3a	Safe's	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; Sharpe et al., 2011
1	Creek	Oriental Weatherloach	*Misgurnus anguillicaudatus*	2012	Austral Research
1	Longmore	Redfin	*Perca fluviatilis*	2013	Austral; Rehwinkel & Sharpe, 2008; Rehwinkel & Sharpe, 2009; Rehwinkel et al., 2010; PIRVic, 2007
1	Phyland	Redfin	*Perca fluviatilis*	2007	Austral; PIRVic, 2007
1	Splatts	Redfin	*Perca fluviatilis*	2013	Austral, 2013; Rehwinkel & Sharpe, 2008
1	Turner	Redfin	*Perca fluviatilis*	2008	Rehwinkel & Sharpe, 2008
1	Upper	Redfin	*Perca fluviatilis*	2010	Rehwinkel et al., 2010; Austral
2	Cockatoo	Redfin	*Perca fluviatilis*	2008	Rehwinkel & Sharpe, 2008
2	Taylors	Redfin	*Perca fluviatilis*	1993	VBA
3a	Safe's	Redfin	*Perca fluviatilis*	2011	Sharpe et al., 2011
1	Creek	Redfin	*Perca fluviatilis*	2012	Austral Research
2	Creek	Redfin	*Perca fluviatilis*	1993	VBA
3a	Creek	Redfin	*Perca fluviatilis*	1990	VBA
3b	Creek	Redfin	*Perca fluviatilis*	1984	VBA
2	Taylors	Tench	*Tinca tinca*	2007	PIRVic, 2007

Appendix 5. Flora species list

Reach	Location	Common name	Scientific name	Most recent record	Source
Native flora species					
1	Unregulated	-	*Alyogyne spp.*	2013	Australian Ecosystems
3a	Creek	Annual Bitter-cress	*Cardamine paucijuga s.l.*	1987	VBA
3a	Creek	Annual Buttercup	*Ranunculus sessiliflorus*	1987	VBA
3a	Creek	Annual Cudweed	*Euchiton sphaericus*	1987	VBA
3a	Safe's	Annual Fireweed	*Senecio glomeratus*	1987	VBA
3a	Creek	Annual Fireweed	*Senecio glomeratus*	1987	VBA
2	Cockatoo	Annual New Holland Daisy	*Vittadinia cervicularis var. cervicularis*	2013	Australian Ecosystems
2	Gum	Annual New Holland Daisy	*Vittadinia cervicularis var. cervicularis*	2013	Australian Ecosystems
2	Taylors	Annual New Holland Daisy	*Vittadinia cervicularis var. cervicularis*	2013	Australian Ecosystems
3a	Safe's	Annual New Holland Daisy	*Vittadinia cervicularis var. cervicularis*	2013	Australian Ecosystems
2	Creek	Annual New Holland Daisy	*Vittadinia cervicularis var. cervicularis*	2012	Australian Ecosystems
3a	Creek	Annual New Holland Daisy	*Vittadinia cervicularis var. cervicularis*	2012	Australian Ecosystems
3a	Creek	Austral Bugle	*Ajuga australis*	1986	VBA
3a	Creek	Austral Crane's-bill	*Geranium solanderi s.l.*	1986	VBA
3a	Creek	Australian Carrot	*Daucus glochidiatus*	1986	VBA
3a	Creek	Australian Piert	*Aphanes australiana*	2008	VBA
1	Heppell	Azolla	*Azolla sp.*	2013	Ayres et al.
1	Longmore	Azolla	*Azolla sp.*	2013	Ayres et al.
1	Turner	Azolla	*Azolla sp.*	2013	Ayres et al.
1	Upper	Azolla	*Azolla sp.*	2013	Ayres et al.
2	Cockatoo	Azolla	*Azolla sp.*	2013	Ayres et al.
3a	Safe's	Azolla	*Azolla sp.*	2013	Ayres et al.
3a	Creek	Balcarra Spear-Grass	*Austrostipa nitida*	2002	VBA
3a	Creek	Bent/Blown Grass	*Agrostis s.l. spp.*	2002	VBA
3a	Creek	Bent-grass	*Deyeuxia spp.*	1987	VBA
1	Longmore	Berrigan	*Eremophila longifolia*	2013	Australian Ecosystems
1	Phyland	Berrigan	*Eremophila longifolia*	2013	Australian Ecosystems
1	Splatts	Berrigan	*Eremophila longifolia*	2013	Australian Ecosystems
1	Turner	Berrigan	*Eremophila longifolia*	2013	Australian Ecosystems
1	Creek	Berrigan	*Eremophila longifolia*	2012	Australian Ecosystems
3a	Creek	Berrigan	*Eremophila longifolia*	1986	VBA
1	Heart	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
1	Heppell	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
1	Phyland	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
1	Splatts	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
1	Turner	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
1	Unregulated	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
1	Upper	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
2	Cockatoo	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
2	Gum	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
2	Taylors	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
3a	Safe's	Berry Saltbush	*Atriplex semibaccata*	2013	Australian Ecosystems
1	Creek	Berry Saltbush	*Atriplex semibaccata*	2012	Australian Ecosystems
2	Creek	Berry Saltbush	*Atriplex semibaccata*	2012	Australian Ecosystems
3a	Creek	Berry Saltbush	*Atriplex semibaccata*	2012	Australian Ecosystems
1	Heart	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Heppell	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Longmore	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Phyland	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Splatts	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Turner	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Unregulated	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Upper	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
2	Cockatoo	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
2	Gum	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
2	Taylors	Billabong Rush	*Juncus usitatus*	2013	Australian Ecosystems
1	Creek	Billabong Rush	*Juncus usitatus*	2012	Australian Ecosystems
2	Creek	Billabong Rush	*Juncus usitatus*	2012	Australian Ecosystems
3a	Creek	Billabong Rush	*Juncus usitatus*	2004	VBA
1	Heart	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
1	Heppell	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
1	Longmore	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
1	Phyland	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Splatts	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
1	Turner	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
1	Unregulated	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
1	Upper	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
2	Cockatoo	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
2	Gum	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
2	Taylors	Black Box	*Eucalyptus largiflorens*	2013	Australian Ecosystems
3a	Safe's	Black Box	*Eucalyptus largiflorens*	2002	VBA
1	Creek	Black Box	*Eucalyptus largiflorens*	2012	Australian Ecosystems
2	Creek	Black Box	*Eucalyptus largiflorens*	2012	Australian Ecosystems
3a	Creek	Black Box	*Eucalyptus largiflorens*	1987	VBA
1	Splatts	Black Cotton-bush	*Maireana decalvans*	2013	Australian Ecosystems
1	Unregulated	Black Cotton-bush	*Maireana decalvans*	2013	Australian Ecosystems
3a	Safe's	Black Cotton-bush	*Maireana decalvans*	2002	VBA
1	Creek	Black Cotton-bush	*Maireana decalvans s.l.*	2012	Australian Ecosystems
3a	Creek	Black Cotton-bush	*Maireana decalvans s.l.*	2002	VBA
1	Heppell	Black Roly-poly	*Sclerolaena muricata*	2013	Australian Ecosystems
1	Longmore	Black Roly-poly	*Sclerolaena muricata*	2013	Australian Ecosystems
1	Phyland	Black Roly-poly	*Sclerolaena muricata*	2013	Australian Ecosystems
1	Splatts	Black Roly-poly	*Sclerolaena muricata*	2013	Australian Ecosystems
1	Turner	Black Roly-poly	*Sclerolaena muricata*	2013	Australian Ecosystems
3a	Safe's	Black Roly-poly	*Sclerolaena muricata*	2002	VBA
1	Creek	Black Roly-poly	*Sclerolaena muricata*	2012	Australian Ecosystems
3a	Creek	Black Roly-poly	*Sclerolaena muricata*	2008	VBA
3b	Creek	Black Roly-poly	*Sclerolaena muricata*	2002	VBA
1	Heart	Black-anther Flax-lily	*Dianella admixta*	2013	Australian Ecosystems
1	Phyland	Black-anther Flax-lily	*Dianella admixta*	2013	Australian Ecosystems
3a	Creek	Black-anther Flax-lily	*Dianella revoluta s.l.*	1987	VBA
1	Phyland	Blackseed Glasswort	*Tecticornia pergranulata subsp. pergranulata*	2013	Australian Ecosystems
1	Turner	Blackseed Glasswort	*Tecticornia pergranulata subsp. pergranulata*	2013	Australian Ecosystems
1	Creek	Blackseed Glasswort	*Tecticornia pergranulata subsp. pergranulata*	2012	Australian Ecosystems
3a	Creek	Blue Heron's-bill	*Erodium crinitum*	1986	VBA
3a	Creek	Blue Rod	*Morgania glabra spp. agg.*	1986	VBA
1	Heppell	Bluish Raspwort	*Haloragis glauca f. glauca*	2013	Australian Ecosystems
1	Splatts	Bluish Raspwort	*Haloragis glauca f. glauca*	2013	Australian Ecosystems
1	Turner	Bluish Raspwort	*Haloragis glauca f. glauca*	2013	Australian Ecosystems
1	Creek	Bluish Raspwort	*Haloragis glauca f. glauca*	2012	Australian Ecosystems
2	Cockatoo	Blushing Bindweed	*Convolvulus angustissimus*	2013	Australian Ecosystems
2	Creek	Blushing Bindweed	*Convolvulus angustissimus*	2012	Australian Ecosystems
3a	Safe's	Bolboschoenus sp.	*Bolboschoenus sp.*	2013	Ayres et al.
1	Unregulated	Box Mistletoe	*Amyema miquelii*	2013	Australian Ecosystems
3a	Creek	Box Mistletoe	*Amyema miquelii*	1987	VBA
1	Upper	Bristly Love-grass	*Eragrostis setifolia*	2013	Australian Ecosystems
1	Heart	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
1	Heppell	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
1	Longmore	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
1	Phyland	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
1	Splatts	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
1	Turner	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
1	Unregulated	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
1	Upper	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
2	Cockatoo	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
2	Gum	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
2	Taylors	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
3a	Safe's	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2013	Australian Ecosystems
3a	Safe's	Bristly Wallaby-grass	*Austrodanthonia setacea*	1987	VBA
1	Creek	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2012	Australian Ecosystems
2	Creek	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2012	Australian Ecosystems
3a	Creek	Bristly Wallaby-grass	*Rytidosperma setaceum var. setaceum*	2012	Australian Ecosystems
3b	Creek	Bristly Wallaby-grass	*Rytidosperma setaceum*	2002	VBA
1	Upper	Broad-leaf Cumbungi	*Typha orientalis*	2013	Australian Ecosystems
2	Cockatoo	Broad-leaf Cumbungi	*Typha orientalis*	2013	Australian Ecosystems
2	Gum	Broad-leaf Cumbungi	*Typha orientalis*	2013	Australian Ecosystems
2	Taylors	Broad-leaf Cumbungi	*Typha orientalis*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Safe's	Broad-leaf Cumbungi	*Typha orientalis*	2013	Australian Ecosystems
2	Creek	Broad-leaf Cumbungi	*Typha orientalis*	2012	Australian Ecosystems
3a	Creek	Broad-leaf Cumbungi	*Typha orientalis*	2012	Australian Ecosystems
2	Cockatoo	Bronze Bluebell	*Wahlenbergia luteola*	2013	Australian Ecosystems
2	Creek	Bronze Bluebell	*Wahlenbergia luteola*	2012	Australian Ecosystems
3a	Creek	Brown-back Wallaby-grass	*Rytidosperma duttonianum*	2002	VBA
1	Heart	Buloke	*Allocasuarina luehmannii*	2013	Australian Ecosystems
2	Gum	Buloke	*Allocasuarina luehmannii*	2013	Australian Ecosystems
2	Creek	Buloke	*Allocasuarina luehmannii*	2012	Australian Ecosystems
3a	Creek	Buloke	*Allocasuarina luehmannii*	1986	VBA
3a	Creek	Buloke Mistletoe	*Amyema linophylla subsp. orientale*	1986	VBA
3a	Safe's	Bulrush	*Typha spp.*	1987	VBA
3a	Creek	Bulrush	*Typha spp.*	2002	VBA
1	Upper	Caltrop	*Opuntia stricta*	2001	VBA
3a	Creek	Clay Plantain	*Plantago cunninghamii*	2008	VBA
1	Heart	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Heppell	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Longmore	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Phyland	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Splatts	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Turner	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Unregulated	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Upper	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
2	Gum	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
2	Taylors	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
3a	Safe's	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2013	Australian Ecosystems
1	Creek	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2012	Australian Ecosystems
2	Creek	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2012	Australian Ecosystems
3a	Creek	Clove-strip	*Ludwigia peploides subsp. montevidensis*	2012	Australian Ecosystems
1	Heart	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Heppell	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Longmore	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Phyland	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Splatts	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Turner	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Unregulated	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Upper	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
2	Cockatoo	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
2	Gum	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
2	Taylors	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
3a	Safe's	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2013	Australian Ecosystems
1	Creek	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2012	Australian Ecosystems
2	Creek	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2012	Australian Ecosystems
3a	Creek	Common Blown-grass	*Lachnagrostis filiformis s.s.*	2012	Australian Ecosystems
1	Upper	Common Boobialla	*Myoporum insulare*	2013	Australian Ecosystems
2	Cockatoo	Common Boobialla	*Myoporum insulare*	2013	Australian Ecosystems
1	Heart	Common Cassinia	*Cassinia aculeata*	2013	Australian Ecosystems
1	Heppell	Common Cassinia	*Cassinia aculeata*	2013	Australian Ecosystems
3a	Safe's	Common Cotula	*Cotula australis*	1987	VBA
3a	Creek	Common Cotula	*Cotula australis*	1987	VBA
1	Turner	Common Cudweed	*Euchiton involucratus s.l.*	2013	Australian Ecosystems
2	Cockatoo	Common Cudweed	*Euchiton involucratus s.l.*	2013	Australian Ecosystems
1	Creek	Common Cudweed	*Euchiton involucratus s.l.*	2012	Australian Ecosystems
2	Creek	Common Cudweed	*Euchiton involucratus s.l.*	2012	Australian Ecosystems
1	Heart	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
1	Heppell	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
1	Longmore	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
1	Phyland	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
1	Splatts	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
1	Turner	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
1	Upper	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
2	Cockatoo	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
2	Gum	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
2	Taylors	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
3a	Safe's	Common Duckweed	*Lemna disperma*	2013	Australian Ecosystems
1	Creek	Common Duckweed	*Lemna disperma*	2012	Australian Ecosystems
2	Creek	Common Duckweed	*Lemna disperma*	2012	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Creek	Common Duckweed	*Lemna disperma*	2012	Australian Ecosystems
3a	Creek	Common Early Nancy	*Wurmbea dioica*	1986	VBA
1	Phyland	Common Nardoo	*Marsilea drummondii*	2013	Australian Ecosystems
1	Turner	Common Nardoo	*Marsilea drummondii*	2013	Australian Ecosystems
1	Unregulated	Common Nardoo	*Marsilea drummondii*	2013	Australian Ecosystems
1	Creek	Common Nardoo	*Marsilea drummondii*	2012	Australian Ecosystems
2	Creek	Common Nardoo	*Marsilea drummondii*	2002	VBA
3a	Creek	Common Nardoo	*Marsilea drummondii*	1987	VBA
1	Turner	Common Reed	*Phragmites australis*	2013	Australian Ecosystems; Ayres et al.
1	Upper	Common Reed	*Phragmites australis*	2013	Australian Ecosystems; Ayres et al.
2	Gum	Common Reed	*Phragmites australis*	2013	Ayres et al.
3a	Safe's	Common Reed	*Phragmites australis*	2013	Australian Ecosystems; Ayres et al.
1	Creek	Common Reed	*Phragmites australis*	2012	Australian Ecosystems
3a	Creek	Common Reed	*Phragmites australis*	2012	Australian Ecosystems
1	Unregulated	Common Sneezeweed	*Centipeda cunninghamii*	2013	Australian Ecosystems
3a	Safe's	Common Sneezeweed	*Centipeda cunninghamii*	1987	VBA
2	Creek	Common Sneezeweed	*Centipeda cunninghamii*	2002	VBA
3a	Creek	Common Sneezeweed	*Centipeda cunninghamii*	1987	VBA
1	Heppell	Common Spike-sedge	*Eleocharis acuta*	2013	Australian Ecosystems
1	Longmore	Common Spike-sedge	*Eleocharis acuta*	2013	Australian Ecosystems
1	Unregulated	Common Spike-sedge	*Eleocharis acuta*	2013	Australian Ecosystems
1	Upper	Common Spike-sedge	*Eleocharis acuta*	2013	Australian Ecosystems
2	Cockatoo	Common Spike-sedge	*Eleocharis acuta*	2013	Australian Ecosystems
2	Taylors	Common Spike-sedge	*Eleocharis acuta*	2013	Australian Ecosystems
3a	Safe's	Common Spike-sedge	*Eleocharis acuta*	2013	Australian Ecosystems
2	Creek	Common Spike-sedge	*Eleocharis acuta*	2012	Australian Ecosystems
3a	Creek	Common Spike-sedge	*Eleocharis acuta*	2012	Australian Ecosystems
3a	Creek	Common Sunray	*Triptilodiscus pygmaeus*	1986	VBA
1	Heppell	Common Swamp Wallaby-grass	*Amphibromus nervosus*	2013	Australian Ecosystems
2	Taylors	Common Swamp Wallaby-grass	*Amphibromus nervosus*	2013	Australian Ecosystems
3a	Creek	Common Swamp Wallaby-grass	*Amphibromus nervosus*	1985	VBA
1	Heart	Common Wallaby-grass	*Rytidosperma caespitosum*	2013	Australian Ecosystems
1	Splatts	Common Wallaby-grass	*Rytidosperma caespitosum*	2013	Australian Ecosystems
1	Creek	Common Wallaby-grass	*Rytidosperma caespitosum*	2012	Australian Ecosystems
3a	Creek	Common Wallaby-grass	*Rytidosperma caespitosum*	1979	VBA
1	Longmore	Common Water Milfoil	*Myriophyllum papillosum*	2013	Ayres et al.
2	Cockatoo	Common Water Milfoil	*Myriophyllum papillosum*	2013	Ayres et al.
1	Heart	Common Wheat-grass	*Anthosachne scabra s.l.*	2013	Australian Ecosystems
1	Heppell	Common Wheat-grass	*Anthosachne scabra s.l.*	2013	Australian Ecosystems
3a	Creek	Common Wheat-grass	*Elymus scaber*	2002	VBA
1	Heppell	Copper-awned Wallaby-grass	*Rytidosperma fulvum*	2013	Australian Ecosystems
1	Turner	Copper-awned Wallaby-grass	*Rytidosperma fulvum*	2013	Australian Ecosystems
1	Unregulated	Copper-awned Wallaby-grass	*Rytidosperma fulvum*	2013	Australian Ecosystems
1	Creek	Copper-awned Wallaby-grass	*Rytidosperma fulvum*	2012	Australian Ecosystems
1	Heart	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
1	Heppell	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
1	Longmore	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
1	Phyland	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
1	Splatts	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
1	Unregulated	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
1	Upper	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
2	Cockatoo	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
2	Gum	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
2	Taylors	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
3a	Safe's	Cotton Fireweed	*Senecio quadridentatus*	2013	Australian Ecosystems
1	Creek	Cotton Fireweed	*Senecio quadridentatus*	2012	Australian Ecosystems
2	Creek	Cotton Fireweed	*Senecio quadridentatus*	2012	Australian Ecosystems
3a	Creek	Cotton Fireweed	*Senecio quadridentatus*	2012	Australian Ecosystems
3a	Safe's	Cottony Saltbush	*Chenopodium curvispicatum*	2002	VBA
2	Cockatoo	Crassula	*Crassula spp.*	2013	Australian Ecosystems
2	Creek	Crassula	*Crassula spp.*	2012	Australian Ecosystems
3a	Creek	Creamy Stackhousia	*Stackhousia monogyna s.l.*	1987	VBA
3a	Safe's	Creeping Cudweed	*Euchiton collinus s.s.*	1987	VBA
3a	Creek	Creeping Cudweed	*Euchiton japonicus s.s.*	1987	VBA

