



## **SCRP Detailed Flora and Fauna Assessment**

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Prepared for Goulburn-Murray Water

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### Ecological Limitations

The initial biodiversity assessment of the study site was undertaken in February 2022. This is considered a somewhat sub-optimal time of year for conducting flora surveys as many flora species have ceased flowering and are difficult to detect. High rainfall events in the study area prior to the site assessment meant that large areas of the study site were inundated during the assessment period. This inundation hindered access to some areas of the study site and increased the difficulty of detection for some flora species particularly those that occur on the margins and fringes of bodies of water. Aquatic fauna surveys were also undertaken throughout January 2022. These assessments are supplemented by information from the database searches.

### Use of Databases

The Victorian Biodiversity Atlas (VBA) database and other databases were used to search a defined geographical area to produce species lists of flora and fauna that have been previously recorded within the search area. The database lists are only as accurate as the quality and quantity of data that have been recorded and documented from the area. The use of the database in a desktop assessment has the following limitations:

- Location details for many records (typically older records) have a relatively low degree of accuracy ( $\leq$  1km). Thus, the database search may not pick up some records of species that were made within the site historically. Due to the large size of the project area flora surveys were focused on areas where VBA sightings of threatened flora have been recorded previously in order to increase the chance of detection.
- These datasets are not exhaustive given many locations locally and across Victoria have low or in some instances no documented survey effort for one or more groups of flora and fauna. During field surveys, it is not uncommon to find species at locations for which there are few or no previous nearby database records.

Professional experience and judgement are used through the assessment process to assess the potential for previously unrecorded threatened flora and fauna to be present within and adjoining the study site. Threatened flora and fauna records that are dated  $\leq$ 1960 have been removed from our data analysis as they are not considered to provide an accurate representation of the species likely to occur within the site at present (unless stated otherwise in this report).

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# Acronyms

Acronyms	Description
AHD	Australian Height Datum
BCS	Bioregional Conservation Status
CaLP Act	<i>Catchment and Land Protection Act 1994</i>
CEMP	Construction Environmental Management Plan
CMA	Catchment Management Authority
DAWE	Commonwealth Department of Agriculture, Water and the Environment
DBH	Diameter at Breast Height (taken 1.3 m from the ground)
DELWP	Department of Environment, Land, Water and Planning
DEPI	Department of Environment and Primary Industries (now DELWP)
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EVC	Ecological Vegetation Class
FFG Act	<i>Flora and Fauna Guarantee Act 1988 and Flora and Fauna Guarantee Amendment Act 2019</i>
GIS	Geographic Information System
Guidelines	<i>Guidelines for the removal, destruction or lopping of native vegetation (DELWP 2017)</i>
ha	Hectares
HIM	Habitat Importance Maps (DELWP 2017)
km	Kilometres
LGA	Local Government Area
m	Metres
MNES	Matters of National Environmental Significance
NVIM	Native Vegetation Information Management tool
PMST	Protected Matters Search Tool (DAWE)
sp.	Species (one species)
spp.	Species (more than one species)
subsp.	Subspecies
VBA	Victorian Biodiversity Atlas (DELWP)
WONS	Weed of National Significance

# Executive Summary

The Sunday Creek Reconfiguration Project (SCRCP) proposes to improve water use efficiency and deliver environmental, cultural and community benefits at Lake Moodemere. The project will deliver a direct pump and pipeline connection from the Murray River to Sunday Creek. This will deliver a more water efficient and cost-effective irrigation supply to the Irrigation Syndicate and may relax hydrological constraints on flora and fauna.

SMEC Australia Pty Ltd (SMEC) was commissioned by Goulburn-Murray Water (GMW) to undertake a detailed flora and fauna assessment to inform works being undertaken as part of the Sunday Creek Reconfiguration Project (the project), namely:

- A new purpose built 36 ML/day electric pump station to extract water from the Murray River;
- A direct pipeline to transfer water from the pump station to Sunday Creek, enabling Lake Moodemere and its fringing marshes to be bypassed;
- A new embankment and regulating structure at Hells Gate, allowing the creek and Lake Moodemere to be operated independently of each other; and
- Decommissioning the old pump station and upgrading the existing Lake Moodemere regulator on the River Murray in line with modern safety standards and facilitate the ongoing management of water levels in the lake.

This flora and fauna assessment was undertaken to identify any known or potential ecological values within and adjoining the study site. The assessment was undertaken by SMEC using available online databases and data was collected as part of a detailed flora and fauna site assessment in February 2022 and subsequent targeted surveys for Yellow Bellied Sheath-tailed Bat, Platypus and Sloane's Froglet (Figure 4). The purpose of this report is to inform GMW of potential impacts associated with the Project, enabling impacts to flora and fauna to be avoided and minimised where possible, and determining the environmental approvals pathway for the project. The report will also support referrals of the project under the Victorian *Environment Effects Act 1978* and Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

This tabulated executive summary provides an overview of identified ecological values, legislative considerations and further recommendations for the project (Table E1).

Table E1: Summary of project findings

Project Summary	
<b>Site location</b>	Sunday Creek and Lake Moodemere, 6 km east of Rutherglen Victoria, 3685
<b>Local Government Area</b>	Indigo Shire Council
<b>Bioregion</b>	Victorian Riverina
<b>Catchment Management Authority</b>	North East
<b>Ecological Vegetation Classes (EVCs) recorded within the study site</b>	<ul style="list-style-type: none"> <li>• Aquatic Herbland (EVC 653) – Benchmark taken from the neighbouring Murray Fans bioregion</li> <li>• Floodplain Riparian Woodland (EVC 56)</li> <li>• Floodway Pond Herbland (EVC 810)</li> <li>• Plains Woodland (EVC 803)</li> <li>• Riverine Grassy Woodland (EVC 295)</li> <li>• Riverine Swamp Forest (EVC 814)</li> <li>• Sedgy Riverine Forest (EVC 816)</li> <li>• Tall Marsh (EVC 825)</li> </ul>



Legislation	Result	Recommendations
<p><i>Environment Protection and Biodiversity Conservation Act 1999</i></p>	<p><b>Flora</b></p> <p>No EPBC listed flora species were detected.</p> <p>Threatened Ecological Community <i>Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia</i> was determined to be present within the broader study site however is not likely to be impacted under current project design.</p> <p><b>Fauna</b></p> <p>The EPBC listed (EN) Sloane's Froglet was detected during targeted surveys within the study site outside of impact areas.</p> <p>The following fauna species are considered likely to utilise habitat within and downstream of the study site:</p> <ul style="list-style-type: none"> <li>• Murray Cod (<i>Maccullochella peelii</i>);</li> <li>• Trout Cod (<i>Maccullochella macquariensis</i>); and</li> <li>• White-throated Needletail (<i>Hirundapus caudacutus</i>) – Flyover only</li> </ul>	<p>Targeted surveys should be undertaken for Mueller Daisy to determine species presence within impact areas.</p> <p>Targeted survey results for Sloane's Froglet should be incorporated into the proposed EPBC referral for the project.</p> <p>An CEMP should be developed that minimises and mitigates any potential impacts downstream of or within the broader study site that may affect EPBC Act-listed fauna outside of project impact areas. Controls surrounding the spread of Chytrid Fungus must be included to prevent possible impacts to Sloane's Froglet populations within and downstream of the study site.</p>
<p><i>Flora and Fauna Guarantee Act 1988 and Flora and Fauna Guarantee Amendment Act 2019</i></p>	<p><b>Flora</b></p> <p>The following FFG Act-listed flora species were recorded within the study site:</p> <ul style="list-style-type: none"> <li>• Straw Wallaby-grass (<i>Rytidosperma richardsonii</i>)</li> <li>• Late-flower Flax-lily (<i>Dianella tarda</i>)</li> <li>• Buloke (<i>Allocasuarina luehmannii</i>)</li> <li>• Buloke Mistletoe (<i>Amyema linophylla</i> subsp. <i>orientalis</i>)</li> <li>• Riverina Bitter-cress (Cardamine <i>moirensis</i>)</li> </ul> <p>The following FFG Act protected flora were recorded within the study site:</p> <ul style="list-style-type: none"> <li>• Scaly Buttons (<i>Leptorhynchus squamatus</i> subsp. <i>squamatus</i>);</li> <li>• Gold-dust Wattle (<i>Acacia acinacea</i>);</li> <li>• Tufted Burr-daisy (<i>Calotis scapigera</i>);</li> </ul>	<p>An FFG Act permit will be required to remove Riverina Bitter-cress plants within impact areas should detailed design be unable to avoid impacts to the species.</p> <p>An FFG Act permit will be required to protected flora should the detailed project design be unable to avoid impacts to the species.</p> <p>An FFG Act permit will be required to remove vegetation associated with the <i>Victorian Temperate Woodland Bird Community</i>. Detailed project design should avoid and mitigate effects to this community where possible.</p>

	<ul style="list-style-type: none"> <li>• Cottony Fireweed (<i>Senecio quadridentatus</i>); and</li> <li>• Fuzzy New Holland Daisy (<i>Vittadinia cuneata</i>).</li> </ul> <p>FFG Act-listed flora species with potential to occur in the study area are discussed in section 4.2.2</p> <p><b>Fauna</b></p> <p>The following FFG Act-listed fauna species were recorded within the study site:</p> <ul style="list-style-type: none"> <li>• Diamond Firetail (<i>Stagonopleura guttata</i>)</li> <li>• Musk Duck (<i>Biziura lobata</i>)</li> <li>• Murray River Turtle (<i>Emydura macquarii</i>)</li> <li>• Broad-shelled Turtle (<i>Chelodina expansa</i>)</li> <li>• Platypus (<i>Ornithorhynchus anatinus</i>)</li> <li>• White-bellied Sea Eagle (<i>Haliaeetus leucogaster</i>)</li> </ul> <p>The following FFG Act-listed fauna species are assumed present within the study site but were not detected during the site assessment:</p> <ul style="list-style-type: none"> <li>• Barking Owl (<i>Ninox connivens</i>)</li> </ul> <p>Impacts to Murray River Turtle and/or Broad-shelled Turtle nesting sites are likely to occur during the construction phase of the Hells Gate embankment construction access track; however, the period of impacts are likely to be limited to a single breeding season.</p> <p><b>Communities</b></p> <p>The FFG Act-listed <i>Victorian Temperate Woodland Bird Community</i> is considered present across all suitable woodland habitat within the study site. A total of 4.036 ha of this community is proposed to be impacted under current project design.</p>	<p>A FMP should be developed prior to construction detailing procedures and mitigation measures to be undertaken prior to and during construction activities.</p> <p>Consult with local DELWP representatives to understand potential FFG Act permit requirements for impacts to the listed species and communities.</p>
<p><i>Environmental Effects Act 1978</i></p>	<p>No ecological triggers in regard to the EE Act have been identified as potentially occurring.</p>	<p>The project will be self-referred to DELWP under the EE Act to obtain confirmation of the project’s potential (or not) to have a significant effect on Victoria’s environment, and the subsequent</p>

		requirement for an Environment Effects Statement.
<i>Planning and Environment Act 1987</i>	A total of 4.10 ha of native vegetation and 56 large trees are proposed to be impacted within the study site.	Native vegetation impacts within the study site must be avoided and minimised where possible (e.g. narrowing overall footprint, no-go zones, reconsidering construction boundaries etc.). A planning permit under Clause 52.17 of the Indigo Shire Planning Scheme will be required to remove native vegetation. Any removal of native vegetation must be offset in accordance with the Guidelines (DELWP 2017).
<i>Catchment and Land Protection Act 1994</i>	A total of 13 noxious weeds were recorded within proximity to the study site, five of which are declared WoNS (detailed in section 4.1.5). Two established pest animals were recorded within the study site European Rabbit ( <i>Oryctolagus cuniculus</i> ) and Red Fox ( <i>Vulpes Vulpes</i> ).	GMW must follow the measures to prevent the spread of declared noxious weeds and pest animals during construction within a suitably prepared CEMP for the project.
<i>Wildlife Act 1975</i>	Habitat for hollow-dependent fauna recorded.  Potential for presence of turtle nests within the Hells Gate embankment construction access track impact footprint.	GMW must obtain a Management Authorisation under the Act for removal of fauna.  A preclearance survey should be undertaken by a qualified ecologist no more than 48 hours prior to construction impacts commencing  An ecologist should be present during hollow bearing tree removal and earth works.
<i>Water Act 1989</i>	North East CMA is the responsible authority for the control, management and authorisation of works and activities in or over designated waterways in the North East CMA's waterway management district.	A 'works on waterways' permit is required for the proposed project works.

**Recommendations**

- Undertake targeted surveys for Mueller Daisy to determine species presence and/or likely utilisation of impact areas;
- Avoid impacts to native vegetation during the detailed design phase wherever practicable, prioritising preservation of threatened species habitat, listed community habitat and large hollow bearing trees;
- Consult with DELWP to determine permit requirements and mitigation measures for potential impacts to listed FFG Act protected species and communities and obtain a permit if required;
- Consult with the Indigo Shire Council regarding obtaining a planning permit for the removal of native vegetation and permit requirements relating to the Environmental Significance Overlay schedule;

- Secure offsets prior to the removal of native vegetation;
- Develop a supplementary watering plan to ensure that water levels within Sunday Creek are maintained at a suitable level to support existing biodiversity values during and outside of the irrigation season.
- Develop a Fauna Management Plan (FMP) to inform aquatic and terrestrial fauna management throughout the construction process/program across the site that addresses:
  - The salvage and or relocation of aquatic and terrestrial fauna.
  - Management actions to control any noxious species encountered during the construction or pre-construction process.
  - Mitigation of impacts to and potential enhancement of suitable Sloane's Froglet foraging habitat and Murray River Turtle and Broad-shelled Turtle nesting habitat; and
- Prepare a CEMP for the project that addresses at a minimum:
  - Fencing of native vegetation to be retained;
  - Any proposed dewatering in preparation of the works and potential impacts to fauna;
  - Development of a Sediment and Erosion Control Management Plan (SECMP) to address erosion and sediment controls including mitigation of potential acid sulphate soils for adjacent waterways (i.e. Sunday Creek, Murray River and Lake Moodemere);
  - Water quality management; and
  - Hygeine and disinfection procedures to limit the spread of Chytrid fungus.
  - The retention of any soil removed during the construction phase of the project and return of this soil to its original location to mitigate any impacts to seedbanks of Riverina Bitter-cress.

# 1 Introduction

## 1.1 Purpose

SMEC Australia Pty Ltd (SMEC) was commissioned by Goulburn-Murray Water (GMW) to undertake a detailed flora and fauna assessment and build upon the existing body of environmental investigations and reporting previously undertaken as part of the proposed Sunday Creek Reconfiguration Project, near Rutherglen, Victoria (the project). The project includes the following elements:

- A new purpose built 36 ML/day electric pump station to extract water from the Murray River;
- A direct pipeline to transfer water from the pump station to Sunday Creek, enabling Lake Moodemere and its fringing marshes to be bypassed;
- A new embankment at Hells Gate, allowing the creek and Lake Moodemere to be operated independently of each other; and
- Decommissioning the old pump station and upgrading the existing Lake Moodemere regulator on the River Murray in line with modern safety standards and facilitate the ongoing management of water levels in the lake.

The project will require the removal of native vegetation and fauna habitat and will alter the current water regime of both Sunday Creek and Lake Moodemere.

This detailed flora and fauna assessment was undertaken to identify the ecological values which may be impacted by the proposed works and involved undertaking a site ecological assessment and aquatic fauna surveys in January and February 2022 at the study site (SMEC 2022). Further targeted surveys for Yellow-bellied Sheath-tail Bat, Platypus and Sloane's Froglet were undertaken in May, April and July 2022 respectively. The purpose of the assessment is to identify potential project constraints related to ecological values present and relevant environmental planning approvals pathway for the project. This report outlines the findings of the desktop and site assessments and provides information regarding potential impacts to ecological values and likely permits, further site visits and documentation required to comply with State and Commonwealth legislation.

## 1.2 Scope of works

The scope of works for the ecological assessment includes:

- Desktop review of known and/or predicted ecological values occurring within the study area;
- Identification of the presence and likelihood of occurrence of State and Commonwealth listed flora, fauna, and communities;
- Mapping of native vegetation recorded within the study site;
- Undertaking an Index of Wetland Condition (IWC) assessment;
- Preparation of a report to document the results of the ecological assessments;
- Identifying permits and referrals which may be required under State and Commonwealth environmental legislation, such as the EPBC Act and FFG Act; and
- Providing a recommendation on the necessity of targeted surveys or further assessments to inform the project.

## 1.3 Study area and site

This report refers to three separate definitions describing the area assessed for the project; *impact footprint*, *study site* and *study area*.

The **impact footprint** refers to areas within the study site where construction and related activities will occur namely:

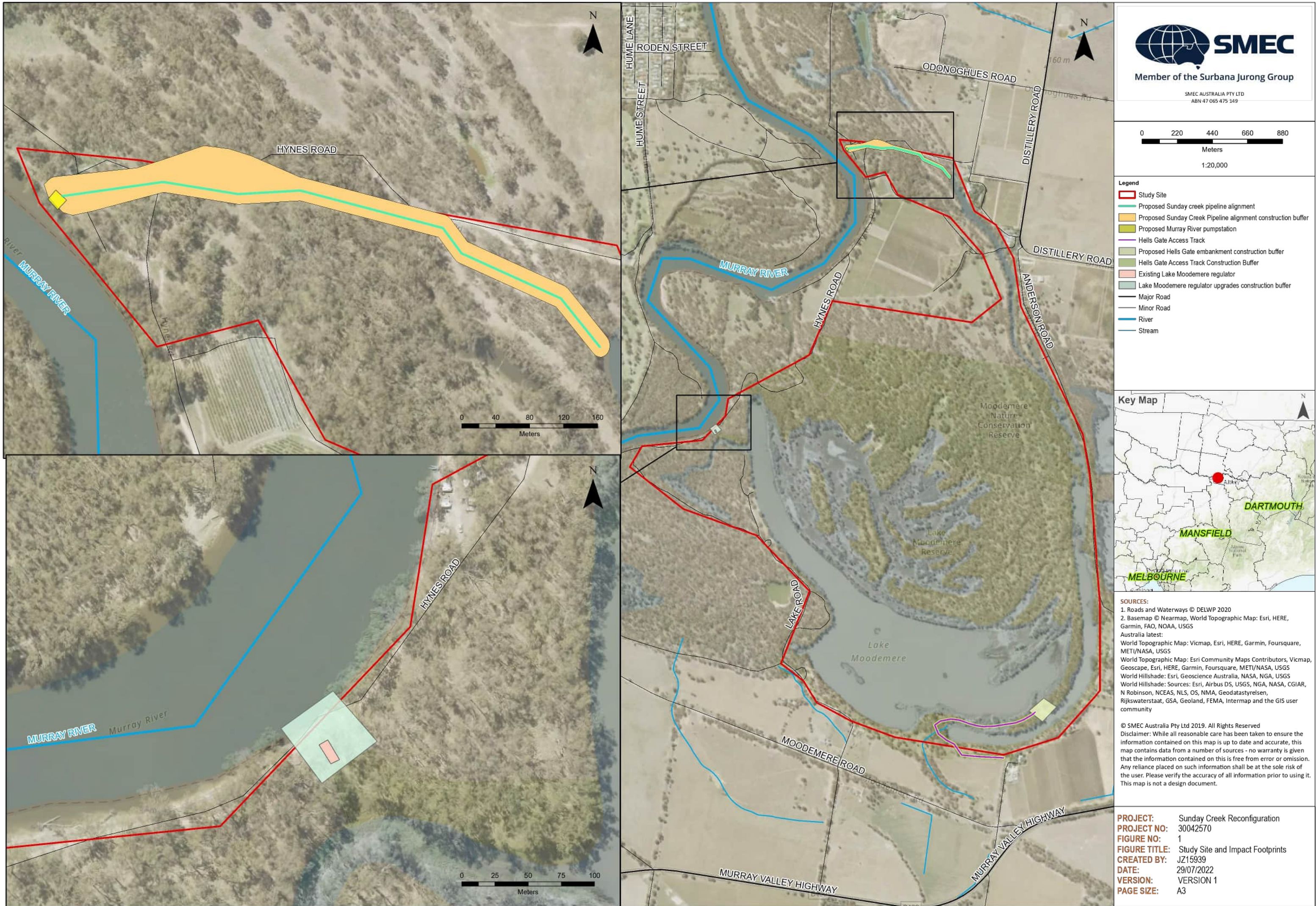
- The new pump station (40 x 40 m footprint) and Sunday Creek Pipeline (24 m corridor);
- The proposed Hells Gate Regulator (100 x 100 m footprint) and associated access track (30 m corridor); and
- Decommissioning and upgrade works associated with the existing Lake Moodemere regulator (40 x 40 m footprint).

These areas were assessed in detail for their ecological values including the mapping of large and scattered trees.

The **study site** includes areas that were surveyed on-ground by SMEC ecologists which includes Lake Moodemere, Sunday Creek, the Northern Marshes and surrounds (Figure 1). The study site occurs within the Victorian Riverina bioregion, Indigo Shire Council Local Government Area (LGA) and North East Catchment Management Authority (CMA) areas. The study site is an approximately 560 ha area encompassing Lake Moodemere, Sunday creek and associated wetland environments which are bordered by agricultural land and vineyards to the east and the Murray river to the west.

The **study area** refers to a 10 km buffer area of the study site and was assessed by desktop only. The study area provides ecological context and further insight as to what ecological values may occur within the study site. This includes, but is not limited to, modelled vegetation and condition, threatened flora and fauna and ecological communities.

Figure 1: Study site and impact footprints



## 1.4 Background

The study site encompasses approximately 560 ha of predominantly public land including Lake Moodemere, the associated Northern Marshes and Sunday Creek located six kilometres west of the Victorian town of Rutherglen.

Prior to European settlement of the region Lake Moodemere served as an important gathering site for indigenous peoples and as a wildlife refuge during times of drought (Jacobs 2020a). With the arrival of European settlers and the discovery of gold in the 20<sup>th</sup> century the region experienced significant growth. In the last 100 years the region has transitioned to agriculture and in particular wine making. As the growth of agriculture continued so too did the need for a stable irrigation supply. Sometime prior to 1941 local irrigators excavated the current Hells Gate channel to allow access to the water stored in Lake Moodemere (GHD 2009). In 1979 the existing Lake Moodemere regulator was constructed to further facilitate access to water for irrigation purposes (GHD 2009).

Lake Moodemere currently hosts the Lake Moodemere regatta Australia's longest running rowing regatta and is a popular swimming, fishing, walking, cycling and bird watching site. There is a shared 13 km trail that takes in both the river and Lake Moodemere past vineyards and along the shores of the lakes which is frequently used by walkers and cyclist (Jacobs 2020a).

The current water regime which has been in effect for approximately 43 years uses operation of the existing Lake Moodemere regulator in conjunction with a diesel pump station to maintain water levels within Lake Moodemere at a level sufficiently high enough to allow gravity assisted flow through the Hells Gate channel to Sunday Creek where irrigators then draw from. During periods of high discharge from the Murray River or large rainfall events within the local catchment area inundation of the Northern Marshes occurs. The frequency of this inundation is likely increased by the artificially high water levels sustained within Lake Moodemere which reduce the volume of water needed to inundate the Northern Marshes.

The evaporative, transpirative and seepage losses associated with this water regime are costly in both a monetary and environmental sense and form the justification of the project. The proposed new infrastructure and resulting water regime aim to provide both cost and water savings. The new water regime will also result in restoration of a more natural wetting and drying cycle for Lake Moodemere between the months of February to August each year.



## 2 Methods

### 2.1 Desktop review

The following resources were investigated as part of the desktop assessment:

- Protected Matters Search Tool (PMST), maintained by the Department of Agriculture, Water and the Environment (DAWE), for Matters of National Environmental Significance (MNES) relevant to the study area, including (DAWE 2022a):
  - Wetlands of international importance (Ramsar)
  - Listed threatened ecological communities
  - Listed threatened species
  - Listed migratory species
  - Listed marine species;
- Victorian Biodiversity Atlas<sup>1</sup> (VBA), maintained by the Department of Environment, Land, Water and Planning (DELWP), for flora and fauna species recorded within the study area (DELWP 2022a);
- Visualising Victoria's Biodiversity (VVB), a Centre for eResearch and Digital Innovation (CERDI) initiative, partnered with State-Wide Integrated Flora and Fauna Teams (SWIFFT) for information on DELWP current wetlands within the study area (VVB 2022);
- DELWP's NatureKit mapping, for Ecological Vegetation Classes (EVCs) (extant and pre-1750s) and location risk mapping (DELWP 2022b);
- Birdlife Australia
- The Native Vegetation Information Management (NVIM) system for biodiversity information relevant to the study site, including (DELWP 2022c):
  - Crown land, parks and reserves
  - Victorian bioregions
  - Catchment Management Areas
  - Modelled native vegetation condition;
- The Victorian Planning Schemes Online (DELWP 2022d) and Planning Maps Online (DELWP 2019e) tools for:
  - Local government areas relevant to the study site
  - Planning zones, overlays and schedules to overlays;
- Relevant background reports, legislation and policies relevant to the study site and broader study area:
  - Lake Moodemere Aquatic Surveys (Austral Research and Consulting January 2022)
  - Lake Moodemere/Sunday Creek Reconfiguration Project – Environmental Impact Statement (Aquaterra 2018)
  - Growling Grass Frog Surveys – Lake Moodemere (Jacobs 2018)

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<sup>1</sup> VBA data has been obtained from DELWP online resources, available at:

<https://www.data.vic.gov.au/data/group/spatial-data>

- Identification of the aquatic vertebrate values and their hydrological requirements for input into the Environmental Watering Plan for the Lake Moodemere-Sunday Creek wetland complex (MDFRC 2011);
- Aerial imagery of the study area; and
- Publicly available LiDAR data sourced from DELWP online resources.