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Creek	Creeping Knotweed	*Persicaria prostrata*	2002	VBA
2	Cockatoo	Creeping mint	*Mentha satureioides*	2013	Australian Ecosystems
2	Creek	Creeping mint	*Mentha satureioides*	2012	Australian Ecosystems
3a	Creek	Creeping mint	*Mentha satureioides*	1986	VBA
1	Heppell	Crested Goosefoot	*Chenopodium cristatum*	2013	Australian Ecosystems
1	Heart	Crested Spear-grass	*Austrostipa blackii*	2013	Australian Ecosystems
1	Heppell	Crimson Bottlebrush	*Callistemon citrinus*	2013	Australian Ecosystems
1	Turner	Crimson Bottlebrush	*Callistemon citrinus*	2013	Australian Ecosystems
2	Gum	Crimson Bottlebrush	*Callistemon citrinus*	2013	Australian Ecosystems
2	Taylors	Crowned Plantain	*Plantago turrifera*	2013	Australian Ecosystems
3a	Creek	Crowned Plantain	*Plantago turrifera*	2008	VBA
1	Heart	Cumbungi	*Typha domingensis*	2013	Ayres et al.
1	Heppell	Cumbungi	*Typha domingensis*	2013	Ayres et al.
1	Longmore	Cumbungi	*Typha domingensis*	2013	Ayres et al.
1	Splatts	Cumbungi	*Typha domingensis*	2013	Ayres et al.
1	Turner	Cumbungi	*Typha domingensis*	2013	Ayres et al.
1	Unregulated	Cumbungi	*Typha domingensis*	2013	Ayres et al.
2	Cockatoo	Cumbungi	*Typha domingensis*	2013	Ayres et al.
2	Gum	Cumbungi	*Typha domingensis*	2013	Ayres et al.
2	Taylors	Cumbungi	*Typha domingensis*	2013	Ayres et al.
3a	Safe's	Cumbungi	*Typha domingensis*	2013	Ayres et al.
2	Cockatoo	Curved Rice-flower	*Pimelea curviflora s.l.*	2013	Australian Ecosystems
2	Creek	Curved Rice-flower	*Pimelea curviflora s.l.*	2012	Australian Ecosystems
1	Unregulated	Cut-leaf Goodenia	*Goodenia pinnatifida*	2013	Australian Ecosystems
3a	Creek	Cut-leaf Goodenia	*Goodenia pinnatifida*	1986	VBA
3a	Creek	Dark Roly-poly	*Sclerolaena muricata var. semiglabra*	1985	VBA
3a	Safe's	Dense Crassula	*Crassula colorata*	2013	Australian Ecosystems
3a	Creek	Dense Crassula	*Crassula colorata*	2012	Australian Ecosystems
1	Phyland	Desert Cassia	*Senna artemisioides spp. agg.*	2013	Australian Ecosystems
2	Gum	Desert Cassia	*Senna artemisioides spp. agg.*	2013	Australian Ecosystems
2	Creek	Desert Cassia	*Senna artemisioides spp. agg.*	2012	Australian Ecosystems
3a	Creek	Dissected New Holland Daisy	*Vittadinia dissecta s.l.*	1986	VBA
3a	Creek	Dwarf Brooklime	*Gratiola pumilo*	1985	VBA
1	Creek	Earth Moss	*Pleuridium nervosum*	1960	VBA
1	Heppell	Eel Grass	*Vallisneria americana var. americana*	2013	Australian Ecosystems
1	Splatts	Eel Grass	*Vallisneria americana var. americana*	2013	Australian Ecosystems
1	Creek	Eel Grass	*Vallisneria americana var. americana*	2012	Australian Ecosystems
1	Upper	Erect Peppercress	*Lepidium pseudopapillosum*	2013	Australian Ecosystems
1	Splatts	Eumong	*Acacia stenophylla*	2013	Australian Ecosystems
1	Heart	Feather Spear-grass	*Austrostipa elegantissima*	2013	Australian Ecosystems
1	Splatts	Feather Spear-grass	*Austrostipa elegantissima*	2013	Australian Ecosystems
1	Turner	Feather Spear-grass	*Austrostipa elegantissima*	2013	Australian Ecosystems
1	Unregulated	Feather Spear-grass	*Austrostipa elegantissima*	2013	Australian Ecosystems
1	Creek	Feather Spear-grass	*Austrostipa elegantissima*	2012	Australian Ecosystems
1	Heart	Ferny Azolla	*Azolla pinnata*	2013	Australian Ecosystems
1	Heppell	Ferny Azolla	*Azolla pinnata*	2013	Australian Ecosystems
1	Longmore	Ferny Azolla	*Azolla pinnata*	2013	Australian Ecosystems
1	Splatts	Ferny Azolla	*Azolla pinnata*	2013	Australian Ecosystems
1	Turner	Ferny Azolla	*Azolla pinnata*	2013	Australian Ecosystems
2	Gum	Ferny Azolla	*Azolla pinnata*	2013	Australian Ecosystems
2	Taylors	Ferny Azolla	*Azolla pinnata*	2013	Australian Ecosystems
1	Creek	Ferny Azolla	*Azolla pinnata*	2012	Australian Ecosystems
2	Creek	Ferny Azolla	*Azolla pinnata*	2012	Australian Ecosystems
3a	Creek	Ferny Small-flower Buttercup	*Ranunculus pumilio*	2002	VBA
1	Heppell	Finger Rush	*Juncus subsecundus*	2013	Australian Ecosystems
1	Turner	Finger Rush	*Juncus subsecundus*	2013	Australian Ecosystems
1	Creek	Finger Rush	*Juncus subsecundus*	2012	Australian Ecosystems
3a	Creek	Finger Rush	*Juncus subsecundus*	1986	VBA
3a	Creek	Flannel Cudweed	*Actinobole uliginosum*	1986	VBA
3a	Safe's	Flat Spurge	*Chamaesyce drummondii*	2013	Australian Ecosystems
3a	Safe's	Flat Spurge	*Chamaesyce drummondii*	1987	VBA
3a	Creek	Fleshy Mistletoe	*Amyema miraculosa subsp. boormanii*	1986	VBA
3a	Safe's	Floating Pondweed	*Potamogeton tricarinatus s.l.*	1987	VBA
3a	Creek	Floating Pondweed	*Potamogeton tricarinatus s.l.*	1987	VBA
1	Heart	Floodplain Fireweed	*Senecio campylocarpus*	2013	Australian Ecosystems
1	Heppell	Floodplain Fireweed	*Senecio campylocarpus*	2013	Australian Ecosystems
1	Longmore	Floodplain Fireweed	*Senecio campylocarpus*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Splatts	Floodplain Fireweed	*Senecio campylocarpus*	2013	Australian Ecosystems
2	Gum	Floodplain Fireweed	*Senecio campylocarpus*	2013	Australian Ecosystems
1	Creek	Floodplain Fireweed	*Senecio campylocarpus*	2012	Australian Ecosystems
2	Creek	Floodplain Fireweed	*Senecio campylocarpus*	2012	Australian Ecosystems
1	Splatts	Forde Poa	*Poa fordeana*	2013	Australian Ecosystems
1	Turner	Forde Poa	*Poa fordeana*	2013	Australian Ecosystems
2	Taylors	Forde Poa	*Poa fordeana*	2013	Australian Ecosystems
1	Creek	Forde Poa	*Poa fordeana*	2012	Australian Ecosystems
1	Heart	Fuzzy New Holland Daisy	*Vittadinia cuneata*	2013	Australian Ecosystems
1	Unregulated	Fuzzy New Holland Daisy	*Vittadinia cuneata*	2013	Australian Ecosystems
3a	Creek	Fuzzy New Holland Daisy	*Vittadinia cuneata*	2002	VBA
1	Splatts	Giant Rush	*Juncus ingens*	2013	Australian Ecosystems
1	Unregulated	Giant Rush	*Juncus ingens*	2013	Australian Ecosystems
2	Cockatoo	Giant Rush	*Juncus ingens*	2013	Australian Ecosystems
1	Creek	Giant Rush	*Juncus ingens*	2012	Australian Ecosystems
2	Creek	Giant Rush	*Juncus ingens*	2012	Australian Ecosystems
3a	Creek	Giant Rush	*Juncus ingens*	1986	VBA
1	Heppell	Glaucous Goosefoot	*Chenopodium glaucum*	2013	Australian Ecosystems
3a	Creek	Glistening Dock	*Rumex crystallinus s.l.*	1986	VBA
3a	Safe's	Gold Rush	*Juncus flavidus*	1987	VBA
3a	Creek	Gold Rush	*Juncus flavidus*	2002	VBA
1	Heart	Gold-dust Wattle	*Acacia acinacea s.s.*	2013	Australian Ecosystems
1	Splatts	Gold-dust Wattle	*Acacia acinacea s.s.*	2013	Australian Ecosystems
1	Unregulated	Gold-dust Wattle	*Acacia acinacea s.s.*	2013	Australian Ecosystems
1	Upper	Gold-dust Wattle	*Acacia acinacea s.s.*	2013	Australian Ecosystems
2	Taylors	Gold-dust Wattle	*Acacia acinacea s.s.*	2013	Australian Ecosystems
1	Creek	Gold-dust Wattle	*Acacia acinacea s.s.*	2012	Australian Ecosystems
3a	Creek	Gold-dust Wattle	*Acacia acinacea s.l.*	1986	VBA
3a	Creek	Grass Cushion	*Isoetopsis graminifolia*	1986	VBA
3a	Creek	Grassland Crane's-bill	*Geranium retrorsum s.l.*	1986	VBA
1	Unregulated	Grassland Wood-sorrel	*Oxalis perennans*	2013	Australian Ecosystems
1	Upper	Grassland Wood-sorrel	*Oxalis perennans*	2013	Australian Ecosystems
3a	Creek	Grassland Wood-sorrel	*Oxalis perennans*	1987	VBA
1	Heppell	Grey Box	*Eucalyptus microcarpa*	2013	Australian Ecosystems
1	Splatts	Grey Box	*Eucalyptus microcarpa*	2013	Australian Ecosystems
1	Turner	Grey Box	*Eucalyptus microcarpa*	2013	Australian Ecosystems
1	Unregulated	Grey Box	*Eucalyptus microcarpa*	2013	Australian Ecosystems
2	Cockatoo	Grey Box	*Eucalyptus microcarpa*	2013	Australian Ecosystems
2	Gum	Grey Box	*Eucalyptus microcarpa*	2013	Australian Ecosystems
2	Taylors	Grey Box	*Eucalyptus microcarpa*	2013	Australian Ecosystems
1	Creek	Grey Box	*Eucalyptus microcarpa*	2012	Australian Ecosystems
2	Creek	Grey Box	*Eucalyptus microcarpa*	2012	Australian Ecosystems
1	Heart	Grey Copperburr	*Sclerolaena diacantha*	2013	Australian Ecosystems
1	Unregulated	Grey Copperburr	*Sclerolaena diacantha*	2013	Australian Ecosystems
3a	Creek	Grey Copperburr	*Sclerolaena diacantha*	1986	VBA
1	Heart	Grey Germander	*Teucrium racemosum s.l.*	2013	Australian Ecosystems
1	Unregulated	Grey Germander	*Teucrium racemosum s.l.*	2013	Australian Ecosystems
2	Cockatoo	Grey Germander	*Teucrium racemosum s.l.*	2013	Australian Ecosystems
2	Taylors	Grey Germander	*Teucrium racemosum s.l.*	2013	Australian Ecosystems
2	Creek	Grey Germander	*Teucrium racemosum s.l.*	2012	Australian Ecosystems
3a	Creek	Grey Germander	*Teucrium racemosum s.l.*	1986	VBA
2	Creek	Grey Mulga	*Acacia brachybotrya*	1985	VBA
2	Cockatoo	Grey Roly-poly	*Sclerolaena muricata var. villosa*	2013	Australian Ecosystems
2	Taylors	Grey Roly-poly	*Sclerolaena muricata var. villosa*	2013	Australian Ecosystems
3a	Safe's	Grey Roly-poly	*Sclerolaena muricata var. villosa*	2013	Australian Ecosystems
2	Creek	Grey Roly-poly	*Sclerolaena muricata var. villosa*	2012	Australian Ecosystems
3a	Creek	Grey Roly-poly	*Sclerolaena muricata var. villosa*	2012	Australian Ecosystems
1	Heppell	Hairy Bluebush	*Maireana pentagona*	2013	Australian Ecosystems
1	Splatts	Hairy Bluebush	*Maireana pentagona*	2013	Australian Ecosystems
1	Creek	Hairy Bluebush	*Maireana pentagona*	2012	Australian Ecosystems
3a	Creek	Hairy Burr-daisy	*Calotis hispidula*	2008	VBA
3a	Creek	Hairy Panic	*Panicum effusum*	1986	VBA
3a	Creek	Hairy Plantain	*Plantago hispida*	1987	VBA
1	Heart	Hairy Willow-herb	*Epilobium hirtigerum*	2013	Australian Ecosystems
1	Heppell	Hairy Willow-herb	*Epilobium hirtigerum*	2013	Australian Ecosystems
1	Splatts	Hairy Willow-herb	*Epilobium hirtigerum*	2013	Australian Ecosystems
2	Gum	Hairy Willow-herb	*Epilobium hirtigerum*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Creek	Hairy Willow-herb	*Epilobium hirtigerum*	2012	Australian Ecosystems
2	Creek	Hairy Willow-herb	*Epilobium hirtigerum*	2012	Australian Ecosystems
3a	Creek	Hairy Willow-herb	*Epilobium hirtigerum*	1986	VBA
3a	Creek	Hard-head Daisy	*Brachyscome lineariloba*	2008	VBA
1	Heart	Hedge Saltbush	*Rhagodia spinescens*	2013	Australian Ecosystems
1	Heppell	Hedge Saltbush	*Rhagodia spinescens*	2013	Australian Ecosystems
1	Longmore	Hedge Saltbush	*Rhagodia spinescens*	2013	Australian Ecosystems
1	Phyland	Hedge Saltbush	*Rhagodia spinescens*	2013	Australian Ecosystems
1	Splatts	Hedge Saltbush	*Rhagodia spinescens*	2013	Australian Ecosystems
2	Cockatoo	Hedge Saltbush	*Rhagodia spinescens*	2013	Australian Ecosystems
2	Taylors	Hedge Saltbush	*Rhagodia spinescens*	2013	Australian Ecosystems
3a	Safe's	Hedge Saltbush	*Rhagodia spinescens*	2002	VBA
3a	Creek	Hill Wallaby-grass	*Rytidosperma erianthum*	2002	VBA
1	Heppell	Hollow Rush	*Juncus amabilis*	2013	Australian Ecosystems
1	Upper	Hollow Rush	*Juncus amabilis*	2013	Australian Ecosystems
2	Cockatoo	Hollow Rush	*Juncus amabilis*	2013	Australian Ecosystems
2	Creek	Hollow Rush	*Juncus amabilis*	2012	Australian Ecosystems
3a	Creek	Hollow Rush	*Juncus amabilis*	1987	VBA
1	Heppell	Honey-myrtle	*Melaleuca spp.*	2013	Australian Ecosystems
1	Heart	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems; Ayres et al.
1	Longmore	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems; Ayres et al.
1	Phyland	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems
1	Splatts	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems
1	Turner	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems; Ayres et al.
1	Upper	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems; Ayres et al, 2013
2	Gum	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems
2	Taylors	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems; Ayres et al.
3a	Safe's	Hornwort	*Ceratophyllum demersum*	2013	Australian Ecosystems; Ayres et al.
1	Creek	Hornwort	*Ceratophyllum demersum*	2012	Australian Ecosystems
2	Creek	Hornwort	*Ceratophyllum demersum*	2012	Australian Ecosystems
3a	Creek	Hornwort	*Ceratophyllum demersum*	2012	Australian Ecosystems
1	Unregulated	Indian Cudweed	*Gnaphalium polycaulon*	2013	Australian Ecosystems
1	Splatts	Inland Verbena	*Verbena officinalis var. africana*	2013	Australian Ecosystems
1	Unregulated	Inland Verbena	*Verbena officinalis var. africana*	2013	Australian Ecosystems
1	Creek	Inland Verbena	*Verbena officinalis var. africana*	2012	Australian Ecosystems
1	Heppell	Jersey Cudweed	*Pseudognaphalium luteoalbum*	2013	Australian Ecosystems
1	Phyland	Jersey Cudweed	*Pseudognaphalium luteoalbum*	2013	Australian Ecosystems
1	Upper	Jersey Cudweed	*Pseudognaphalium luteoalbum*	2013	Australian Ecosystems
2	Cockatoo	Jersey Cudweed	*Pseudognaphalium luteoalbum*	2013	Australian Ecosystems
3a	Safe's	Jersey Cudweed	*Pseudognaphalium luteoalbum*	1987	VBA
2	Creek	Jersey Cudweed	*Helichrysum luteoalbum*	2012	Australian Ecosystems
3a	Creek	Jersey Cudweed	*Helichrysum luteoalbum*	2004	VBA
3a	Creek	Jointed Rush x Joint-leaf Rush hybrid	*Juncus articulatus x holoschoenus*	1987	VBA
3a	Safe's	Joint-leaf Rush	*Juncus holoschoenus*	2013	Australian Ecosystems
3a	Creek	Joint-leaf Rush	*Juncus holoschoenus*	2012	Australian Ecosystems
1	Heart	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
1	Heppell	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
1	Phyland	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
1	Splatts	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
1	Turner	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
1	Unregulated	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
1	Upper	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
2	Gum	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
2	Taylors	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
3a	Safe's	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
2	Cockatoo	Juncus sp.	*Juncus sp.*	2013	Ayres et al.
2	Gum	Kneed Spear-grass	*Austrostipa bigeniculata*	2013	Australian Ecosystems
2	Creek	Kneed Spear-grass	*Austrostipa bigeniculata*	2012	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Heppell	Knob Sedge	*Carex inversa*	2013	Australian Ecosystems
1	Splatts	Knob Sedge	*Carex inversa*	2013	Australian Ecosystems
1	Unregulated	Knob Sedge	*Carex inversa*	2013	Australian Ecosystems
3a	Safe's	Knob Sedge	*Carex inversa*	1987	VBA
1	Creek	Knob Sedge	*Carex inversa*	2012	Australian Ecosystems
3a	Creek	Knob Sedge	*Carex inversa*	1987	VBA
1	Unregulated	Knotty Spear-grass	*Austrostipa nodosa*	2013	Australian Ecosystems
2	Cockatoo	Knotty Spear-grass	*Austrostipa nodosa*	2013	Australian Ecosystems
2	Taylors	Knotty Spear-grass	*Austrostipa nodosa*	2013	Australian Ecosystems
3a	Safe's	Knotty Spear-grass	*Austrostipa nodosa*	2013	Australian Ecosystems
2	Creek	Knotty Spear-grass	*Austrostipa nodosa*	2012	Australian Ecosystems
3a	Creek	Knotty Spear-grass	*Austrostipa nodosa*	2012	Australian Ecosystems
1	Turner	Kunzea	*Kunzea spp.*	2013	Australian Ecosystems
1	Creek	Kunzea	*Kunzea spp.*	2012	Australian Ecosystems
1	Heppell	Kurrajong	*Brachychiton populneus subsp. populneus*	2013	Australian Ecosystems
1	Turner	Kurrajong	*Brachychiton populneus subsp. populneus*	2013	Australian Ecosystems
1	Unregulated	Kurrajong	*Brachychiton populneus subsp. populneus*	2013	Australian Ecosystems
2	Taylors	Lake Water-milfoil	*Myriophyllum salsugineum*	2013	Australian Ecosystems
1	Heppell	Lantern Flower	*Abutilon spp.*	2013	Australian Ecosystems
3a	Creek	Large Mudwort	*Limosella curdieana*	1986	VBA
1	Creek	Late-flower Flax-lily	*Dianella tarda*	2013	Australian Ecosystems
3a	Creek	Leafless Ballart	*Exocarpos aphyllus*	1986	VBA
3a	Creek	Lemon Beauty-heads	*Calocephalus citreus*	1987	VBA
1	Heppell	Lesser Joyweed	*Alternanthera denticulata s.l.*	2013	Australian Ecosystems
1	Upper	Lesser Joyweed	*Alternanthera denticulata s.l.*	2013	Australian Ecosystems
2	Taylors	Lesser Joyweed	*Alternanthera denticulata s.l.*	2013	Australian Ecosystems
3a	Safe's	Lesser Joyweed	*Alternanthera denticulata s.l.*	1987	VBA
3a	Creek	Lesser Joyweed	*Alternanthera denticulata s.l.*	1987	VBA
2	Cockatoo	Lignum	*Muehlenbeckia florulenta*	2013	Ayres et al.
2	Gum	Loose-flower Rush	*Juncus pauciflorus*	2013	Australian Ecosystems
2	Creek	Loose-flower Rush	*Juncus pauciflorus*	2012	Australian Ecosystems
3a	Creek	Mallow	*Malva spp.*	2004	VBA
3a	Creek	Matted Starwort	*Stellaria caespitosa*	1986	VBA
3a	Creek	Matted Water-starwort	*Callitriche sonderi*	1986	VBA
1	Longmore	Mint	*Mentha spp.*	2013	Australian Ecosystems
2	Gum	Moonah	*Melaleuca lanceolata subsp. lanceolata*	2013	Australian Ecosystems
2	Creek	Moonah	*Melaleuca lanceolata*	2012	Australian Ecosystems
3a	Creek	Moonah	*Melaleuca lanceolata*	1986	VBA
3a	Creek	Mousetail	*Myosurus australis*	1986	VBA
1	Longmore	Mud Dock	*Rumex bidens*	2013	Australian Ecosystems
1	Heart	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
1	Heppell	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
1	Longmore	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
1	Phyland	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems; Ayres et al.
1	Splatts	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
1	Turner	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
1	Unregulated	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
1	Upper	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
2	Gum	Narrow-leaf Cumbungi	*Typha domingensis*	2013	Australian Ecosystems
1	Creek	Narrow-leaf Cumbungi	*Typha domingensis*	2012	Australian Ecosystems
2	Creek	Narrow-leaf Cumbungi	*Typha domingensis*	2012	Australian Ecosystems
3a	Creek	Narrow-leaf Cumbungi	*Typha domingensis*	1986	VBA
2	Cockatoo	Narrow-leaf Dock	*Rumex tenax*	2013	Australian Ecosystems
3a	Safe's	Narrow-leaf Dock	*Rumex tenax*	2013	Australian Ecosystems
2	Creek	Narrow-leaf Dock	*Rumex tenax*	2012	Australian Ecosystems
3a	Creek	Narrow-leaf Dock	*Rumex tenax*	2012	Australian Ecosystems
3a	Creek	Narrow-leaf Nardoo	*Marsilea costulifera*	1986	VBA
1	Heppell	Native Peppercress	*Lepidium pseudohyssopifolium*	2013	Australian Ecosystems
1	Splatts	Native Peppercress	*Lepidium pseudohyssopifolium*	2013	Australian Ecosystems
1	Turner	Native Peppercress	*Lepidium pseudohyssopifolium*	2013	Australian Ecosystems
1	Upper	Native Peppercress	*Lepidium pseudohyssopifolium*	2013	Australian Ecosystems
1	Creek	Native Peppercress	*Lepidium pseudohyssopifolium*	2012	Australian Ecosystems
3a	Creek	Native Peppercress	*Lepidium pseudohyssopifolium*	1986	VBA
3a	Creek	New Holland Daisy	*Vittadinia spp.*	1987	VBA

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Creek	Nigger-heads	*Enneapogon nigricans*	1986	VBA
1	Longmore	Nitre-bush	*Nitraria billardierei*	2013	Australian Ecosystems
1	Splatts	Nitre-bush	*Nitraria billardierei*	2013	Australian Ecosystems
1	Turner	Nitre-bush	*Nitraria billardierei*	2013	Australian Ecosystems
1	Creek	Nitre-bush	*Nitraria billardierei*	2012	Australian Ecosystems
3a	Creek	Nodding Chocolate-lily	*Arthropodium fimbriatum*	1986	VBA
1	Heart	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
1	Heppell	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
1	Longmore	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
1	Phyland	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
1	Splatts	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
1	Turner	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
1	Unregulated	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
1	Upper	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
2	Cockatoo	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
2	Taylors	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems
3a	Safe's	Nodding Saltbush	*Einadia nutans subsp. nutans*	2013	Australian Ecosystems; VBA
1	Creek	Nodding Saltbush	*Einadia nutans subsp. nutans*	2012	Australian Ecosystems
2	Creek	Nodding Saltbush	*Einadia nutans subsp. nutans*	2012	Australian Ecosystems
3a	Creek	Nodding Saltbush	*Einadia nutans subsp. nutans*	2012	Australian Ecosystems
1	Phyland	Old-man Saltbush	*Atriplex nummularia subsp. nummularia*	2013	Australian Ecosystems
1	Splatts	Old-man Saltbush	*Atriplex nummularia subsp. nummularia*	2013	Australian Ecosystems
1	Creek	Old-man Saltbush	*Atriplex nummularia subsp. nummularia*	2012	Australian Ecosystems
1	Unregulated	Oondoroo	*Solanum simile*	2013	Australian Ecosystems
1	Upper	Ovens Wattle	*Acacia pravissima*	2013	Australian Ecosystems
1	Heart	Pacific Azolla	*Azolla filiculoides*	2013	Australian Ecosystems
1	Longmore	Pacific Azolla	*Azolla filiculoides*	2013	Australian Ecosystems
1	Splatts	Pacific Azolla	*Azolla filiculoides*	2013	Australian Ecosystems
1	Upper	Pacific Azolla	*Azolla filiculoides*	2013	Australian Ecosystems
2	Cockatoo	Pacific Azolla	*Azolla filiculoides*	2013	Australian Ecosystems
2	Gum	Pacific Azolla	*Azolla filiculoides*	2013	Australian Ecosystems
3a	Safe's	Pacific Azolla	*Azolla filiculoides*	2013	Australian Ecosystems; VBA
1	Creek	Pacific Azolla	*Azolla filiculoides*	2012	Australian Ecosystems
2	Creek	Pacific Azolla	*Azolla filiculoides*	2012	Australian Ecosystems
3a	Creek	Pacific Azolla	*Azolla filiculoides*	2012	Australian Ecosystems
3a	Creek	Pale Beauty-heads	*Calocephalus sonderi*	1985	VBA
3a	Creek	Pale Flax-lily	*Dianella longifolia var. longifolia s.l.*	1986	VBA
3a	Creek	Pale Goodenia	*Goodenia glauca*	1986	VBA
1	Heppell	Pale Knotweed	*Persicaria lapathifolia*	2013	Australian Ecosystems
1	Splatts	Pale Knotweed	*Persicaria lapathifolia*	2013	Australian Ecosystems
1	Creek	Pale Knotweed	*Persicaria lapathifolia*	2012	Australian Ecosystems
3a	Creek	Pale Knotweed	*Persicaria lapathifolia*	1986	VBA
1	Heart	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
1	Heppell	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
1	Longmore	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
1	Turner	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
1	Unregulated	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
2	Cockatoo	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
2	Gum	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
2	Taylors	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems
3a	Safe's	Pale-fruit Ballart	*Exocarpos strictus*	2013	Australian Ecosystems; VBA
1	Creek	Pale-fruit Ballart	*Exocarpos strictus*	2012	Australian Ecosystems
2	Creek	Pale-fruit Ballart	*Exocarpos strictus*	2012	Australian Ecosystems
3a	Creek	Pale-fruit Ballart	*Exocarpos strictus*	2012	Australian Ecosystems
3a	Creek	Paper Sunray	*Rhodanthe corymbiflora*	1987	VBA
3a	Creek	Pink Bindweed	*Convolvulus erubescens spp. agg.*	1986	VBA
3b	Creek	Pink Bindweed	*Convolvulus erubescens spp. agg.*	2002	VBA
3a	Creek	Pink Purslane	*Calandrinia calyptrata*	1986	VBA
1	Heart	Plains Sedge	*Carex bichenoviana*	2013	Australian Ecosystems
1	Heppell	Plains Sedge	*Carex bichenoviana*	2013	Australian Ecosystems
1	Splatts	Plains Sedge	*Carex bichenoviana*	2013	Australian Ecosystems
1	Turner	Plains Sedge	*Carex bichenoviana*	2013	Australian Ecosystems
1	Upper	Plains Sedge	*Carex bichenoviana*	2013	Australian Ecosystems
2	Cockatoo	Plains Sedge	*Carex bichenoviana*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Safe's	Plains Sedge	*Carex bichenoviana*	2013	Australian Ecosystems
1	Creek	Plains Sedge	*Carex bichenoviana*	2012	Australian Ecosystems
2	Creek	Plains Sedge	*Carex bichenoviana*	2012	Australian Ecosystems
3a	Creek	Plains Sedge	*Carex bichenoviana*	2012	Australian Ecosystems
3a	Creek	Plains Stackhousia	*Stackhousia subterranea*	1979	VBA
1	Splatts	Plump Spear-grass	*Austrostipa aristiglumis*	2013	Australian Ecosystems
1	Creek	Plump Spear-grass	*Austrostipa aristiglumis*	2012	Australian Ecosystems
1	Splatts	Poison Pratia	*Lobelia concolor*	2013	Australian Ecosystems
2	Gum	Poison Pratia	*Lobelia concolor*	2013	Australian Ecosystems
3a	Safe's	Poison Pratia	*Lobelia concolor*	2013	Australian Ecosystems
1	Creek	Poison Pratia	*Lobelia concolor*	2012	Australian Ecosystems
2	Creek	Poison Pratia	*Lobelia concolor*	2012	Australian Ecosystems
3a	Creek	Poison Pratia	*Lobelia concolor*	2012	Australian Ecosystems
1	Heart	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
1	Heppell	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
1	Longmore	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
1	Phyland	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
1	Splatts	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
1	Turner	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
1	Unregulated	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
1	Upper	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
2	Cockatoo	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
2	Gum	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
2	Taylors	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems
3a	Safe's	Poong'ort	*Carex tereticaulis*	2013	Australian Ecosystems; VBA
1	Creek	Poong'ort	*Carex tereticaulis*	2012	Australian Ecosystems
2	Creek	Poong'ort	*Carex tereticaulis*	2012	Australian Ecosystems
3a	Creek	Poong'ort	*Carex tereticaulis*	2012	Australian Ecosystems
1	Heppell	Prickly Saltwort	*Salsola tragus*	2013	Australian Ecosystems
1	Longmore	Prickly Saltwort	*Salsola tragus*	2013	Australian Ecosystems
1	Splatts	Prickly Saltwort	*Salsola tragus*	2013	Australian Ecosystems
1	Turner	Prickly Saltwort	*Salsola tragus*	2013	Australian Ecosystems
3a	Safe's	Prickly Saltwort	*Salsola tragus*	2013	Australian Ecosystems; VBA
1	Creek	Prickly Saltwort	*Salsola tragus*	2012	Australian Ecosystems
3a	Creek	Prickly Saltwort	*Salsola tragus*	2012	Australian Ecosystems
3b	Creek	Prickly Saltwort	*Salsola tragus*	2002	VBA
1	Creek	Purple Crassula	*Crassula peduncularis*	1874	VBA
3a	Creek	Purple Crassula	*Crassula peduncularis*	1986	VBA
1	Heppell	Quena	*Solanum esuriale*	2013	Australian Ecosystems
1	Unregulated	Quena	*Solanum esuriale*	2013	Australian Ecosystems
1	Turner	Red Pondweed	*Potamogeton cheesemanii*	2013	Australian Ecosystems
1	Creek	Red Pondweed	*Potamogeton cheesemanii*	2012	Australian Ecosystems
3a	Creek	Reed Bent-grass	*Deyeuxia quadriseta*	1987	VBA
1	Splatts	Rigid Panic	*Walwhalleya proluta*	2013	Australian Ecosystems
1	Creek	Rigid Panic	*Walwhalleya proluta*	2012	Australian Ecosystems
1	Phyland	River Bluebell	*Wahlenbergia fluminalis*	2013	Australian Ecosystems
1	Splatts	River Bluebell	*Wahlenbergia fluminalis*	2013	Australian Ecosystems
1	Upper	River Bluebell	*Wahlenbergia fluminalis*	2013	Australian Ecosystems
3a	Safe's	River Bluebell	*Wahlenbergia fluminalis*	1987	VBA
1	Creek	River Bluebell	*Wahlenbergia fluminalis*	2012	Australian Ecosystems
3a	Creek	River Bluebell	*Wahlenbergia fluminalis*	1987	VBA
2	Gum	River Buttercup	*Ranunculus inundatus*	2013	Australian Ecosystems
2	Creek	River Buttercup	*Ranunculus inundatus*	2012	Australian Ecosystems
3a	Creek	River Buttercup	*Ranunculus inundatus*	2012	Australian Ecosystems
3a	Safe's	River club sedge	*Schoenoplectus tabernaemontani*	2013	Ayres et al.
1	Heart	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems
1	Longmore	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems; Ayres et al.
1	Splatts	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems; Ayres et al.
1	Turner	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems
1	Upper	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems; Ayres et al.