## 2.2 Site assessment

A site assessment was undertaken by four SMEC ecologists on 31 January – 4 February 2022 to assess the study site and impact footprint for the project. A detailed ecological assessment was conducted which involved:

- A Habitat Hectares assessment in accordance with current DELWP methodology and the *Vegetation Quality Assessment Manual* (version 1.3, DSE 2004). Data was collected in accordance with the DELWP *Guidelines for the removal, destruction or lopping of native vegetation* (The Guidelines; DELWP 2017) and included mapping of:
  - Remnant patches of native vegetation (including canopy drip line and on-ground extent of understorey collected by a surveyor to an accuracy of <1 m)
  - Large trees within patches within the impact footprint (*Assessor's handbook - Applications to remove, destroy or lop native vegetation*, DELWP 2017)
  - Scattered trees within the impact footprint;
- Identifying the presence or likelihood of occurrence of species listed as threatened under the *Flora and Fauna Guarantee Act 1988* (FFG Act) and EPBC Act;
- Determining the presence of EPBC Act-listed and FFG Act-listed Threatened Ecological Communities;
- Recording the number of specimens of FFG Act-listed protected flora recorded within the study site; and
- Recording all native and exotic flora and fauna species encountered during the site assessment.

Data from the site assessment was used to inform the outcomes of this report. Data was collected using the ArcGIS Collector app, which is of standard GPS accuracy ( $\pm 4$  m).

In conjunction with the site assessment performed by SMEC ecologists, aquatic surveys were undertaken between the 7 and 11 of January 2022 by Austral Research and Consulting (Austral 2022). The results of these surveys have been integrated within this report.

Following the initial site assessment the following targeted surveys were undertaken:

- Yellow-bellied Sheathtail Bat: 31<sup>st</sup> March – 20<sup>th</sup> April. Two week songmeter deployment in key impact areas with data analysis performed by subconsultant EcoAerial.
- Platypus: 24<sup>th</sup> March. eDNA water sampling by subconsultant Austral Research and Consulting with analysis undertaken by EnviroDNA.
- Sloane's Froglet: 30<sup>th</sup> June - 7<sup>th</sup> July. One week songmeter deployment and two night call playback/spotlight survey. Songmeter data analysis undertaken by SMEC.

## 2.3 Implications of a changed water regime

Predictive water modelling is currently being undertaken for the Project but has yet to be completed and as such predictions within this report relating to the responses of flora and fauna to the proposed water regime are based on historical water level data of the Murray River and Lake Moodemere only and make the following assumptions:

- The consistently high water levels in Lake Moodemere from the current water regime are likely to have increased the frequency and duration of flooding within the Northern Marshes by decreasing the water volume necessary to reach the point at which the Northern Marshes begin inundation (129.3 m AHD), during periods of high flow in the Murray River and rainfall events within the catchment area of Lake Moodemere.
- The proposed Hells Gate embankment structure will hydrologically separate Sunday Creek and Lake Moodemere. The proposed sill height of the embankment is 129m AHD and is thus the height at which irrigation drawdown within Sunday Creek will no longer affect water levels within Lake Moodemere. 129m AHD is 30 cm higher than levels currently maintained within Lake Moodemere for water conveyance and is likely to increase the frequency and duration of inundation of the Northern Marshes should high Murray River discharge or rainfall occur during this period.
- High Murray River water levels and flood events will remain as the main causes of inundation of the Northern Marshes.
- Drawdown of water within the Northern Marshes during periods of inundation is likely to follow historic trends and will occur as a result of evaporation, transpiration, seepage and irrigation drawdown from within the hydrologically connected Sunday Creek until a level of 129 m AHD is reached. From this level only natural drawdown will occur as Sunday Creek and Lake Moodemere will operate as separate bodies of water due to the proposed Hells Gate embankment structure.
- Environmental factors such as the El Nino Southern Oscillation (ENSO) and climate change are likely to play a role in historic and future trends relating to inundation frequency, depth and duration within Lake Moodemere and the Northern Marshes due primarily to alterations in rainfall and mean average temperatures and the subsequent changes in evaporative rates.

Due to the above variables it is difficult to predict the responses of flora and fauna within the study site to the changed water regime with certainty. For this reason, three scenarios have been chosen that reflect water levels that are likely to occur under the proposed water regime. These scenarios are a static snapshot of what is a dynamic system which is constantly changing due to the effects of drawdown and inflows to the system.

The following sources were used when analysing trends in historic water levels of Lake Moodemere, Sunday Creek and the Murray River.

- Murray Darling Basin Authority Corowa and Doctors Point historic river data 1957 – present (MDBA 2022);
- Historical water level records from Chambers Gauge Lake Moodemere 1965 – 2006 (GHD 2018); and
- Publicly available LiDAR data and historic aerial imagery from DELWP (DELWP 2022c).

## 3 Results of site assessment

### 3.1 Site summary

The study site encompasses a natural floodplain 560 ha in size which includes public and private land comprising of eight EVCs and five habitat types across four broad areas; Sunday Creek, Lake Moodemere, the Murray River and the Northern Marshes. River Red-gum (*Eucalyptus camaldulensis*) is the dominant canopy species within the floodplain and the groundcover comprised mostly sedges, rushes and grasses. Vegetation surrounding Lake Moodemere and within the Northern marshes was generally of high quality but roadsides to the north of the study site, recreational sites and areas close to private property were often dominated by non-native grasses particularly Paspalum (*Paspalum dilatatum*) and Rats-tail Fescue (*Vulpia myuros*). Patches of Aquatic Herbland (EVC 653) were common in areas of saturated soil or shallow inundation and aquatic herbs made up a large component of vegetation on the fringes of Lake Moodemere and the Northern Marshes. The waterbodies and wetlands present within the study site form a dynamic system that is in a constant state of change. Whilst the current water regime restricts certain aspects of a natural wetting and drying cycle from occurring the study site still undergoes significant change to both flora and fauna during the duration of an inundation or drawdown event.

#### 3.1.1 Sunday Creek

Sunday Creek is a historic anabranch of the Murray River now a still water creek approximately 3 km long (within the study site) fringed to the east by degraded riparian vegetation often including non-native escapees from bordering private properties and the west by high quality open forest and woodland of mature River Red-gums with a sedgy to grassy understorey, though lacking any native mid-story species. Historically Sunday Creek would have flowed north to south receiving flows from its connection with the Murray River in the town of Wahgunyah 3km upstream of the study site. This connection with the Murray has since been dammed and Sunday Creek now flows south to north receiving the bulk of it's inflows from Lake Moodemere through the Hells Gate channel. Patches of emergent aquatic macrophytes are present throughout the creek and large amounts of detritus and debris offer aquatic habitat throughout. The creek is approximately 35 m wide at its northernmost reach within the study site and widens to approximately 70 m in the south. Whilst understorey vegetation cover was limited along the extent of the creek (particularly in the northern extent of the study site where livestock grazing pressures are evident) the waterbody hosts a number of aquatic fauna species including the FFG Act listed Platypus, Murray River Turtle and Broad-shelled Turtle. Terrestrial and wetland bird species also utilised the habitat within and along Sunday Creek for foraging and nesting with several roosts and nests recorded within mature River Red-gum along the banks of the creek.

#### 3.1.2 Lake Moodemere

For the previous 43 years (the duration of the current water regime) Lake Moodemere has been maintained as a permanent freshwater lake approximately 60ha in size and approximately 1-3m deep when not spilling into the Northern Marshes. Historical aerial imagery shows that drawdown of the lake has occurred in the past to approximately 128.0 m AHD, 60cm lower than the operational limit of the current irrigation regime. The lake is bordered to the south by a raised terrace formation largely vegetated by Grey Box (*Eucalyptus macrocarpa*) and Buloke (*Allocasuarina luehmannii*) grassy woodland, to the north by the River Red-gum forest swamp complex of the Northern Marshes and to the west and east by the Murray River and Sunday Creek respectively. The Lake is fringed by emergent semi-aquatic macrophytes and large mature River Red-gums and contains small island monocultures of Giant Rush which provide breeding and foraging habitat for aquatic and terrestrial fauna.

#### 3.1.3 Northern Marshes

The Northern Marshes are a River Red Gum-dominated swamp complex that differs in floristic and fauna composition depending on inundation levels. At the time of assessment the Northern Marshes were largely inundated with evidence that water levels had been stable for several months. Raised areas of dry land dotted throughout were sparsely vegetated by Poong'ort (*Carex tereticaulis*) and *Juncus* species whilst semi aquatic species such as Lesser Joyweed (*Alternanthera denticulata*) and Clovestrip (*Ludwigia peploides* subsp.

*montevidensis*) dominated the saturated fringes under a canopy of mature River Red Gum. Ferny Azolla (*Azolla pinnata*), Thin Duckweed (*Spirodela punctata*) and Giant Rush (*Juncus ingens*) were prevalent throughout the Northern Marshes and constituted the majority of vegetation within inundated areas. Turtle nests (disturbed) were observed on the higher landforms and it is likely that turtles utilise the surrounding waters for foraging. Habitat for wading water birds was limited at the time of assessment however is expected to increase substantially as water levels decrease exposing mudflats. Evidence was present that indicated that the Northern Marshes had experienced a dry cycle sometime in the past three years.

### 3.1.4 Murray River

The Murray River borders the study site to the west and is approximately 60 -100 m wide. Historically the Murray River would have undergone a seasonal flow variation with lower flow in summer and flood events in winter – spring driven largely by rainfall within its catchment area. Today the Murray River is largely regulated with Lake Dartmouth and Lake Hume upstream of the study site providing managed discharge inline with irrigation demand typically resulting in elevated flows from late spring – autumn whilst also buffering flood events. Vegetation along the banks is of moderate quality being generally composed of a River Red Gum canopy with the occasional River Bottle Brush or Silver Wattle overlaying a grassy understorey often with Common Reed. Weed incursion is variable but Willows, Poplars and agricultural weeds are common along the banks. The river provides aquatic habitat for fish and turtles and foraging opportunities for avifauna.

## 3.2 Flora

### 3.2.1 Species summary

The VBA database contains records of 266 flora species previously identified within the study area (DELWP 2022a). These records include 162 native species (including eight native species occurring outside of their natural range) and 104 introduced species.

During the site assessment for the study site, 163 flora species were observed, including 96 native (3 outside their natural range) and 67 introduced species. A full list of the species recorded during the site assessment is detailed in Appendix A.

### 3.2.1 Scattered trees and large trees

A total of 56 large trees in patches and zero scattered trees were recorded within proximity to impact footprints. River Red Gum was the only species recorded. A summary of potentially impacted large trees is included within Table 5 and documented in Appendix A. Figure 3 below shows the approximate location of large trees within proximity to impact areas within the study site.

### 3.2.2 Ecological Vegetation Classes (EVCs)

DELWP's NatureKit map indicates that eight EVCs (extant mapping) occur within and immediately adjoining the study site presented below, with their Bioregional Conservation Status (BCS) within the Victorian Riverina bioregion (DELWP 2022b):

- Floodplain Riparian Woodland (EVC 56) - vulnerable
- Riverine Grassy Woodland (EVC 295) - vulnerable
- Plains Woodland (EVC 803) - endangered
- Riverine Swamp Forest (EVC 814) - depleted
- Riverine Swampy Woodland (EVC 815) - vulnerable
- Sedgy Riverine Forest (816) - vulnerable
- Tall Marsh (EVC 821) - depleted

## Results of site assessment

- Aquatic Herbland (EVC 653) – depleted<sup>2</sup>

The site assessment confirmed the presence of the above EVCs within the study site with the exception of EVC 815. The site assessment also indicated the presence of Floodway Pond Herbland (EVC 810) within the study site which was not included in the DELWP mapping. A description of these EVCs<sup>3</sup> and other vegetation types mapped during the site assessment are described in Table 1 and the location of these EVCs is shown in Figure 2.

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<sup>2</sup> This EVC does not have a benchmark with the Victorian Riverina bioregion, values and status are taken from the neighbouring Murray Fans bioregion.

<sup>3</sup> General vegetation descriptions were obtained from the DELWP EVC benchmark descriptions, available at: <https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks>

Table 1: Vegetation descriptions.


EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Floodplain Riparian Woodland (EVC 56)		<p>An open eucalypt woodland or open forest to 20 m tall over a medium to tall shrub layer with a ground layer consisting of amphibious and aquatic herbs and sedges. Occurs along the banks and floodplains of the larger meandering rivers and major creeks, often in conjunction with one or more floodplain wetland communities. Elevation and rainfall are relatively low and soils are fertile alluviums subject to periodic flooding and inundation.</p> <p>Floodplain Riparian Woodland within the study site is mostly confined to the banks of the Murray River and Sunday Creek as well as an unnamed tributary. River Red Gum to 20m tall formed the canopy with the occasional Wattle (<i>A. dealbata</i> and <i>A. implexa</i>) or River Bottlebrush (<i>Callistemon sieberi</i>) present as a shrub layer. The ground cover is variable often dominated by graminoids such as Common Tussock-grass (<i>Poa labillardierei</i>) Common Wheat-grass (<i>Anthosachne scabra</i>) or <i>Carex</i> and <i>Juncus</i> species.</p> <p>This EVC was often highly impacted by weed incursion the major components of which included Phalaris (<i>Phalaris aquatica</i>), Tall Fleabane (<i>Erigeron sumatrensis</i>) and <i>Paspalum</i></p>	


<sup>4</sup> EVC descriptions from: <https://www.environment.vic.gov.au/biodiversity/bioregions-and-evc-benchmarks>


EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Riverine Grassy Woodland (EVC 295)		<p>Occurs on the floodplain of major rivers, in a slightly elevated position where floods are infrequent, on deposited silts and sands, forming fertile alluvial soils. River Red Gum woodland to 20 m tall with a ground layer dominated by graminoids. Occasional tall shrubs present.</p> <p>This EVC was present in a mostly degraded state due to prolonged grazing pressures and weed incursion. It was characterised by a generally smaller (relative to the rest of the site) canopy of River Red Gums and occupied higher ground within the study site so displayed no signs of inundation during the site assessment. The ground cover was predominantly graminoid species such as Bristly Wallaby-grass (<i>Rytidosperma setaceum</i>) and <i>Juncus</i> spp. in areas of higher quality but was often dominated by weed species such as Rats-tail Fescue, Rye grass (<i>Lolium</i> sp.) and Brome (<i>Bromus</i> sp.).</p>	




EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Plains Woodland (EVC 803)		<p>An open, eucalypt woodland to 15 m tall occurring on a number of geologies and soil types. Occupies fertile clays and clay loam soils on flat or gently undulating plains at low elevations in areas with &lt;600 mm annual rainfall. The understorey consists of a few sparse shrubs over a species-rich grassy and herbaceous ground layer and chenopods are often present.</p> <p>This EVC was present in discontinuous segments occupying an elevated position surrounding Sunday Creek and Lake Moodemere. The overstorey comprised Grey Box (<i>Eucalyptus microcarpa</i>) or Buloke (<i>Allocasuarina luehmannii</i>) depending on site and understorey was dominated by Spear grasses (<i>Austrostipa blackii</i> and <i>A. scabra</i>) and Clustered Wallaby Grass (<i>Rytidosperma racemosum</i> var. <i>racemosum</i>) Ruby Saltbush (<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>), Wingless Bluebush (<i>Maireana enchylaenoides</i>) and Nodding Saltbush (<i>Einadia nutans</i>) were also commonly present.</p> <p>Common weed species included Quaking Grass (<i>Briza</i> sp.), Wild oat (<i>Avena</i> sp.) and Brome Grass (<i>Bromus</i> sp.).</p>	

EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Riverine Swamp Forest (EVC 814)		<p>Open eucalypt forest to 25 m tall with understorey dominated by obligate wetland species (or opportunistic annuals during sustained dry periods) and can range from closed sedgeland or herbland to grassy-herbaceous or extremely sparse and with cover primarily leaf-litter, black water or exposed alluvium. Occupies low-lying areas subject to reasonably regular flooding, typically flood-prone lower river terraces and low-lying areas adjacent to floodways through or within riverine forest.</p> <p>Riverine Swamp Forest constituted a large proportion of the vegetation present within the Northern Marshes of the Lake Moodemere wetland complex. The canopy was entirely made up of River Red Gum to 25 m tall and a shrub layer was absent. The understorey comprised differing combinations of aquatic herbs (<i>Alternanthera denticulata</i>) and sedges (<i>Carex tereticaulis</i>) in shallow and non-inundated areas while <i>Juncus</i> species, Ferny Azolla (<i>Azolla pinnata</i>) and Thin Duckweed (<i>Spirodela punctata</i>) dominated flooded portions of the EVC.</p> <p>Weeds species were notably less dominant than in neighbouring EVCs however Fogfruit (<i>Phylla nodiflora</i>) and Spear Thistle (<i>Cirsium vulgare</i>) were present in drier areas of the EVC.</p>	

EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Sedgy Riverine Forest (816)		<p>Riverine Sedgy Forest occurs on the floodplain of major rivers in areas of frequent flooding. The overstorey is a tall forest of River Red Gum to 25 m tall. The ground layer is dominated by flood-related grass and sedge species. Depending on time of year and flooding level, associated water plants may be present.</p> <p>This EVC occurred along the boundaries of water courses and more inundated EVCs (814, 810, 653) and the canopy was once again dominated by River Red Gum to 25m tall. The understory was variable with some areas being an almost monoculture of Plains Sedge (<i>Carex bichenoviana</i>) whilst other areas were a combination of Juncus, Carex and semi-aquatic herbs. Poong'ort (<i>Carex tereticaulis</i>) and Warrego Summer-grass (<i>Paspalidium jubiflorum</i>) were common between most instances of this EVC.</p> <p>Weed species in this EVC were variable depending on inundation level however Spear Thistle (<i>Cirsium vulgare</i>) was the most regularly recorded species.</p>	

EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Tall Marsh (EVC 821)		<p>Wetland dominated by tall emergent graminoids (rushes, sedges, reeds), typically in thick species-poor swards. Competitive exclusion in core wetland habitat - of optimum growing conditions for species tolerant of sustained shallow inundation. Occupies wetlands usually associated with anabranch creeks. Soils are almost permanently moist. Dominant species are tolerant of relatively deep and sustained inundation, but not total immersion for any sustained period.</p> <p>Tall Marsh was present in island like monocultures of Giant Rush (<i>Juncus ingens</i>) within Lake Moodemere and also formed stands fringing the lake and Sunday Creek. Common Reed (<i>Phragmites australis</i>) was also occasionally present as fringing vegetation of both the lake and Sunday creek.</p> <p>Weed species were notably absent from most of these vegetation patches most likely due to the level of inundation.</p>	

EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Aquatic Herbland (EVC 653)		<p>Semi-permanent to seasonal wetland vegetation, treeless (or nearly so), dominated by herbaceous aquatic species such as <i>Cychnogetum</i> sp., <i>Myriophyllum</i> sp., (typically with at least rootstocks tolerant of dry periods). Widespread, but rare in mountains and north-west.</p> <p>Aquatic Herbland occupied the margins of the Northern Marshes and areas that showed evidence of prolonged shallow inundation (&lt;30cm in depth) often forming linear wetlands. The EVC was generally treeless with the occasional River Red Gum recruit. Water Millfoil (<i>Myriophyllum crispatum</i>), Clove Strip, (<i>Ludwigia peploides</i> subsp. <i>montevidensis</i>), Swamp Wallaby-grass (<i>Amphibromus neesii</i>) and Narrow-leaf Nardoo (<i>Marsilea costulifera</i>) were common components of this EVC.</p> <p>Grassy weed species such as Rye Grass (<i>Lolium</i> sp.) and Brome Grass (<i>Bromus</i> sp) were common along the drier margins of this EVC whilst Common Pennyroyal (<i>Mentha pulegium</i>) was present as a semi aquatic weed species.</p>	

EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Floodway pond Herbland (EVC 810)		<p>Low herbland to 0.3 m tall with occasional emergent life forms, usually with a high content of ephemeral species. Floors of ponds associated with floodway systems. Typically heavy deeply cracking clay soils. Characteristically smaller wetlands with a more regular flooding and drying cycle in comparison to sites supporting Lake Bed Herbland.</p> <p>Floodway Pond Herbland was present in a narrow linear band that ran parallel with Sunday Creek and showed various levels of inundation from dry ground through to complete flooding. The vegetation within this EVC was similar to aquatic herbland but more variable depending on depth of water present. Deeper margins of this patch were dominated by Clove Strip and Water Ribbons (<i>Cycnogetum</i> sp.) whilst shallow regions were more diverse often including Knotweed (<i>Persecaria</i> sp.), Spike Sedge (<i>Eleocharis acuta</i>), Lessor Joyweed (<i>Altenanthera denticulata</i>), and Sneezeweed (<i>Centipeda minima</i> and <i>C. cunninghamii</i>)</p> <p>Weed species in the EVC were mostly confined to the drier margins and in areas where water had retreated completely and were typical of other weed species encountered across the site.</p>	


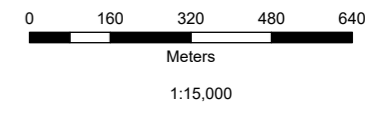
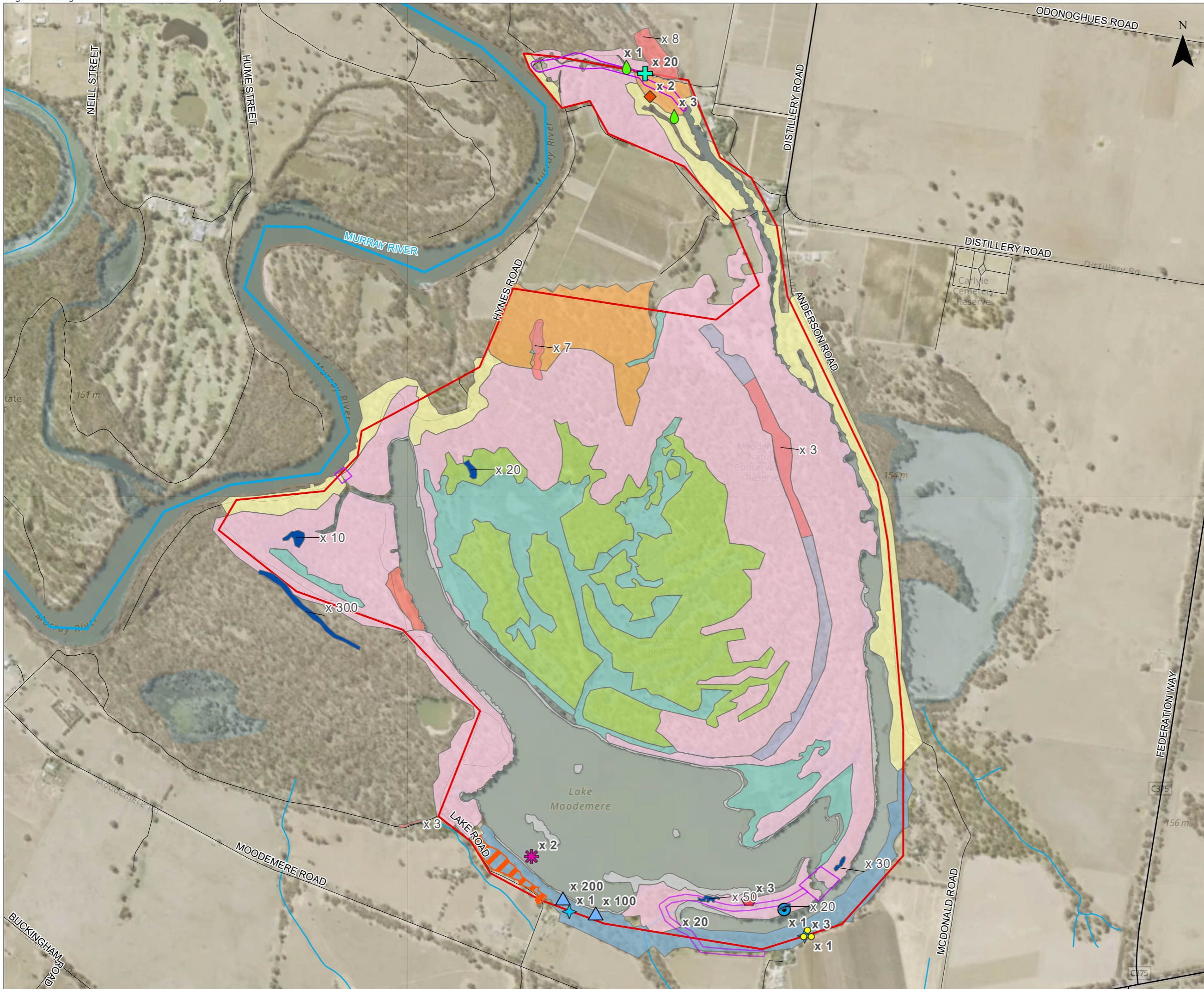
EVC Name	Habitat zones	Description <sup>4</sup>	Photo of vegetation at the study site
Non-native vegetation		<p>4 Agricultural land fringed the study site and was almost entirely composed of non-native species particularly pasture grasses and weeds of pastures. Non-native garden species were present within most private properties some of which such as Tree of Heaven (<i>Ailanthus altissima</i>) and Canary Island Date Palm (<i>Phoenix canariensis</i>) showed evidence of establishing within the Northern Marshes of Lake Moodemere and Sunday Creek as escapees.</p>	