Reach	Location	Common name	Scientific name	Most recent record	Source
2	Gum	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems
3a	Safe's	River Club-sedge	*Schoenoplectus tabernaemontani*	2013	Australian Ecosystems; Ayres et al.
1	Creek	River Club-sedge	*Schoenoplectus tabernaemontani*	2012	Australian Ecosystems
2	Creek	River Club-sedge	*Schoenoplectus tabernaemontani*	2012	Australian Ecosystems
3a	Creek	River Club-sedge	*Schoenoplectus tabernaemontani*	2012	Australian Ecosystems
1	Heart	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
1	Heppell	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
1	Longmore	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
1	Phyland	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
1	Splatts	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
1	Turner	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
1	Unregulated	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
1	Upper	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
2	Cockatoo	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
2	Gum	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems
3a	Safe's	River Red-gum	*Eucalyptus camaldulensis*	2013	Australian Ecosystems; VBA
1	Creek	River Red-gum	*Eucalyptus camaldulensis*	2012	Australian Ecosystems
2	Creek	River Red-gum	*Eucalyptus camaldulensis*	2012	Australian Ecosystems
3a	Creek	River Red-gum	*Eucalyptus camaldulensis*	2012	Australian Ecosystems
3b	Creek	River Red-gum	*Eucalyptus camaldulensis*	2002	VBA
3a	Creek	River Swamp Wallaby-grass	*Amphibromus fluitans*	1986	VBA
1	Heart	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
1	Longmore	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
1	Phyland	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
1	Splatts	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
1	Turner	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
1	Upper	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
2	Gum	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
2	Taylors	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems
3a	Safe's	Robust Water-milfoil	*Myriophyllum papillosum*	2013	Australian Ecosystems; VBA
1	Creek	Robust Water-milfoil	*Myriophyllum papillosum*	2012	Australian Ecosystems
2	Creek	Robust Water-milfoil	*Myriophyllum papillosum*	2012	Australian Ecosystems
3a	Creek	Robust Water-milfoil	*Myriophyllum papillosum*	2012	Australian Ecosystems
3a	Creek	Rough Bedstraw	*Galium gaudichaudii*	1986	VBA
3a	Creek	Rough Raspwort	*Haloragis aspera*	1987	VBA
1	Heart	Rough Spear-grass	*Austrostipa scabra*	2013	Australian Ecosystems
1	Heppell	Rough Spear-grass	*Austrostipa scabra*	2013	Australian Ecosystems
1	Splatts	Rough Spear-grass	*Austrostipa scabra*	2013	Australian Ecosystems
1	Turner	Rough Spear-grass	*Austrostipa scabra*	2013	Australian Ecosystems
2	Cockatoo	Rough Spear-grass	*Austrostipa scabra*	2013	Australian Ecosystems
2	Gum	Rough Spear-grass	*Austrostipa scabra*	2013	Australian Ecosystems
2	Taylors	Rough Spear-grass	*Austrostipa scabra subsp. falcata*	2013	Australian Ecosystems
1	Creek	Rough Spear-grass	*Austrostipa scabra*	2012	Australian Ecosystems
2	Creek	Rough Spear-grass	*Austrostipa scabra*	2012	Australian Ecosystems
3a	Creek	Rough Spear-grass	*Austrostipa scabra subsp. scabra*	2002	VBA
3b	Creek	Rough Spear-grass	*Austrostipa scabra*	2002	VBA
1	Heart	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
1	Heppell	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
1	Phyland	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
1	Splatts	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
1	Turner	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
1	Unregulated	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
1	Upper	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
2	Cockatoo	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
2	Gum	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
2	Taylors	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems
3a	Safe's	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2013	Australian Ecosystems; VBA
1	Creek	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2012	Australian Ecosystems
2	Creek	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2012	Australian Ecosystems
3a	Creek	Ruby Saltbush	*Enchylaena tomentosa var. tomentosa*	2012	Australian Ecosystems
2	Gum	Ruddy Ground-fern	*Hypolepis rugosula*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
2	Creek	Ruddy Ground-fern	*Hypolepis rugosula*	2012	Australian Ecosystems
3a	Creek	Rush	*Juncus spp.*	2004	VBA
2	Taylors	Salt Sand-spurrey	*Spergularia marina s.l.*	2013	Australian Ecosystems
1	Heart	Scented Mat-rush	*Lomandra effusa*	2013	Australian Ecosystems
1	Splatts	Scented Mat-rush	*Lomandra effusa*	2013	Australian Ecosystems
2	Gum	Scented Mat-rush	*Lomandra effusa*	2013	Australian Ecosystems
1	Creek	Scented Mat-rush	*Lomandra effusa*	2012	Australian Ecosystems
2	Creek	Scented Mat-rush	*Lomandra effusa*	2012	Australian Ecosystems
1	Upper	Shade Peppercress	*Lepidium pseudotasmanicum*	2013	Australian Ecosystems
1	Heart	Short-crown Spear-grass	*Austrostipa curticoma*	2013	Australian Ecosystems
1	Splatts	Short-crown Spear-grass	*Austrostipa curticoma*	2013	Australian Ecosystems
1	Creek	Short-crown Spear-grass	*Austrostipa curticoma*	2012	Australian Ecosystems
3a	Creek	Short-fruit Nardoo	*Marsilea hirsuta*	1987	VBA
1	Heart	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
1	Heppell	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
1	Longmore	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
1	Phyland	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
1	Splatts	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
1	Turner	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
1	Unregulated	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
2	Cockatoo	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
2	Gum	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
2	Taylors	Short-leaf Bluebush	*Maireana brevifolia*	2013	Australian Ecosystems
1	Creek	Short-leaf Bluebush	*Maireana brevifolia*	2012	Australian Ecosystems
2	Creek	Short-leaf Bluebush	*Maireana brevifolia*	2012	Australian Ecosystems
3a	Creek	Short-leaf Bluebush	*Maireana brevifolia*	2008	VBA
1	Unregulated	Sieber Crassula	*Crassula sieberiana s.l.*	2013	Australian Ecosystems
2	Cockatoo	Sieber Crassula	*Crassula sieberiana s.l.*	2013	Australian Ecosystems
2	Taylors	Sieber Crassula	*Crassula sieberiana s.l.*	2013	Australian Ecosystems
2	Creek	Sieber Crassula	*Crassula sieberiana s.l.*	2012	Australian Ecosystems
3a	Creek	Sieber Crassula	*Crassula sieberiana s.l.*	2008	VBA
1	Heart	Silver Wattle	*Acacia dealbata subsp. dealbata*	2013	Australian Ecosystems
1	Heppell	Silver Wattle	*Acacia dealbata subsp. dealbata*	2013	Australian Ecosystems
1	Unregulated	Silver Wattle	*Acacia dealbata subsp. dealbata*	2013	Australian Ecosystems
2	Cockatoo	Slender Dock	*Rumex brownii*	2013	Australian Ecosystems
2	Gum	Slender Dock	*Rumex brownii*	2013	Australian Ecosystems
3a	Safe's	Slender Dock	*Rumex brownii*	2013	Australian Ecosystems; VBA
2	Creek	Slender Dock	*Rumex brownii*	2012	Australian Ecosystems
3a	Creek	Slender Dock	*Rumex brownii*	2012	Australian Ecosystems
1	Heart	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
1	Heppell	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
1	Longmore	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
1	Phyland	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
1	Splatts	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
1	Turner	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
1	Unregulated	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
1	Upper	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems
2	Cockatoo	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; Ayres et al.
2	Gum	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems
2	Taylors	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems
3a	Safe's	Slender Knotweed	*Persicaria decipiens*	2013	Australian Ecosystems; VBA
1	Creek	Slender Knotweed	*Persicaria decipiens*	2012	Australian Ecosystems
2	Creek	Slender Knotweed	*Persicaria decipiens*	2012	Australian Ecosystems
3a	Creek	Slender Knotweed	*Persicaria decipiens*	2012	Australian Ecosystems
2	Gum	Slender Monkey-flower	*Mimulus gracilis*	2013	Australian Ecosystems
2	Creek	Slender Monkey-flower	*Mimulus gracilis*	2012	Australian Ecosystems
1	Heppell	Slender Wallaby-grass	*Rytidosperma racemosum var. racemosum*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Unregulated	Slender Wallaby-grass	*Rytidosperma racemosum var. racemosum*	2013	Australian Ecosystems
3b	Creek	Slender Wallaby-grass	*Rytidosperma racemosum var. racemosum*	2002	VBA
1	Heart	Slender-fruit Saltbush	*Atriplex leptocarpa*	2013	Australian Ecosystems
1	Splatts	Slender-fruit Saltbush	*Atriplex leptocarpa*	2013	Australian Ecosystems
3a	Safe's	Slender-fruit Saltbush	*Atriplex leptocarpa*	2013	Australian Ecosystems
1	Creek	Slender-fruit Saltbush	*Atriplex leptocarpa*	2012	Australian Ecosystems
3a	Creek	Slender-fruit Saltbush	*Atriplex leptocarpa*	2012	Australian Ecosystems
1	Splatts	Small Loosestrife	*Lythrum hyssopifolia*	2013	Australian Ecosystems
1	Turner	Small Loosestrife	*Lythrum hyssopifolia*	2013	Australian Ecosystems
1	Upper	Small Loosestrife	*Lythrum hyssopifolia*	2013	Australian Ecosystems
2	Cockatoo	Small Loosestrife	*Lythrum hyssopifolia*	2013	Australian Ecosystems
2	Taylors	Small Loosestrife	*Lythrum hyssopifolia*	2013	Australian Ecosystems
3a	Safe's	Small Loosestrife	*Lythrum hyssopifolia*	1987	VBA
1	Creek	Small Loosestrife	*Lythrum hyssopifolia*	2012	Australian Ecosystems
2	Creek	Small Loosestrife	*Lythrum hyssopifolia*	2012	Australian Ecosystems
3a	Creek	Small Loosestrife	*Lythrum hyssopifolia*	1987	VBA
3a	Creek	Small Saltbush	*Atriplex eardleyae*	2008	VBA
3a	Creek	Small Spike-sedge	*Eleocharis pusilla*	1987	VBA
3a	Creek	Small-flower Goodenia	*Goodenia pusilliflora*	2008	VBA
1	Splatts	Small-leaved Clematis	*Clematis microphylla s.l.*	2013	Australian Ecosystems
1	Turner	Small-leaved Clematis	*Clematis microphylla s.l.*	2013	Australian Ecosystems
1	Creek	Small-leaved Clematis	*Clematis microphylla s.l.*	2012	Australian Ecosystems
3a	Creek	Smooth Minuria	*Minuria integerrima*	1986	VBA
1	Turner	Southern Cane-grass	*Eragrostis infecunda*	2013	Australian Ecosystems
1	Creek	Southern Cane-grass	*Eragrostis infecunda*	2012	Australian Ecosystems
1	Heart	Spider Grass	*Enteropogon acicularis*	2013	Australian Ecosystems
1	Splatts	Spider Grass	*Enteropogon acicularis*	2013	Australian Ecosystems
2	Gum	Spider Grass	*Enteropogon acicularis*	2013	Australian Ecosystems
1	Creek	Spider Grass	*Enteropogon acicularis*	2012	Australian Ecosystems
2	Creek	Spider Grass	*Enteropogon acicularis*	2012	Australian Ecosystems
3a	Creek	Spider Grass	*Enteropogon acicularis*	2002	VBA
3b	Creek	Spider Grass	*Enteropogon acicularis*	2002	VBA
1	Heppell	Spiny Mud-grass	*Pseudoraphis spinescens*	2013	Australian Ecosystems
1	Splatts	Spiny Mud-grass	*Pseudoraphis spinescens*	2013	Australian Ecosystems
1	Unregulated	Spiny Mud-grass	*Pseudoraphis spinescens*	2013	Australian Ecosystems
1	Creek	Spiny Mud-grass	*Pseudoraphis spinescens*	2012	Australian Ecosystems
3a	Creek	Spiny Mud-grass	*Pseudoraphis spinescens*	1986	VBA
3a	Creek	Spoon Cudweed	*Stuartina muelleri*	1986	VBA
2	Gum	Spotted Knotweed	*Persicaria praetermissa*	2013	Australian Ecosystems
2	Creek	Spotted Knotweed	*Persicaria praetermissa*	2012	Australian Ecosystems
1	Turner	Sprawling Saltbush	*Atriplex suberecta*	2013	Australian Ecosystems
2	Gum	Sprawling Saltbush	*Atriplex suberecta*	2013	Australian Ecosystems
3a	Safe's	Sprawling Saltbush	*Atriplex suberecta*	2013	Australian Ecosystems
3a	Creek	Spreading Crassula	*Crassula decumbens var. decumbens*	1986	VBA
3a	Creek	Spreading Sneezeweed	*Centipeda minima s.l.*	1986	VBA
2	Creek	Star Fruit	*Damasonium minus*	2002	VBA
3a	Creek	Star Fruit	*Damasonium minus*	1986	VBA
3a	Creek	Starry Goosefoot	*Scleroblitum atriplicinum*	1978	VBA
1	Heart	Sticky Hop-bush	*Dodonaea viscosa*	2013	Australian Ecosystems
3a	Creek	Stiff Cup-flower	*Pogonolepis muelleriana*	1986	VBA
3a	Creek	Summer Grass	*Digitaria spp.*	2002	VBA
1	Longmore	Swamp Crassula	*Crassula helmsii*	2013	Australian Ecosystems
2	Cockatoo	Swamp Crassula	*Crassula helmsii*	2013	Australian Ecosystems
2	Creek	Swamp Crassula	*Crassula helmsii*	2012	Australian Ecosystems
3a	Creek	Swamp Crassula	*Crassula helmsii*	2002	VBA
3a	Creek	Swamp Starwort	*Stellaria angustifolia*	2002	VBA
1	Heart	Sweet Bursaria	*Bursaria spinosa subsp. spinosa*	2013	Australian Ecosystems
1	Splatts	Sweet Bursaria	*Bursaria spinosa subsp. spinosa*	2013	Australian Ecosystems
1	Turner	Sweet Bursaria	*Bursaria spinosa subsp. spinosa*	2013	Australian Ecosystems
2	Cockatoo	Sweet Bursaria	*Bursaria spinosa*	2013	Australian Ecosystems
2	Gum	Sweet Bursaria	*Bursaria spinosa subsp. spinosa*	2013	Australian Ecosystems
1	Creek	Sweet Bursaria	*Bursaria spinosa subsp. spinosa*	2012	Australian Ecosystems
2	Creek	Sweet Bursaria	*Bursaria spinosa subsp. spinosa*	2012	Australian Ecosystems
1	Upper	Sweet Pittosporum	*Pittosporum undulatum*	2013	Australian Ecosystems
2	Gum	Sweet Pittosporum	*Pittosporum undulatum*	2013	Australian Ecosystems
3a	Safe's	Tall Club-sedge	*Bolboschoenus fluviatilis*	2013	Australian Ecosystems
3a	Creek	Tall Club-sedge	*Bolboschoenus fluviatilis*	2012	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Longmore	Tall Fireweed	*Senecio runcinifolius*	2013	Australian Ecosystems
1	Unregulated	Tall Fireweed	*Senecio runcinifolius*	2013	Australian Ecosystems
1	Upper	Tall Fireweed	*Senecio runcinifolius*	2013	Australian Ecosystems
2	Gum	Tall Fireweed	*Senecio runcinifolius*	2013	Australian Ecosystems
3a	Safe's	Tall Fireweed	*Senecio runcinifolius*	2013	Australian Ecosystems
2	Creek	Tall Fireweed	*Senecio runcinifolius*	2012	Australian Ecosystems
3a	Creek	Tall Fireweed	*Senecio runcinifolius*	2012	Australian Ecosystems
1	Unregulated	Tall Flat-sedge	*Cyperus exaltatus*	2013	Australian Ecosystems
1	Heppell	Tall Sedge	*Carex appressa*	2013	Australian Ecosystems; Ayres et al.
1	Splatts	Tall Sedge	*Carex appressa*	2013	Australian Ecosystems
1	Turner	Tall Sedge	*Carex appressa*	2013	Australian Ecosystems; Ayres et al.
1	Upper	Tall Sedge	*Carex appressa*	2013	Australian Ecosystems
1	Creek	Tall Sedge	*Carex appressa*	2012	Australian Ecosystems
1	Turner	Tall Spikerush	*Eleocharis sphacelata*	2013	Ayres et al.
1	Upper	Tall Spike-rush	*Eleocharis sphacelata*	2013	Ayres et al.
1	Heart	Tall Spike-sedge	*Eleocharis sphacelata*	2013	Australian Ecosystems
1	Longmore	Tall Spike-sedge	*Eleocharis sphacelata*	2013	Australian Ecosystems; Ayres et al.
2	Gum	Tall Spike-sedge	*Eleocharis sphacelata*	2013	Australian Ecosystems: Ayres et al.
3a	Safe's	Tall Spike-sedge	*Eleocharis sphacelata*	2013	Australian Ecosystems; Ayres et al.
2	Creek	Tall Spike-sedge	*Eleocharis sphacelata*	2012	Australian Ecosystems
3a	Creek	Tall Spike-sedge	*Eleocharis sphacelata*	2012	Australian Ecosystems
1	Heart	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Heppell	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Longmore	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Phyland	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Splatts	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Turner	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Unregulated	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Upper	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
2	Gum	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
2	Taylors	Tangled Lignum	*Muehlenbeckia florulenta*	2013	Australian Ecosystems
1	Creek	Tangled Lignum	*Duma florulenta*	2012	Australian Ecosystems
2	Creek	Tangled Lignum	*Duma florulenta*	2012	Australian Ecosystems
3a	Creek	Tangled Lignum	*Duma florulenta*	1986	VBA
1	Longmore	Tassel Sedge	*Carex fascicularis*	2013	Australian Ecosystems
1	Upper	Thin Duckweed	*Landoltia punctata*	2013	Australian Ecosystems
3a	Creek	Thin Duckweed	*Landoltia punctata*	1986	VBA
3a	Creek	Tiny Star	*Hypoxis glabella var. glabella*	1986	VBA
1	Unregulated	Toad Rush	*Juncus bufonius*	2013	Australian Ecosystems
1	Heart	Tough Scurf-pea	*Cullen tenax*	2013	Australian Ecosystems
1	Splatts	Tough Scurf-pea	*Cullen tenax*	2013	Australian Ecosystems
1	Unregulated	Tough Scurf-pea	*Cullen tenax*	2013	Australian Ecosystems
1	Creek	Tough Scurf-pea	*Cullen tenax*	2012	Australian Ecosystems
1	Heart	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
1	Longmore	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
1	Splatts	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
1	Unregulated	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
1	Upper	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
2	Cockatoo	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
2	Gum	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
2	Taylors	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
3a	Safe's	Tussock Rush	*Juncus aridicola*	2013	Australian Ecosystems
1	Creek	Tussock Rush	*Juncus aridicola*	2012	Australian Ecosystems
2	Creek	Tussock Rush	*Juncus aridicola*	2012	Australian Ecosystems
3a	Creek	Tussock Rush	*Juncus aridicola*	2012	Australian Ecosystems
3a	Creek	Twiggy Sida	*Sida intricata*	1986	VBA
2	Creek	Umbrella Grass	*Digitaria divaricatissima var. divaricatissima*	1949	VBA
1	Heart	Umbrella Wattle	*Acacia oswaldii*	2013	Australian Ecosystems
1	Phyland	Umbrella Wattle	*Acacia oswaldii*	2013	Australian Ecosystems
1	Splatts	Umbrella Wattle	*Acacia oswaldii*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Unregulated	Umbrella Wattle	*Acacia oswaldii*	2013	Australian Ecosystems
2	Gum	Umbrella Wattle	*Acacia oswaldii*	2013	Australian Ecosystems
1	Creek	Umbrella Wattle	*Acacia oswaldii*	2012	Australian Ecosystems
2	Creek	Umbrella Wattle	*Acacia oswaldii*	2012	Australian Ecosystems
3a	Creek	Umbrella Wattle	*Acacia oswaldii*	1986	VBA
1	Longmore	Upright Water-milfoil	*Myriophyllum crispatum*	2013	Australian Ecosystems
2	Cockatoo	Upright Water-milfoil	*Myriophyllum crispatum*	2013	Australian Ecosystems
2	Gum	Upright Water-milfoil	*Myriophyllum crispatum*	2013	Australian Ecosystems
3a	Safe's	Upright Water-milfoil	*Myriophyllum crispatum*	2013	Australian Ecosystems; VBA
2	Creek	Upright Water-milfoil	*Myriophyllum crispatum*	2012	Australian Ecosystems
3a	Creek	Upright Water-milfoil	*Myriophyllum crispatum*	2012	Australian Ecosystems
2	Cockatoo	Variable Glycine	*Glycine tabacina s.l.*	2013	Australian Ecosystems
1	Creek	Variable Glycine	*Glycine tabacina s.l.*	2013	Australian Ecosystems
2	Creek	Variable Glycine	*Glycine tabacina s.l.*	2012	Australian Ecosystems
1	Unregulated	Variable Plantain	*Plantago varia*	2013	Australian Ecosystems
3a	Creek	Variable Plantain	*Plantago varia*	1986	VBA
2	Taylors	Variable Sida	*Sida corrugata*	2013	Australian Ecosystems
3a	Safe's	Variable Sida	*Sida corrugata*	2013	Australian Ecosystems
3a	Creek	Variable Sida	*Sida corrugata*	2012	Australian Ecosystems
3b	Creek	Variable Sida	*Sida corrugata*	2002	VBA
1	Heart	Variable Sida (broad-leaf form)	*Sida corrugata var. corrugata (= broad leaf form)*	2013	Australian Ecosystems
1	Heppell	Variable Sida (broad-leaf form)	*Sida corrugata var. corrugata (= broad leaf form)*	2013	Australian Ecosystems
1	Splatts	Variable Sida (broad-leaf form)	*Sida corrugata var. corrugata (= broad leaf form)*	2013	Australian Ecosystems
1	Turner	Variable Sida (broad-leaf form)	*Sida corrugata var. corrugata (= broad leaf form)*	2013	Australian Ecosystems
1	Unregulated	Variable Sida (broad-leaf form)	*Sida corrugata var. corrugata (= broad leaf form)*	2013	Australian Ecosystems
1	Creek	Variable Sida (broad-leaf form)	*Sida corrugata var. corrugata (= broad leaf form)*	2012	Australian Ecosystems
3a	Creek	Variable Willow-herb	*Epilobium billardierianum*	2002	VBA
3a	Creek	Varied Raspwort	*Haloragis heterophylla*	1986	VBA
1	Creek	Victorian Club-sedge	*Isolepis victoriensis*	1874	VBA
3a	Creek	Wallaby Grass	*Rytidosperma sp. aff. setaceum*	2002	VBA
1	Heart	Warrego Summer-grass	*Paspalidium jubiflorum*	2013	Australian Ecosystems
1	Heppell	Warrego Summer-grass	*Paspalidium jubiflorum*	2013	Australian Ecosystems
3a	Safe's	Warrego Summer-grass	*Paspalidium jubiflorum*	1987	VBA
1	Heppell	Water couch	*Paspalum distichum*	2013	Ayres et al.
1	Longmore	Water Couch	*Paspalum distichum*	2013	Ayres et al.
1	Phyland	Water Couch	*Paspalum distichum*	2013	Ayres et al.
1	Splatts	Water Couch	*Paspalum distichum*	2013	Ayres et al.
1	Turner	Water Couch	*Paspalum distichum*	2013	Ayres et al.
1	Upper	Water Couch	*Paspalum distichum*	2013	Ayres et al.
3a	Creek	Water Milfoil	*Myriophyllum spp.*	2004	VBA
1	Heppell	Water Pepper	*Persicaria hydropiper*	2013	Australian Ecosystems
1	Longmore	Water Pepper	*Persicaria hydropiper*	2013	Australian Ecosystems
1	Turner	Water Pepper	*Persicaria hydropiper*	2013	Australian Ecosystems
1	Upper	Water Pepper	*Persicaria hydropiper*	2013	Australian Ecosystems
1	Creek	Water Pepper	*Persicaria hydropiper*	2012	Australian Ecosystems
3a	Creek	Water Pepper	*Persicaria hydropiper*	1986	VBA
1	Longmore	Water Plantain	*Alisma plantago-aquatica*	2013	Australian Ecosystems
1	Heart	Water Primrose	*Ludwigia peploides*	2013	Ayres et al.
1	Longmore	Water Primrose	*Ludwigia peploides*	2013	Ayres et al.
1	Phyland	Water Primrose	*Ludwigia peploides*	20132	Ayres et al.
1	Splatts	Water Primrose	*Ludwigia peploides*	2013	Ayres et al.
1	Turner	Water primrose	*Ludwigia peploides*	2013	Ayres et al.
1	Upper	Water primrose	*Ludwigia peploides*	2013	Ayres et al.
3a	Safe's	Water primrose	*Ludwigia peploides*	2013	Ayres et al.
1	Heppell	Water Ribbons	*Triglochin procera s.l.*	2013	Australian Ecosystems; Ayres et al.
1	Splatts	Water Ribbons	*Triglochin procerum*	2013	Ayres et al.
1	Turner	Water Ribbons	*Triglochin procera s.l.*	2013	Australian Ecosystems
2	Taylors	Water Ribbons	*Triglochin procera s.l.*	2013	Australian Ecosystems
3a	Safe's	Water Ribbons	*Triglochin procera s.l.*	2013	Australian Ecosystems;

Reach	Location	Common name	Scientific name	Most recent record	Source
					VBA
1	Creek	Water Ribbons	*Triglochin procera s.l.*	2012	Australian Ecosystems
3a	Creek	Water Ribbons	*Triglochin procera s.l.*	2012	Australian Ecosystems
1	Longmore	Waterbush	*Myoporum montanum*	2013	Australian Ecosystems
1	Phyland	Waterbush	*Myoporum montanum*	2013	Australian Ecosystems
1	Splatts	Waterbush	*Myoporum montanum*	2013	Australian Ecosystems
1	Turner	Waterbush	*Myoporum montanum*	2013	Australian Ecosystems
1	Upper	Waterbush	*Myoporum montanum*	2013	Australian Ecosystems
2	Cockatoo	Waterbush	*Myoporum montanum*	2013	Australian Ecosystems
1	Creek	Waterbush	*Myoporum montanum*	2013	Australian Ecosystems
2	Creek	Waterbush	*Myoporum montanum*	2012	Australian Ecosystems
1	Upper	Waterwort	*Elatine gratioloides*	2013	Australian Ecosystems
2	Gum	Waterwort	*Elatine gratioloides*	2013	Australian Ecosystems
2	Creek	Waterwort	*Elatine gratioloides*	2012	Australian Ecosystems
3a	Creek	Waterwort	*Elatine gratioloides*	1986	VBA
3a	Creek	Wavy Marshwort	*Nymphoides crenata*	1986	VBA
3a	Creek	Weeping Grass	*Microlaena stipoides var. stipoides*	1987	VBA
1	Heart	Weeping Pittosporum	*Pittosporum angustifolium*	2013	Australian Ecosystems
1	Splatts	Weeping Pittosporum	*Pittosporum angustifolium*	2013	Australian Ecosystems
1	Turner	Weeping Pittosporum	*Pittosporum angustifolium*	2013	Australian Ecosystems
1	Unregulated	Weeping Pittosporum	*Pittosporum angustifolium*	2013	Australian Ecosystems
2	Cockatoo	Weeping Pittosporum	*Pittosporum angustifolium*	2013	Australian Ecosystems
2	Gum	Weeping Pittosporum	*Pittosporum angustifolium*	2013	Australian Ecosystems
2	Taylors	Weeping Pittosporum	*Pittosporum angustifolium*	2013	Australian Ecosystems
1	Creek	Weeping Pittosporum	*Pittosporum angustifolium*	2012	Australian Ecosystems
2	Creek	Weeping Pittosporum	*Pittosporum angustifolium*	2012	Australian Ecosystems
3a	Creek	Weeping Pittosporum	*Pittosporum angustifolium*	1987	VBA
3a	Creek	White Rochelia	*Plagiobothrys plurisepalus*	1986	VBA
1	Splatts	White Sallow-wattle	*Acacia floribunda*	2013	Australian Ecosystems
1	Upper	White Sallow-wattle	*Acacia floribunda*	2013	Australian Ecosystems
1	Longmore	Willow Wattle	*Acacia salicina*	2013	Australian Ecosystems
1	Splatts	Willow Wattle	*Acacia salicina*	2013	Australian Ecosystems
1	Turner	Willow Wattle	*Acacia salicina*	2013	Australian Ecosystems
1	Creek	Willow Wattle	*Acacia salicina*	2012	Australian Ecosystems
3a	Creek	Willow Wattle	*Acacia salicina*	2002	VBA
1	Heppell	Windmill Grass	*Chloris truncata*	2013	Australian Ecosystems
1	Phyland	Windmill Grass	*Chloris truncata*	2013	Australian Ecosystems
1	Turner	Windmill Grass	*Chloris truncata*	2013	Australian Ecosystems
1	Unregulated	Windmill Grass	*Chloris truncata*	2013	Australian Ecosystems
2	Taylors	Windmill Grass	*Chloris truncata*	2013	Australian Ecosystems
1	Creek	Windmill Grass	*Chloris truncata*	2012	Australian Ecosystems
3a	Creek	Windmill Grass	*Chloris truncata*	1986	VBA
1	Heppell	Wingless Bluebush	*Maireana enchylaenoides*	2013	Australian Ecosystems
3a	Creek	Wingless Bluebush	*Maireana enchylaenoides*	1986	VBA
3a	Creek	Wire-leaf Mistletoe	*Amyema preissii*	1986	VBA
1	Heart	Woolly New Holland Daisy	*Vittadinia gracilis*	2013	Australian Ecosystems
1	Heppell	Woolly New Holland Daisy	*Vittadinia gracilis*	2013	Australian Ecosystems
1	Phyland	Woolly New Holland Daisy	*Vittadinia gracilis*	2013	Australian Ecosystems
2	Cockatoo	Woolly New Holland Daisy	*Vittadinia gracilis*	2013	Australian Ecosystems
2	Creek	Woolly New Holland Daisy	*Vittadinia gracilis*	2012	Australian Ecosystems
3a	Creek	Woolly New Holland Daisy	*Vittadinia gracilis*	1987	VBA
3a	Creek	Woolly-heads	*Myriocephalus rhizocephalus*	1986	VBA
1	Heart	Yellow Bladderwort	*Utricularia australis*	2013	Australian Ecosystems
2	Cockatoo	Yellow Bladderwort	*Utricularia australis*	2013	Australian Ecosystems
2	Taylors	Yellow Bladderwort	*Utricularia australis*	2013	Australian Ecosystems
2	Creek	Yellow Bladderwort	*Utricularia australis*	2012	Australian Ecosystems
Native but some stands may be alien					
2	Creek	Caltrop	*Tribulus terrestris*	2001	VBA
3a	Creek	Caltrop	*Tribulus terrestris*	1986	VBA
3a	Creek	Clammy Goosefoot	*Dysphania pumilio*	1986	VBA
2	Creek	Common Boobialla	*Myoporum insulare*	2012	Australian Ecosystems
1	Creek	Crimson Bottlebrush	*Callistemon citrinus*	2012	Australian Ecosystems
2	Creek	Crimson Bottlebrush	*Callistemon citrinus*	2012	Australian Ecosystems
1	Creek	Eumong	*Acacia stenophylla*	2012	Australian Ecosystems
3a	Creek	Flat Spurge	*Euphorbia drummondii*	2012	Australian Ecosystems
1	Creek	Hedge Saltbush	*Rhagodia spinescens*	2012	Australian Ecosystems
2	Creek	Hedge Saltbush	*Rhagodia spinescens*	2012	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Creek	Hedge Saltbush	*Rhagodia spinescens*	1986	VBA
1	Creek	Kurrajong	*Brachychiton populneus subsp. populneus*	2012	Australian Ecosystems
1	Creek	Sprawling Saltbush	*Atriplex suberecta*	2012	Australian Ecosystems
2	Creek	Sprawling Saltbush	*Atriplex suberecta*	2012	Australian Ecosystems
3a	Creek	Sprawling Saltbush	*Atriplex suberecta*	2012	Australian Ecosystems
2	Creek	Sweet Pittosporum	*Pittosporum undulatum*	2012	Australian Ecosystems
3a	Creek	Tah-vine	*Boerhavia dominii*	1986	VBA
3b	Creek	Tah-vine	*Boerhavia dominii*	2002	VBA
3a	Creek	Warrego Summer-grass	*Paspalidium jubiflorum*	2002	VBA
3b	Creek	Warrego Summer-grass	*Paspalidium jubiflorum*	2002	VBA
1	Creek	White Sallow-wattle	*Acacia floribunda*	2012	Australian Ecosystems
3a	Creek	Yellow Twin-heads	*Eclipta platyglossa subsp. platyglossa*	1986	VBA
Exotic flora species					
1	Heart	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems
1	Heppell	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems
1	Longmore	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA; Ayres et al.
1	Phyland	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA
1	Splatts	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA
1	Turner	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA
1	Unregulated	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems
1	Upper	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA; Ayres et al.
2	Cockatoo	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA
2	Gum	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; Nitschke, 2008; VBA
2	Taylors	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA
3a	Safe's	African Box-thorn	*Lycium ferocissimum*	2013	Australian Ecosystems; VBA
1	Creek	African Box-thorn	*Lycium ferocissimum*	2012	Australian Ecosystems
2	Creek	African Box-thorn	*Lycium ferocissimum*	2012	Australian Ecosystems
2	Creek	African Box-thorn	*Lycium ferocissimum*	2003	VBA
3a	Creek	African Box-thorn	*Lycium ferocissimum*	2012	Australian Ecosystems
1	Heppell	Agapanthus	*Agapanthus praecox subsp. orientalis*	2013	Australian Ecosystems
2	Taylors	Agapanthus	*Agapanthus praecox subsp. orientalis*	2013	Australian Ecosystems
2	Taylors	Alkali Sida	*Malvella leprosa*	2002	VBA
2	Creek	Alkali Sida	*Malvella leprosa*	2008	VBA
1	Heppell	Angled Pigface	*Carpobrotus aequilaterus*	2013	Australian Ecosystems
2	Cockatoo	Angled Pigface	*Carpobrotus aequilaterus*	2013	Australian Ecosystems
2	Creek	Angled Pigface	*Carpobrotus aequilaterus*	2012	Australian Ecosystems
1	Phyland	Annual Beard-grass	*Polypogon monspeliensis*	2013	Australian Ecosystems
1	Turner	Annual Beard-grass	*Polypogon monspeliensis*	2013	Australian Ecosystems
1	Unregulated	Annual Beard-grass	*Polypogon monspeliensis*	2013	Australian Ecosystems
1	Upper	Annual Beard-grass	*Polypogon monspeliensis*	2013	Australian Ecosystems
1	Creek	Annual Beard-grass	*Polypogon monspeliensis*	2012	Australian Ecosystems
2	Creek	Annual Beard-grass	*Polypogon monspeliensis*	2002	VBA
3a	Creek	Annual Beard-grass	*Polypogon monspeliensis*	2002	VBA
3a	Creek	Annual Cat's-tail	*Rostraria cristata*	1987	VBA
3a	Creek	Annual Meadow-grass	*Poa annua*	1986	VBA
1	Heart	Annual Veldt-grass	*Ehrharta longiflora*	2013	Australian Ecosystems
1	Heppell	Annual Veldt-grass	*Ehrharta longiflora*	2013	Australian Ecosystems
1	Longmore	Annual Veldt-grass	*Ehrharta longiflora*	2013	Australian Ecosystems
1	Phyland	Annual Veldt-grass	*Ehrharta longiflora*	2013	Australian Ecosystems
1	Splatts	Annual Veldt-grass	*Ehrharta longiflora*	2013	Australian Ecosystems
1	Unregulated	Annual Veldt-grass	*Ehrharta longiflora*	2013	Australian Ecosystems
1	Upper	Annual Veldt-grass	*Ehrharta longiflora*	2013	Australian Ecosystems
1	Creek	Annual Veldt-grass	*Ehrharta longiflora*	2012	Australian Ecosystems
3a	Creek	Annual Veldt-grass	*Ehrharta longiflora*	2004	VBA
3a	Creek	Arabian Grass	*Schismus barbatus*	1986	VBA
1	Turner	Artichoke Thistle	*Cynara cardunculus*	2001	VBA
1	Phyland	Asparagus	*Asparagus officinalis*	2013	Australian Ecosystems
1	Splatts	Asparagus	*Asparagus officinalis*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Upper	Asparagus	*Asparagus officinalis*	2013	Australian Ecosystems
2	Taylors	Asparagus	*Asparagus officinalis*	2013	Australian Ecosystems
1	Creek	Asparagus	*Asparagus officinalis*	2012	Australian Ecosystems
1	Splatts	Aster Weed	*Aster subulatus*	2013	Ayres et al.
1	Heart	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
1	Heppell	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
1	Longmore	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
1	Turner	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
1	Unregulated	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
1	Upper	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
2	Gum	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
2	Taylors	Aster-weed	*Aster subulatus*	2013	Australian Ecosystems
3a	Safe's	Aster-weed	*Aster subulatus*	1987	VBA
1	Creek	Aster-weed	*Aster subulatus*	2012	Australian Ecosystems
2	Creek	Aster-weed	*Aster subulatus*	2012	Australian Ecosystems
3a	Creek	Aster-weed	*Aster subulatus*	2004	VBA
1	Turner	Athel Tree	*Tamarix aphylla*	2013	Australian Ecosystems
1	Creek	Athel Tree	*Tamarix aphylla*	2012	Australian Ecosystems
1	Heart	Barley Grass	*Hordeum spp.*	2013	Australian Ecosystems
1	Longmore	Barley Grass	*Hordeum spp.*	2013	Australian Ecosystems
1	Heppell	Barley-grass	*Hordeum leporinum*	2013	Australian Ecosystems
1	Turner	Barley-grass	*Hordeum leporinum*	2013	Australian Ecosystems
1	Unregulated	Barley-grass	*Hordeum leporinum*	2013	Australian Ecosystems
2	Gum	Barley-grass	*Hordeum leporinum*	2013	Australian Ecosystems
2	Taylors	Barley-grass	*Hordeum leporinum*	2013	Australian Ecosystems
3a	Safe's	Barley-grass	*Hordeum leporinum*	2013	Australian Ecosystems; VBA
1	Creek	Barley-grass	*Hordeum leporinum*	2012	Australian Ecosystems
2	Creek	Barley-grass	*Hordeum leporinum*	2012	Australian Ecosystems
3a	Creek	Barley-grass	*Hordeum leporinum*	2012	Australian Ecosystems
2	Gum	Barrel Medic	*Medicago truncatula*	2013	Australian Ecosystems
2	Taylors	Barrel Medic	*Medicago truncatula*	2013	Australian Ecosystems
2	Creek	Barrel Medic	*Medicago truncatula*	2012	Australian Ecosystems
3a	Safe's	Bathurst Burr	*Xanthium spinosum*	2013	Australian Ecosystems
3a	Creek	Bathurst Burr	*Xanthium spinosum*	2012	Australian Ecosystems
1	Turner	Bearded Oat	*Avena barbata*	2013	Australian Ecosystems
1	Unregulated	Bearded Oat	*Avena barbata*	2013	Australian Ecosystems
2	Gum	Bearded Oat	*Avena barbata*	2013	Australian Ecosystems
2	Taylors	Bearded Oat	*Avena barbata*	2013	Australian Ecosystems
1	Creek	Bearded Oat	*Avena barbata*	2012	Australian Ecosystems
2	Creek	Bearded Oat	*Avena barbata*	2012	Australian Ecosystems
3a	Creek	Black Nightshade	*Solanum nigrum s.l.*	1986	VBA
1	Creek	Blackberry	*Rubus fruticosus spp. agg.*	2005	VBA
2	Creek	Blackberry	*Rubus fruticosus spp. agg.*	2005	VBA
1	Phyland	Bokhara Clover	*Melilotus albus*	2013	Australian Ecosystems
1	Unregulated	Bokhara Clover	*Melilotus albus*	2013	Australian Ecosystems
1	Upper	Bokhara Clover	*Melilotus albus*	2013	Australian Ecosystems
2	Cockatoo	Bokhara Clover	*Melilotus albus*	2013	Australian Ecosystems
2	Taylors	Bokhara Clover	*Melilotus albus*	2013	Australian Ecosystems
2	Creek	Bokhara Clover	*Melilotus albus*	2012	Australian Ecosystems
1	Heart	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Heppell	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Longmore	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Phyland	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Splatts	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Turner	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Unregulated	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Upper	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
2	Cockatoo	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
2	Gum	Bridal Creeper	*Asparagus asparagoides*	2001	VBA
2	Taylors	Bridal Creeper	*Asparagus asparagoides*	2013	Australian Ecosystems
1	Creek	Bridal Creeper	*Asparagus asparagoides*	2012	Australian Ecosystems
2	Creek	Bridal Creeper	*Asparagus asparagoides*	2012	Australian Ecosystems
2	Creek	Buck's-horn Plantain	*Plantago coronopus*	2008	VBA
3a	Creek	Buck's-horn Plantain	*Plantago coronopus*	2004	VBA
2	Cockatoo	Burr Medic	*Medicago polymorpha*	2013	Australian Ecosystems
2	Taylors	Burr Medic	*Medicago polymorpha*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Safe's	Burr Medic	*Medicago polymorpha*	1987	VBA
2	Creek	Burr Medic	*Medicago polymorpha*	2012	Australian Ecosystems
3a	Creek	Burr Medic	*Medicago polymorpha*	2008	VBA
2	Taylors	Button Medic	*Medicago orbicularis*	2013	Australian Ecosystems
1	Turner	Canadian Poplar	*Populus X canadensis*	2013	Australian Ecosystems
1	Creek	Canadian Poplar	*Populus X canadensis*	2012	Australian Ecosystems
1	Unregulated	Canary Island Date-palm	*Phoenix canariensis*	2013	Australian Ecosystems
2	Gum	Canary Island Date-palm	*Phoenix canariensis*	2013	Australian Ecosystems
2	Taylors	Canary Island Date-palm	*Phoenix canariensis*	2013	Australian Ecosystems
1	Creek	Canary Island Date-palm	*Phoenix canariensis*	2012	Australian Ecosystems
2	Creek	Canary Island Date-palm	*Phoenix canariensis*	2012	Australian Ecosystems
1	Turner	Cape Wattle	*Paraserianthes lophantha subsp. lophantha*	2013	Australian Ecosystems
1	Creek	Cape Wattle	*Paraserianthes lophantha subsp. lophantha*	2012	Australian Ecosystems
3a	Creek	Cape Weed	*Arctotheca calendula*	2004	VBA
1	Heppell	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2013	Australian Ecosystems
1	Turner	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2013	Australian Ecosystems
1	Upper	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2013	Australian Ecosystems
2	Gum	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2013	Australian Ecosystems
2	Taylors	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2013	Australian Ecosystems
1	Creek	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2012	Australian Ecosystems
2	Creek	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2012	Australian Ecosystems
3a	Creek	Celery Buttercup	*Ranunculus sceleratus subsp. sceleratus*	2002	VBA
1	Unregulated	Century Plant	*Agave americana*	2013	Australian Ecosystems
1	Upper	Century Plant	*Agave americana*	2013	Australian Ecosystems
2	Taylors	Century Plant	*Agave americana*	2013	Australian Ecosystems
1	Upper	Cherry Plum	*Prunus cerasifera*	2013	Australian Ecosystems
2	Gum	Cherry Plum	*Prunus cerasifera*	2013	Australian Ecosystems
2	Taylors	Cherry Plum	*Prunus cerasifera*	2013	Australian Ecosystems
2	Creek	Cherry Plum	*Prunus cerasifera*	2012	Australian Ecosystems
3a	Creek	Chickweed	*Stellaria media*	1986	VBA
1	Turner	Chicory	*Cichorium intybus*	2013	Australian Ecosystems
1	Upper	Chicory	*Cichorium intybus*	2013	Australian Ecosystems
2	Gum	Chicory	*Cichorium intybus*	2013	Australian Ecosystems
2	Taylors	Chicory	*Cichorium intybus*	2013	Australian Ecosystems
1	Creek	Chicory	*Cichorium intybus*	2012	Australian Ecosystems
2	Creek	Chicory	*Cichorium intybus*	2012	Australian Ecosystems
3a	Creek	Chicory	*Cichorium intybus*	1986	VBA
1	Heppell	Cleavers	*Galium aparine*	2013	Australian Ecosystems
1	Unregulated	Cleavers	*Galium aparine*	2013	Australian Ecosystems
1	Upper	Cleavers	*Galium aparine*	2013	Australian Ecosystems
2	Gum	Cleavers	*Galium aparine*	2013	Australian Ecosystems
2	Creek	Cleavers	*Galium aparine*	2012	Australian Ecosystems
3a	Creek	Cleavers	*Galium aparine*	1986	VBA
3a	Creek	Clover	*Trifolium spp.*	2004	VBA
1	Upper	Cluster Clover	*Trifolium glomeratum*	2013	Australian Ecosystems
2	Cockatoo	Cluster Clover	*Trifolium glomeratum*	2013	Australian Ecosystems
3a	Safe's	Cluster Clover	*Trifolium glomeratum*	1987	VBA
2	Creek	Cluster Clover	*Trifolium glomeratum*	2012	Australian Ecosystems
3a	Creek	Cluster Clover	*Trifolium glomeratum*	1987	VBA
1	Phyland	Clustered Dock	*Rumex conglomeratus*	2013	Australian Ecosystems
1	Turner	Clustered Dock	*Rumex conglomeratus*	2013	Australian Ecosystems
1	Upper	Clustered Dock	*Rumex conglomeratus*	2013	Australian Ecosystems
1	Creek	Clustered Dock	*Rumex conglomeratus*	2012	Australian Ecosystems
3a	Creek	Clustered Dock	*Rumex conglomeratus*	2002	VBA
3a	Creek	Coast Barb-grass	*Parapholis incurva*	1986	VBA
1	Heart	Cocksfoot	*Dactylis glomerata*	2013	Australian Ecosystems
1	Turner	Common Bindweed	*Convolvulus arvensis*	2001	VBA
2	Cockatoo	Common Bindweed	*Convolvulus arvensis*	2001	VBA
1	Heart	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems
1	Heppell	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems
1	Longmore	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems; VBA; Ayres et al.
1	Phyland	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems; VBA; Ayres et al.
1	Splatts	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems; VBA; Ayres et al.
1	Turner	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems;