Figure 2: Ecological values recorded within the study site



- Legend**
- Study Site
  - Impact Footprint
  - EPBC Act threatened ecological community**
  - Grey Box Grassy Woodlands and Derived Native Grasslands of South-eastern Australia
  - EPBC Act listed Fauna**
  - Sloane's Froglet Habitat
  - FFG Act-listed Threatened Flora species**
  - ◆ Buloke
  - ◆ Buloke Mistletoe
  - ◆ Late-flower Flax-lily
  - ◆ Straw Wallaby-grass
  - ◆ Riverine Bittercress
  - FFG Act-listed Protected Flora species**
  - ▲ Tufted Burr-daisy
  - ▲ Cottony Fireweed
  - + Fuzzy New Holland Daisy
  - FFG Act-listed Threatened Fauna species**
  - Diamond Firetail
  - ◆ Musk Duck
  - Ecological Vegetation Classes (EVCs)**
  - Aquatic Hermland EVC 653
  - Floodplain Riparian Woodland EVC 56
  - Floodway Pond Hermland EVC 810
  - Modified (mown)
  - Plains Woodland EVC 803
  - Riverine Grassy Woodland EVC 295
  - Riverine Swamp Forest EVC 814
  - Sedgy Riverine Forest EVC 816
  - Tall Marsh EVC 821



**SOURCES:**

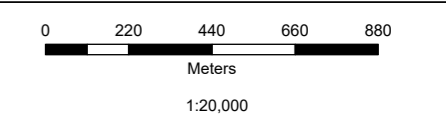
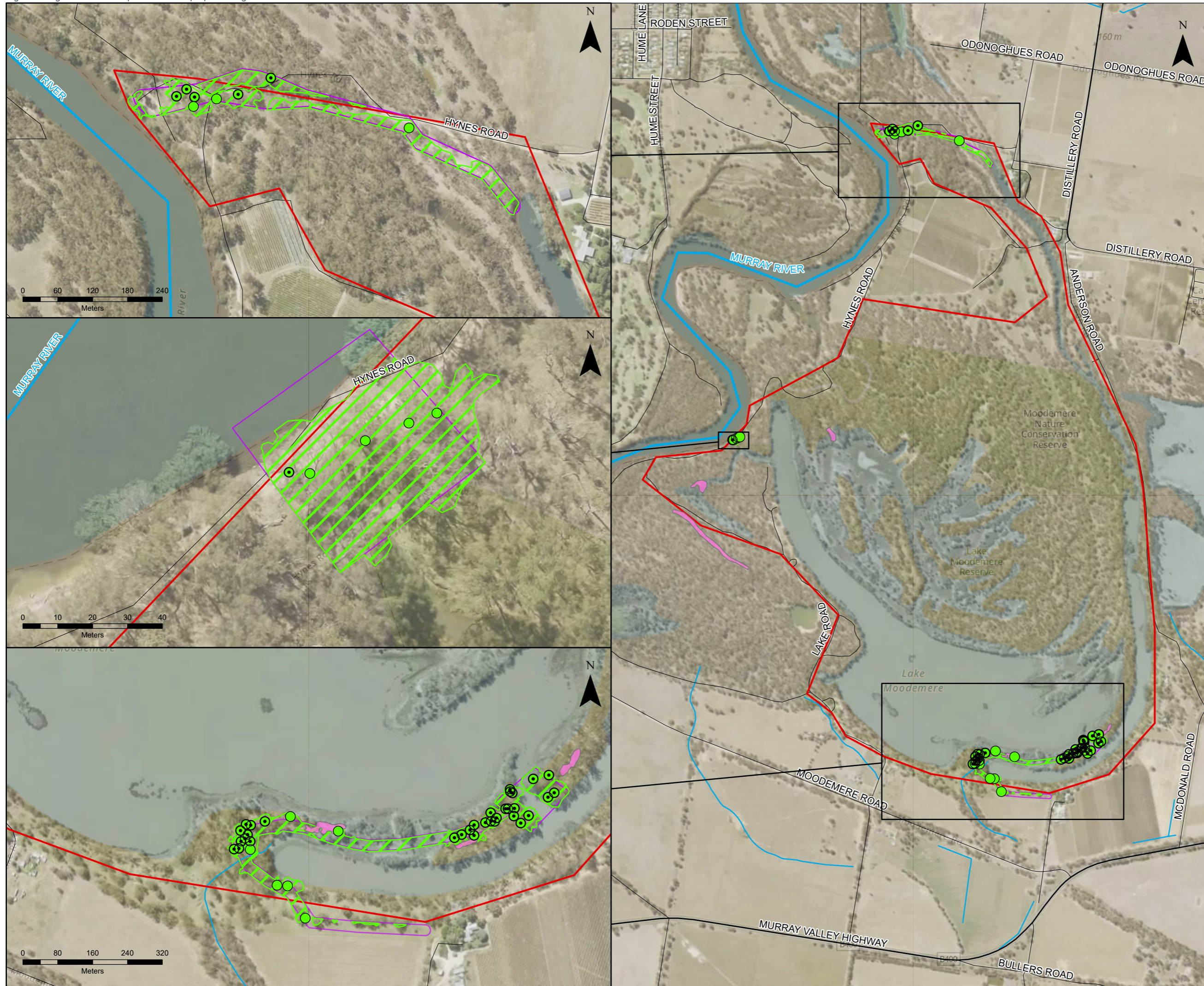
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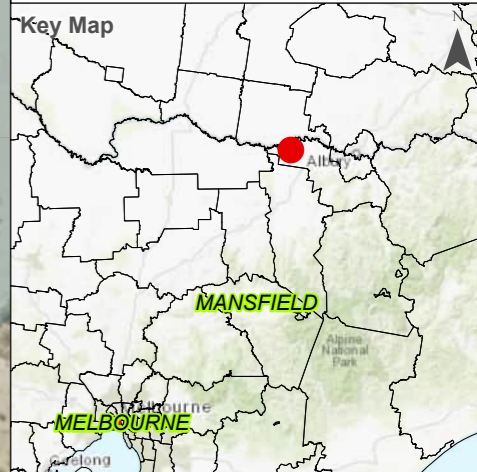
**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 2  
**FIGURE TITLE:** Ecological values within study site  
**CREATED BY:** JZ15939  
**DATE:** 29/07/2022  
**VERSION:** VERSION 1  
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Figure 3 Large trees within impact areas and proposed vegetation removal



- Legend**
- Study Site
  - Impact Footprint
  - Riverine Bittercress Patch
  - Large Trees Within Impact Area
  - Hollow Bearing Trees



**SOURCES:**

1. Roads and Waterways © DELWP 2020
2. Basemap © Nearmap, World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS Australia latest: World Topographic Map: Vicmap, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS World Topographic Map: Esri Community Maps Contributors, Vicmap, Geoscape, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS World Topographic Map: Esri Community Maps Contributors, Spatial Services, Vicmap, Geoscape, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS World Hillshade: Sources: Esri, Airbus DS, USGS, NGA, NASA, CGIAR, N Robinson, NCEAS, NLS, OS, NMA, Geodatasysteisen, Rijkswaterstaat, GSA, Geoland, FEMA, Intermap and the GIS user community

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**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 3  
**FIGURE TITLE:** Trees in proximity to impact footprints  
**CREATED BY:** JZ15939  
**DATE:** 29/07/2022  
**VERSION:** VERSION 1  
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### 4.1.1 Plant Functional Groups (PFGs)

Plant functional groups are assemblies of flora species that share common ecological, morphological and functional responses to inundation with each other. Plant functional groups are a useful classifier to determine vegetation responses to abiotic environmental factors such as water level. Table 3 below details the PFGs that were detected within the study site.

Table 2: Plant Functional Groups occurring or predicted to occur within the study site.

Plant functional group name	Description	Example species recorded within study site
Submerged	Submerged or floating plants that do not survive prolonged exposure of the wetland substrate (drying) and lack perpetuating rootstocks. Seed or spores may persist in soil during dry times.	<ul style="list-style-type: none"> <li>Ferny Azolla</li> <li>Thin Duckweed</li> </ul>
Amphibious fluctuation responders – Floating leaves	Species which germinate in flooded conditions, grow in both flooded and damp conditions, reproduce above the surface of the water, and which have floating leaves when inundated.  Aerial parts of plants survive exposure of the wetland substrate (drying) for sustained periods of time. Plants survive drying by dying back to rootstocks.	<ul style="list-style-type: none"> <li>Clovestrip</li> <li>Spiny Mudgrass</li> <li>Water Ribbons</li> </ul>
Amphibious fluctuation responders – Morphologically plastic	Species which germinate in flooded conditions, grow in both flooded and damp conditions, reproduce above the surface of the water, and which have morphological plasticity (e.g. heterophylly) in response to water-level variation.  Can actively grow when substrate exposed but still moist but may die back to rootstocks or seed during sustained dry periods.	<ul style="list-style-type: none"> <li>Water Milfoil</li> </ul>
Amphibious fluctuation tolerators – Low growing species	Species which germinate in damp or flooded conditions, which tolerate variation in water-level, which are low-growing and tolerate complete submersion when water-levels rise.  May dieback to rootstocks if unable to develop emergent growth during sustained inundation.	<ul style="list-style-type: none"> <li>Spreading Sneezeweed</li> <li>Narrow-leaf Nardoo</li> </ul>
Amphibious fluctuation tolerators – Emergent species	Species which germinate in damp or flooded conditions, which tolerate variation in water-level, and which grow with their basal portions under water and reproduce out of the water	<ul style="list-style-type: none"> <li>Common Spike-sedge</li> <li>Giant Rush</li> <li>Tall Spike-sedge</li> <li>Common Reed</li> <li>Star fruit</li> </ul>

Plant functional group name	Description	Example species recorded within study site
Terrestrial damp	<p>Species which germinate, grow and reproduce on saturated soil.</p> <p>Rootstocks intolerant of more than superficial inundation, but occurring in areas of good soil moisture conditions, which may be influenced by proximity to river and water seepage through soil.</p>	<ul style="list-style-type: none"> <li>• Lesser Joyweed</li> <li>• Creeping Knotweed</li> <li>• Water Pepper</li> <li>• Slender Dock</li> <li>• Tufted Burr-daisy</li> </ul>
Terrestrial dry	<p>Species which germinate, grow and reproduce where there is no surface water and the water table is below the soil surface.</p> <p>Flood intolerant</p>	<ul style="list-style-type: none"> <li>• Bristly Wallaby Grass</li> <li>• Straw Wallaby Grass</li> <li>• Rough Spear-grass</li> <li>• Common Wheat-grass</li> </ul>

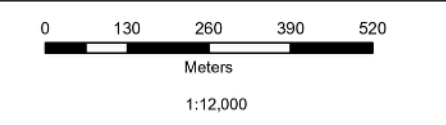
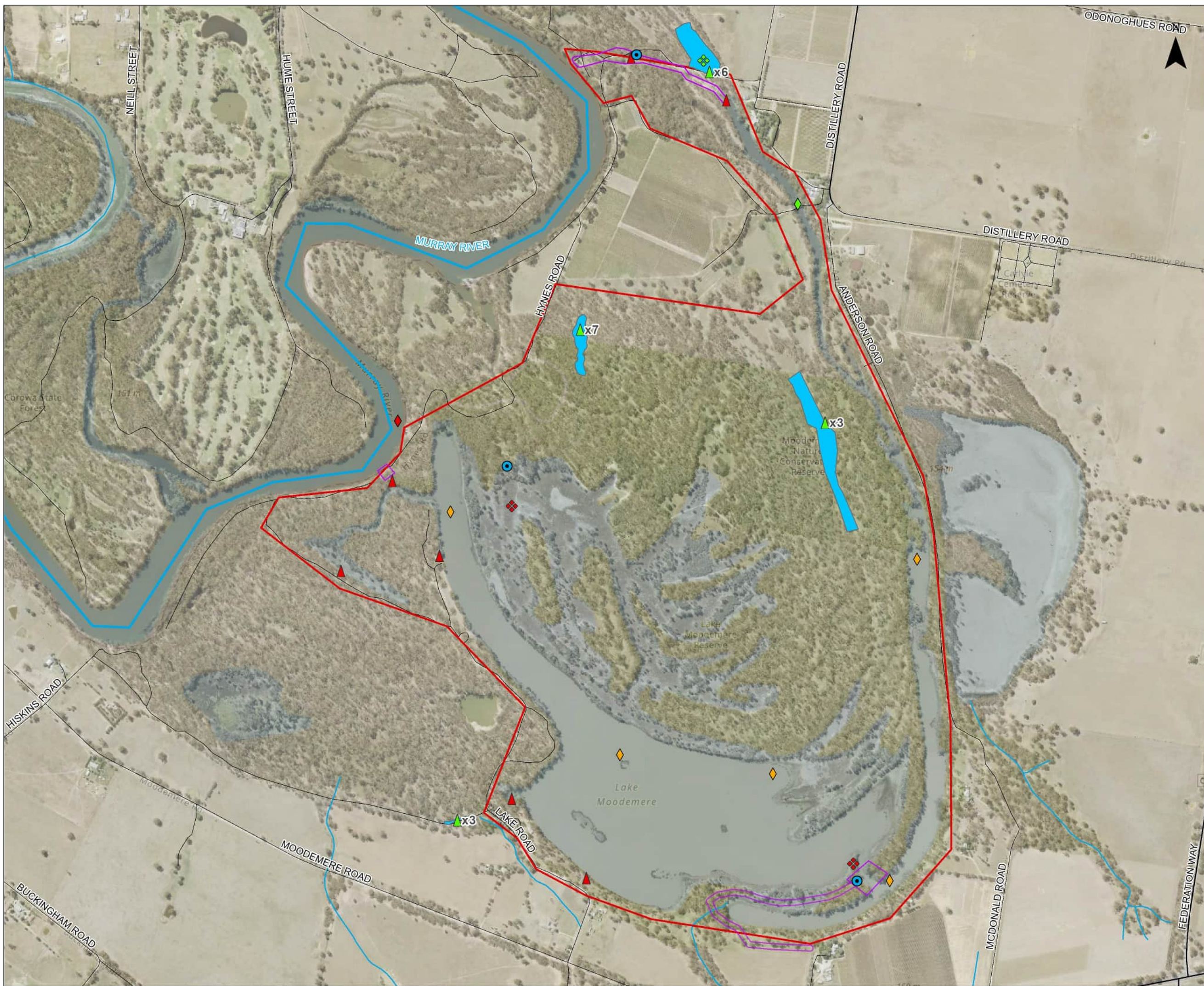
#### 4.1.2 Habitat Hectare assessment

A total of eight habitat zones were identified during the site assessment. The results of the Habitat Hectare assessment are provided in Table 3 below. Where a DELWP modelled wetland occurred outside areas of mapped native vegetation condition scores were obtained from modelled habitat.

EVC #	810	56	821	295	803	814	816	653	653
EVC Name	Floodway Pond Herbland	Floodplain Riparian Woodland	Tall Marsh	Riverine Grassy Woodland	Plains Woodland	Riverine Swamp Forest	Sedgy Riverine Forest	Aquatic herbland	Aquatic Herbland (invaded by <i>Juncus ingens</i> )
Habitat Zone #	FPH1	FRW2, FRW3	TM4	RGW13, RGW14	PW5	RSF6, RSF7	SRF8, SRF9	AH11	AH12
Bioregion <sup>5</sup>	VRIV	VRIV	VRIV	VRIV	VRIV	VRIV	VRIV	VRIV	VRIV
Large Trees	N/A	9	N/A	9	9	8	8	N/A	N/A
Canopy Cover	N/A	4	N/A	4	4	4	4	N/A	N/A
Understorey	15	10	5	15	10	15	10	20	10
Weeds	7	4	7	4	7	7	7	9	15
Recruitment	6	1	3	5	1	10	6	6	3
Organic Litter	3	3	3	3	3	3	3	5	5
Logs	2	2	N/A	0	0	5	5	N/A	N/A
<b>Subtotal (out of max. 75)</b>	<b>34</b>	<b>33</b>	<b>18</b>	<b>40</b>	<b>34</b>	<b>52</b>	<b>43</b>	<b>40</b>	<b>33</b>
<b>Score standardiser for treeless EVCs</b>	1.25	1	1.36	1	1	1	1	1.36	1.36
<b>Score after standardiser</b>	<b>42.5</b>	<b>33</b>	<b>24.48</b>	<b>40</b>	<b>34</b>	<b>52</b>	<b>43</b>	<b>55.76</b>	<b>44.88</b>
Patch Size	4	4	2	4	4	10	10	10	10
Distance to Core	5	5	5	4	4	5	5	5	5
Neighbourhood	6	6.8	6	6	2	6.8	6	6	6.8
<b>Subtotal (out of max. 25)</b>	<b>15</b>	<b>15.8</b>	<b>13</b>	<b>14</b>	<b>10</b>	<b>21.8</b>	<b>21</b>	<b>21</b>	<b>21.8</b>
<b>Final Habitat Score (total out of 100)</b>	<b>57.5</b>	<b>48.8</b>	<b>37.48</b>	<b>54</b>	<b>44</b>	<b>73.8</b>	<b>64</b>	<b>76.76</b>	<b>66.68</b>

Table 3: Habitat Hectare scores for EVCs within the study site

Figure 4: Targeted survey program



- Legend**
- Study Site
  - Impact Footprint
  - Platypus Targeted Survey**
    - ◆ Low levels of Platypus eDNA detected
    - ◆ No Platypus eDNA detected
    - ◆ Platypus eDNA detected
  - Yellow-bellied Sheathtail Bat Targeted Survey**
    - Songmeter
  - Sloane's Froglet Targeted Survey**
    - Habitat currently utilised by Sloane's Froglet
  - Call Playback**
    - ▲ Sloane's Froglet detected
    - ▲ Sloane's Froglet not detected
  - Songmeter**
    - ◆ Sloane's Froglet detected
    - ◆ Sloane's Froglet not detected



**SOURCES:**  
 1. Roads and Waterways © DELWP 2020  
 2. Basemap © Nearmap, World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS  
 Australia latest:  
 World Topographic Map: Esri Community Maps Contributors, Vicmap, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS  
 World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS

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**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 4  
**FIGURE TITLE:** Targeted survey program and results  
**CREATED BY:** JZ15939  
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### 4.1.3 Native Vegetation Impacts

Construction buffers have been applied to all proposed infrastructure to evaluate potential vegetation removal however are not an accurate representation of the vegetation removal that will be necessary for construction of key infrastructure. These construction buffers represent a 'worst case scenario'. As the project has yet to progress to the detailed design phase all values are indicative only.

Based on the project footprint (i.e. the concept design boundary), vegetation proposed for removal comprises 4.181 ha of native vegetation including impacts to 56 large trees (Figure 3).

The details of the impacted vegetation are provided below in Table 4 with current EnSym scenario test provided in Appendix C. Offset requirements for the Project are provided in Section 6.3.3.

Table 4: Native vegetation impacts.

Site	EVC	Area (ha)	Large tree count
New Pump Station and Pipeline	Floodplain Riparian Woodland (EVC 56)	0.028	0
	Sedgy Riverine Forest (EVC 816)	0.535	7
	Riverine Grassy Woodland (EVC 295)	0.524	1
	DELWP modelled wetland	0.045	0
<b>Subtotal</b>		<b>1.087</b>	<b>20</b>
Hells Gate Regulator	Sedgy Riverine Forest (EVC 816)	2.740	38
	Tall Marsh (EVC 821)	0.064	0
	Plains Woodland (EVC 803)	0.100	1
	DELWP modelled wetland	0.176	0
<b>Subtotal</b>		<b>2.908</b>	<b>46</b>
Existing Lake Moodemere Regulator	Floodplain Riparian Woodland (EVC 56)	0.064	2
	Sedgy Riverine Forest (EVC 816)	0.044	7
<b>Subtotal</b>		<b>0.108</b>	<b>9</b>
<b>Grand total</b>		<b>4.18</b>	<b>75</b>

### 4.1.4 FFG Act-listed protected flora

An FFG Act-permit is required for removal of protected flora. The following FFG protected species were recorded in or adjacent to the study site:

- Buloke (*Allocasuarina luehmannii*)<sup>6</sup>;
- Scaly Buttons (*Leptorhynchos squamatus* subsp. *squamatus*)<sup>6</sup>;
- Gold-dust Wattle (*Acacia acinacea*)<sup>6</sup>;
- Tufted Burr-daisy (*Calotis scapigera*)<sup>6</sup>;
- Cottony Fireweed (*Senecio quadridentatus*); and
- Fuzzy New Holland Daisy (*Vittadinia cuneata*).

<sup>6</sup> Species located outside impact footprint and highly unlikely to be directly impacted under current project designs

Approximate locations are shown in Figure 2.

#### 4.1.5 Noxious weeds

Thirteen noxious weeds listed under the *Catchment and Land Protection Act 1994* (CaLP Act) and/or as a Weed of National Significance (WONS) were identified within the study site (Table 5).

Table 5: Noxious weeds recorded within the study site

Scientific name	Common name	Listing <sup>7</sup>
<i>Ailanthus altissima</i>	Tree of Heaven	CaLP (C)
<i>Asparagus asparagoides</i>	Bridal Creeper	CaLP (R), WONS
<i>Cirsium vulgare</i>	Spear Thistle	CaLP (R)
<i>Echium plantagineum</i>	Paterson's Curse	CaLP (C)
<i>Hypericum perforatum</i> subsp. <i>veronense</i>	St John's Wort	CaLP (C)
<i>Lycium ferocissimum</i>	African Box-thorn	CaLP (R), WONS
<i>Marrubium vulgare</i>	Horehound	CaLP (C)
<i>Nassella neesiana</i>	Chilean Needle-grass	CaLP (R), WONS
<i>Opuntia stricta</i>	Common Prickly-pear	CaLP (R), WONS
<i>Rosa rubiginosa</i>	Sweet Briar	CaLP (C)
<i>Salix</i> sp.	Willow	CaLP (R), WONS
<i>Silybum marianum</i>	Variegated Thistle	CaLP (C)
<i>Tribulus terrestris</i>	Caltrop	CaLP (C)

<sup>7</sup> C = Listed as Regionally Controlled under the CaLP Act, R = Listed as Restricted under the CaLP Act within the North East CMA region.

## 4.2 Threatened flora

The VBA contains records for seven flora species listed under the FFG Act previously recorded in the study area (DELWP 2022a; DELWP 2022g; Appendix A). The PMST (DAWE 2022a) lists an additional seven EPBC Act-listed flora species with potential to occur due to species modelled distributions, for which there are no previous records within the study area. The locations of previous records for threatened flora within the study area are displayed in Figure 5.

### 4.2.1 EPBC Act-listed species

No EPBC listed flora species were recorded within the study site during the site assessment.

Two flora species listed as Vulnerable under the EPBC Act were previously recorded within the study area (Australian Ecosystems 2011), and seven species were identified by the PMST as having potential habitat within the study area (DAWE 2022a). Four of these species have suitable habitat within the study site and/or have been previously recorded:

- River Swamp Wallaby-grass (*Amphibromus fluitans*) – Listed as Vulnerable;
- Mueller Daisy (*Brachyscome muelleroides*) – Listed as Vulnerable;
- Winged Pepper-cress (*Lepidium monolocoides*) – Listed as Endangered; and
- Woodland Leek-orchid (*Prasophyllum* sp. af. *validum*). – Listed as Vulnerable.

Considerations of potential impacts on these species is provided below. Other EPBC Act-listed flora species are considered unlikely to occur within the study site due to absence of suitable habitat and/or lack of previous records within the study area.

#### River Swamp Wallaby-grass

This species is largely confined to permanent swamps, principally along the Murray River between Wodonga and Echuca, uncommon to rare in the south (e.g. Casterton, Moe, Yarram), probably due to historic drainage of wetlands. Flowers from November to March (VicFlora 2022).

This species was not observed during the site assessment however habitat is present in areas surrounding the margins of Lake Moodemere and the Northern marshes (EVC 653 and 810). River Swamp Wallaby-grass has been recorded within the study site previously (Australian Ecosystems 2011) however subsequent survey of these locations did not detect the species so it is possible that these populations have since become extinct.

Whilst River Swamp Wallaby-grass may be present in the broader study site It is considered unlikely that the species is present within the project area or would be impacted directly or indirectly by proposed works.

#### Mueller Daisy

Mueller Daisy is extremely rare in Victoria and restricted to the mid-Murray region in Victoria.

This species was not observed during the site assessment however habitat is present in areas surrounding the margins of Lake Moodemere and the Northern Marshes (EVCs 816 and 814). Mueller Daisy has been recorded in the study site previously within the Northern Marshes (Australian Ecosystems 2011) however it is unknown whether this population still persists. Survey timing was considered suboptimal for this species and further targeted surveys are recommended within the impact footprints of the proposed Hells Gate embankment and associated access track where suitable habitat is present to confirm the presence of Mueller Daisy prior to construction.