Reach	Location	Common name	Scientific name	Most recent record	Source
					Ayres et al.
1	Upper	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems; VBA; Ayres et al.
2	Taylors	Common Blackberry	*Rubus anglocandicans*	2013	Australian Ecosystems; VBA; Ayres et al.
1	Creek	Common Blackberry	*Rubus anglocandicans*	2012	Australian Ecosystems
3a	Creek	Common Heliotrope	*Heliotropium europaeum*	1986	VBA
3a	Creek	Common Heron's-bill	*Erodium cicutarium*	1986	VBA
1	Upper	Common Ice-plant	*Mesembryanthemum crystallinum*	2013	Australian Ecosystems
2	Cockatoo	Common Ice-plant	*Mesembryanthemum crystallinum*	2013	Australian Ecosystems
2	Creek	Common Ice-plant	*Mesembryanthemum crystallinum*	2012	Australian Ecosystems
3a	Creek	Common Mouse-ear Chickweed	*Cerastium glomeratum s.l.*	1986	VBA
1	Heppell	Common Peppercress	*Lepidium africanum*	2013	Australian Ecosystems
1	Turner	Common Peppercress	*Lepidium africanum*	2013	Australian Ecosystems
2	Cockatoo	Common Peppercress	*Lepidium africanum*	2013	Australian Ecosystems
2	Gum	Common Peppercress	*Lepidium africanum*	2013	Australian Ecosystems
2	Taylors	Common Peppercress	*Lepidium africanum*	2013	Australian Ecosystems
3a	Safe's	Common Peppercress	*Lepidium africanum*	2013	Australian Ecosystems; VBA
1	Creek	Common Peppercress	*Lepidium africanum*	2012	Australian Ecosystems
2	Creek	Common Peppercress	*Lepidium africanum*	2012	Australian Ecosystems
3a	Creek	Common Peppercress	*Lepidium africanum*	2012	Australian Ecosystems
1	Phyland	Common Prickly-pear	*Opuntia stricta*	2013	Australian Ecosystems
1	Upper	Common Prickly-pear	*Opuntia stricta*	2013	Australian Ecosystems; VBA
2	Creek	Common Prickly-pear	*Opuntia stricta*	2001	VBA
1	Heppell	Common Sow-thistle	*Sonchus oleraceus*	2013	Australian Ecosystems
1	Phyland	Common Sow-thistle	*Sonchus oleraceus*	2013	Australian Ecosystems
1	Turner	Common Sow-thistle	*Sonchus oleraceus*	2013	Australian Ecosystems
1	Unregulated	Common Sow-thistle	*Sonchus oleraceus*	2013	Australian Ecosystems
2	Cockatoo	Common Sow-thistle	*Sonchus oleraceus*	2013	Australian Ecosystems
3a	Safe's	Common Sow-thistle	*Sonchus oleraceus*	1987	VBA
1	Creek	Common Sow-thistle	*Sonchus oleraceus*	2012	Australian Ecosystems
2	Creek	Common Sow-thistle	*Sonchus oleraceus*	2012	Australian Ecosystems
3a	Creek	Common Sow-thistle	*Sonchus oleraceus*	2004	VBA
3a	Creek	Common Thorn-apple	*Datura stramonium*	2001	VBA
3a	Safe's	Common Vetch	*Vicia sativa*	1987	VBA
3a	Creek	Common Vetch	*Vicia sativa*	2004	VBA
2	Gum	Common Violet	*Viola odorata*	2013	Australian Ecosystems
2	Creek	Common Violet	*Viola odorata*	2012	Australian Ecosystems
3a	Creek	Common Water-starwort	*Callitriche stagnalis*	1985	VBA
1	Turner	Cootamundra Wattle	*Acacia baileyana*	2013	Australian Ecosystems
1	Creek	Cootamundra Wattle	*Acacia baileyana*	2012	Australian Ecosystems
1	Upper	Coppery Mesembryanthemum	*Malephora crocea*	2013	Australian Ecosystems
1	Heart	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Heppell	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Longmore	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Phyland	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Splatts	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Turner	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Unregulated	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Upper	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
2	Cockatoo	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
2	Gum	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
2	Taylors	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
3a	Safe's	Couch	*Cynodon dactylon var. dactylon*	2013	Australian Ecosystems
1	Creek	Couch	*Cynodon dactylon var. dactylon*	2012	Australian Ecosystems
2	Creek	Couch	*Cynodon dactylon var. dactylon*	2012	Australian Ecosystems
3a	Creek	Couch	*Cynodon dactylon var. dactylon*	2012	Australian Ecosystems
3a	Creek	Creeping Buttercup	*Ranunculus repens*	2004	VBA
1	Phyland	Creeping Knapweed	*Rhaponticum repens*	1999	VBA
1	Turner	Creeping Knapweed	*Rhaponticum repens*	1999	VBA
1	Heppell	Curled Dock	*Rumex crispus*	2013	Australian Ecosystems; Ayres et al.
1	Phyland	Curled dock	*Rumex crispus*	2013	Ayres et al.
1	Unregulated	Curled Dock	*Rumex crispus*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
2	Cockatoo	Curled Dock	*Rumex crispus*	2013	Australian Ecosystems
2	Gum	Curled Dock	*Rumex crispus*	2013	Australian Ecosystems
2	Taylors	Curled Dock	*Rumex crispus*	2013	Australian Ecosystems
2	Creek	Curled Dock	*Rumex crispus*	2012	Australian Ecosystems
3a	Creek	Curled Dock	*Rumex crispus*	2004	VBA
1	Heppell	Desert Ash	*Fraxinus angustifolia*	2013	Australian Ecosystems
1	Longmore	Desert Ash	*Fraxinus angustifolia*	2013	Australian Ecosystems
1	Splatts	Desert Ash	*Fraxinus angustifolia*	2013	Australian Ecosystems
1	Upper	Desert Ash	*Fraxinus angustifolia*	2013	Australian Ecosystems
2	Cockatoo	Desert Ash	*Fraxinus angustifolia subsp. angustifolia*	2013	Australian Ecosystems
2	Gum	Desert Ash	*Fraxinus angustifolia*	2013	Australian Ecosystems
1	Creek	Desert Ash	*Fraxinus angustifolia*	2012	Australian Ecosystems
2	Creek	Desert Ash	*Fraxinus angustifolia*	2012	Australian Ecosystems
1	Unregulated	Dimorphotheca	*Osteospermum fruticosum*	2013	Australian Ecosystems
2	Taylors	Dimorphotheca	*Osteospermum fruticosum*	2013	Australian Ecosystems
1	Longmore	Dog Rose	*Rosa canina*	2013	Australian Ecosystems
1	Upper	Dog Rose	*Rosa canina*	2013	Australian Ecosystems
2	Gum	Dog Rose	*Rosa canina*	2013	Australian Ecosystems
2	Taylors	Dog Rose	*Rosa canina*	2013	Australian Ecosystems
3a	Safe's	Dog Rose	*Rosa canina*	2013	Australian Ecosystems
2	Creek	Dog Rose	*Rosa canina*	2012	Australian Ecosystems
3a	Creek	Dog Rose	*Rosa canina*	2012	Australian Ecosystems
1	Heart	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
1	Heppell	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
1	Longmore	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
1	Phyland	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
1	Turner	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
1	Unregulated	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
2	Cockatoo	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
2	Gum	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
2	Taylors	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems
3a	Safe's	Drain Flat-sedge	*Cyperus eragrostis*	2013	Australian Ecosystems; VBA
3a	Safe's	Drain Flat-sedge	*Cyperus eragrostis*	1987	VBA
1	Creek	Drain Flat-sedge	*Cyperus eragrostis*	2012	Australian Ecosystems
2	Creek	Drain Flat-sedge	*Cyperus eragrostis*	2012	Australian Ecosystems
3a	Creek	Drain Flat-sedge	*Cyperus eragrostis*	2012	Australian Ecosystems
1	Heppell	Emerald fern	*Asparagus aethiopicus*	2013	Australian Ecosystems
1	Phyland	Emerald fern	*Asparagus aethiopicus*	2013	Australian Ecosystems
1	Turner	Emerald fern	*Asparagus aethiopicus*	2013	Australian Ecosystems
1	Creek	Emerald fern	*Asparagus aethiopicus*	2012	Australian Ecosystems
1	Longmore	English Holly	*Ilex aquifolium*	2013	Australian Ecosystems
1	Heppell	Fat Hen	*Chenopodium album*	2013	Australian Ecosystems
1	Phyland	Fat Hen	*Chenopodium album*	2013	Australian Ecosystems
2	Cockatoo	Fennel	*Foeniculum vulgare*	2013	Australian Ecosystems
3a	Safe's	Fennel	*Foeniculum vulgare*	2001	VBA
2	Creek	Fennel	*Foeniculum vulgare*	2012	Australian Ecosystems
3a	Creek	Ferny Cotula	*Cotula bipinnata*	1986	VBA
2	Gum	Fig	*Ficus carica*	2013	Australian Ecosystems
2	Creek	Fig	*Ficus carica*	2012	Australian Ecosystems
1	Heart	Flatweed	*Hypochaeris radicata*	2013	Australian Ecosystems
1	Heppell	Flatweed	*Hypochaeris radicata*	2013	Australian Ecosystems
1	Longmore	Flatweed	*Hypochaeris radicata*	2013	Australian Ecosystems
1	Unregulated	Flatweed	*Hypochaeris radicata*	2013	Australian Ecosystems
1	Upper	Flatweed	*Hypochaeris radicata*	2013	Australian Ecosystems
2	Cockatoo	Flatweed	*Hypochaeris radicata*	2013	Australian Ecosystems
2	Taylors	Flatweed	*Hypochaeris radicata*	2013	Australian Ecosystems
3a	Safe's	Flatweed	*Hypochaeris radicata*	1987	VBA
2	Creek	Flatweed	*Hypochaeris radicata*	2012	Australian Ecosystems
3a	Creek	Flatweed	*Hypochaeris radicata*	2004	VBA
1	Heart	Flaxleaf Fleabane	*Conyza bonariensis*	2013	Australian Ecosystems
1	Heppell	Flaxleaf Fleabane	*Conyza bonariensis*	2013	Australian Ecosystems
1	Splatts	Flaxleaf Fleabane	*Conyza bonariensis*	2013	Australian Ecosystems
1	Unregulated	Flaxleaf Fleabane	*Conyza bonariensis*	2013	Australian Ecosystems
2	Gum	Flaxleaf Fleabane	*Conyza bonariensis*	2013	Australian Ecosystems
1	Creek	Flaxleaf Fleabane	*Conyza bonariensis*	2012	Australian Ecosystems
2	Creek	Flaxleaf Fleabane	*Conyza bonariensis*	2012	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Creek	Flaxleaf Fleabane	*Conyza bonariensis*	2004	VBA
1	Heppell	Fog-fruit	*Phyla canescens*	2013	Australian Ecosystems
3a	Safe's	Four-leaved Allseed	*Polycarpon tetraphyllum*	2013	Australian Ecosystems
3a	Creek	Four-leaved Allseed	*Polycarpon tetraphyllum*	2012	Australian Ecosystems
1	Unregulated	Fumitory	*Fumaria spp.*	2013	Australian Ecosystems
3a	Creek	Fumitory	*Fumaria spp.*	2004	VBA
1	Heppell	Galenia	*Galenia pubescens var. pubescens*	2013	Australian Ecosystems
1	Splatts	Galenia	*Galenia pubescens var. pubescens*	2013	Australian Ecosystems
1	Upper	Galenia	*Galenia pubescens var. pubescens*	2013	Australian Ecosystems
2	Cockatoo	Galenia	*Galenia pubescens var. pubescens*	2013	Australian Ecosystems
2	Gum	Galenia	*Galenia pubescens var. pubescens*	2013	Australian Ecosystems
1	Creek	Galenia	*Galenia pubescens var. pubescens*	2012	Australian Ecosystems
2	Creek	Galenia	*Galenia pubescens var. pubescens*	2012	Australian Ecosystems
3a	Creek	Galenia	*Galenia pubescens var. pubescens*	2004	VBA
1	Heppell	Gazania	*Gazania linearis*	2013	Australian Ecosystems
2	Cockatoo	Gazania	*Gazania spp.*	2013	Australian Ecosystems
2	Taylors	Gazania	*Gazania spp.*	2013	Australian Ecosystems
2	Creek	Gazania	*Gazania spp.*	2012	Australian Ecosystems
1	Heppell	Golden Wreath Wattle	*Acacia saligna*	2013	Australian Ecosystems
3a	Creek	Golden-top	*Lamarckia aurea*	1987	VBA
1	Heppell	Great Brome	*Bromus diandrus*	2013	Australian Ecosystems
1	Phyland	Great Brome	*Bromus diandrus*	2013	Australian Ecosystems
1	Unregulated	Great Brome	*Bromus diandrus*	2013	Australian Ecosystems
1	Upper	Great Brome	*Bromus diandrus*	2013	Australian Ecosystems
2	Cockatoo	Great Brome	*Bromus diandrus*	2013	Australian Ecosystems
2	Gum	Great Brome	*Bromus diandrus*	2013	Australian Ecosystems
2	Taylors	Great Brome	*Bromus diandrus*	2013	Australian Ecosystems
2	Creek	Great Brome	*Bromus diandrus*	2012	Australian Ecosystems
3a	Creek	Great Brome	*Bromus diandrus*	2004	VBA
1	Heppell	Greater Bird's-foot Trefoil	*Lotus uliginosus*	2013	Australian Ecosystems
1	Upper	Ground Cherry	*Physalis spp.*	2013	Australian Ecosystems
2	Taylors	Hairy Hawkbit	*Leontodon taraxacoides subsp. taraxacoides*	2013	Australian Ecosystems
3a	Creek	Hairy Hawkbit	*Leontodon taraxacoides subsp. taraxacoides*	1987	VBA
1	Heppell	Hare's-foot Clover	*Trifolium arvense var. arvense*	2013	Australian Ecosystems
1	Unregulated	Hare's-foot Clover	*Trifolium arvense var. arvense*	2013	Australian Ecosystems
1	Upper	Hare's-foot Clover	*Trifolium arvense var. arvense*	2013	Australian Ecosystems
2	Cockatoo	Hare's-foot Clover	*Trifolium arvense var. arvense*	2013	Australian Ecosystems
2	Creek	Hare's-foot Clover	*Trifolium arvense var. arvense*	2012	Australian Ecosystems
3a	Creek	Hare's-foot Clover	*Trifolium arvense var. arvense*	1987	VBA
1	Upper	Hastate Orache	*Atriplex prostrata*	2013	Australian Ecosystems
3a	Safe's	Hop Clover	*Trifolium campestre var. campestre*	1987	VBA
3a	Creek	Hop Clover	*Trifolium campestre var. campestre*	1987	VBA
1	Heart	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
1	Heppell	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
1	Longmore	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
1	Phyland	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
1	Splatts	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
1	Turner	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
1	Unregulated	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
1	Upper	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
2	Cockatoo	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
2	Taylors	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems
3a	Safe's	Horehound	*Marrubium vulgare*	2013	Australian Ecosystems; VBA
1	Creek	Horehound	*Marrubium vulgare*	2012	Australian Ecosystems
2	Creek	Horehound	*Marrubium vulgare*	2012	Australian Ecosystems
3a	Creek	Horehound	*Marrubium vulgare*	2012	Australian Ecosystems
3b	Creek	Horehound	*Marrubium vulgare*	2002	VBA
1	Longmore	Ice Plant	*Mesembryanthemum spp.*	2013	Australian Ecosystems
1	Splatts	Indian Fig	*Opuntia ficus-indica*	2013	Australian Ecosystems
1	Creek	Indian Fig	*Opuntia ficus-indica*	2012	Australian Ecosystems
1	Turner	Indian Shot	*Canna indica*	2013	Australian Ecosystems
1	Creek	Indian Shot	*Canna indica*	2012	Australian Ecosystems
2	Gum	Japanese Honeysuckle	*Lonicera japonica*	2013	Australian Ecosystems
2	Taylors	Japanese Honeysuckle	*Lonicera japonica*	2013	Australian Ecosystems
2	Creek	Japanese Honeysuckle	*Lonicera japonica*	2012	Australian Ecosystems
1	Upper	Jointed Rush	*Juncus articulatus*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
2	Cockatoo	Jointed Rush	*Juncus articulatus*	2013	Australian Ecosystems
2	Gum	Jointed Rush	*Juncus articulatus*	2013	Australian Ecosystems
3a	Safe's	Jointed Rush	*Juncus articulatus*	2013	Australian Ecosystems
2	Creek	Jointed Rush	*Juncus articulatus subsp. articulatus*	2012	Australian Ecosystems
3a	Creek	Jointed Rush	*Juncus articulatus subsp. articulatus*	2012	Australian Ecosystems
1	Heppell	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
1	Longmore	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
1	Phyland	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
1	Turner	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
1	Upper	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
2	Cockatoo	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
2	Gum	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
2	Taylors	Kikuyu	*Pennisetum clandestinum*	2013	Australian Ecosystems
1	Creek	Kikuyu	*Cenchrus clandestinus*	2012	Australian Ecosystems
2	Creek	Kikuyu	*Cenchrus clandestinus*	2012	Australian Ecosystems
3a	Creek	Kikuyu	*Cenchrus clandestinus*	2004	VBA
3a	Creek	Knotted Clover	*Trifolium striatum*	1986	VBA
1	Upper	Large-leaf Privet	*Ligustrum lucidum*	2013	Australian Ecosystems
2	Taylors	Large-leaf Privet	*Ligustrum lucidum*	2013	Australian Ecosystems
3a	Creek	Lesser Canary-grass	*Phalaris minor*	1986	VBA
3a	Creek	Lesser Chickweed	*Stellaria pallida*	1986	VBA
3a	Creek	Lesser Quaking-grass	*Briza minor*	2002	VBA
3a	Creek	Little Medic	*Medicago minima*	1986	VBA
3b	Creek	Little Medic	*Medicago minima*	2002	VBA
1	Upper	Locust Tree	*Robinia pseudoacacia*	2013	Australian Ecosystems
1	Heppell	Lombardy Poplar	*Populus nigra 'Italica'*	2013	Australian Ecosystems
1	Upper	London Rocket	*Sisymbrium irio*	2013	Australian Ecosystems
2	Cockatoo	London Rocket	*Sisymbrium irio*	2013	Australian Ecosystems
2	Creek	London Rocket	*Sisymbrium irio*	2012	Australian Ecosystems
3a	Creek	London Rocket	*Sisymbrium irio*	1986	VBA
1	Phyland	Lucerne	*Medicago sativa subsp. sativa*	2013	Australian Ecosystems
2	Taylors	Lucerne	*Medicago sativa subsp. sativa*	2013	Australian Ecosystems
1	Heppell	Madrid Brome	*Bromus madritensis*	2013	Australian Ecosystems
2	Cockatoo	Madrid Brome	*Bromus madritensis*	2013	Australian Ecosystems
2	Gum	Madrid Brome	*Bromus madritensis*	2013	Australian Ecosystems
3a	Safe's	Madrid Brome	*Bromus madritensis*	2013	Australian Ecosystems
2	Creek	Madrid Brome	*Bromus madritensis*	2012	Australian Ecosystems
3a	Creek	Madrid Brome	*Bromus madritensis*	2012	Australian Ecosystems
3a	Creek	Malta Thistle	*Centaurea melitensis*	1986	VBA
1	Turner	Medic	*Medicago spp.*	2013	Australian Ecosystems
1	Creek	Medic	*Medicago spp.*	2012	Australian Ecosystems
2	Cockatoo	Mediterranean Barley-grass	*Hordeum hystrix*	2013	Australian Ecosystems
2	Creek	Mediterranean Barley-grass	*Hordeum hystrix*	2012	Australian Ecosystems
3a	Creek	Mediterranean Brome	*Bromus alopecuros*	1986	VBA
1	Splatts	Mexican Tea	*Chenopodium ambrosioides*	2013	Australian Ecosystems
1	Creek	Mexican Tea	*Dysphania ambrosioides*	2012	Australian Ecosystems
1	Upper	Montbretia	*Crocosmia X crocosmiiflora*	2013	Australian Ecosystems
2	Gum	Montpellier Broom	*Genista monspessulana*	2013	Australian Ecosystems
2	Creek	Montpellier Broom	*Genista monspessulana*	2012	Australian Ecosystems
2	Gum	Mullumbimby Couch	*Cyperus brevifolius*	2013	Australian Ecosystems
2	Creek	Mullumbimby Couch	*Cyperus brevifolius*	2012	Australian Ecosystems
3a	Creek	Musky Heron's-bill	*Erodium moschatum*	1986	VBA
3a	Creek	Oat	*Avena spp.*	2004	VBA
1	Upper	Oleander	*Nerium oleander*	2013	Australian Ecosystems
1	Turner	Olive	*Olea europaea*	2013	Australian Ecosystems
1	Upper	Olive	*Olea europaea*	2013	Australian Ecosystems
2	Cockatoo	Olive	*Olea europaea*	2013	Australian Ecosystems
1	Creek	Olive	*Olea europaea*	2012	Australian Ecosystems
2	Creek	Olive	*Olea europaea*	2012	Australian Ecosystems
3b	Creek	Onion Grass	*Romulea rosea*	2002	VBA
1	Heppell	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
1	Phyland	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
1	Turner	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
1	Unregulated	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
1	Upper	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
2	Cockatoo	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
2	Gum	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
2	Taylors	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
3a	Safe's	Ox-tongue	*Helminthotheca echioides*	2013	Australian Ecosystems
1	Creek	Ox-tongue	*Helminthotheca echioides*	2012	Australian Ecosystems
2	Creek	Ox-tongue	*Helminthotheca echioides*	2012	Australian Ecosystems
3a	Creek	Ox-tongue	*Helminthotheca echioides*	2012	Australian Ecosystems
3a	Creek	Paddy Melon	*Cucumis myriocarpus subsp. leptodermis*	1986	VBA
1	Heart	Pampas Grass	*Cortaderia selloana*	2013	Australian Ecosystems
2	Cockatoo	Panic Veldt-grass	*Ehrharta erecta var. erecta*	2013	Australian Ecosystems
2	Creek	Panic Veldt-grass	*Ehrharta erecta var. erecta*	2012	Australian Ecosystems
2	Taylors	Paradoxical Canary-grass	*Phalaris paradoxa*	2013	Australian Ecosystems
3a	Creek	Paradoxical Canary-grass	*Phalaris paradoxa*	1987	VBA
1	Heart	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Ayres et al.
1	Heppell	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Nitschke, 2008
1	Longmore	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Ayres et al.
1	Splatts	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Ayres et al.
1	Turner	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Ayres et al.
1	Unregulated	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Ayres et al.
1	Upper	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
2	Gum	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Ayres et al.
3a	Safe's	Parrot's Feather	*Myriophyllum aquaticum*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
1	Creek	Parrot's Feather	*Myriophyllum aquaticum*	2012	Australian Ecosystems
2	Creek	Parrot's Feather	*Myriophyllum aquaticum*	2012	Australian Ecosystems
3a	Creek	Parrot's Feather	*Myriophyllum aquaticum*	2012	Australian Ecosystems
1	Heart	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
1	Heppell	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
1	Longmore	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
1	Splatts	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
1	Upper	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
2	Gum	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
2	Taylors	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
3a	Safe's	Paspalum	*Paspalum dilatatum*	2013	Australian Ecosystems
1	Creek	Paspalum	*Paspalum dilatatum*	2012	Australian Ecosystems
2	Creek	Paspalum	*Paspalum dilatatum*	2012	Australian Ecosystems
3a	Creek	Paspalum	*Paspalum dilatatum*	2012	Australian Ecosystems
1	Longmore	Paterson's Curse	*Echium plantagineum*	2013	Australian Ecosystems
2	Cockatoo	Paterson's Curse	*Echium plantagineum*	2013	Australian Ecosystems
2	Taylors	Paterson's Curse	*Echium plantagineum*	2013	Australian Ecosystems
3a	Safe's	Paterson's Curse	*Echium plantagineum*	1996	VBA
2	Creek	Paterson's Curse	*Echium plantagineum*	2012	Australian Ecosystems
3a	Creek	Paterson's Curse	*Echium plantagineum*	2006	VBA
1	Heppell	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
1	Longmore	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
1	Phyland	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
1	Splatts	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
1	Turner	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
1	Upper	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
2	Cockatoo	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
2	Gum	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
2	Taylors	Pepper Tree	*Schinus molle*	2013	Australian Ecosystems
1	Creek	Pepper Tree	*Schinus molle*	2012	Australian Ecosystems
2	Creek	Pepper Tree	*Schinus molle*	2012	Australian Ecosystems
2	Creek	Pepper Tree	*Schinus molle*	2012	Australian Ecosystems
3a	Creek	Pepper Tree	*Schinus molle*	1986	VBA
3b	Creek	Pepper Tree	*Schinus molle*	2002	VBA
1	Longmore	Peppercorn	*Schinus areira*	2013	Ayres et al.
1	Splatts	Peppercorn	*Schinus areira*	2013	Ayres et al.

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Turner	Peppercorn	*Schinus areira*	2013	Ayres et al.
2	Cockatoo	Peppercorn	*Schinus areira*	2013	Ayres et al.
1	Heppell	Perennial Rye-grass	*Lolium perenne*	2013	Australian Ecosystems
1	Turner	Perennial Rye-grass	*Lolium perenne*	2013	Australian Ecosystems
1	Unregulated	Perennial Rye-grass	*Lolium perenne*	2013	Australian Ecosystems
3a	Safe's	Perennial Rye-grass	*Lolium perenne*	1987	VBA
1	Creek	Perennial Rye-grass	*Lolium perenne*	2012	Australian Ecosystems
3a	Creek	Perennial Rye-grass	*Lolium perenne*	1987	VBA
3b	Creek	Perennial Rye-grass	*Lolium perenne*	2002	VBA
1	Longmore	Poplar	*Populus sp.*	2013	Ayres et al.
1	Turner	Poplar	*Populus sp.*	2013	Ayres et al.
2	Taylors	Poplar	*Populus spp.*	2013	Australian Ecosystems
1	Heppell	Prairie Grass	*Bromus catharticus*	2013	Australian Ecosystems
1	Phyland	Prairie Grass	*Bromus catharticus*	2013	Australian Ecosystems
1	Unregulated	Prairie Grass	*Bromus catharticus*	2013	Australian Ecosystems
1	Upper	Prairie Grass	*Bromus catharticus*	2013	Australian Ecosystems
2	Gum	Prairie Grass	*Bromus catharticus*	2013	Australian Ecosystems
2	Taylors	Prairie Grass	*Bromus catharticus*	2013	Australian Ecosystems
2	Creek	Prairie Grass	*Bromus catharticus*	2012	Australian Ecosystems
1	Heart	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
1	Heppell	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
1	Longmore	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
1	Phyland	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
1	Splatts	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
1	Unregulated	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
2	Cockatoo	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
2	Gum	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
2	Taylors	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
3a	Safe's	Prickly Lettuce	*Lactuca serriola*	2013	Australian Ecosystems
1	Creek	Prickly Lettuce	*Lactuca serriola*	2012	Australian Ecosystems
2	Creek	Prickly Lettuce	*Lactuca serriola*	2012	Australian Ecosystems
3a	Creek	Prickly Lettuce	*Lactuca serriola*	2012	Australian Ecosystems
1	Upper	Prickly Paperbark	*Melaleuca styphelioides*	2013	Australian Ecosystems
1	Heppell	Prostrate Knotweed	*Polygonum aviculare s.l.*	2013	Australian Ecosystems
1	Unregulated	Prostrate Knotweed	*Polygonum aviculare s.l.*	2013	Australian Ecosystems
1	Upper	Prostrate Knotweed	*Polygonum aviculare s.l.*	2013	Australian Ecosystems
2	Gum	Prostrate Knotweed	*Polygonum aviculare s.l.*	2013	Australian Ecosystems
2	Taylors	Prostrate Knotweed	*Polygonum aviculare s.l.*	2013	Australian Ecosystems
2	Creek	Prostrate Knotweed	*Polygonum aviculare s.l.*	2012	Australian Ecosystems
3a	Creek	Prostrate Knotweed	*Polygonum aviculare s.l.*	1986	VBA
1	Splatts	Prunus	*Prunus spp.*	2013	Australian Ecosystems
1	Turner	Prunus	*Prunus spp.*	2013	Australian Ecosystems
1	Creek	Prunus	*Prunus spp.*	2012	Australian Ecosystems
1	Upper	Pyramid Tree	*Lagunaria patersonia subsp. patersonia*	2013	Australian Ecosystems
1	Creek	Pyramid Tree	*Lagunaria patersonia subsp. patersonia*	2012	Australian Ecosystems
2	Creek	Pyramid Tree	*Lagunaria patersonia subsp. patersonia*	2012	Australian Ecosystems
3a	Creek	Quicksilver Grass	*Aira cupaniana*	1986	VBA
1	Upper	Radiata Pine	*Pinus radiata*	2013	Australian Ecosystems
1	Heppell	Rat's-tail Fescue	*Vulpia myuros*	2013	Australian Ecosystems
1	Turner	Rat's-tail Fescue	*Vulpia myuros*	2013	Australian Ecosystems
1	Unregulated	Rat's-tail Fescue	*Vulpia myuros*	2013	Australian Ecosystems
1	Upper	Rat's-tail Fescue	*Vulpia myuros f. myuros*	2013	Australian Ecosystems
2	Cockatoo	Rat's-tail Fescue	*Vulpia myuros f. myuros*	2013	Australian Ecosystems
2	Gum	Rat's-tail Fescue	*Vulpia myuros*	2013	Australian Ecosystems
3a	Safe's	Rat's-tail Fescue	*Vulpia myuros*	1987	Australian Ecosystems; VBA
1	Creek	Rat's-tail Fescue	*Vulpia myuros*	2012	Australian Ecosystems
2	Creek	Rat's-tail Fescue	*Vulpia myuros*	2012	Australian Ecosystems
3a	Creek	Rat's-tail Fescue	*Vulpia myuros f. myuros*	2012	Australian Ecosystems
3a	Creek	Recurved Thorn-apple	*Datura inoxia*	1985	VBA
1	Upper	Red Brome	*Bromus rubens*	2013	Australian Ecosystems
3a	Safe's	Red Brome	*Bromus rubens*	1987	VBA
3a	Creek	Red Brome	*Bromus rubens*	1987	VBA
3a	Creek	Red Sand-spurrey	*Spergularia rubra s.l.*	1987	VBA
1	Heppell	Red-flower Mallow	*Modiola caroliniana*	2013	Australian Ecosystems
1	Phyland	Red-flower Mallow	*Modiola caroliniana*	2013	Australian Ecosystems
1	Turner	Red-flower Mallow	*Modiola caroliniana*	2013	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
1	Unregulated	Red-flower Mallow	*Modiola caroliniana*	2013	Australian Ecosystems
1	Upper	Red-flower Mallow	*Modiola caroliniana*	2013	Australian Ecosystems
1	Creek	Red-flower Mallow	*Modiola caroliniana*	2012	Australian Ecosystems
3a	Creek	Red-flower Mallow	*Modiola caroliniana*	2004	VBA
3b	Creek	Red-flower Mallow	*Modiola caroliniana*	2002	VBA
2	Cockatoo	Reed sweetgrass	*Glyceria maxima*	2013	Ayres et al.
1	Upper	Reed Sweet-grass	*Glyceria maxima*	2013	Australian Ecosystems; Ayres et al.
2	Gum	Reed Sweet-grass	*Glyceria maxima*	2013	Australian Ecosystems; Ayres et al.
1	Creek	Reed Sweet-grass	*Glyceria maxima*	1978	VBA
2	Creek	Reed Sweet-grass	*Glyceria maxima*	2012	Australian Ecosystems
1	Longmore	Ribwort	*Plantago lanceolata*	2013	Australian Ecosystems
1	Splatts	Ribwort	*Plantago lanceolata*	2013	Australian Ecosystems
1	Turner	Ribwort	*Plantago lanceolata*	2013	Australian Ecosystems
1	Unregulated	Ribwort	*Plantago lanceolata*	2013	Australian Ecosystems
2	Cockatoo	Ribwort	*Plantago lanceolata*	2013	Australian Ecosystems
2	Gum	Ribwort	*Plantago lanceolata*	2013	Australian Ecosystems
1	Creek	Ribwort	*Plantago lanceolata*	2012	Australian Ecosystems
2	Creek	Ribwort	*Plantago lanceolata*	2012	Australian Ecosystems
3a	Creek	Ribwort	*Plantago lanceolata*	2004	VBA
1	Splatts	River Oak	*Casuarina cunninghamiana subsp. cunninghamiana*	2013	Australian Ecosystems
1	Creek	River Oak	*Casuarina cunninghamiana subsp. cunninghamiana*	2012	Australian Ecosystems
1	Phyland	Rough Sow-thistle	*Sonchus asper s.s.*	2013	Australian Ecosystems
1	Upper	Rough Sow-thistle	*Sonchus asper s.s.*	2013	Australian Ecosystems
2	Gum	Rough Sow-thistle	*Sonchus asper s.s.*	2013	Australian Ecosystems
3a	Safe's	Rough Sow-thistle	*Sonchus asper s.s.*	2013	Australian Ecosystems
2	Creek	Rough Sow-thistle	*Sonchus asper s.s.*	2012	Australian Ecosystems
3a	Creek	Rough Sow-thistle	*Sonchus asper s.s.*	2012	Australian Ecosystems
3a	Creek	Saffron Thistle	*Carthamus lanatus*	1986	VBA
2	Taylors	Salsify	*Tragopogon porrifolius subsp. porrifolius*	2013	Australian Ecosystems
3a	Creek	Scorzonera	*Scorzonera laciniata*	1986	VBA
1	Heppell	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
1	Phyland	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
1	Turner	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
1	Upper	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
2	Cockatoo	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
2	Gum	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
2	Taylors	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
3a	Safe's	Sea Barley-grass	*Hordeum marinum*	2013	Australian Ecosystems
1	Creek	Sea Barley-grass	*Hordeum marinum*	2012	Australian Ecosystems
2	Creek	Sea Barley-grass	*Hordeum marinum*	2012	Australian Ecosystems
3a	Creek	Sea Barley-grass	*Hordeum marinum*	2012	Australian Ecosystems
2	Cockatoo	Shade Crassula	*Crassula multicava subsp. multicava*	2013	Australian Ecosystems
2	Creek	Shade Crassula	*Crassula multicava subsp. multicava*	2012	Australian Ecosystems
3a	Creek	Shepherd's Purse	*Capsella bursa-pastoris*	1986	VBA
1	Heppell	Silky Oak	*Grevillea robusta*	2013	Australian Ecosystems
1	Upper	Silky Oak	*Grevillea robusta*	2013	Australian Ecosystems
1	Heppell	Silver Wormwood	*Artemisia arborescens*	2013	Australian Ecosystems
1	Heppell	Silver-leaf Nightshade	*Solanum elaeagnifolium*	2013	Australian Ecosystems
3a	Creek	Silvery Hair-grass	*Aira caryophyllea subsp. caryophyllea*	1987	VBA
2	Cockatoo	Slender Barb-grass	*Parapholis strigosa*	2013	Australian Ecosystems
2	Gum	Slender Barb-grass	*Parapholis strigosa*	2013	Australian Ecosystems
2	Creek	Slender Barb-grass	*Parapholis strigosa*	2012	Australian Ecosystems
3a	Creek	Slender Centaury	*Centaurium tenuiflorum*	1986	VBA
2	Gum	Slender Thistle	*Carduus pycnocephalus*	2013	Australian Ecosystems
2	Creek	Slender Thistle	*Carduus pycnocephalus*	2012	Australian Ecosystems
3a	Creek	Slender Thistle	*Carduus pycnocephalus*	1986	VBA
3a	Creek	Small Goosegrass	*Galium murale*	1979	VBA
1	Phyland	Small Ice-plant	*Mesembryanthemum nodiflorum*	2013	Australian Ecosystems
1	Turner	Small Ice-plant	*Mesembryanthemum nodiflorum*	2013	Australian Ecosystems
2	Cockatoo	Small Ice-plant	*Mesembryanthemum nodiflorum*	2013	Australian Ecosystems
2	Gum	Small Ice-plant	*Mesembryanthemum nodiflorum*	2013	Australian Ecosystems
2	Taylors	Small Ice-plant	*Mesembryanthemum nodiflorum*	2013	Australian Ecosystems
1	Creek	Small Ice-plant	*Mesembryanthemum nodiflorum*	2012	Australian Ecosystems

Reach	Location	Common name	Scientific name	Most recent record	Source
2	Creek	Small Ice-plant	*Mesembryanthemum nodiflorum*	2012	Australian Ecosystems
3a	Creek	Small Ice-plant	*Mesembryanthemum nodiflorum*	2008	VBA
3a	Creek	Small Nettle	*Urtica urens*	1986	VBA
1	Upper	Small-flower Mallow	*Malva parviflora*	2013	Australian Ecosystems
2	Gum	Small-flower Mallow	*Malva parviflora*	2013	Australian Ecosystems
2	Taylors	Small-flower Mallow	*Malva parviflora*	2013	Australian Ecosystems
2	Creek	Small-flower Mallow	*Malva parviflora*	2012	Australian Ecosystems
3a	Creek	Small-flower Mallow	*Malva parviflora*	1986	VBA
2	Cockatoo	Smooth Cat's-ear	*Hypochaeris glabra*	2013	Australian Ecosystems
3a	Safe's	Smooth Cat's-ear	*Hypochaeris glabra*	1987	VBA
2	Creek	Smooth Cat's-ear	*Hypochaeris glabra*	2012	Australian Ecosystems
3a	Creek	Smooth Cat's-ear	*Hypochaeris glabra*	1987	VBA
1	Heppell	Smooth Mustard	*Sisymbrium erysimoides*	2013	Australian Ecosystems
3a	Creek	Smooth Mustard	*Sisymbrium erysimoides*	1986	VBA
1	Heart	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	2013	Australian Ecosystems
1	Heppell	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	2013	Australian Ecosystems
1	Upper	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	2013	Australian Ecosystems
2	Gum	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	2013	Australian Ecosystems
3a	Safe's	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	1987	Australian Ecosystems; VBA
2	Creek	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	2012	Australian Ecosystems
3a	Creek	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	2012	Australian Ecosystems
3b	Creek	Soft Brome	*Bromus hordeaceus subsp. hordeaceus*	2002	VBA
3a	Creek	Soursob	*Oxalis pes-caprae*	2004	VBA
1	Unregulated	Sowbane	*Chenopodium murale*	2013	Australian Ecosystems
1	Upper	Sowbane	*Chenopodium murale*	2013	Australian Ecosystems
2	Gum	Sowbane	*Chenopodium murale*	2013	Australian Ecosystems
2	Creek	Sowbane	*Chenopodium murale*	2012	Australian Ecosystems
3a	Creek	Sowbane	*Chenopodium murale*	1986	VBA
1	Heart	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
1	Heppell	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
1	Longmore	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
1	Phyland	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
1	Splatts	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
1	Turner	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
1	Unregulated	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
1	Upper	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
2	Cockatoo	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
2	Gum	Spear Thistle	*Cirsium vulgare*	2013	Australian Ecosystems
3a	Safe's	Spear Thistle	*Cirsium vulgare*	1987	Australian Ecosystems; VBA
1	Creek	Spear Thistle	*Cirsium vulgare*	2012	Australian Ecosystems
2	Creek	Spear Thistle	*Cirsium vulgare*	2012	Australian Ecosystems
3a	Creek	Spear Thistle	*Cirsium vulgare*	2012	Australian Ecosystems
1	Longmore	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
1	Phyland	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
1	Splatts	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
1	Turner	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems; VBA
1	Unregulated	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
1	Upper	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
2	Cockatoo	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
2	Gum	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
3a	Safe's	Spiny Rush	*Juncus acutus subsp. acutus*	2013	Australian Ecosystems
1	Creek	Spiny Rush	*Juncus acutus subsp. acutus*	2012	Australian Ecosystems
2	Creek	Spiny Rush	*Juncus acutus subsp. acutus*	2012	Australian Ecosystems
3a	Creek	Spiny Rush	*Juncus acutus subsp. acutus*	2012	Australian Ecosystems
3a	Safe's	Squirrel-tail Fescue	*Vulpia bromoides*	1987	VBA
3a	Creek	Squirrel-tail Fescue	*Vulpia bromoides*	1987	VBA
3b	Creek	Squirrel-tail Fescue	*Vulpia bromoides*	2002	VBA
1	Turner	Stemless Thistle	*Onopordum acaulon*	2001	VBA
3a	Creek	Sticky Ground-cherry	*Physalis hederifolia*	1986	VBA
3a	Creek	Stink Grass	*Eragrostis cilianensis*	1986	VBA
3a	Creek	Stinkwort	*Dittrichia graveolens*	1986	VBA
2	Cockatoo	Stonecrop	*Sedum spp.*	2013	Australian Ecosystems
2	Creek	Stonecrop	*Sedum spp.*	2012	Australian Ecosystems
3a	Creek	Strawberry Clover	*Trifolium fragiferum var. fragiferum*	1986	VBA