#### Winged Peppercress

This species mostly occurs on heavy soils near lakes and watercourses. Flowers mostly spring–summer. (VicFlora 2022). The nearest recorded sighting is 100 km west of the study site within Barmah National Park (DELWP 2022b). The species produces a distinctive fruiting body that persists after foliage is no longer present.

Winged Peppercress was not observed during the site assessment however suitable habitat is present in areas surrounding the margins of Lake Moodemere and within the Northern Marshes (EVCs 816 and 814). It is considered unlikely that the species is present within impact footprints or would be affected by proposed works as evidence of the species was not recorded within these areas.



### Woodland Leek-orchid

Woodland Leek-orchid occurs in open forest and woodland communities on stony and sandy soils the nearest recorded sighting being 17 km south east of the study site near Chiltern (VicFlora 2022, DELWP 2022a.). The species was not detected within the study site during the site assessment and no suitable habitat is present within impact footprints.

It is considered unlikely that the species is present within the project area or would be impacted by proposed works due to the lack of suitable habitat within impact footprints.

## 4.2.2 FFG Act-listed species

A total of seven FFG Act-listed threatened flora species have been previously recorded within the study area (DELWP 2022a; Figure 5). The following 5 species were detected within or adjacent to the study site and are discussed below:

- Riverina Bitter-cress (*Cardamine moirensis*) – endangered;
- Late-flower Flax-lily (*Dianella tarda*) – critically endangered;
- Straw Wallaby-grass (*Rytidosperma richardsonii*) – endangered;
- Buloke (*Allocasuarina luehmannii*) – vulnerable; and
- Buloke Mistletoe (*Amyema linophylla subsp. orientalis*) – critically endangered

### Riverina Bitter-cress

An annual herb with thin leaves and slender, leafy stems occurring in the north and west in seasonally wet areas. Flowers mostly winter-spring (VicFlora 2022).

This species was not recorded during the initial site assessment however was recorded incidentally during subsequent surveys. Multiple populations were recorded across the study site germinating on exposed saturated bare ground and are shown in Figure 2. Whilst further surveys would be required to accurately estimate the current population of Riverina Bitter-cress within the study site it is likely over 3000 plants based on the prevalence of the species where suitable habitat was present.

Approximately ten Riverina Bitter-cress plants were recorded within the impact footprint of the proposed Hells Gate construction access track however this number is likely to increase following further reduction in water level. Whilst current project timelines likely indicate that Riverina Bitter-cress plants will most likely not be visible during construction activities (the annual nature of the plant will likely mean that no living plant material will remain by summer when construction is proposed to begin) there is the potential for impacts to Riverine Bitter-cress seed banks within the proposed Hells Gate and Sunday Creek pipeline alignment. Provided topsoil removed during construction is not transported offsite and is returned to its original location then it is likely that the species will be able to recolonise these areas.

### Late-flower Flax-lily

Occurs in open often grassy forests of foothills and plains of north-eastern and north-central Victoria (e.g. Mansfield, Euroa, Chiltern, Nagambie, Nathalia areas). Often on lower slopes or near gullies and watercourses, usually on clay or clay-loam soils (VicFlora 2022). This species was previously recorded within the study site (Australian Ecosystems 2011).

Seven plants of this species were detected approximately 11 m north and 25 m south of the proposed pipeline construction buffer alignment (see Figure 2) during the site assessment. Due to the distance from proposed impact areas (that are already buffers of proposed infrastructure) it is unlikely that the project will have any impact on this species. If removal or impacts are identified after detailed design then an FFG act permit will be required for removal any Late-flower Flax-lily plant. Further detail should be sought from DELWP regarding permit conditions and any additional mitigation measures that may be necessary regarding the removal of Late-flowered Flax-lily from the study site.

### Straw Wallaby-grass

Straw Wallaby-grass has been recorded from grassy woodlands in a few localities in north-east Victoria (e.g. Barnawartha, Dookie, Rutherglen, Springhurst and Yarrawonga) (VicFlora 2022). Due to the difficulty in identifying *Rytidosperma* species in the field during the site assessment samples were taken of all *Rytidosperma* species present on site and an experienced SMEC botanist later confirmed the identification of Straw Wallaby-grass along with three other non-threatened species.

Approximately five Straw Wallaby-grass plants were detected approximately 30 m south of the proposed pipeline alignment (see Figure 2) during the site assessment. Due to the distance from proposed impact areas (that are already buffers of proposed infrastructure) it is unlikely that the project will have any impact on this species. If removal is required, an FFG Act-permit will be required for its removal. Further liaison with DELWP will also be required to understand permit requirements and any additional mitigation measures needed for its removal.

### Buloke

Occurring predominately in the north west of the state usually growing in woodland with *Eucalyptus microcarpa*, on non-calcareous soils (VicFlora 2022).

Multiple Buloke occurred fringing the study site on the raised banks surrounding Lake Moodemere and Sunday Creek. It is unclear whether these are remnant stands or have been planted however due to their location on top of surrounding ridges, at considerable distance (100-200 m) from impact footprints it is unlikely that the proposed works will impact the species or require their removal. As such an FFG Act-permit is unlikely to be required.

### Buloke Mistletoe

Buloke Mistletoe is a parasitic mistletoe that uses the Buloke as a host exclusively. Widespread in western Victoria but scarce due to depletion of its host species (VicFlora 2022).

This species was detected adjacent to the study site on the raised banks overlooking Sunday Creek and Lake Moodemere. It is considered unlikely that Buloke Mistletoe will be impacted as part of the proposed works for the project and as such an FFG permit for the removal of this species is unlikely to be required.

The following FFG Act-listed species were determined to have suitable habitat within the study site but were not recorded during the site assessment:

- Waterbush (*Myoporum montanum*) – endangered;
- Water Shield (*Brasenia schreberi*) – critically endangered;
- Riverine Bitter-cress (*Cardamine moirensis*) – endangered;
- Wavy Marshwort (*Nymphoides crenata*) – endangered; and
- Hydrilla (*Hydrilla verticillata*) – vulnerable.

### Waterbush

Scattered across northern Victoria where uncommon to rather rare. Mostly in mallee and riparian woodland communities but also in rocky gorges (VicFlora 2022).

This species was not detected during the site assessment. Previous records for Waterbush exist approximately 6km west of the study site (DELWP 2022). Whilst suitable habitat (EVCs 803, 295 and 56) is present within the study site it is unlikely that the species will be impacted by the proposed works due to it not being detected within or adjacent the project impact footprints.

### Water Shield

Known in recent times only from shallow lagoons of the Goulburn River and tributaries near Nagambie, but there locally common. Early records from the lower Ovens and Mitta Mitta Rivers suggest a former wider range. Plants need to remain submerged (except for floating leaves and flowers) in freshwater year-round.

This species was not recorded during the site assessment and has not previously been recorded within the study site. Whilst habitat is present in areas of shallow water along the margins of Lake Moodemere and within the Northern Marshes (EVCs 810 and 653) that could support Water Shield within the study site it is considered unlikely that the species will be impacted by the proposed works due to the distance of suitable habitat from impact areas.

### Wavy Marshwort

Occurs in fresh, still to slow-flowing water to 1.5 m deep in swamps, lagoons, irrigation channels and streams, also frequent in temporarily inundated depressions. Rare in all regions except RIV (and perhaps now extinct in MID, PROM and WIM from where there have been no contemporary collections) (VicFlora 2022).

This species was not recorded during the site assessment however has been recorded within the study site previously (DELWP 2022a) (Australian Ecosystems 2011). Suitable habitat is present in areas surrounding the margins of Lake Moodemere and the Northern Marshes (EVCs 810 and 653). Wavy Marshwort is unlikely to be impacted by the proposed works due to the lack of suitable habitat within impact areas.

### Hydrilla

Recorded from scattered localities along the Murray River between Yarrawonga and Mildura, and possibly occurring further downstream (Aston 1973). In still to slow-flowing freshwater of lakes and streams, to a depth of at least 3.5 m. Male flowers recorded in May (VicFlora 2022).

This species was not recorded during the site assessment however has been recorded within the study site previously (DELWP 2022a) (Australian Ecosystems 2011). Suitable habitat is present within the study site in areas of open water within Lake Moodemere and the Northern Marshes. Hydrilla is unlikely to be impacted by the proposed works due to the lack of suitable habitat within the impact areas.

## 4.2.3 Index of Wetland Condition assessment

The wetland health of Lake Moodemere and Northern Marshes was assessed using the Index of Wetland Condition (IWC) method developed by DELWP in order to gauge the biological, physical and chemical components of the wetland ecosystem and their interactions (DELWP 2020d). At the time of assessment, the study site was determined to be in a maximum state of inundation.

The Overall IWC score was determined to be 7.2/10 indicating that the study site was in good condition. Water properties and physical form were both in excellent condition and wetland catchment, soils and biota were in good condition. Hydrology of the wetland was determined to be very poor as a result of the historical alterations and current water regime.

Table 5 below summarises the findings of the IWC assessment.

Table 6: IWC sub-index scores.

IWC sub-index	Score	Condition
Wetland catchment	16/20	Good
Physical form	19.3/20	Excellent
Hydrology	5/20	Very poor
Water properties	17/20	Excellent
Soils	15/20	Good
Biota	15.6/20	Good
<b>Overall IWC</b>	<b>7.2/10</b>	<b>Good</b>

### 4.2.3.1 Wetland Catchment

The wetland catchment sub-index is a measure of both the native vegetation buffer surrounding the maximum inundation level of the wetland and the land use within 250 m of the wetland. Over 95% of the Lake Moodemere, Northern Marshes and Sunday Creek complex has a buffer of over 50 m of native vegetation, most of which is made up of EVCs 803, 56 and 295. Agriculture in the form of livestock pastures and viticulture were present as the main land use identified within and adjacent to the study site. The wetland catchment sub-index scored a 16/20 indicating that it is in good condition.

#### **4.2.3.2 Physical Form**

The physical form sub-index measures changes to the extent of the wetland relative to its historic condition. Whilst some excavation has taken place, namely within the Hells Gate channel and in the channel leading to the existing Lake Moodemere regulator, there has been little change to the bathymetry of Lake Moodemere, the Northern marshes or Sunday Creek. The sub-index score for physical form was determined to be 19.3/20 indicating excellent condition.

#### **4.2.3.3 Hydrology**

The hydrology sub-index is a measure of changes to the water regime of the wetland specifically relating to changes in the frequency, timing and duration of inundation events. As Lake Moodemere has been artificially filled by controlled inflows or pumping from the Murray River and artificial drawdown of the lake system from Sunday Creek continues for irrigation purposes the wetland is considered to be significantly altered from its natural state. The sub-index score for hydrology was determined to be 5 due to changes in timing and duration and water regime category indicating very poor condition.

#### **4.2.3.4 Water Properties**

The water properties sub-index is a measure of nutrient enrichment and salinity changes within the wetland. Whilst no algal blooms were recorded and water quality within the system was generally good evidence of livestock grazing and the probable run-off of nutrients associated with livestock and nearby viticulture indicated that low nutrient enrichment was occurring within the northern reaches of Northern Marshes. The water properties sub-index scored a 17/20 indicating that it is in excellent condition.

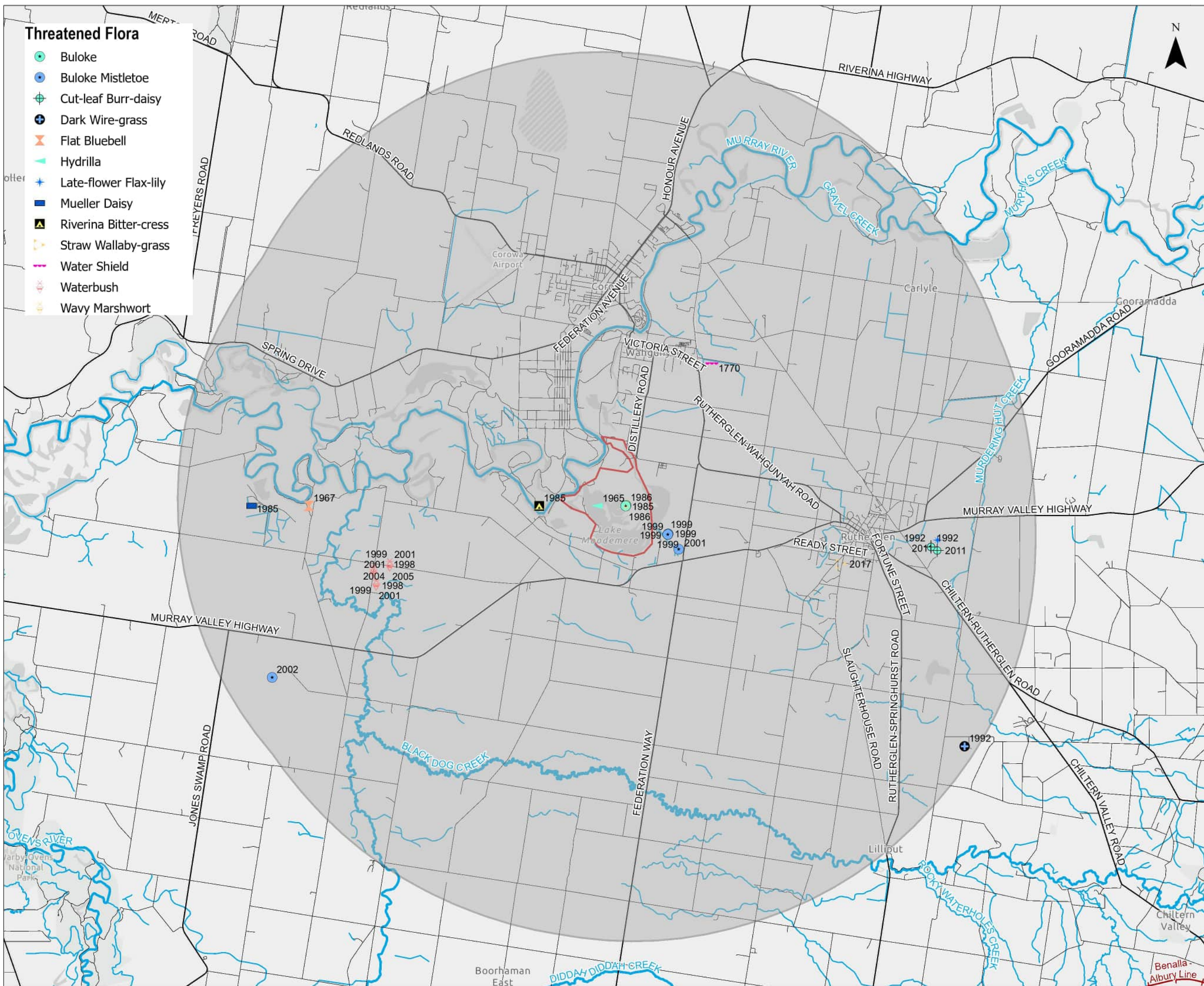
#### **4.2.3.5 Soils**

The soils sub-index assesses disturbance of wetland soils. Evidence of carp muddling, pugging by livestock and vehicle tracks were present throughout the wetland however these were only observed in low density and as isolated occurrences. The soils sub-index scored a 15/20 indicating that it is in good condition.

#### **4.2.3.6 Biota**

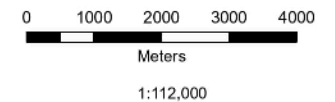
The biota sub-index is a measure of the quality of wetland EVCs present within or adjacent to the wetland particularly in relation to the presence or absence of critical lifeforms, weed cover, indications of disturbance and vegetation structure and health. With the exception of Floodplain Riparian Woodland and Riverine Grassy Woodland which were determined to be of poor quality due to the modification of critical lifeform groups and significant disturbance to the understorey due to weed incursion or grazing pressures all EVCs scored higher than 15/20 indicating they were in good to excellent condition. The biota sub-index total was determined to be 15.6/20 indicating good condition.

Figure 5: Threatened flora species previously recorded within the study area



**Threatened Flora**

- Buloke
- Buloke Mistletoe
- ⊕ Cut-leaf Burr-daisy
- ⊕ Dark Wire-grass
- ✕ Flat Bluebell
- ▲ Hydrilla
- + Late-flower Flax-lily
- Mueller Daisy
- ▲ Riverina Bitter-cress
- ✕ Straw Wallaby-grass
- ✕ Water Shield
- ✕ Waterbush
- Wavy Marshwort



**Legend**

- Study Site
- Major Road
- Minor Road
- River
- Stream
- + Rail

**Key Map**



**SOURCES:**  
 1. Roads and Waterways © DELWP 2020  
 2. Basemap © Nearmap, World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS  
 Light Gray Reference: Vicmap, Esri, HERE, Garmin, Foursquare, METI/ NASA, USGS  
 Light Gray Base: Vicmap, Esri, HERE, Garmin, Foursquare, METI/ NASA, USGS

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**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 5  
**FIGURE TITLE:** Threatened Flora (VBA Records)  
**CREATED BY:** JZ15939  
**DATE:** 29/07/2022  
**VERSION:** VERSION 1  
**PAGE SIZE:** A3

## 4.3 Threatened floristic communities

### 4.3.1 EPBC Act

A search of the PMST database (DAWE 2022a) identified five threatened ecological communities listed under the EPBC Act predicted or known to occur within the study area:

- Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions – endangered;
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland – critically endangered;
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia – endangered;
- Natural Grasslands of the Murray Valley Plains – critically endangered; and
- Weeping Myall Woodlands – endangered.

Of these listed communities predicted to occur within the study site one vegetation patch (EVC 803) was present that was synonymous with Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia.

#### 4.3.1.1 Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grassland of South-eastern Australia

This community occurs on the lower slopes and plains of eastern Australia, inland of the Great Dividing Range. It typically occurs on flat to undulating plains, low slopes and rises. It often occupies soils derived from alluvial or colluvial materials but can occur on a range of substrates. The structure of the community is a woodland to open forest with a Grey Box-dominated canopy. The understorey is dense to sparse and the ground layer is dominated by perennial and annual forbs and graminoids (DEWHA 2010). A patch of Grey Box dominated Plains Woodland (EVC 803) vegetation recorded within the study site was assessed against the key diagnostic criteria and condition thresholds listed below as follows:

##### Key diagnostic characteristics

- The ecological community occurs on low slopes and plains – yes;
- The vegetation structure of the ecological community is typically a woodland to open forest – yes;
- The tree canopy is dominated by Grey Box – yes;
- The mid layer comprises shrubs of variable composition and cover – yes
- The ground layer is highly variable, from absent to grassy to forb-rich – yes
- Derived grasslands may have absent canopy crown cover, but the native ground layer comprises  $\geq 50\%$  native vegetation cover – yes.

##### Condition thresholds

The condition thresholds of this community are split depending if the patch size is  $>2$  ha or  $<2$  ha.

For all patches, condition thresholds are:

- Minimum patch size of 0.5 ha -yes;
- The canopy layer contains Grey Box as the dominant or co-dominant species – yes; and
- The vegetation covers of non-grass weed species in the ground layer is  $<30\%$  at any time of the year – yes.

As the patch in question was  $<2$  ha it was assessed as per below:

- At least 50% of the vegetation cover in the ground layer comprises perennial native species at any time of year – yes; and
- 8 or more perennial native species are present in the mid and ground layers at any time of year – yes.

- As the condition thresholds have been met the EPBC listed Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia community is determined as present within the study site.
- Patches of Plains Woodland adjacent to the proposed Hells Gate embankment construction access track are not considered to be synonymous with the EPBC Act listed community as Grey Box was not present as the dominant canopy species.
- Further surveys should be undertaken to the south of Lake Moodemere in areas of suitable habitat to determine the full extent of this community. This community will not be impacted by the proposed works due to the distance of the community from the project site provided that current designs are not significantly altered.

#### **4.3.2 FFG Act**

The vegetation recorded within the study site is not synonymous with any FFG Act-listed threatened floristic communities.

## 4.4 Fauna

### 4.4.1 Species summary

The VBA database contains previous records of 227 fauna species from within the study area (DELWP 2022a). These records include 210 native species and 17 introduced species.

During the site assessment a total of 165 fauna species were observed comprising 140 native and 15 introduced species (SMEC 2022), (Austral 2022). A list of the species recorded during the site assessment are detailed in Appendix B.

### 4.4.2 Established pest animals

Two pest animals listed under the CaLP Act were recorded during the site assessment: European Rabbit (*Oryctolagus cuniculus*) and Red Fox (*Vulpes Vulpes*).

Fox predation of turtle nests was observed within the Northern Marshes, Sunday Creek and the raised terraces surrounding Lake Moodemere.

### 4.4.3 Fauna habitats and surrounding landscape

Five broad habitat types were identified within the study site and surrounding landscape including eucalypt woodland, riparian woodland, open water, closed swamp and aquatic herb land. Habitat attributes and the fauna species identified during the site assessment are summarised below in Table 7.



Table 7: Fauna habitat recorded within the study site and study area (SMEC 2021).

Habitat type	Description
Eucalypt woodland	<p>Eucalypt woodland habitat was synonymous with Sedgy Riverine Forest, Plains Woodland and Riverine Grassy Woodland within the study site. This habitat type was characterised by a canopy of River Red Gum (<i>Eucalyptus camaldulensis</i>) with a grassy or sedgy understorey with scattered rushes and forbs. There was generally a high cover of organic litter and woody debris, providing ideal habitat for reptiles with both Red Bellied Black Snake (<i>Pseudechis porphyriacus</i>) and Brown Snake (<i>Pseudonaja textilis</i>) recorded. Small hollows were also abundant within this habitat type providing breeding habitat for hollow-dependant species such as lorikeets, parrots, possums and microbats.</p> <p>Multiple active nests were observed within the canopy of larger River Red Gums particularly along the proposed Hells Gate regulator access track. Nesting species observed included: Yellow Billed Spoonbill (<i>Platalea flavipes</i>), Little Black Cormorant (<i>Phalacrocorax sulcirostris</i>), Little Pied Cormorant (<i>Microcarbo melanoleucos</i>) and Australasian Darter (<i>Anhinga novaehollandiae</i>)</p> <p>Species identified within eucalypt woodland habitat included: Diamond Firetail (<i>Stagonopleura guttata</i>), Brown Treecreeper (<i>Climacteris picumnus</i>), Little Corella (<i>Cacatua sanguinea</i>), Oriental Dollarbird (<i>Eurystomus orientalis</i>), Rainbow Bee-eater (<i>Merops ornatus</i>), Yellow Rosella (<i>Platycercus elegans flaveolus</i>), Laughing Kookaburra (<i>Dacelo novaeguineae</i>) and Mistletoebird (<i>Dicaeum hirundinaceum</i>).</p> <p>Elevated areas of eucalypt woodland adjacent to water provides nesting habitat for Murray River Turtle (<i>Emydura macquarii</i>) and Broad Shelled Turtle (<i>Chelodina expansa</i>) however predation of nests was recorded within the Northern Marshes during the assessment (Austral 2022).</p>

Habitat type	Description
Riparian woodland and Murray River	<p>Riparian woodland is synonymous with Floodplain Riparian Woodland (EVC 56) and was recorded along the Murray River and Sunday Creek and an unnamed tributary. This habitat is dominated by a canopy of River Red Gum with an occasional midstorey species present such as River Bottle Brush (<i>Callistemon sieberi</i>) or Wattle (<i>A. implexa</i> and <i>A. dealbata</i>). The understorey was variable but commonly contained Common Tussock Grass (<i>Poa labillardierei</i>) or Poong'ort (<i>Carex tereticaulis</i>) along with scattered rushes and forbs. River Red Gum in the area were abundant with hollows providing breeding habitat for hollow-dependant species such as lorikeets, parrots, possums and microbats.</p> <p>Species composition was similar to that of the above eucalypt woodland and provided similar foraging and nesting opportunities.</p> <p>Aquatic environments within the Murray River adjacent to the Riparian Woodland support large bodied fish species such as Murray Cod (<i>Maccullochella peelii</i>) and Trout Cod (<i>Maccullochella macquariensis</i>) which were not recorded within Lake Moodemere or Sunday Creek.</p>

Habitat type	Description
Open water wetland and Lake	<p>Open bodies of water were associated with Lake Moodemere, Sunday Creek and the open areas of the Northern Marshes (EVC 653). The margins of these areas were often vegetated with a dense stand of Giant Rush (<i>Juncus ingens</i>), Common Reed (<i>Phragmites australis</i>) in areas of Tall Marsh (EVC 821) or occasionally a floating mat of Spiny Mudgrass (<i>Pseudoraphis spinescens</i>). Sites where inundation showed signs of being less permanent were often dominated by smaller rush species such as Hollow Rush (<i>Juncus amabilis</i>).</p> <p>Bodies of open water varied in depth from 2 m to 0.3 m and provided foraging habitat for wetland bird species such as Musk Duck (<i>Biziura lobata</i>), Pied Cormorant (<i>Phalacrocorax varius</i>), Pacific Black Duck, Australasian Darter (<i>Anhinga novaehollandiae</i>), Azure Kingfisher (<i>Ceyx azureus</i>) and Sacred Kingfisher (<i>Todiramphus sanctus</i>). Habitat containing dense stands of vegetation provides nesting and foraging habitat for species such as Australasian Swamphen (<i>Porphyrio melanotus</i>), Little Grassbird (<i>Poodytes gramineus</i>) and Nankeen Night-Heron (<i>Nycticorax caledonicus</i>) of which juveniles were recorded within the study site indicating a breeding population.</p>

Habitat type	Description
Closed Swamp	<p>Closed swamp habitat was synonymous with Riverine Swamp Forest (EVC 814) within the study site. This habitat type was characterised by a River Red Gum canopy to 25 m tall overlying either blackwater often covered by Ferny Azolla (<i>Azolla pinnata</i>) or Duckweed (<i>Spirodela punctata</i>) or a sparse ground story containing Hollow Rush (<i>Juncus amabilis</i>), Poong'ort (<i>Carex tereticaulis</i>) and Knob Sedge (<i>Juncus inversa</i>) with occasional small forbs such as Sneezeweed (<i>Centipeda minima</i> and <i>C. cunninghamii</i>) and Kidney Weed (<i>Dichondra repens</i>). Stands of Giant Rush (<i>Juncus ingens</i>) and thickets of River Red Gum seedlings were present in some areas.</p> <p>Shallow water provides foraging habitat for wetland bird species whilst canopy cover provides protection from predatory bird species such as Brown Goshawk (<i>Accipiter fasciatus</i>) and Colored Sparrowhawk (<i>Accipiter cirrocephalus</i>) which were active over more open areas within the study site. Turtle species such as Murray River Turtle (<i>Emydura macquarii</i>) and Broad Shelled Turtle (<i>Chelodina expansa</i>) recorded within Lake Moodemere are likely to utilise this habitat for both foraging and nesting.</p> <p>Species recorded within this habitat type included Azure Kingfisher (<i>Ceyx azureus</i>), Australian Wood Duck (<i>Chenonetta jubata</i>) and Rainbow Bee-eater (<i>Merops ornatus</i>).</p>

Habitat type	Description
Aquatic Herbland and mudflats	<p>Aquatic Herbland (EVC 653) and Floodway Pond Herbland (EVC 810) were recorded within the study site and was dominated by a layer of native graminoids and aquatic plants in shallow water (&lt; 30 cm).</p> <p>Mudflats were absent at time of the site assessment but are expected to form with a reduction in water levels along the margins of Lake Moodemere and within the Northern Marshes.</p> <p>Low lying aquatic vegetation provides breeding habitat for frogs, invertebrates and fish and thus ideal foraging habitat for wading wetland bird species.</p> <p>Species recorded within the study site that would utilise this habitat for foraging include: Australasian Swamphen (<i>Porphyrio melanotus</i>), Australian White Ibis (<i>Threskiornis Molucca</i>), Masked Lapwing (<i>Vanellus miles</i>), Nankeen Night-Heron (<i>Nycticorax caledonicus</i>), Straw-necked Ibis (<i>Threskiornis spinicollis</i>) and Yellow-billed Spoonbill (<i>Platalea flavipes</i>).</p>

Habitat type	Description
<p>Modified vegetation / ornamental plantings within the broader area (SMEC 2021)</p>	<p>Planted species such as Sugar Gum (<i>Eucalyptus cladocalyx</i>) and Radiata Pine (<i>Pinus radiata</i>) on private land surrounding the study site offer foraging habitat for lorikeets, parrots and possums.</p> <p>Species identified in this habitat type during the field assessment included Red Wattlebird (<i>Anthochaera carunculata</i>), Australian Magpie (<i>Gymnorhina tibicen</i>), Galah (<i>Eolophus roseicapilla</i>) and Magpie-lark (<i>Grallina cyanoleuca</i>).</p>

## 4.5 Threatened fauna

Of the native species previously recorded within the study area on the VBA database (DELWP 2022a), 31 are considered to be of conservation significance and are listed under the EPBC Act and/or the FFG Act (DELWP 2022g). The PMST lists an additional 18 EPBC Act-listed fauna species with potential to occur due to species modelled distributions, for which there are currently no records within the study area (DAWE 2022a). The locations of previous records for fauna within the study area are provided in Figure 6. The likelihood of occurrence of threatened fauna species is provided in Appendix B.

### 4.5.1 EPBC Act-listed species

No EPBC listed fauna were recorded during the site assessment.

A total of five EPBC Act-listed species have been previously recorded (or are predicted to occur) within the study area (DELWP 2022a) (Australian Ecosystems 2018). Of the EPBC Act-listed fauna species which have been recorded (or are predicted to occur), the following nine species are considered to potentially occur in habitats within or in proximity to the study site:

- Regent Honeyeater (*Anthochaera phrygia*) – Critically Endangered;
- Flat-headed Galaxias (*Galaxias rostratus*) Critically Endangered
- Curlew Sandpiper (*Calidris ferruginea*) – Critically Endangered
- Australasian Bittern (*Botaurus poiciloptilus*) – Endangered
- Australian Painted Snipe (*Rostratula australis*) - Endangered
- Sloane's Froglet (*Crinia sloanei*) - Endangered
- Trout Cod (*Maccullochella macquariensis*) – Endangered
- White-throated Needletail (*Hirundapus caudacutus*) – Vulnerable.
- Murray Cod (*Maccullochella peelii*) – Vulnerable

One EPBC Act listed fauna species, Sloane's Froglet, was recorded during the targeted survey program following the initial site assessment.

Considerations of potential impacts on these species is provided below. Other EPBC Act-listed fauna species are considered unlikely to occur within the study site due to absence of suitable habitat and/or lack of previous records within the study area.

#### 4.5.1.1 Sloane's Froglet

Four separate populations of Sloane's Froglet were detected across the study site during targeted surveys undertaken for the species (Figure. 4). No individuals were recorded within impact areas however one population occurred approximately 20 m north of the eastern extent of the proposed Sunday Creek pipeline construction buffer.

Within the study site Sloane's Froglet was observed utilising ephemeral wetland habitats with a high percentage cover of small – medium graminoids (often a mix of native species such as Silky Brown-top and Common Spike-sedge and introduced species such as Paspalum) often in degraded habitats such as 4WD tracks. The species was not observed on the margins of Lake Moodemere or within the Northern marshes and no habitat was present within impact areas at the time of the targeted surveys (primarily due to habitat degradation by livestock).

Sloane's Froglet occurs in temporary and permanent waterbodies including oxbows off creeks and rivers, farm dams, large and small natural wetlands, constructed frog pond and temporary puddles (Knight 2013). They prefer wetlands which contain riparian and aquatic vegetation with grasses and reeds which reach a medium height and have small stem diameters (i.e. Common Spike-rush [*Eleocharis acuta*]). Waterbodies with this vegetation are important for egg-laying as they will attach eggs to vegetation rather than as a frothy mass on the surface of the water like some other frogs. Sloane's Froglet is also highly mobile and requires connectivity between breeding and refuge sites in order to move across the landscape (which they typically do following

rainfall). They are known to use roadside drains, table drains, irrigation channels and inundated grasslands as movement corridors (Knight 2013).

A significant impact assessment has been undertaken for this species (Appendix B) however no significant impact has been identified as potentially occurring as a result of the project. No habitat observed being utilised by Sloane's Froglet within the study site is likely to be dependent on the current water regime.

#### **4.5.1.1 Trout Cod**

Trout Cod are known to occur in the Murray River and tributaries however aquatic surveys undertaken in January 2022 failed to detect the species within Sunday Creek or Lake Moodemere (Austral 2022).

It is expected that flood events may introduce the species to Sunday Creek and Lake Moodemere but the species was not recorded in recent aquatic surveys (Austral 2022).

Construction impacts from the proposed Sunday Creek pump station and works associated with upgrades to the existing Lake Moodemere regulator have the potential to impact the species. Such impacts to the species were assessed within a significant impact assessment (Appendix B), and it was concluded that a significant impact to the species is unlikely given that impacts to breeding and foraging habitat are likely to be minimal and that the species is not likely present within Lake Moodemere or Sunday Creek.

A significant impact assessment has been undertaken for this species (Appendix B) however no significant impact has been identified as potentially occurring as a result of the project.

A project specific CEMP should be developed to mitigate and avoid direct and downstream impacts from the project works.

#### **4.5.1.1 Murray Cod**

Murray Cod are known to occur in the Murray River and tributaries however aquatic surveys undertaken in January 2022 failed to detect the species within Sunday Creek or Lake Moodemere (Austral 2022). It is expected that flood events may introduce the species to Sunday Creek and Lake Moodemere but their persistence within the study site was not recorded in recent surveys (Austral 2022).

Construction impacts from the proposed Sunday Creek pump station and works associated with upgrades to the existing Lake Moodemere regulator have the potential to impact the species and as such a significant impact assessment has been completed (Appendix B) however it was determined that it is unlikely that the proposed works will result in a significant impact to the species due to the limited impacts to habitat. A project specific CEMP should be developed to mitigate and avoid direct and downstream impacts from the project works.

A significant impact assessment has been undertaken for this species (Appendix B) however no significant impact has been identified as potentially occurring as a result of the project.

#### **4.5.1.2 Regent Honeyeater**

There are previous breeding records for Regent Honeyeater within 4 km of the study site near Corowa (Dan Weller personal communication) and previous records in Rutherglen from 2014 (Figure 6; DELWP 2022a) (Ebird 2022). This species is heavily reliant on large, mature eucalypt species which are heavy nectar producers and are predominantly associated with Box-Ironbark habitat types (Saunders and Tzaros 2011; DoE 2016). For example, Birdlife International has identified the Warby-Chiltern Box Ironbark Region as an Important Bird Area (ALA 2019).

Preferred foraging habitat is located within the study site primarily in areas of Plains Woodland (EVC 803) where Grey Box (*Eucalyptus microcarpa*) is the dominant canopy species, however this habitat occurs outside the impact footprint. Regent Honeyeater may also utilise mature River Red Gums (*Eucalyptus camaldulensis*) on occasion as a food source however this is not a preferred foraging tree for the species.

The project is unlikely to have a significant impact on Regent Honeyeater due to extensive alternative foraging habitat of high quality occurring outside the impact footprint. Future planning of the project should avoid removal of large mature trees supporting key foraging resources when in flower.



No impacts to this species are expected to occur as a result of the construction or operational phase of the project, and therefore a significant impact assessment has not been undertaken.

#### **4.5.1.3 Flat-headed Galaxias**

There have been no recent records of Flat-Headed Galaxias within the study area however they have been known to occur downstream of the study site in Black Dog Creek and the Ovens River historically (DELWP 2022).

The ecology of the Flat-headed Galaxia is poorly understood however was historically collected from slow moving waters of creeks, lakes and billabongs of the southern Murray-Darling Basin (DELWP 2022a) (MDBA 2022).

Whilst habitat exists within the study site that may support Flat-headed Galaxia, aquatic surveys undertaken in January did not detect the species and as such it is unlikely that the species is present within the study site (Austral 2022).

No impacts to this species are expected to occur as a result of the construction or operational phase of the project, and therefore a significant impact assessment has not been undertaken.

#### **4.5.1.4 White-throated Needletail**

White-throated Needletail was not detected during the site assessment however the species has been previously recorded within the study area with the most recent sighting being 2014 (DELWP 2022a) (eBird 2022). The White-throated Needletail is a highly mobile species and often tracks low pressure systems across the landscape to forage on the wing in updraughts and the convergence of opposing wind currents. It forages anywhere between 'cloud level' (up to 1000 m) to 'ground level' and readily forms mixed feeding flocks with other aerial insectivores (DAWE 2022i).

On very rare occasions, White-throated Needletail have been observed to roost in hollows or the dense canopies of large trees in extensive heavily wooded or forested areas on elevated ridgelines and ranges, usually in response to extreme weather conditions. References to the species roosting in trees and hollows while over-wintering in Australia is noted to potentially over-emphasize such occurrences (Higgins 1999).

As no records of the species within the study area exist, the species is predominantly aerial and does not breed in Australia, and the study site is not near the limit of the species range, no 'important populations' of White-throated Needletail are expected to occur within the study site.

No impacts to this species are expected to occur as a result of the construction or operational phase of the project, and therefore a significant impact assessment has not been undertaken.

#### **4.5.1.5 Curlew Sandpiper**

Curlew Sandpiper has been recorded approximately 8 km north of the study site near Corowa as recently as 2018 (DELWP 2022a) (EBird 2022). In Australia, Curlew Sandpipers occur around the coasts and are also quite widespread inland, though in smaller numbers. Records occur in all states during the non-breeding period, and also during the breeding season when many non-breeding one-year old birds remain in Australia rather than migrating north (DAWE 2022).

Curlew Sandpipers mainly occur on intertidal mudflats in sheltered coastal areas, such as estuaries, bays, inlets and lagoons, and also around non-tidal swamps, lakes and lagoons near the coast, and ponds in saltworks and sewage farms. They are also recorded inland, though less often, including around ephemeral and permanent lakes, dams, waterholes and bore drains, usually with bare edges of mud or sand. They occur in both fresh and brackish waters. Occasionally they are recorded around floodwaters (Higgins & Davies 1996).

Whilst habitat for the Curlew Sandpiper may be present during periods of reduced inundation of Lake Moodemere and the Northern Marshes, water depth recorded during the site assessment was too deep to support foraging habitat for the species. It is likely that a more natural hydrological regime (i.e. wetting and drying cycles) will result in an increase in foraging habitat within the study site for Curlew Sandpiper.

No impacts to this species are expected to occur as a result of the construction or operational phase of the project, and therefore a significant impact assessment has not been undertaken.

#### 4.5.1.6 Australasian Bittern

Australasian Bittern was not recorded during the site assessment however the species has been previously detected approximately 20 km south of the study site in 2008 (DELWP 2022). The Australasian Bittern is a large, heron-like bird that was once widespread across reedy wetlands of southern Australia but loss and degradation of its preferred habitat caused substantial declines.

Australasian Bittern chicks and juveniles are also vulnerable to predation by foxes (DAWE 2022). The largest population now nests in irrigated rice paddies in the Riverina, where industry partners have significantly contributed to recovery activities, including through encouraging rice farmers to use bittern-friendly methods (DAWE 2022).

At the time of the assessment suitable foraging and nesting habitat for the Australasian Bittern was not present within the study site however it is likely that a more natural hydrological regime (i.e. wetting and drying cycles) will result in an increase in foraging habitat and potential development of nesting habitat in the future.

No impacts to this species are expected to occur as a result of the construction or operational phase of the project, and therefore a significant impact assessment has not been undertaken.

#### 4.5.1.7 Australian Painted Snipe

Australian Painted Snipe was not recorded during the site assessment however the species has been previously recorded approximately 8 km east of the study site near Rutherglen (Ebird 2022) (DELWP 2022). The Australian Painted Snipe has been recorded at wetlands in all states of Australia (Barrett et al. 2003; Blakers et al. 1984; Hall 1910b). It is most common in eastern Australia, where it has been recorded at scattered locations throughout much of Queensland, NSW, Victoria and south-eastern South Australia.

The Australian Painted Snipe generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*). The Australian Painted Snipe sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber (Marchant & Higgins 1993).

Whilst Australian Painted Snipe was not detected during the site assessment foraging habitat is present within the study site. It is expected that the species utilises that study site for foraging habitat when conditions are suitable. It is likely that a more natural hydrological regime (i.e. wetting and drying cycles) will result in an increase in foraging habitat and potential development of nesting habitat in the future.

No impacts to this species are expected to occur as a result of the construction or operational phase of the project due to the lack of foraging or nesting habitat within the impact footprint, and therefore a significant impact assessment has not been undertaken.

### 4.5.2 FFG Act-listed species

Ten FFG Act-listed fauna species were recorded during the site assessment or aquatic surveys undertaken in January 2022 or subsequent surveys in April, May, June and July 2022:

- Plumed Egret (*Ardea intermedia plumifera*) listed as critically endangered;
- Murray River Turtle (*Emydura macquarii*) listed as critically endangered;
- White-bellied Sea-Eagle (*Haliaeetus leucogaster*) listed as endangered;
- Broad Shelled Turtle (*Chelodina expansa*) listed as endangered;
- Sloane's Froglet (*Crinia sloanei*) listed as endangered;

- Diamond Firetail (*Stagonopleura guttata*) listed as vulnerable;
- Musk Duck (*Biziura lobata*) listed as vulnerable;
- Platypus (*Ornithorhynchus anatinus*) listed as vulnerable;
- Australasian Shoveler (*Spatula rhynchotis*) listed as vulnerable; and
- Eastern Great Egret (*Ardea alba modesta*) listed as vulnerable.

Whilst these species are likely to utilise habitat within the study site, and potentially within impact footprints for foraging no nests or evidence of breeding habitat was present within impact areas with the exception of potential nesting habitat for Murray River Turtle and Broad Shelled Turtle.

Murray River Turtle and Broad-shelled Turtle may have nesting sites within the proposed Hells Gate embankment construction access track impact footprint and surveys should be conducted prior to construction to confirm the presence of nesting sites where suitable habitat is present once detailed design has been completed. Impacts to these species are likely to be limited to a single breeding season. Habitat suitable for nesting is abundant within the study site and as such impacts to nests within the Hells Gate regulator impact footprint are unlikely to have a significant impact on the overall populations of either species within the study site.

A total of 30 species listed as threatened under the FFG Act have been previously recorded within the study area (DELWP 2022a). With the exception of species previously mentioned in Section 4.5.1 and above, an additional 17 FFG Act-listed species are considered to potentially occur, in habitats within or in proximity to the study site (Appendix B). These include:

- Barking Owl (*Ninox connivens*) – critically endangered.
- Black Falcon (*Falco subniger*) – critically endangered;
- Carpet Python (*Morelia spilota metcalfei*) – endangered;
- Freckled Duck (*Stictonetta naevosa*) – endangered;
- Freshwater Catfish (*Tandanus tandanus*) – endangered;
- Brolga (*Antigone rubicunda*) – endangered;
- Lace Monitor (*Varanus varius*) – endangered;
- Murray Spiny Crayfish (*Euastacus armatus*) – threatened;
- Little Eagle (*Hieraaetus morphnoides*) – vulnerable;
- Turquoise Parrot (*Neophema pulchella*) – vulnerable;
- Apostlebird (*Struthidea cinerea*) – vulnerable;
- Magpie Goose (*Anseranas semipalmata*) – vulnerable;
- Hardhead Duck (*Aythya australis*) – vulnerable;
- Blue-billed Duck (*Oxyura australis*) – vulnerable;
- Grey-crowned Babbler (*Pomatostomus temporalis*) – vulnerable;
- Diamond Dove (*Geopelia cuneata*) – vulnerable; and
- Yellow-bellied Sheath-tail Bat (*Saccolaimus flaviventris*) – vulnerable

Suitable roosting habitat for Yellow-bellied Sheath-tail Bat was present within the proposed Hells Gate regulator impact footprint however targeted surveys undertaken in April 2022 did not detect the species.

Suitable habitat for Carpet Python, Turquoise Parrot and Lace Monitor is present within the proposed construction buffer of the Hells Gate embankment and associated access track however these species were not detected during the initial site assessment or subsequently during additional surveys in April, May, June and July nor have they previously been detected within the study site. Prior to the removal of any large hollow bearing trees pre-clearance surveys of hollows should be undertaken to mitigate impacts to these species and any other hollow dependant fauna species.

The majority of the above-mentioned species are highly mobile and will forage in woodland and aquatic habitats identified throughout the broader study site. There are multiple records within the study area for these listed

species from as recently as 2021 (DELWP 2022a; 2022b). Many of these species will utilise woodland habitats within the study site and open pastoral land adjacent to the study site for foraging and roosting behaviours. Large hollow bearing River Red Gums within impact areas provide suitable foraging and nesting/breeding habitat for a number of the above species and should be retained wherever possible in the design phase of the project.

Project works should avoid impacts to native woodland vegetation and in particularly large hollow bearing trees where possible during the design phase of the project in order to reduce impacts to these FFG Act-listed species.

Further effort should be made during the design phase of the project to reduce impacts to threatened species habitat by avoiding the removal of native vegetation. A CEMP should be developed that mitigates risk to FFG Act-listed fauna during the construction and operation phases of the project.

## 4.6 Threatened fauna communities

One FFG Act-listed threatened fauna community is considered to occur within the study site, *Victorian Temperate Woodland Bird Community*. The FFG Act-listed *Victorian Temperate Woodland Bird Community* has been defined as a suite of bird species, mainly associated with drier woodlands on the slopes and plains north of the Great Dividing Range<sup>8</sup>. This community is synonymous with drier woodlands dominated by Box, Stringybark, Ironbark, Yellow Gum or River Red-gum or by Buloke or Cypress Pine.

The community identifies 24 key *woodland-dependant* bird species, with the presence of one or more species representative of the community (Scientific Advisory Committee 2000). The community lists another 21 *woodland-associated* bird species that are known to occur in the same habitat but are not included in the FFG Act listing (Scientific Advisory Committee 2000).

Four woodland-dependant species were observed during the field assessment within Eucalypt woodland habitat; Brown-headed Honeyeater (*Melithreptus brevirostris*), Western Gerygone (*Gerygone fusca*), Diamond Firetail (*Stagonopleura guttata*) and Brown Treecreeper (*Climacteris picumnus victoriae*). Individuals of these species were recorded within impact areas associated with the proposed Hells Gate Regulator.

Although not all impact areas had *Victorian Temperate Woodland Bird Community* species recorded during the time of the surveys, it is considered likely for these woodland birds to use all native vegetation patches within the study site. This is due to the suitability of habitat found bordering Lake Moodemere, Sunday creek and within the Northern Marshes that represents typical descriptions of the woodland community and ability of woodland bird species to move short distances between habitat patches.

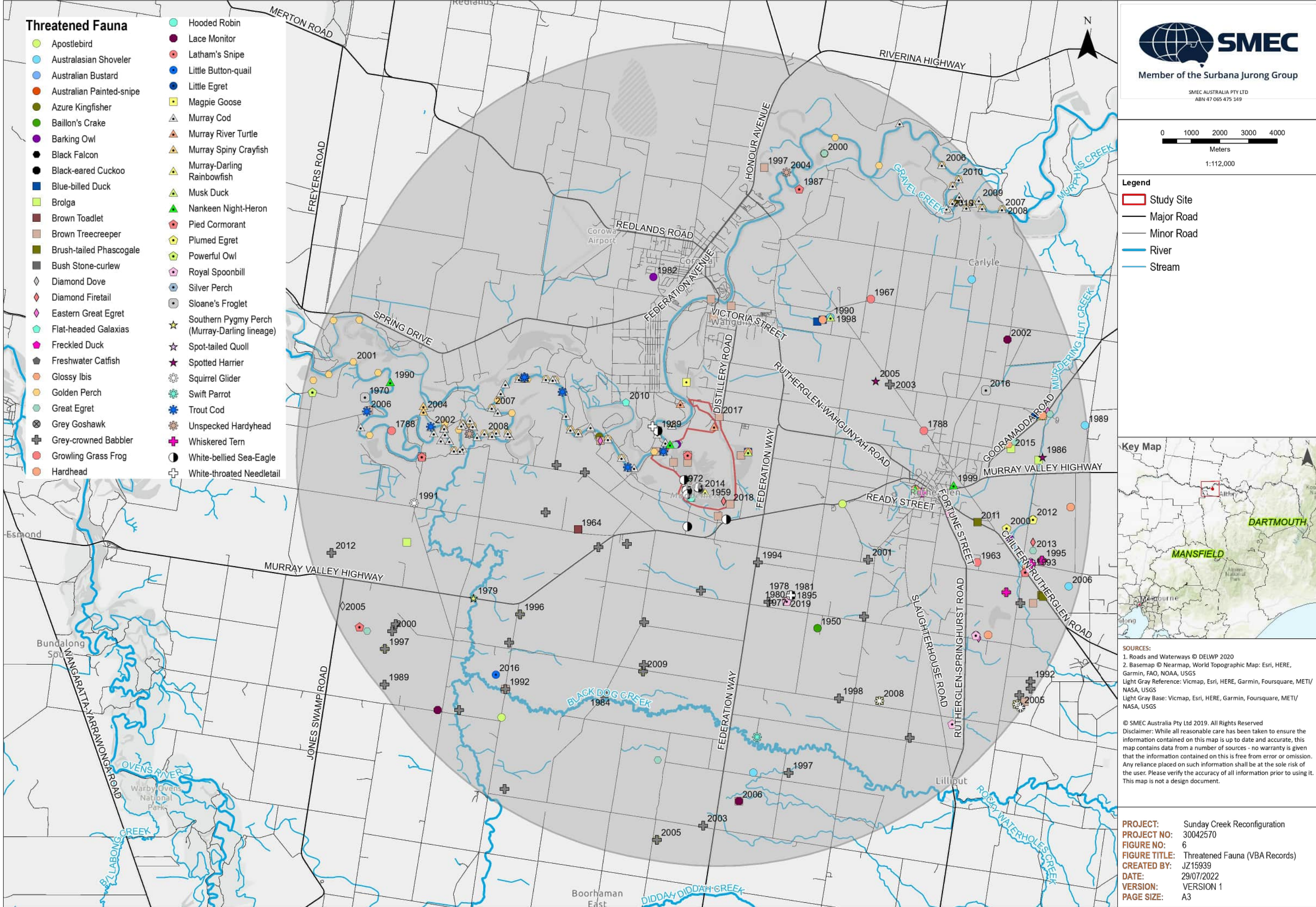
Total impacts to this community are currently estimated at 4.036 ha based on the concept design. Further discussion with DELWP is required to understand avoidance and mitigation requirements for this listed community.