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Safe's	Subterranean Clover	*Trifolium subterraneum*	1987	VBA
3a	Creek	Subterranean Clover	*Trifolium subterraneum*	1987	VBA
2	Gum	Sweet Melilot	*Melilotus indicus*	2013	Australian Ecosystems
2	Taylors	Sweet Melilot	*Melilotus indicus*	2013	Australian Ecosystems
2	Creek	Sweet Melilot	*Melilotus indicus*	2012	Australian Ecosystems
2	Cockatoo	Tall Fleabane	*Conyza sumatrensis*	2013	Australian Ecosystems
2	Taylors	Tall Fleabane	*Conyza sumatrensis*	2013	Australian Ecosystems
2	Creek	Tall Fleabane	*Conyza sumatrensis var. sumatrensis*	2012	Australian Ecosystems
1	Longmore	Tall Wheat-grass	*Lophopyrum ponticum*	2013	Australian Ecosystems
1	Phyland	Tall Wheat-grass	*Lophopyrum ponticum*	2013	Australian Ecosystems
1	Upper	Tall Wheat-grass	*Lophopyrum ponticum*	2013	Australian Ecosystems
2	Gum	Tall Wheat-grass	*Lophopyrum ponticum*	2013	Australian Ecosystems
2	Taylors	Tall Wheat-grass	*Lophopyrum ponticum*	2013	Australian Ecosystems
2	Creek	Tall Wheat-grass	*Lophopyrum ponticum*	2012	Australian Ecosystems
3a	Creek	Tamarisk	*Tamarix ramosissima*	1986	VBA
3a	Creek	Thorn Apple	*Datura spp.*	1987	VBA
2	Gum	Thread Iris	*Moraea setifolia*	2013	Australian Ecosystems
2	Creek	Thread Iris	*Moraea setifolia*	2012	Australian Ecosystems
3a	Creek	Thread Water-starwort	*Callitriche brutia subsp. brutia*	1985	VBA
3a	Safe's	Tiny Vetch	*Vicia hirsuta*	1987	VBA
3a	Creek	Tiny Vetch	*Vicia hirsuta*	1987	VBA
1	Heppell	Toowoomba Canary-grass	*Phalaris aquatica*	2013	Australian Ecosystems
1	Longmore	Toowoomba Canary-grass	*Phalaris aquatica*	2013	Australian Ecosystems
1	Splatts	Toowoomba Canary-grass	*Phalaris aquatica*	2013	Australian Ecosystems
1	Creek	Toowoomba Canary-grass	*Phalaris aquatica*	2012	Australian Ecosystems
3a	Creek	Toowoomba Canary-grass	*Phalaris aquatica*	1986	VBA
3a	Creek	Twiggy Mullein	*Verbascum virgatum*	1986	VBA
1	Heart	Umbrella Sedge	*Cyperus eragrostis*	2013	Ayres et al.
1	Heppell	Umbrella Sedge	*Cyperus eragrostis*	2013	Ayres et al.
1	Longmore	Umbrella Sedge	*Cyperus eragrostis*	2013	Ayres et al.
1	Splatts	Umbrella Sedge	*Cyperus eragrostis*	2013	Ayres et al.
1	Unregulated	Umbrella Sedge	*Cyperus eragrostis*	2013	Ayres et al.
2	Cockatoo	Umbrella sedge	*Cyperus eragrostis*	2013	Ayres et al.
1	Splatts	Variegated Thistle	*Silybum marianum*	2013	VBA
3a	Creek	Variegated Thistle	*Silybum marianum*	1986	VBA
1	Splatts	Velvet Cotoneaster	*Cotoneaster pannosus*	2013	Australian Ecosystems
1	Upper	Velvet Cotoneaster	*Cotoneaster pannosus*	2013	Australian Ecosystems
2	Taylors	Velvet Cotoneaster	*Cotoneaster pannosus*	2013	Australian Ecosystems
1	Creek	Velvet Cotoneaster	*Cotoneaster pannosus*	2012	Australian Ecosystems
3a	Safe's	Velvety Pink	*Petrorhagia dubia*	1987	VBA
3a	Creek	Velvety Pink	*Petrorhagia dubia*	1987	VBA
2	Gum	Wall Fescue	*Vulpia muralis*	2013	Australian Ecosystems
2	Creek	Wall Fescue	*Vulpia muralis*	2012	Australian Ecosystems
3a	Creek	Wall Fescue	*Vulpia muralis*	1986	VBA
3a	Creek	Wall Speedwell	*Veronica arvensis*	1986	VBA
1	Upper	Water Buttons	*Cotula coronopifolia*	2013	Australian Ecosystems
2	Cockatoo	Water Buttons	*Cotula coronopifolia*	2013	Australian Ecosystems
2	Creek	Water Buttons	*Cotula coronopifolia*	2012	Australian Ecosystems
3a	Creek	Water Buttons	*Cotula coronopifolia*	1987	VBA
1	Heart	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Heppell	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Longmore	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Phyland	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Splatts	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Turner	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Unregulated	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Upper	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
2	Cockatoo	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
2	Gum	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
2	Taylors	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
3a	Safe's	Water Couch	*Paspalum distichum*	2013	Australian Ecosystems
1	Creek	Water Couch	*Paspalum distichum*	2012	Australian Ecosystems
2	Creek	Water Couch	*Paspalum distichum*	2012	Australian Ecosystems
3a	Creek	Water Couch	*Paspalum distichum*	2012	Australian Ecosystems
1	Heppell	White Clover	*Trifolium repens var. repens*	2013	Australian Ecosystems
1	Unregulated	White Clover	*Trifolium repens var. repens*	2013	Australian Ecosystems
3a	Safe's	White Clover	*Trifolium repens var. repens*	1987	VBA

Reach	Location	Common name	Scientific name	Most recent record	Source
3a	Creek	White Clover	*Trifolium repens var. repens*	1987	VBA
1	Heppell	White Waterlily	*Nymphaea alba*	2013	Australian Ecosystems
1	Phyland	White Waterlily	*Nymphaea alba*	2013	Australian Ecosystems; Ayres et al.
1	Turner	White Waterlily	*Nymphaea alba*	2013	Australian Ecosystems
2	Cockatoo	White Waterlily	*Nymphaea alba*	2013	Australian Ecosystems
2	Taylors	White Waterlily	*Nymphaea alba*	2013	Australian Ecosystems
2	Creek	White Waterlily	*Nymphaea alba*	2012	Australian Ecosystems
1	Heart	Wild Oat	*Avena fatua*	2013	Australian Ecosystems
3a	Creek	Wild Oat	*Avena fatua*	1987	VBA
1	Heppell	Willow	*Salix spp.*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
1	Longmore	Willow	*Salix spp.*	2013	Australian Ecosystems; Ayres et al.
1	Phyland	Willow	*Salix spp.*	2013	Australian Ecosystems; Ayres et al.
1	Splatts	Willow	*Salix spp.*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
1	Turner	Willow	*Salix spp.*	2013	Australian Ecosystems; Ayres et al.
1	Upper	Willow	*Salix spp.*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	Willow	*Salix spp.*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
2	Gum	Willow	*Salix spp.*	2013	Australian Ecosystems; Nitschke, 2008
2	Taylors	Willow	*Salix spp.*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
3a	Safe's	Willow	*Salix spp.*	2013	Australian Ecosystems; Nitschke, 2008
1	Creek	Willow	*Salix spp.*	2012	Australian Ecosystems
2	Creek	Willow	*Salix spp.*	2012	Australian Ecosystems
3a	Creek	Willow	*Salix spp.*	2012	Australian Ecosystems
3a	Safe's	Willow-leaf Lettuce	*Lactuca saligna*	2013	Australian Ecosystems
3a	Creek	Willow-leaf Lettuce	*Lactuca saligna*	2012	Australian Ecosystems
1	Upper	Wimmera Rye-grass	*Lolium rigidum*	2013	Australian Ecosystems
2	Cockatoo	Wimmera Rye-grass	*Lolium rigidum*	2013	Australian Ecosystems
2	Gum	Wimmera Rye-grass	*Lolium rigidum*	2013	Australian Ecosystems
3a	Safe's	Wimmera Rye-grass	*Lolium rigidum*	2013	Australian Ecosystems
2	Creek	Wimmera Rye-grass	*Lolium rigidum*	2012	Australian Ecosystems
3a	Creek	Wimmera Rye-grass	*Lolium rigidum*	2012	Australian Ecosystems
2	Taylors	Winged Slender-thistle	*Carduus tenuiflorus*	2013	Australian Ecosystems
3a	Creek	Winged Slender-thistle	*Carduus tenuiflorus*	1987	VBA
1	Upper	Yellow Flag Iris	*Iris pseudacorus*	2013	Australian Ecosystems
2	Cockatoo	Yellow Flag Iris	*Iris pseudacorus*	2013	Australian Ecosystems
2	Creek	Yellow Flag Iris	*Iris pseudacorus*	2012	Australian Ecosystems
1	Heart	Yellow Waterlily	*Nymphaea mexicana*	2013	Australian Ecosystems; Ayres et al.
1	Heppell	Yellow Waterlily	*Nymphaea mexicana*	2013	Nitschke, 2008; Ayres et al.
1	Longmore	Yellow Waterlily	*Nymphaea mexicana*	2013	Australian Ecosystems; Ayres et al.
1	Turner	Yellow waterlily	*Nymphaea mexicana*	2013	Ayres et al.
1	Splatts	Yellow Waterlily	*Nymphaea mexicana*	2013	Australian Ecosystems
1	Upper	Yellow Waterlily	*Nymphaea mexicana*	2013	Australian Ecosystems; Ayres et al.
2	Cockatoo	Yellow Waterlily	*Nymphaea mexicana*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
2	Gum	Yellow Waterlily	*Nymphaea mexicana*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
2	Taylors	Yellow Waterlily	*Nymphaea mexicana*	2013	Australian Ecosystems; Nitschke, 2008; Ayres et al.
3a	Safe's	Yellow Waterlily	*Nymphaea mexicana*	2008	Nitschke, 2008
1	Creek	Yellow Waterlily	*Nymphaea mexicana*	2012	Australian Ecosystems
2	Creek	Yellow Waterlily	*Nymphaea mexicana*	2012	Australian Ecosystems
1	Upper	Yorkshire Fog	*Holcus lanatus*	2013	Australian Ecosystems

Appendix 6. Ecological Vegetation Classes (EVCs)

Reach 1

Gunbower Creek and Lagoons National Offtake to Gunbower

Ecological Vegetation Classes

- Billabong Wetland Aggregate - Tall Marsh - Juncus spp.
- Billabong Wetland Aggregate - Tall Marsh / Aquatic Herbland
- Billabong Wetland Aggregate - Tall Marsh / Aquatic Herbland - Juncus spp.
- Billabong Wetland Aggregate / Tall Marsh
- Dwarf Floating Aquatic Herbland / Submerged Aquatic Herbland
- Open Water / Submerged Aquatic Herbland
- Open water / Dwarf Floating Aquatic Herbland / Submerged Aquatic Herbland Complex
- Open water / Dwarf Floating Aquatic Herbland Complex
- Open water / Submerged Aquatic Herbland Complex
- Sedgy Riverine Forest / Riverine Chenopod Woodland
- Submerged Aquatic Herbland / Aquatic Herbland Complex
- Tall Marsh / Aquatic Herbland Complex
- 56 Floodplain Riparian Woodland
- 103 Riverine Chenopod Woodland
- 106 Grassy Riverine Forest
- 264 Sand Ridge Woodland
- 295 Riverine Grassy Woodland
- 308 Aquatic Sedgeland
- 334 Billabong Wetland Aggregate
- 369 Black Box Wetland
- 653 Aquatic Herbland
- 803 Plains Woodland
- 809 Floodplain Grassy Wetland
- 816 Sedgy Riverine Forest
- 821 Tall Marsh
- 823 Lignum Swampy Woodland
- 918 Submerged Aquatic Herbland
- 932 Wet Verge Sedgeland
- 949 Dwarf Floating Aquatic Herbland
- 97 Semi-arid Woodland
- 132 Plains Grassland
- 814 Riverine Swamp Forest
- GunbowerCreek
- Gunbower Lagoons

Kilometers
0 1 2 4

NORTH CENTRAL Catchment Management Authority
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State Government Victoria

DISCLAIMER:
This information product has been derived from the best quality data available at the time of its development. The North Central CMA accepts no responsibility for the accuracy of this product.

Reach 2

Gunbower Creek and Lagoons Gunbower to Cohuna

Ecological Vegetation Classes

- Billabong Wetland Aggregate / Tall Marsh
- Open Water / Submerged Aquatic Herbland
- 103 Riverine Chenopod Woodland
- 264 Sand Ridge Woodland
- 295 Riverine Grassy Woodland
- 334 Billabong Wetland Aggregate
- 816 Sedgy Riverine Forest
- 821 Tall Marsh
- 918 Submerged Aquatic Herbland
- 949 Dwarf Floating Aquatic Herbland
- 132 Plains Grassland
- 803 Plains Woodland
- 814 Riverine Swamp Forest
- 819 Spike-sedge Wetland
- GunbowerCreek
- Gunbower Lagoons

Kilometers

0 1 2 4

NORTH CENTRAL Catchment Management Authority
Connecting Rivers, Landscapes, People

State Government Victoria

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Reach 3 (a and b)

Gunbower Creek and Lagoons Cohuna to Koondrook

Ecological Vegetation Classes

- 264 Sand Ridge Woodland
- 295 Riverine Grassy Woodland
- 308 Aquatic Sedgeland
- 334 Billabong Wetland Aggregate
- 653 Aquatic Herbland
- 816 Sedgy Riverine Forest
- 821 Tall Marsh
- 918 Submerged Aquatic Herbland
- 949 Dwarf Floating Aquatic Herbland
- 56 Floodplain Riparian Woodland
- 103 Riverine Chenopod Woodland
- 106 Grassy Riverine Forest
- 803 Plains Woodland
- 814 Riverine Swamp Forest
- 817 Sedgy Riverine Forest/Riverine Swamp Forest Complex
- 819 Spike-sedge Wetland
- GunbowerCreek
- Gunbower Lagoons

Kilometers

0 1.25 2.5 5

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Appendix 7. Assessment against the Murray Darling Basin Plan Criteria for Identifying an Environmental Asset

Item	Criteria	Meets criteria	Description for the Gunbower Creek System
Criterion 1: The ecosystem function supports the creation and maintenance of vital habitats and populations			
1	**Assessment indicator:** An ecosystem function requires environmental watering to sustain it if it provides vital habitat including:		
	(a) a refugium for native water-dependent biota during dry periods and drought; or	✓	During periods of low flow, the Gunbower Creek System supports a series of pool habitats that are critical for the survival of water dependent species within the system (i.e. Murray Cod and Platypus). These are particularly important due to the barriers for fish movement both in and out of the system.
	(b) pathways for the dispersal, migration and movement of native water-dependent biota; or	✓	The Gunbower Creek System has been identified as the only sizeable breeding population of Platypus known to inhabit either the Murray River, its downstream anabranch systems and the lower tributary reaches downstream of Echuca (Serena & Williams, 2011 cited in Serena & Williams, 2013). The system also supports a genetically distinct population of Freshwater Catfish. The removal of fish barriers at Koondrook, the National Channel offtake as well as at selected lagoons will connect the whole 144 kilometres of the creek and associated lagoons with the Murray River.
	(c) a diversity of important feeding, breeding and nursery sites for native water-dependent biota; or	✓	The diversity of habitat types with the Gunbower Creek System provides a range of feeding and breeding habitat for water dependent fauna. In particular, historical waterbird, turtle and Platypus have breed at a number of the lagoons and the lower reaches of the creek are noted to be vital habitat for Murray Cod spawning. In additional, benches, ISW and riparian and aquatic plants support a diversity of food sources. The connection to the Gunbower Forest also provides a surge of nutrients and food into the creek during periods when water is released back into the Gunbower Creek.
	(d) a diversity of aquatic environments including pools, rifle and run environments; or	✓	The highly diverse hydrodynamics of the Gunbower Creek system provides a diversity of aquatic environments, including runs of fast and slow flowing water, backwaters, pools and still water habitats. The channel morphology comprises a variety of slopes and benches which engage during different flow events.
	(e) a vital habitat that is essential for preventing the decline of native water-dependent biota.	✓	The Gunbower Creek system provides habitat for a significant number of threatened flora and fauna species. The provision of an appropriate water regime (on top of irrigation flows) will cue fauna, in particular fish, to move, breed and survive till adulthood. However migration in and out of the system is prevented by fish barriers at Koondrook and the National Channel, preventing adults from leaving or entering the system.
Criterion 2: The ecosystem function supports the transportation and dilution of nutrients, organic matter and sediment			
2	**Assessment indicator:** An ecosystem function requires environmental watering to sustain it if it provides for the transportation and dilution of nutrients, organic matter and sediment, including:		
	(a) pathways for the dispersal and movement of organic and inorganic sediment, delivery to downstream reaches and to the ocean, and to and from the floodplain; or	✓	The Gunbower Creek System is an anabranch of the Murray River and historically received floodwaters off the Gunbower Forest, allowing it receive and disperse nutrients, organic matter and sediments in the system. The system is however considered carbon poor due to the regulated nature of the system and lack of connection with the Gunbower Forest. Integration of environmental water management actions that allow water coming off the floodplain to enter Gunbower Creek is considered vital for improved health.
	(b) the dilution of carbon and nutrients from the floodplain to the river systems.	✓	During large flood events or managed exits of environmental water off the floodplain, the Gunbower Creek System can assist with diluting carbon and other nutrients. This was the case during the 2013-14 watering event of Gunbower Creek, where a passing flow was maintained to assist with diluting floodplain water.

Item	Criteria	Meets criteria	Description for the Gunbower Creek System
Criterion 3: The ecosystem function provides connections along a watercourse (longitudinal connections)			
3	**Assessment indicator:** An ecosystem function requires environmental watering to sustain it if it provides connections along a watercourse or to the ocean, including longitudinal connections:		
	(a) for dispersal and re-colonisation of native water-dependent communities; or	✓	With the construction of fishways at Koondrook Weir and National Channel headworks, potential exists to increase the richness of fish species throughout the Gunbower Creek System. This will assist with bolstering the native fish communities (i.e. both in terms of genetic diversity and species) within the creek system to ensure long term stability within the system.
	(b) for migration to fulfil requirements of life history stages; or	✓	Migratory species (i.e. Golden and Silver Perch) are present within the Gunbower Creek System; however migration in and out of the system (and some of the lagoons) is limited to instream barriers. However within the creek system, Migration can in and out of lagoons that are not regulated, as well as below Cohuna Weir (concept design for fishway at Cohuna Weir currently underway) to National Channel and above Cohuna Weir to Koondrook Weir.
	(c) For in-stream primary production.	✓	The Gunbower Creek System has extensive coverage of IWH, although the density is less in the upstream reaches. Biofilms and silts collect on IWH providing an important food source for aquatic fauna. In additional aquatic and riparian vegetation input organic matter into the system which is taken up by primary consumers. This supports higher level consumers and maintains the food web functionality within the system.
Criterion 4: The ecosystem function provides connections across floodplains, adjacent wetlands and billabongs (lateral connections)			
4	**Assessment indicator:** An ecosystem function requires environmental watering to sustain it if it provides connections across floodplains, adjacent wetlands and billabongs, including:		
	(a) lateral connections for foraging, migration and re-colonisation of native water-dependent species and communities; or	✓	Due to the construction of a number of levees and the presence of agricultural land surrounding the creek and lagoon system, there is very little opportunity for lateral connectivity between the floodplain and creek system. However opportunities to connect with the forest can be facilitated through opening regulators in the upper forest wetlands (i.e. Reedy and Black Swamps) and allowing water to return to the creek from the forest.
	(b) lateral connections for off-stream primary production.	✓	The Gunbower Creek system rarely experiences overbank floods to inundate the riparian zone. However areas of the creek and lagoons have relatively intact riparian vegetation which provides a source of organic matter and IWH to the system.