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<sup>8</sup> FFG Act community descriptions available at:

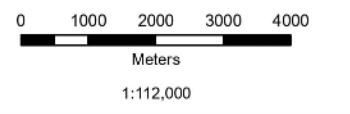
[https://www.environment.vic.gov.au/\\_\\_data/assets/pdf\\_file/0018/50418/Flora-and-Fauna-Guarantee-Characteristics-of-Threatened-Communities-.pdf](https://www.environment.vic.gov.au/__data/assets/pdf_file/0018/50418/Flora-and-Fauna-Guarantee-Characteristics-of-Threatened-Communities-.pdf)

Figure 6: Threatened fauna species previously recorded within the study area.



**Threatened Fauna**

- |                            |                                                 |
|----------------------------|-------------------------------------------------|
| ● Apostlebird              | ● Hooded Robin                                  |
| ● Australasian Shoveler    | ● Lace Monitor                                  |
| ● Australian Bustard       | ● Latham's Snipe                                |
| ● Australian Painted-snipe | ● Little Button-quail                           |
| ● Azure Kingfisher         | ● Little Egret                                  |
| ● Baillon's Crake          | ■ Magpie Goose                                  |
| ● Barking Owl              | ▲ Murray Cod                                    |
| ● Black Falcon             | ▲ Murray River Turtle                           |
| ● Black-eared Cuckoo       | ▲ Murray Spiny Crayfish                         |
| ● Blue-billed Duck         | ▲ Murray-Darling Rainbowfish                    |
| ■ Brolga                   | ▲ Musk Duck                                     |
| ■ Brown Toadlet            | ▲ Nankeen Night-Heron                           |
| ■ Brown Treecreeper        | ● Pied Cormorant                                |
| ■ Brush-tailed Phascogale  | ● Plumed Egret                                  |
| ■ Bush Stone-curlew        | ● Powerful Owl                                  |
| ◆ Diamond Dove             | ● Royal Spoonbill                               |
| ◆ Diamond Firetail         | ● Silver Perch                                  |
| ◆ Eastern Great Egret      | ● Sloane's Froglet                              |
| ◆ Flat-headed Galaxias     | ★ Southern Pygmy Perch (Murray-Darling lineage) |
| ◆ Freckled Duck            | ★ Spot-tailed Quoll                             |
| ■ Freshwater Catfish       | ★ Spotted Harrier                               |
| ● Glossy Ibis              | ● Squirrel Glider                               |
| ● Golden Perch             | ● Swift Parrot                                  |
| ● Great Egret              | ● Trout Cod                                     |
| ● Grey Goshawk             | ● Unspecked Hardyhead                           |
| ● Grey-crowned Babbler     | ● Whiskered Tern                                |
| ● Growing Grass Frog       | ● White-bellied Sea-Eagle                       |
| ● Hardhead                 | ● White-throated Needletail                     |



- Legend**
- ▭ Study Site
  - Major Road
  - Minor Road
  - River
  - Stream



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**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 6  
**FIGURE TITLE:** Threatened Fauna (VBA Records)  
**CREATED BY:** JZ15939  
**DATE:** 29/07/2022  
**VERSION:** VERSION 1  
**PAGE SIZE:** A3

## 4.7 Ramsar Wetlands

The PMST identifies six Ramsar wetland as occurring within the study area, including:

- Banrock Station wetland complex;
- Gunbower Forest;
- Hattah-kulkyne Lakes;
- NSW Central Murray State Forests;
- Barmah Forest;
- Riverland; and
- The Coorong, and Lakes Alexandrina and Albert wetland.

These sites are located between 50-500 km downstream of the study area and are associated with the Murray and Darling River systems. The closest Ramsar listed wetland to the study site is the Barmah Forest wetland which is over 250km downstream. Given the large distance and

Based on the proximity of the study site to the above Ramsar sites, there are unlikely to be direct or indirect impacts associated with the proposed action on these MNES.

## 4.8 Migratory and marine species

The PMST report identified 11 migratory/marine species that may occur within the study area (DAWE 2022a). Of these, five species have previous records within the study area and/or have suitable habitat within the broader area (DEWLP 2022a). Depending on water levels within Lake Moodemere and the Northern Marshes habitat may be present to support these species. It is likely that a more natural hydrological regime (i.e. wetting and drying cycles) will result in an increase in foraging habitat for migratory and marine species.

Project works are unlikely to detrimentally impact migratory/marine species due to the distance of impact areas from suitable foraging habitat.

# 5 Implications of changed water regime

## 5.1 Current water regime

The current water regime relies on water inflows from the Murray River directly into Lake Moodemere from either gravity flow through the existing regulator or diesel pumping. The current water level within the study site is held artificially high (128.7 m AHD) to allow for flow into Sunday Creek from Lake Moodemere through the existing Hells Gate channel. Water losses through evaporation and transpiration as a result of the Lake Moodemere being filled under this water regime are driving the necessity of the project and an alternative approach to delivering water to local irrigators.

Records of Murray River flow at Corowa approximately 6.5 km upstream from the Lake Moodemere regulator show an annual cycle of flow rate. Lower rates of flow (less than 4,000 ML/d) are generally observed in Autumn and Winter. From late Winter to early Spring flow rates generally increase as a result of rainfall within the catchment and regulated flows to support downstream irrigators and environmental watering targets. Flows generally peak in Spring (greater than 10,000 ML/d) with flood events (greater than 20,000 ML/d) generally occurring in this period. Summer flows (greater than 8,000 ML/d) are similar to Spring but flood events are less likely to occur. High discharge periods of the Murray River (greater than 20,000 ML/d) are dependent on environmental conditions and the frequency and duration of these events is not predictable with high certainty. It is likely the El Nino Southern Oscillation (ENSO) plays a role in flood event frequency and duration (MDBA 2022) (SMEC 2022) (GHD 2018). Between 1957 and 2006 flow rate in the Murray River was sufficient to inundate the Northern Marshes approximately 40 times provided the Lake Moodemere regulator was open (8-10 years in 10 inundation frequency).

Historical water level data of Lake Moodemere prior to 2006 indicates that the lake water level relies heavily on the flow rate of the Murray River and annual trends are similar (GHD 2018) (SMEC 2022). However due to the current water regime drawdown events (lake levels less than 128 m AHD) that have historically occurred no longer take place (MDBA 2022) (DELWP 2022). The consistently high water levels in Lake Moodemere are likely to have increased the frequency and duration of flooding within the Northern Marshes by decreasing the water volume necessary to reach the point at which the Northern Marshes begin inundation (129.3 m AHD) during periods of high flow in the Murray River and rainfall events within the catchment area of Lake Moodemere. From 1965 to 2006<sup>9</sup> the Northern Marshes have been inundated to varying degrees approximately 40 times. The longest duration inundation event recorded was 2 years beginning in May of 1991. The average duration of inundation is however 1-5 months. Lake Moodemere water level records indicate the Northern Marshes' longest period without inundation was approximately 3 years which occurred during the Millennium drought.

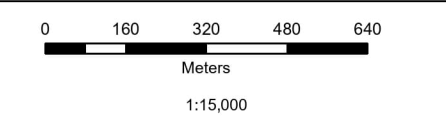
Water quality in Sunday Creek as a result of the current water regime is considered to be of poor quality with areas of hypoxic conditions (Water Technology 2012) however the creek does provide extensive aquatic habitat.

The site was assessed (SMEC 2022) under peak inundation levels as evidenced by water flowing over the existing Lake Moodemere regulator overflow wall back into the Murray River. The level of inundation during the assessment is represented conceptually in figure 7 and is equivalent to a water level within the lake of 129.8 RL m AHD. This represents a 'wet' or flood cycle of the Lake Moodemere and Northern Marshes.

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<sup>9</sup> Chambers gauge monitoring period.

Figure 7: Inundation level of Lake Moodemere during site assessment

- Legend**
- Study Site
  - Inundated Areas (@129.81 m AHD)
  - Major Road
  - Minor Road
  - River
  - Stream



**SOURCES:**

1. Roads and Waterways © DELWP 2020
2. Basemap © Nearmap, World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS Australia latest: World Topographic Map: Esri Community Maps Contributors, Vicmap, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS

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**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 7  
**FIGURE TITLE:** Inundation level of Lake Moodemere during DFFA  
**CREATED BY:** JZ15939  
**DATE:** 29/07/2022  
**VERSION:** VERSION 1  
**PAGE SIZE:** A3



## 5.2 Proposed water regime

Under the proposed new water regime water levels within Lake Moodemere and the Northern Marshes are expected to follow a similar trend to historic water levels with the following key differences:

- A minimum water level of 128.7 m AHD in Lake Moodemere is required by the 1<sup>st</sup> of January each year for the annual rowing regatta. Water levels will not be maintained after this point;
- Water levels in Lake Moodemere will be permitted to drawdown below the level (128.7m AHD) currently maintained for irrigation supply;
- Artificial drawdown during periods when the Northern Marshes are inundated will now be to 129 m AHD instead of 128.7 m AHD due to the proposed Hells Gate regulator separating the two water bodies at this point; and
- Upgrades to the existing Lake Moodemere regulator will increase the overflow wall height from 129.85 m AHD to 130 m AHD.

The above changes are likely to result in the following effects to the water regime:

- Natural drawdown of Lake Moodemere will now occur after January each year. This will expose margins of the lake that have been inundated for the previous 43 years;
- Due to decreased lake water levels inundation events are likely to occur less frequently in the Northern Marshes particularly when high Murray River water levels are not sustained for long periods and are not sufficient to fill the lake and inundate the Northern Marshes;
- The proposed Hells Gate regulator structure will prohibit artificial drawdown of Lake Moodemere below 129 m AHD which may increase the frequency of inundation of the Northern Marshes should high Murray inflows or rainfall coincide with this period;
- The approximate 15 cm increase to the height of the overflow wall of the existing Lake Moodemere regulator may have two contradictory effects:
- The increased height of the overflow wall will cause an increase in depth and subsequently duration of inundation of the Northern Marshes during flood events
- Should the regulating structure be closed during a high discharge period of the Murray River inflows above 129.85 m AHD will no longer enter Lake Moodemere and subsequently inundation frequency of the Northern Marshes and water levels within Lake Moodemere may decline.

The water level in Sunday Creek will be maintained between 128.7 -128.9 m RL AHD to supply local irrigators. This level is similar to the existing supply levels within Sunday Creek and as such significant changes are not expected to occur. However an increase in water quality may occur, particularly dissolved oxygen content, which may benefit native aquatic fauna species. During drawdown periods of Lake Moodemere Sunday Creek may provide a refuge for aquatic species particularly species capable of movement over terrestrial environments such as amphibians and reptiles.

### 5.2.1 Proposed water regime scenarios

The following scenarios which represent three water level scenarios predicted to occur under the proposed Lake Moodemere-Sunday Creek water regime. The proposed water regime is still currently being determined and as such detailed water modelling information is currently unavailable. The following scenarios have been chosen to help conceptualise the responses of flora and fauna to the new water regime using water level values that are likely to occur. Due to the variables discussed above it is difficult to predict the frequency that these scenarios may occur

with accuracy however it is expected they will continue to follow historical trends with particular respect to water levels in the Murray River.

### Scenario 1 – Drawdown to 128.0 m AHD

This situation is predicted to potentially occur between February and December each year when the lake is no longer artificially filled and drawdown occurs as a result of evaporation and transpiration decreasing the water level below 128.7 m AHD. Colonisation of exposed margins by aquatic and semi-aquatic flora of Lake Moodemere is likely to occur as water levels recede and exposed mudflats will provide foraging opportunities for bird species. Depending on draw down level habitat for aquatic species within Lake Moodemere may become limited however is not expected to be eliminated. The Northern Marshes are expected to be dry in this situation and will most likely be colonised by terrestrial grasses and sedges. This water level is represented conceptually in Figure 9.

### Scenario 2 – Water level maintained at 128.7 m AHD

Scenario 2 represents the predicted water levels within Lake Moodemere as a result of the proposed water regime target of maintaining an approximate water level of 128.7 m AHD by the beginning of January each year. This will rely on gravity flows from the Murray River through the existing regulator or by pumping through the proposed pipeline and subsequent overflow from the Hells Gate regulator sill wall. The duration which this level is likely to be maintained is dependent on environmental conditions. During the month of January, provided the water level does not exceed 128.7 m AHD due to natural causes, it is likely that aquatic and semiaquatic flora will colonise the margins of Lake Moodemere. As with scenario 1 the Northern marshes are expected to be dry.

### Scenario 3 – Low level inundation of the Northern Marshes

This scenario is predicted to occur during times of high discharge from the Murray River or large rainfall and flood events or during drawdown periods after such events. At a water level of approximately 129.3 m AHD low level inundation of the Northern Marshes occurs (0-30 cm water depth). This level of inundation is considered optimal for most of the inundation tolerant and responding PFGs. Shallow and exposed saturated soil provides mudflat foraging habitat for wetland bird species particularly wading wetland birds. Increased habitat for invertebrates and zooplankton will improve foraging opportunities for nearly all species within the Northern Marshes. This scenario is likely to support the peak biodiversity values of Lake Moodemere and the Northern Marshes with respect to both flora and fauna. It should be noted that this scenario is a component of a dynamic wetting and drying cycle and is unlikely to exist for long durations. Based on historical flow data for the Murray River and current proposed operation of the Lake Moodemere regulator it is expected that this scenario will occur approximately once every five years in the absence of drought events. This water level is represented conceptually in Figure 8.

### Levels observed during site assessment

Water levels of 129.85 m AHD are considered to be synonymous with conditions recorded within the study site during the site assessment (see figure 7). This scenario may occur during flood events and periods of high rainfall or discharge from the Murray River.

### Flood and inundation events

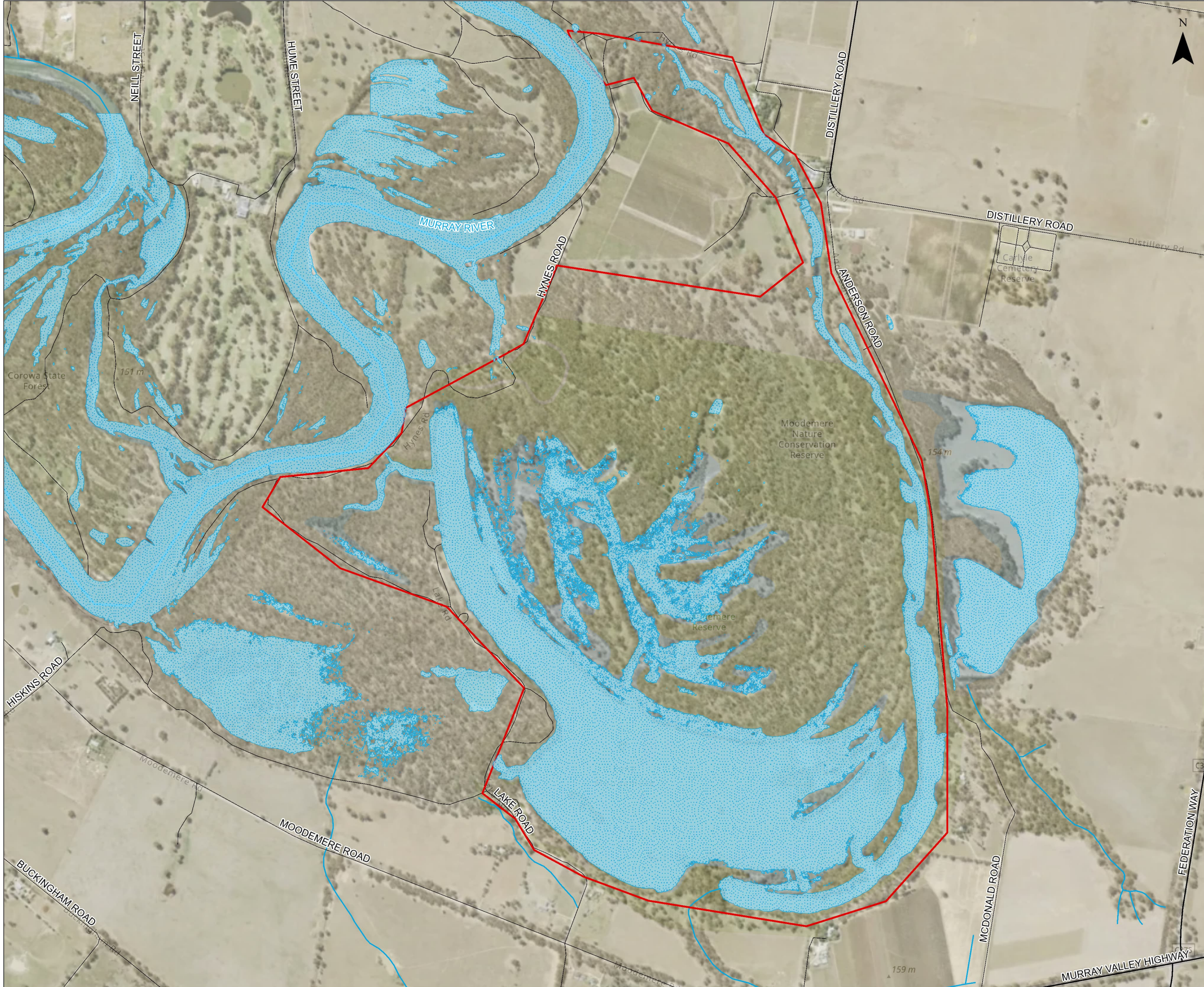
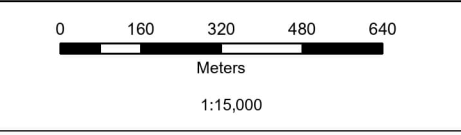
Inflows from the Murray River during periods of high discharge (greater than approx. 20,000 ML/day at Doctors Point Gauge) or large rainfall events in the Sunday Creek/Lake Moodemere catchment area are likely to occur periodically in the future causing inundation of the Northern Marshes (SMEC 2022) (MDBA 2022). These events may lead to substantial inundation of the Northern Marshes for prolonged periods of time with durations of up to three years recorded previously. Historical flow data of the Murray River suggests that inundation of the Northern Marshes will occur approximately once in five years in the absence of drought events but may occur more frequently.

### Assumptions

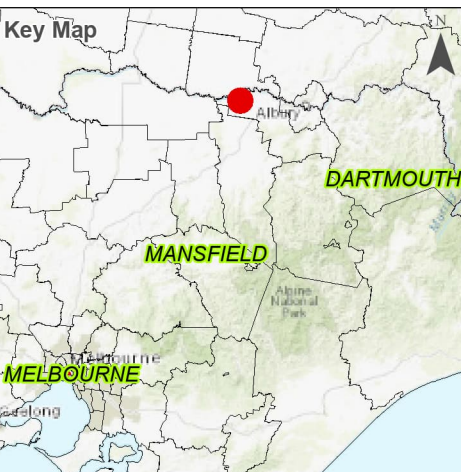
The listed scenarios make the following assumptions:

- The Lake Moodemere regulator will remain closed from September to the start of February each year; and
- The Lake Moodemere regulator will not discharge water to the Murray River unless it overflows the top of the regulator wall (approx. 130 m AHD).

Figure 8: Scenario 2. Low level inundation of the Northern Marshes

- Legend**
- Study Site
  - Inundated Areas (@129.3 m AHD)
  - Major Road
  - Minor Road
  - River
  - Stream



- SOURCES:**
1. Roads and Waterways © DELWP 2020
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**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 8  
**FIGURE TITLE:** Scenario 2: Low level inundation of the Northern Marshes  
**CREATED BY:** JZ15839  
**DATE:** 29/07/2022  
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### 5.3 Implications for Plant Functional Groups

Table 6 below describes expected changes in the vegetative cover of the plant functional groups identified within the study site in response to the proposed new water regime. These predictions are based on water levels that will occur within Lake Moodemere as a result of the proposed water regime, inflows from the Murray River during times of high flow and natural drawdown of Lake Moodemere after January each year.

Table 8: PFG vegetation cover responses to water levels within Lake Moodemere and the Northern Marshes<sup>10</sup>.

Plant Functional Group	Area of study site	Scenario 1 – Drawdown below 128.0m AHD	Scenario 2 – Water maintained at 127.8m AHD	Scenario 3 – Low level inundation of Northern Marshes	Occurrence during site assessment
Submerged	Lake Moodemere	<ul style="list-style-type: none"> <li>Likely to persist within Lake Moodemere.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to persist within Lake Moodemere.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to persist within Lake Moodemere.</li> </ul>	Occurs throughout Northern Marshes and margins of Lake Moodemere
	Northern Marshes	<ul style="list-style-type: none"> <li>Decrease in vegetation cover.</li> </ul>	<ul style="list-style-type: none"> <li>Decrease in vegetation cover.</li> </ul>	<ul style="list-style-type: none"> <li>Decrease in vegetation cover.</li> <li>Likely to persist within areas of deeper inundation.</li> </ul>	
Amphibious fluctuation responders – Floating leaves	Lake Moodemere	<ul style="list-style-type: none"> <li>Decrease in vegetation cover.</li> </ul>	<ul style="list-style-type: none"> <li>Decrease in vegetation cover, will die back to rootstocks</li> </ul>	<ul style="list-style-type: none"> <li>Likely to persist within Lake Moodemere.</li> </ul>	Occurs within Northern Marshes and fringing pools of Lake Moodemere.
	Northern Marshes	<ul style="list-style-type: none"> <li>Unlikely to occur within Northern Marshes.</li> </ul>	<ul style="list-style-type: none"> <li>Unlikely to occur within Northern Marshes. Will dieback to rootstocks.</li> </ul>	<ul style="list-style-type: none"> <li>Distribution likely to change but will persist within Northern Marshes</li> </ul>	
Amphibious fluctuation responders – Morphologically plastic	Lake Moodemere	<ul style="list-style-type: none"> <li>May colonise shallow water on margins of Lake Moodemere</li> </ul>	<ul style="list-style-type: none"> <li>May colonise shallow water on margins of Lake Moodemere</li> </ul>	<ul style="list-style-type: none"> <li>Likely to colonise shallow water within Lake Moodemere.</li> </ul>	Occurs within shallower margins of Northern Marshes and Lake Moodemere
	Northern Marshes	<ul style="list-style-type: none"> <li>Decrease in vegetation cover.</li> <li>Unlikely to occur within Northern Marshes.</li> </ul>	<ul style="list-style-type: none"> <li>Decrease in vegetation cover.</li> <li>Unlikely to occur within Northern Marshes. Will dieback to rootstocks.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to colonise shallow water within Northern Marshes.</li> </ul>	
Amphibious fluctuation tolerators – Low growing species	Lake Moodemere	<ul style="list-style-type: none"> <li>Likely to persist within saturated margins of Lake Moodemere.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to colonise saturated margins of Lake Moodemere.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to further colonise saturated margins of Lake Moodemere.</li> </ul>	Occurs within saturated margins of Northern Marshes and Lake Moodemere
	Northern Marshes	<ul style="list-style-type: none"> <li>Unlikely to occur within Northern Marshes.</li> </ul>	<ul style="list-style-type: none"> <li>Unlikely to occur within Northern Marshes.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to further colonise saturated margins of Northern Marshes</li> </ul>	
Amphibious fluctuation tolerators – Emergent species	Lake Moodemere	<ul style="list-style-type: none"> <li>May colonise margins of Lake Moodemere further.</li> </ul>	<ul style="list-style-type: none"> <li>May colonise margins of lake Moodemere further.</li> </ul>	<ul style="list-style-type: none"> <li>May colonise margins of Lake Moodemere further.</li> </ul>	Widespread throughout Northern marshes and margins of Lake Moodemere
	Northern Marshes	<ul style="list-style-type: none"> <li>Will persist longer than other PFG's in Northern Marshes but unlikely to survive dry cycle of long duration.</li> </ul>	<ul style="list-style-type: none"> <li>Will persist longer than other PFG's in Northern Marshes but unlikely to survive long duration</li> </ul>	<ul style="list-style-type: none"> <li>May colonise Northern Marshes further.</li> </ul>	
Terrestrial damp	Lake Moodemere	<ul style="list-style-type: none"> <li>May colonise non-inundated margins of Lake Moodemere</li> </ul>	<ul style="list-style-type: none"> <li>Unlikely to persist in Northern Marshes</li> <li>May colonise non-inundated margins of Lake Moodemere</li> </ul>	<ul style="list-style-type: none"> <li>Likely to further colonise margins of Lake Moodemere.</li> </ul>	Occurs within saturated margins of Northern Marshes and Lake Moodemere
	Northern Marshes	<ul style="list-style-type: none"> <li>Unlikely to occur in Northern Marshes.</li> </ul>	<ul style="list-style-type: none"> <li>Unlikely to occur in Northern Marshes.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to further colonise Northern Marshes.</li> </ul>	
Terrestrial dry	Lake Moodemere	<ul style="list-style-type: none"> <li>Likely to colonise formally saturated soil within Lake Moodemere.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to colonise formally saturated soil within Lake Moodemere.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to colonise formally saturated soil surrounding Lake Moodemere.</li> </ul>	Widespread within northern reach of Northern Marshes and along banks of Lake Moodemere and the Murray River
	Northern Marshes	<ul style="list-style-type: none"> <li>Likely to become dominant in the Northern Marshes.</li> </ul>	<ul style="list-style-type: none"> <li>Likely to colonise formally saturated soil within Northern Marshes</li> </ul>	<ul style="list-style-type: none"> <li>Likely to colonise formally saturated soil within Northern Marshes</li> </ul>	

<sup>10</sup> Positive = expected increase in PFG vegetation cover relative to current values.

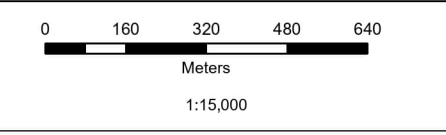
Negative = expected decrease in PFG vegetation cover relative to current value.

Neutral = No expected change in PFG vegetation cover.

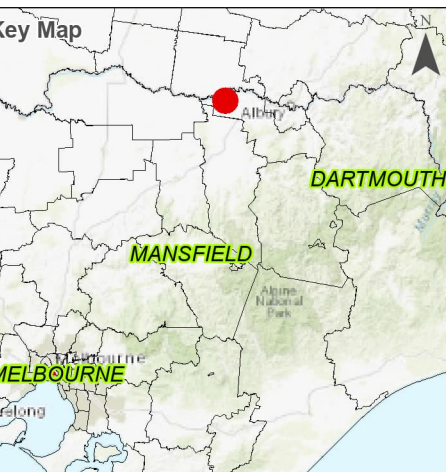
Figure 9: Possible drawdown of Lake Moodemere after January each year



**SMEC**  
Member of the Surlana Jurong Group  
SMEC AUSTRALIA PTY LTD  
ABN 47 065 475 149



- Legend**
- Study Site
  - Inundated Areas (@128 m AHD)



- SOURCES:**
1. Roads and Waterways © DELWP 2020
  2. Basemap © Nearmap, World Topographic Map: Esri, HERE, Garmin, FAO, NOAA, USGS Australia latest: World Topographic Map: Esri Community Maps Contributors, Vicmap, Esri, HERE, Garmin, Foursquare, METI/NASA, USGS World Hillshade: Esri, Geoscience Australia, NASA, NGA, USGS

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Disclaimer: While all reasonable care has been taken to ensure the information contained on this map is up to date and accurate, this map contains data from a number of sources - no warranty is given that the information contained on this is free from error or omission. Any reliance placed on such information shall be at the sole risk of the user. Please verify the accuracy of all information prior to using it. This map is not a design document.

**PROJECT:** Sunday Creek Reconfiguration  
**PROJECT NO:** 30042570  
**FIGURE NO:** 9  
**FIGURE TITLE:** Scenario 3: Lake Moodemere drawdown to 128.0 m AHD  
**CREATED BY:** JZ15939  
**DATE:** 29/07/2022  
**VERSION:** VERSION 1  
**PAGE SIZE:** A3

## 5.4 EVC response to changed water regime

EVCs identified as dependant on inundation as part of their recruitment process are listed below. Plains Woodland (EVC 803) and Floodplain Riparian Woodland (EVC 56) have not being included as they are unlikely to be affected by the proposed changes to water regime. Flood events are predicted based on historical flow rate of the Murray River at Doctors Point in Albury and do not take into account prolonged drought or rainfall events (MBDE 2022) (SMEC 2022). Desirable flood interval is adapted from Victorian Riverina bioregion EVC benchmarks and Australian Ecosystems; Identification of Vegetation, Bird and Frog Values and their Hydrological Requirements for input into the Lake Moodemere Environmental Watering Plan report previously prepared for the project in 2011.

Responses of EVCs are based on historical flood interval and predicted effects of the proposed water regime with respect to natural drawdown of water within the study site after January each year. These responses do not take into account the changes proposed infrastructure may have on water levels within the study site.

Table 9: EVC response to changed water regime<sup>11</sup>

EVC	Desirable flood interval	Predicted flood interval	Dry period tolerated	Predicted dry period	Predicted response in Northern Marshes	Predicted response in lake Moodemere
Tall Marsh (821)	8 in 10 years	1-4 in 10 years	1-3 years	1-5 in 10 years	Positive	Positive
Riverine Grassy Woodland (295)	Occasional		>5 years		Positive	Not Present
Aquatic Herbland (653)	8 in 10 years		1 year		Neutral - Negative	Positive
Floodway Pond Herbland (810)	8 in 10 years		1 year		Neutral - Negative	Positive
Riverine Swamp Forest (814)	8 in 10 years		>5 years		Neutral	Not Present
Sedgy Riverine Forest (816)	6 in 10 years		>5 years		Neutral	Neutral

<sup>11</sup> **Positive** = expected increase in EVC extent and quality relative to current values.

**Negative** = expected decrease in EVC extent and quality relative to current values.

**Neutral** = No expected change in EVC extent and quality relative to current values.

## 5.5 Fauna responses to changed water regime

Fauna responses are difficult to predict due to interrelationships between factors such as habitat diversity, habitat quality and food availability. In general as habitat diversity and quality increase so does fauna diversity and population. Increased habitat for invertebrates and plankton and other species that form the base of a wetland food chain will have positive effects on predator and prey species alike. Seasonal factors such as weather and rainfall further complicate fauna population predictions based on the proposed water regime.

Table 8 summarises predicted responses of fauna groups to the proposed water regime. Scenarios 1 and 3 from section 5.3 are used for comparison as these are likely to represent the range of water levels that occur under the proposed water regime.



Table 10. Predicted fauna responses to changed water regime within Lake Moodemere and the Northern Marshes<sup>12</sup>

Faunal group	Example species recorded within study site/area	Predicted response			
		Scenario 1 – Drawdown to 128.0 m AHD	Scenario 3 – Low level inundation of the Northern Marshes	Current occurrence	
Invertebrates		Decrease in habitat	Increase in habitat		
Arboreal mammals	Common Brushtail Possum	Decreased food availability (minor)	Increase in habitat (minor)	Prevalent throughout study site	
Aquatic monotremes	Platypus*	Neutral – improved water quality in Sunday creek may benefit species.		Occur within Sunday Creek	
Bats	Gould’s Wattled Bat	Decreased food availability (minor)	Increased food availability	Forage within study area	
Avifauna	VTWB community	Decreased food availability (minor)	Increased food availability	Forage and nest within study site	
	Raptors	White-bellied Sea Eagle	Increased food availability (pest species)	Increased food availability	Forage and nest within study site
	Waders	Yellow-billed Spoonbill	Increase in habitat and food availability	Increase in habitat and food availability	Forage and nest within study site
	Ducks	Musk Duck	Decrease in habitat and foraging resources	Decrease in habitat but increase in food availability	Forage and nest within study site
	Migratory birds	White-throated Needletail	Increase in food availability and foraging resources	Increase in food availability	Predicted to forage within study area
	Terrestrial birds	Rainbow Bee-eater	Decreased food availability (minor)	Increase in food availability	Forage and nest within study site
Reptiles	Turtles	Decrease in habitat Increased predation pressure	Decrease in habitat Increased predation pressure	Forage and nest within study site	
	Snakes	Red-bellied Black Snake	Increase in habitat	Increased food availability	Forage and nest within study site
	Lizards	Boulenger’s Skink	Increase in habitat	Increase in habitat and food availability	Predicted to forage within study area
	Frogs	Striped Marsh Frog	Decreased habitat and food availability	Increase in habitat and food availability	Forage and breed within study site
	Pest animals	Red Fox	Increase in access to prey	Increase in food availability and access to prey	Forage in study area

<sup>12</sup> **Positive** = expected increase in faunal group population relative to current values.  
**Negative** = expected decrease in faunal group population relative to current values.  
**Neutral** = no change expected in faunal group population relative to current values.

## 6 Legislation and Policy

### 6.1 Commonwealth legislation

#### 6.1.1 *Environment Protection and Biodiversity Conservation Act 1999*

The EPBC Act provides Commonwealth legislation for the environment within Australia, particularly for MNES. The Act aims to promote the conservation of biodiversity through the protection of natural biodiversity and heritage values. Ecological MNES considered relevant to the proposed works under the EPBC Act include:

- Listed threatened species and ecological communities; and
- Migratory species.

##### 6.1.1.1 Implications

An assessment of impacts and recommendations for these MNES is summarised below in Table 11.

Table 11: Summary of potential impacts to MNES and recommendations.

MNES	Potential Impacts	Recommendations
Threatened species and communities	<p>One threatened fauna species is known to utilise habitat within the study site, Sloane's Froglet, however the species was not detected within impact areas and habitat within impact areas is of poor suitability for the species. Construction activities associated with the project have to potential to introduce the potentially fatal Chytrid fungus into the study site provided it is not already present.</p> <p>Regent Honeyeater, Murray Cod, Trout Cod and White-throated Needletail may utilise habitat within the study site for foraging however no high quality, preferred foraging habitat is present within impact areas.</p> <p>Based on the footprint of the concept design it is unlikely that there will be significant impact to any EPBC Act listed fauna species.</p> <p>The EPBC listed community <i>Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-Eastern Australia</i> is present within the study site but outside of the impact footprint.</p>	<p><b>Targeted surveys are recommended.</b> Targeted surveys should be undertaken for Mueller Daisy to determine the species presence/absence within impact footprints.</p> <p><b>Referral may be required.</b> GMW will self-refer the project however no significant impacts have been identified to MNES. However targeted surveys for Mueller Daisy have yet to be undertaken.</p> <p>Mitigation measures during construction including strict hygiene and disinfection procedures should be implemented during construction to limit impacts to Sloane's Froglet within the study site.</p>
Ramsar wetlands	There is considered to be no direct impact associated with the proposed action on Ramsar wetlands.	<b>No referral required.</b>
Migratory species	White-throated Needletail may utilise habitat within the broader study site for opportunistic foraging however	<b>No referral required.</b>

MNES	Potential Impacts	Recommendations
	given the highly localised extent of impact areas and the large size of the study site the species is unlikely to be impacted.	

## 6.2 State legislation

### 6.2.1 *Environmental Effects Act 1978*

The *Environmental Effects Act 1978* (EE Act) provides for an assessment of proposed projects that are capable of having a significant effect on the environment. Projects that trigger the referral criteria must be referred to the Minister administering the EE Act to decide if an Environmental Effects Statement (EES) should be prepared.

The EES process allows for relevant statutory decision makers to make decisions about whether a project should proceed based on the level of perceived environmental impact. Preliminary desktop investigation identifies the following potential ecological triggers for the project (DSE 2006):

- Removal of native vegetation identified as endangered;
- Loss of 1-5% of known threatened species habitat;
- Potential extensive or major effects on the health or biodiversity of aquatic, estuarine or marine ecosystems, over the long term;

#### 6.2.1.1 Implications

GMW are self-referring this project under the EE Act however none of the identified potential impacts will occur at a magnitude to be considered a potential ecological trigger under the EE Act.

Following the final detailed design for the project, the referral criteria should be reassessed (including quantifying loss of habitat for threatened species and communities) to identify the requirement of an EES for the project.

### 6.2.2 *Flora and Fauna Guarantee Act 1988*

The FFG Act is an important component of the Victorian legislation for the protection and management of threatened flora and fauna species and communities. The key objective of the FFG Act is to protect and conserve Victoria's native flora, fauna and communities through the management of potentially threatening processes. Threatening processes are listed under Section 10 of the FFG Act, and those relevant to the project include:

- Increase in sediment input into Victorian rivers and streams due to human activities;
- Invasion of native vegetation by environmental weeds;
- Loss of coarse woody debris from Victorian native forests and woodlands; and
- Loss of hollow bearing trees from Victorian native forests.

#### 6.2.2.1 Implications

Three FFG Act-listed threatened and seven protected flora species were recorded within the study site. Of the FFG Act-listed threatened flora recorded within the study site one species was recorded within proposed impact areas; Riverina Bitter-creed however the species is likely locally common within the broader study site. Potential impacts to this species include direct removal of individual plants, removal of potential seedbank and localised alteration of hydrology which could alter the suitability of habitat for the species within and adjacent to impact areas (but not the broader study site).

Of the ten FFG Act listed species recorded within the study site potential impacts have been identified to the following species:

- Broad-shelled Turtle – Potential disturbance of nests and reduction in foraging habitat.
- Murray River Turtle – Potential disturbance of nests and reduction in foraging habitat.
- Riverina Bitter-creed – Potential removal and alteration of habitat, potential removal of individual plants.
- Sloane’s Froglet – Introduction of Chytrid fungus.

The FFG listed Temperate Woodland Bird community is present across most of the study site.

The currently proposed construction buffers and associated vegetation and large tree removal represents a ‘worst case scenario’ for the purposes of identifying the largest potential impact that the project could have on the local environment. This has been done to identify potential triggers to the EE Act and EPBC Act so that mitigation measures can be developed during the detailed design phase of the project.

Consultation with DELWP is required to understand the extent of potential mitigation measures and permit requirements. A permit will be required to remove threatened and protected flora species should avoidance through project design not be possible.

### **6.2.3 Catchment and Land Protection Act 1994**

The key legislation governing the management and classification of noxious weeds and pest animals throughout Victoria is the CALP Act. The Act aims to protect primary production, Crown land, the environment and community health from the effects of noxious weeds and pest animals (Agriculture Victoria 2021). The Act requires landowners to manage noxious weeds and pest animals on their land. This includes the prevention of spread, direct management or in some instances eradication of regionally prohibited or controlled weeds and pest animal species on their land (Agriculture Victoria 2021).

#### **6.2.3.1 Implications**

Thirteen noxious weed species and two pest animal species were observed during the site assessments. GMW is required to ensure that the proposed works aim to prevent the growth and spread of noxious weed species and pest animals during all stages of construction. It is recommended that a suitably prepared Construction Environmental Management Plan (CEMP) is developed by the contractor to ensure appropriate risk management measures are implemented during works to comply with the broader objectives of the CaLP Act.

### **6.2.4 Wildlife Act 1975 and Wildlife Regulations 2013**

The *Wildlife Act 1975* and *Wildlife Regulations 2013* are both Victorian legislation which prevent harm to wildlife through the following key objectives:

*Wildlife Act 1975:*

1. to establish procedures in order to promote:
  - (a) the protection and conservation of wildlife;
  - (b) the prevention of taxa of wildlife from becoming extinct;
  - (c) the sustainable use of and access to wildlife; and
2. to prohibit and regulate the conduct of persons engaged in activities concerning or related to wildlife.

*Wildlife Regulations 2013:*

1. to provide for the management and conservation of wildlife and wildlife habitat;
2. to provide for humane use of and access to wildlife;

3. to make further provision in relation to the licensing system established by section 22 of the *Wildlife Act 1975*;
4. to prescribe fees, offences, royalties and various other matters for the purposes of the *Wildlife Act 1975*; and
5. to provide for exemptions from certain provisions of the *Wildlife Act 1975*.

#### **6.2.4.1 Implications**

A permit is required under the *Wildlife Act 1975* to carry out field investigations for the purpose of conserving, monitoring, improving or maintaining wildlife habitat within Victoria. This also includes the salvage and translocation of wildlife from a particular locality which requires a specific *Wildlife Act 1975* permit (authorised by DELWP) for the capture, handling and relocation of wildlife.

Any works requiring the removal or relocation of wildlife within or adjoining the study site should be undertaken by suitably qualified and licenced personnel. Appropriate mitigation measures must be employed during the vegetation removal, such as directional clearing towards areas of remaining habitat where applicable, and suitable protocols and contingency measures to manage any injured or displaced fauna during construction.

### **6.2.5 Water Act 1989**

The *Water Act 1989* regulates the management and use of all water under the control of the Crown in Victoria. The Act provides Water Authorities with a range of enforcement powers and imposes obligations on persons and organisations not to interfere with assets of Water Authorities, waterways and water.

The Act governs the entitlement of surface and groundwater for a range of uses including industrial and mining water use. A licence is required for works involving construction on a waterway, including temporary or permanent deviation or diversion of a waterway. The right to take water is attained in the form a licence, water share, bulk entitlement or environmental entitlement.

#### **6.2.5.1 Implications**

North East CMA is the responsible authority for the control, management and authorisation of works and activities in or over designated waterways in the study site. Approval from North East CMA will be required for construction activities adjoining the watercourses within the study site, including the Murray River, Sunday creek and Lake Moodemere.

### **6.2.6 Planning and Environment Act 1987**

The *Planning and Environment Act 1987* (P&E Act) governs the planning framework for the use, development and protection of land in Victoria. The P&E Act provides procedures for the preparation and amendment of the Victoria Planning Provisions and planning schemes. The Act also provides avenues for the acquisition and compliance of permits under local planning schemes. The P&E Act implements the functions listed below to achieve these objectives:

- Set the broad objectives for planning in Victoria;
- Set the main rules and principles for how the Victorian planning system works;
- Set up the key planning procedures and legal instruments in the Victorian planning system; and
- Define the roles and responsibilities of the Minister, councils, government departments, the community and other stakeholders in the planning system.

#### **6.2.6.1 Victoria Planning Provisions**

The Victoria Planning Provisions (VPP) are developed by the Minister for Planning under the PE Act and form the basis for all local planning schemes. The VPP provides the framework, standard provisions and State planning policy, with input from local councils, incorporated documents, planning zones and overlays, for inclusion into any new or amended planning scheme. Amendments to the VPP are made to keep policies current with relevant changes throughout local government.

Lake Moodemere, Sunday Creek and the proposed pipeline and Hells Gate regulator works all fall under land designated as public conservation and resource zone by the Indigo Shire Council. A bushfire management overlay is present across the northern area of the study site however does not include the proposed Hells Gate regulator.

Native vegetation occurs within the study site. The requirement for a planning permit to remove native vegetation is detailed in Particular Provision: Clause 52.17 - Native vegetation of the c. In all instances where a planning permit is required under this clause, the Guidelines and the three-step approach outlined in Section 4.3 below must be applied.

#### **6.2.6.2 Environmental planning Overlays**

The entire study site is included within an Environmental Significance Overlay with a schedule attached to this overlay pertaining specifically to Lake Moodemere and surrounds (ESO 2). This schedule highlights the following environmental objectives to be achieved:

- To maintain and protect the diversity of native fauna and remnant vegetation.
- To recognise and protect conservation attributes of Lake Moodemere.
- To protect and enhance the rural setting surrounding Lake Moodemere.
- To protect the Lake from inappropriate development.
- To maintain and enhance the recreational use of the land for the enjoyment of all visitors.

With the exception of the western most point of the Hells Gate regulator access track the study site also occurs within a Floodway Overlay.

Clarification should be sought from Council and the North East CMA regarding works and building requirements within these overlays and zones. A permit from Indigo Shire will be required to carry out the proposed vegetation removal.

### **6.3 Victoria's Guidelines for the removal, destruction or lopping of native vegetation**

The Guidelines were incorporated into the Victorian Planning Provisions and all planning schemes in Victoria in December 2017 (DELWP 2017a).

#### **6.3.1 Three-step approach**

Under the Guidelines, all applications for a permit to remove native vegetation in Victoria must follow a three-step approach:

1. Avoid the removal, destruction or lopping of native vegetation;
2. Minimise impacts from the removal, destruction or lopping of native vegetation that cannot be avoided; and
3. Provide an offset to compensate for the biodiversity impact from the removal, destruction or lopping of native vegetation.

In accordance with the Guidelines, an application to remove native vegetation must clearly demonstrate that no options exist to further avoid and minimise the impacts of native vegetation removal, that will not undermine the objectives of the proposed use or development (DELWP 2017a).

#### **6.3.2 Avoid and Minimise Statement**

The following Avoid and Minimise Statement has been developed in accordance with the decision guidelines outlined in Table 2, page 17 of the *Assessor's handbook for applications to remove, destroy or lop native vegetation* (DELWP 2017b).

The study site encompasses three areas that will see the construction of new and upgrades to existing infrastructure (the project) namely:

- Murray River pump station: Construction of a new purpose built 36ML/day 3-phase electric pump station to extract water from the Murray River located on the bank of the Murray River to be accessed by the existing Hynes Road.
- Sunday Creek Pipeline: Construction of a 350 m long pipeline (to be buried to a depth of 600mm) to transfer water directly from the proposed Murray River pump station to Sunday Creek south of Hynes Road, bypassing Lake Moodemere and the Northern Marshes. The pipeline alignment has been sited to follow Hynes Road and an existing powerline maintenance track to minimise impacts to native vegetation and fauna habitat. The exact dimensions required for the trenching of the pipeline have yet to be finalised but a highly conservative buffer of 10m either side of the pipeline alignment has been applied to indicate a 'worst case scenario' for calculating native vegetation removal impacts.
- Hells Gate embankment: Construction of a new fixed crest embankment structure at the existing artificial channel between Lake Moodemere and Sunday Creek (known as Hells Gate) (100x100 m construction footprint), which will hydraulically separate Lake Moodemere and Sunday Creek at a water level below 129 m AHD (proposed top of crest).
- Hells Gate Access track: Construction of an approximately 1km long 4 m wide access track required for construction of the proposed Hells Gate regulator. A conservative buffer of 10m either side of the access track has been applied to indicate a 'worst case scenario' for calculating native vegetation removal impacts.
- Murray River-Lake Moodemere regulator: Decommissioning the old pump station and upgrading the existing regulating structure between the Murray River and Lake Moodemere in line with modern safety standards and facilitate the ongoing management of water levels in the lake (40x40 m construction footprint).

The project aims to provide water savings by altering the currently artificial water regime of Lake Moodemere and Sunday Creek. This change will benefit both local irrigators and the environment by means of providing a more efficient water supply in Sunday creek and generating water savings. The project will require the removal of native vegetation and fauna habitat during the construction phase and may indirectly impact floristic and faunal composition of the study site as a result of altering the current water regime.

The proposed project footprint has been designed to impact the smallest area possible to avoid overall impacts on native vegetation and fauna habitat. An initial footprint of vegetation proposed for removal includes 56 large trees and 4.18 ha of native vegetation comprising five EVCs:

- Floodplain Riparian Woodland (EVC 56 -Vulnerable);
- Riverine Grassy Woodland (EVC 295 – Vulnerable);
- Plains Woodland (EVC 803 – Endangered);
- Sedgy Riverine Forest (816 – Vulnerable); and
- Tall Marsh (EVC 821 – Depleted).

The removal of this native vegetation will result in the removal of:

- A segment of endangered EVC within the Victorian Riverina bioregion.
- Up to two FFG protected flora species.
- One FFG Act-listed flora species.

Options for siting for this project are limited, due to the locality of the irrigators and existing infrastructure at the study site. Options for location and design of the new pump were investigated but it was determined that the current design is most suitable for the project.

The project has been designed to minimise the impact on native vegetation. A Fauna Management Plan (FMP) will be developed and implemented to inform aquatic and terrestrial fauna management throughout the construction process/program across the study site.

A detailed CEMP will be implemented to further reduce impacts on the environment. The CEMP will address (at minimum):

- Fencing of native vegetation to be retained;
- Any proposed dewatering in preparation of the works and potential impacts to fauna; and
- Water quality management;

A Sediment and Erosion Control Management Plan (SECMP) will be developed to address erosion and sediment controls including mitigation of potential acid sulphate soils for adjacent waterways (i.e. Sunday Creek, Murray River and Lake Moodemere).

The new water regime is likely to increase the frequency which habitat for mudflat flora develops and result in an increase in habitat quality for several fauna groups.

A Native Vegetation Removal (NVR) report for the project has been obtained from DELWP detailing offset requirements (see Table 12 and Appendix C).

Third Party offsets will be secured via a registered offset broker or RCS's existing registered offset broker. Evidence that offsets are available must be attached to the planning permit application.

### 6.3.3 Application of the Guidelines for this project

The location mapping for the study site (DELWP 2020d) identifies that impacts within the study site are proposed to occur within Location 2. The project proposes to remove 4.18 ha of native vegetation and 75 large trees and as such the project will follow the **detailed** assessment pathway.

An NVR report for the project has been obtained from DELWP using the site condition scores from the native vegetation assessment and provides details of offset requirements. These are summarised in Table 12 and presented in Appendix C.

Table 12: Native vegetation removal details.

Proposed vegetation removal details	
<b>Assessment pathway</b>	Detailed
<b>Extent of removal</b>	4.100 ha
<b>No. large trees to be removed</b>	56
<b>General offset amount</b>	3.487 general habitat units 56 Large trees
<b>Total number of Large trees that offset must protect</b>	75
<b>Minimum strategic biodiversity score</b>	0.661



## 7 Summary and Recommendations

SMEC recommends that GMW undertakes the following next steps for the project:

- Undertake targeted surveys for EPBC Act-listed Mueller Daisy to determine species presence within impact areas;
- Avoid impacts to native vegetation during the detailed design phase wherever practicable, prioritising preservation of threatened species habitat, listed community habitat and large hollow bearing trees;
- Consult with DELWP to determine permit requirements and mitigation measures for potential impacts to listed FFG Act protected species and communities and obtain a permit if required;
- Consult with the Indigo Shire Council regarding obtaining a planning permit for the removal of native vegetation and permit requirements relating to the Environmental Significance Overlay schedule;
- Secure offsets prior to the removal of native vegetation;
- Develop a Fauna Management Plan (FMP) to inform aquatic and terrestrial fauna management throughout the construction process/program across the site that addresses:
  - The salvage and or relocation of aquatic and terrestrial fauna;
  - Preclearance surveys of any fauna habitat prior to construction.
  - Management actions to control any noxious species encountered during the construction or pre-construction process;
  - Mitigation of impacts to and potential enhancement of suitable turtle nesting habitat; and
- Prepare a CEMP for the project that addresses at a minimum:
  - Fencing of native vegetation to be retained;
  - Any proposed dewatering in preparation of the works and potential impacts to fauna;
  - Development of a Sediment and Erosion Control Management Plan (SECMP) to address erosion and sediment controls including mitigation of potential acid sulphate soils for adjacent waterways (i.e. Sunday Creek, Murray River and Lake Moodemere);
  - Water quality management;
  - Avoid and/or minimise vegetation removal and works south of the existing Lake Moodemere regulator to avoid triggering species offsets for Trout Cod which are currently unavailable; and
- Develop a supplementary watering plan to ensure that water levels within Sunday Creek are maintained at a suitable level to support existing biodiversity values during and outside of the irrigation season.

## 7.1 Nomenclature

### 7.1.1 Victorian Biodiversity Atlas data

The VBA database search encompassed a 10 km search radius around the study site. Multiple records for a species at a single location will refer to the most recent record in all tables and mapping associated with this project. Records prior to 1960 have also been removed from the VBA dataset.

### 7.1.2 Flora species

Common and scientific names for plants follow the VBA database (current version).

### 7.1.3 Vegetation communities

Ecological Vegetation Classes (EVCs) are the standard unit for classifying native vegetation types in Victoria. EVCs are characterised by a combination of floristics, lifeforms and ecological characteristics and include a benchmark for the characteristics of the vegetation type in its mature, natural (pre-1750) state (DELWP 2021f).

Other vegetation types that may occur in Victoria include 'ecological communities' listed as threatened on the EPBC Act and 'communities of flora and fauna' (i.e. flora communities) listed as threatened on the FFG Act. These two acts have vegetation classification systems that differ from each other and also from the EVC classification system. As such, any single patch of native vegetation occurring within the study area (or anywhere in Victoria) will be classifiable as a particular EVC and may also be classifiable as a different ecological community under the EPBC Act, and/or as another flora community under the FFG Act.

### 7.1.4 Fauna species

Unless otherwise noted, common and scientific names for terrestrial fauna (mammals, birds, reptiles, amphibians, invertebrates) follow the VBA database (current version).

### 7.1.5 Fauna communities

There is no official classification system for fauna communities in Victoria. Fauna communities known or potentially occurring within the study area or surrounds are only considered in this report if they are listed under either of the EPBC Act and/or the FFG Act, which list a small number of fauna communities that are considered threatened at a national or state level.

## 7.2 Native vegetation descriptions

### 7.2.1 Native vegetation guidelines

The *Guidelines for the removal, destruction or lopping of native vegetation* (the Guidelines, DELWP 2017) are incorporated into the Victoria Planning Provisions and all planning schemes in Victoria (DELWP 2017).

The Guidelines apply a three-step approach (avoid, minimise and offset) as part of a strategic policy to manage the removal of native vegetation, in order to achieve 'no net loss' to biodiversity as a result of the removal, destruction or lopping of native vegetation (DELWP 2017). It is treated as a precautionary approach so that the removal of native vegetation is limited to what is reasonably necessary, and that Victoria's biodiversity is appropriately compensated for any removal of native vegetation that is approved (DELWP 2017).

To assist projects with policy and planning decisions, a number of biodiversity information resources have been developed by DELWP to measure biodiversity values across Victoria and guarantee biodiversity outcomes are delivered in accordance with the Government's investment programs. The following sections provide a summary of each of these information sources that have been used to inform this desktop flora and fauna assessment.

### 7.2.2 Bioregions

Bioregions are a landscape-scale approach to classifying the environment using a range of attributes such as climate, geomorphology, geology, soils and vegetation. There are 28 bioregions identified within Victoria and

each comprises a selection of EVCs and both can be viewed on NatureKit and the NVIM tool (DELWP 2021b, DELWP 2021c).

### 7.2.3 Location categories

There are three location categories that indicate the potential risk to biodiversity for the removal of native vegetation (DELWP 2017). These location categories include Location 3, Location 2 and Location 1 as described below:

**Location 3** – includes locations where the removal of less than 0.5 hectares of native vegetation could have a significant impact on habitat for a rare or threatened species;

**Location 2** – includes locations that are mapped as endangered EVCs and/or sensitive wetlands and coastal areas and are not included in Location 3; and

**Location 1** – includes all remaining locations in Victoria.

### 7.2.4 Native vegetation condition

Native vegetation condition is presented by the condition scores modelled (shown as *Native vegetation condition map*) on the NVIM tool which provides an indication of how relative native vegetation is to its mature, natural state, as represented by benchmarks for the relevant EVCs (DELWP 2018b; DELWP 2021c). These condition scores are also used to calculate biodiversity losses associated with vegetation removal at a site.

### 7.2.5 Assessment pathways

An assessment pathway determines how an application to remove native vegetation may impact biodiversity and the outcome of an application based on the location and extent of the native vegetation to be removed and is shown in Table 13 (DELWP 2017). The three assessment pathways include:

**Basic** – limited impacts on biodiversity;

**Intermediate** – could impact on large trees, endangered EVCs, and sensitive wetlands and coastal areas; and

**Detailed** – could impact on large trees, endangered EVCs, sensitive wetlands and coastal areas, and could significantly impact on habitat for rare or threatened species.

Table 13: Determining the assessment pathway for native vegetation removals.

Extent of Native Vegetation	Location Category		
	Location 1	Location 2	Location 3
Less than 0.5 hectares and not including any large trees	Basic	Intermediate	Detailed
Less than 0.5 hectares and including ≥1 large trees	Intermediate	Intermediate	Detailed
0.5 hectares or more	Detailed	Detailed	Detailed

When native vegetation removal is permitted, an offset must be secured that achieves a no net loss outcome for biodiversity. The type and amount of offset required depends on the native vegetation being removed and the contribution it makes to Victoria's biodiversity.

## 7.3 Habitat for rare or threatened species

A series of *habitat importance maps* have been developed by DELWP to show areas of Victoria that are habitat for rare or threatened species (DELWP 2017). Rare or threatened species are those species listed as critically endangered, endangered, vulnerable or rare on Advisory Lists maintained by DELWP (DSE 2013, DSE 2009, DEPI 2014).

The importance of a site in the landscape as habitat for a rare or threatened species is represented by a habitat importance score (ranging between 0-1). If native vegetation is mapped as habitat for a rare or threatened species, it will have an associated habitat importance score for each species (DELWP 2017).

The presence of modelled habitat for rare or threatened species will therefore contribute to the determination of assessment pathway of an application to remove native vegetation as important habitats are used to calculate biodiversity losses and offset requirements under the Guidelines (DELWP 2017).

## 7.4 Sensitive wetlands

### 7.4.1 DELWP current wetlands

Wetlands in Victoria are shown in the Current wetlands map on the NVIM tool and may be fresh or saline habitats (DELWP 2017).

DELWP defines wetlands as *'areas, whether natural, modified or artificial, subject to permanent or temporary inundation, that hold static or very slow-moving water and develop, or have the potential to develop, biota'*. The boundaries of each wetland indicate the maximum extent of inundation, determined using a combination of site features including extent of inundation in wet conditions, the distribution of hydric soils and geomorphological features such as break of slope (DELWP 2017).

Any areas proposed to be removed which extend within the Current wetlands map area will be treated as a patch of native vegetation and must be offset in accordance with the Guidelines. The Current wetlands map aims to identify wetlands that are normally difficult to identify and accurately assess on site due to natural fluctuations in extent and condition and associated variability throughout the wetting and drying cycles (DELWP 2017).

### 7.4.2 Directory of important wetlands in Australia

The *Directory of Important Wetlands of Australia* is a list of nationally recognised important wetlands with over 150 listed in Victoria. A wetland may be considered nationally important if it meets at least one of the following criteria:

It is a good example of a wetland type occurring within a biogeographic region in Australia;

It plays an important ecological or hydrological role in the natural functioning of a major wetland system or complex; or

It is habitat for animal taxa at a vulnerable stage in their life cycles or provides a refuge when adverse conditions such as drought prevail.

A list of important wetlands in Victoria is available on the Australian Government's DAWE website located here: <http://www.environment.gov.au/cgi-bin/wetlands/search.pl?smode=DOIW> (DAWE 2021b).

### 7.4.3 Ramsar sites

The Convention on Wetlands of International Importance, especially as waterfowl habitat, otherwise known as the Ramsar Convention, came into being in Ramsar, Iran in 1971 and was ratified in 1975 (DAWE 2021c). The convention provides the framework for local, regional and national actions, and international cooperation, for the conservation and wise use of wetlands. Wetlands of international importance are selected based on their international significance in terms of ecology, botany, zoology, limnology and or hydrology.

Australia's Ramsar wetlands were protected under the EPBC Act, as of 16 July 2000, as Matters of National Environmental Significance. The EPBC Act regulates actions that will, or are likely to, have a significant impact on any matter of national environmental significance, which includes the ecological character of a Ramsar wetland. This includes relevant actions that occur outside the boundaries of a Ramsar wetland.

An action that will, or is likely to, have a significant impact on a Ramsar wetland will be subject to a rigorous environmental assessment and approval regime under the EPBC Act.

## 7.5 Migratory and marine species

Migratory species are those animals that migrate to Australia and its external territories or pass through or over Australian waters during their annual migrations. Examples of migratory species are species of birds (e.g. shorebirds, albatrosses and petrels), mammals (e.g. whales) or reptiles (e.g. turtles).

Listed migratory species are those listed in the:

- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention);
- China-Australia Migratory Bird Agreement (CAMBA);
- Japan-Australia Migratory Bird Agreement (JAMBA); and
- Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA).

All listed migratory species are MNES under the EPBC Act. An action will require approval if the action has, will have, or is likely to have, a significant impact on a listed migratory species.

The term 'important habitat', as identified in the *'EPBC Act Policy Statement 1.1 Significant Impact Guidelines—Matters of National Environmental Significance 2009'* (DoE 2013), is a significant component of managing migratory species. The widely recognised approach to identifying internationally important habitat throughout the world is using criteria adopted under the Ramsar Convention (Ramsar 1971).

Further assistance in identifying important habitats and survey guidelines for migratory species and shorebirds is available in *'EPBC Act Policy Statement 3.21—Industry Guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species'* (DoE 2017) and *Referral guideline for 14 birds listed as migratory species under the EPBC Act* (DoE 2015a).

### 7.5.1 Important habitat for migratory shorebirds

Internationally important sites for Migratory Shorebirds of the East Asian-Australasian Flyway (EAAF) consist of wetland and coastal areas that are habitat for one or more migratory shorebird species. Important habitats in Australia for migratory shorebirds under the EPBC Act include those recognised as nationally or internationally important. According to this approach, wetland habitat should be considered internationally important if it regularly supports (DoE 2017):

- 1 per cent of the individuals in a population of one species or subspecies of waterbird; or
- A total abundance of at least 20,000 waterbirds.

The description of nationally important habitat for migratory shorebirds is defined using a similar approach to these international criteria, that is, if it regularly supports (DoE 2017):

- 1 per cent of the flyway population of a single species of migratory shorebird; or
- 2000 migratory shorebirds; or
- 15 migratory shorebird species.

### 7.5.2 Marine species

Under the United Nations Convention on the Law of the Sea, Australia has rights and responsibilities over its ocean territories. A declaration by the Minister for the Environment and Heritage under section 248 of the EPBC Act identifies all species currently listed with Marine status under the Act. It is an offence to kill, injure, take, trade, keep, or move any member of a listed marine species on Australian Government land or in Commonwealth waters without a permit (DAWE 2021d).

## 7.6 Recent legislative changes

### 7.6.1 *Flora and Fauna Guarantee Amendment Act 2019*

The FFG Act has been amended to provide a modern and strengthened framework for the protection of Victoria's biodiversity. The *Flora and Fauna Guarantee Amendment Act 2019* (the Amendment Act) came into effect on June 1, 2020.

The Amendment Act:

- Introduces principles to guide the implementation of the FFG Act, including consideration of the rights and interests of Traditional Owners and the impacts of climate change;
- Requires consideration of biodiversity across government to ensure decisions and policies are made with proper consideration of the potential impacts on biodiversity;
- Clarifies existing powers to determine critical habitat and improves their protection by encouraging cooperative management;
- Gives effect to a consistent national approach to assessing and listing threatened species using the Common Assessment Method (CAM), which will reduce duplication of effort between jurisdictions and facilitate the monitoring and reporting of species' conservation status; and
- Modernises the FFG Act's enforcement framework including stronger penalties.

#### **Flora and Fauna Guarantee Act Regulations**

The FFG Act is supported by the Flora and Fauna Guarantee Regulations 2020. The Regulations were made under section 69 of the FFG Act. The key elements of the Regulations are:

- Eligibility criteria for the listing of taxa, communities of flora or fauna and potentially threatening processes;
- Information that must be included in nominations for the listing of taxa of flora and fauna;
- Decision-making criteria for licences, permits and authorisations consistent with the updated objectives of the Flora and Fauna Guarantee Act; and
- The form of notices, applications and certificates issued under the Act.

#### **Victorian Threatened Species Advisory Lists**

The introduction of the *Flora and Fauna Guarantee Amendment Act 2019* has streamlined the process for identifying and protecting threatened flora and fauna species in Victoria. Previously, Victoria had multiple lists of threatened species - those listed under the FFG Act, and non-statutory lists called the Victorian Threatened Species Advisory Lists. The recent amendments to the FFG Act have removed duplication by establishing a single comprehensive list of threatened flora and fauna species. This will continue to be known as the FFG Act Threatened List.

With the new comprehensive list now in effect, the Advisory lists have been revoked and are not discussed within this report.

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## Appendix A Flora Results

### Key to table:

- EPBC Commonwealth Environment Protection and Biodiversity Conservation Act 1999
- FFG Victorian Flora and Fauna Guarantee Amendment Act 2019
- CaLP Catchment and Land Protection Act 1994

### Likelihood:

- Present Species confirmed present in the study site based on direct observation, specialist knowledge or relevant reports pertaining to the site
- Likely Suitable habitat available to support species populations/individuals, numerous previous records or specialist knowledge of the study site
- Possible Suitable habitat may be available to support species populations/individuals, and some previous records in proximity to the study site
- Unlikely No suitable habitat to support species populations/individuals, or absence/lack of species records in proximity to the study site

### Status of species:

- CR Critically Endangered under the EPBC Act
- EN Endangered under the EPBC Act
- VU Vulnerable under the EPBC Act
- P Listed as protected under the FFG Act
- cr Critically Endangered under the FFG Act
- en Endangered under the FFG Act
- vu Vulnerable under the FFG Act
- thr Threatened under the FFG Act
- CaLP (C) Listed as regionally controlled under the CaLP Act
- CaLP (R) Listed as regionally restricted under the CaLP Act
- WONS Weed of National Significance
- # Native but may be alien species

## Table A1: Flora species recorded during the detailed site assessment

The following species were detected across the three impact areas and the broader study site.

Scientific Name	Common Name	FFG Status	EPBC Act	Status	Study Site	Proposed SC Pipeline	HG Regulator	Existing Regulator
<i>Acacia acinacea s.l.</i>	Gold-dust Wattle			P	x			
<i>Acacia dealbata</i>	Silver Wattle				x			
<i>Acacia implexa</i>	Lightwood Wattle				x			
<i>Acacia paradoxa</i>	Hedge Wattle				x			
<i>Acetosella vulgaris</i>	Sheep Sorrel			*	x	x	x	
<i>Ailanthus altissima</i>	Tree of Heaven			*	x			
<i>Allocasuarina luehmannii</i>	Buloke	vu		P	x			
<i>Aloe maculata</i>	Aloe-vera			*	x			
<i>Alternanthera denticulata s.l.</i>	Lesser Joyweed				x	x	x	x
<i>Amphibromus neesii</i>	Swamp Wallaby-grass				x			
<i>Amyema linophylla subsp. orientalis</i>	Buloke Mistletoe	cr			x			
<i>Anthosachne scabra s.l.</i>	Common Wheat-grass				x			x
<i>Arctotheca calendula</i>	Cape Weed			*	x	x		
<i>Aristida behriana</i>	Brush Wire-grass				x			
<i>Aristida calycina var. calycina</i>	Dark Wire-grass				x	x		
<i>Arthropodium strictum s.l.</i>	Chocolate Lily				x	x		
<i>Asparagus asparagoides</i>	Bridal Creeper			WoNS	x			
<i>Asparagus officinalis</i>	Asparagus			*	x	x		

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<i>Atriplex semibaccata</i>	Berry Saltbush				X			
<i>Austrostipa blackii</i>	Crested Spear-grass				X	X		
<i>Austrostipa scabra</i>	Rough Spear-grass				X	X		
<i>Avena fatua</i>	Wild Oat			*	X	X		X
<i>Avena sativa</i>	Oat			*	X	X		
<i>Azolla pinnata</i>	Ferny Azolla				X	X	X	
<i>Boerhavia dominii</i>	Tah-vine				X			
<i>Bothriochloa macra</i>	Red-leg Grass				X			
<i>Brachychiton populneus subsp. populneus</i>	Kurrajong				X			
<i>Briza maxima</i>	Large Quaking-grass			*	X	X	X	X
<i>Briza minor</i>	Lesser Quaking-grass			*	X	X	X	
<i>Bromus catharticus</i>	Prairie Grass			*	X	X	X	X
<i>Bromus diandrus</i>	Great Brome			*	X	X		
<i>Bromus hordeaceus</i>	Soft Brome			*	X	X		
<i>Bursaria spinosa subsp. spinosa</i>	Sweet Bursaria				X			
<i>Callistemon sieberi</i>	River Bottlebrush				X	X		
<i>Calotis scapigera</i>	Tufted Burr-daisy			P	X		X	
<i>Carduus pycnocephalus</i>	Slender Thistle			*	X	X	X	
<i>Carex bichenoviana</i>	Plains Sedge				X		X	
<i>Carex inversa</i>	Knob Sedge			#	X	X	X	X
<i>Carex tereticaulis</i>	Poong'ort				X		X	X

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<i>Centella cordifolia</i>	Centella				X			
<i>Centipeda cunninghamii</i>	Common Sneezeweed				X	X	X	
<i>Centipeda minima s.l.</i>	Spreading Sneezeweed				X	X	X	
<i>Chenopodium desertorum subsp. microphyllum</i>	Small-leaf Goosefoot				X			
<i>Chenopodium nitrariaceum</i>	Nitre Goosefoot				X		X	
<i>Chloris truncata</i>	Windmill Grass				X	X		
<i>Cirsium vulgare</i>	Spear Thistle			*	X	X		X
<i>Citrullus lanatus</i>	Camel Melon			*	X			
<i>Cycnogeton spp.</i>	Water Ribbons				X			
<i>Cynodon dactylon</i>	Couch			#	X	X		
<i>Cynosurus echinatus</i>	Rough Dogs-tail			*	X			
<i>Cyperus eragrostis</i>	Drain Flat-sedge			*	X	X		X
<i>Damasonium minus</i>	Star Fruit				X			
<i>Dianella tarda</i>	Late-flower Flax-lily	cr			X	X		
<i>Dichanthium sericeum subsp. sericeum</i>	Silky Blue-grass				X			
<i>Dichondra repens</i>	Kidney-weed				X	X		
<i>Dysphania pumilio</i>	Small Crumbweed				X	X	X	
<i>Echinochloa crus-galli</i>	Barnyard Grass			*	X			
<i>Echium plantagineum</i>	Paterson's Curse			*	X	X		
<i>Ehrharta longiflora</i>	Annual Veldt-grass			*	X	X		
<i>Einadia hastata</i>	Saloop				X			

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<i>Einadia nutans</i>	Nodding Saltbush				X			
<i>Eleocharis acuta</i>	Common Spike-sedge				X	X		
<i>Eleocharis gracilis</i>	Slender Spike-sedge				X			
<i>Eleocharis pusilla</i>	Small Spike-sedge				X	X		
<i>Eleocharis sphacelata</i>	Tall Spike-sedge				X			
<i>Enchylaena tomentosa</i> var. <i>tomentosa</i>	Ruby Saltbush				X			
<i>Enteropogon acicularis</i>	Spider Grass				X	X		
<i>Epilobium billardioreanum</i> subsp. <i>cinereum</i>	Grey Willow-herb				X	X		
<i>Eragrostis brownii</i>	Common Love-grass				X	X		
<i>Eragrostis elongata</i>	Close-headed Love-grass				X	X		
<i>Erigeron bonariensis</i>	Flaxleaf Fleabane			*	X	X		X
<i>Erigeron sumatrensis</i>	Tall Fleabane			*	X	X		X
<i>Eucalyptus camaldulensis</i>	River Red-gum				X	X	X	X
<i>Eucalyptus microcarpa</i>	Grey Box				X			
<i>Eulalia aurea</i>	Silky Browntop				X	X		
<i>Euphorbia dallachyana</i>	Caustic Weed				X	X		
<i>Euphorbia lathyris</i>	Caper Spurge			*	X		X	
<i>Goodenia humilis</i>	Swamp Goodenia				X			
<i>Gratiola peruviana</i>	Austral Brooklime				X			
<i>Heliotropium europaeum</i>	Common Heliotrope			*	X	X	X	
<i>Hordeum leporinum</i>	Barley-grass			*	X	X		

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<i>Hypericum perforatum subsp. veronense</i>	St John's Wort			*	X			
<i>Hypochaeris glabra</i>	Smooth Cat's-ear			*	X	X		
<i>Hypochaeris radicata</i>	Flatweed			*	X	X		
<i>Isotoma fluviatilis subsp. australis</i>	Swamp Isotome				X			
<i>Juncus amabilis</i>	Hollow Rush				X	X	X	
<i>Juncus ingens</i>	Giant Rush				X		X	
<i>Juncus remotiflorus</i>	Remote-flowered Rush				X		X	
<i>Kickxia elatine</i>	Hairy Toad-flax			*	X		X	
<i>Lachnagrostis filiformis s.l.</i>	Common Blown-grass				X	X		
<i>Lactuca serriola</i>	Prickly Lettuce			*	X	X	X	
<i>Lepidium africanum</i>	Common Peppergrass			*	X			
<i>Leptorhynchos squamatus subsp. squamatus</i>	Scaly Buttons			P	X			
<i>Lobelia concolor</i>	Poison Pratia				X			
<i>Lolium spp.</i>	Rye Grass			*	X	X	X	X
<i>Lomandra filiformis subsp. filiformis</i>	Wattle Mat-rush				X	X		
<i>Ludwigia peploides subsp. montevidensis</i>	Clove-strip			#	X	X	X	
<i>Lycium ferocissimum</i>	African Box-thorn			WoNS	X			
<i>Lythrum hyssopifolia</i>	Small Loosestrife				X	X		X
<i>Maireana enchylaenoides</i>	Wingless Bluebush				X			
<i>Malva parviflora</i>	Small-flowered Mallow			*	X	X		

Appendix A Threatened Flora

<i>Marrubium vulgare</i>	Horehound			*	X			
<i>Marsilea costulifera</i>	Narrow-leaf Nardoo				X			
<i>Mentha diemenica</i>	Slender Mint				X			
<i>Mentha pulegium</i>	Common Pennyroyal			*	X			
<i>Modiola caroliniana</i>	Red-flower Mallow			*	X			
<i>Myoporum insulare</i>	Common Boobiolla				X			X
<i>Myriophyllum crispatum</i>	Upright Water-milfoil				X			
<i>Nassella neesiana</i>	Chilean Needle-grass			WoNS	X	X		
<i>Opuntia stricta</i>	Common Prickly-pear			WoNS	X		X	
<i>Ottelia ovalifolia subsp. ovalifolia</i>	Swamp Lily				X			
<i>Oxalis perennans</i>	Grassland Wood-sorrel				X	X	X	X
<i>Paspalidium jubiflorum</i>	Warrego Summer-grass				X			
<i>Paspalum dilatatum</i>	Paspalum			*	X	X		
<i>Paspalum distichum</i>	Water Couch			*	X			
<i>Persicaria hydropiper</i>	Water Pepper			#	X			
<i>Persicaria prostrata</i>	Creeping Knotweed				X	X		
<i>Phragmites australis</i>	Common Reed				X	X		
<i>Phyla nodiflora</i>	Fogfruit			*	X			
<i>Plantago lanceolata</i>	Ribwort			*	X	X		
<i>Plantago major</i>	Greater Plantain			*	X			
<i>Poa labillardierei</i>	Common Tussock-grass				X		X	X
<i>Polygonum aviculare s.l.</i>	Prostrate Knotweed			*	X			



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<i>Populus alba</i>	White Poplar			*	X	X		
<i>Portulaca oleracea</i>	Pigweed			#	X			
<i>Prunus sp.</i>	Plum			*	X			
<i>Pseudoraphis spinescens</i>	Spiny Mud-grass				X		X	
<i>Ranunculus inundatus</i>	River Buttercup				X			
<i>Rhagodia spinescens</i>	Spiny Saltbush				X			
<i>Cardamine moirensis</i>	<i>Riverina Bitter-cress</i>	en			X		X	
<i>Romulea rosea</i>	Onion Grass			*	X	X		
<i>Rosa rubiginosa</i>	Sweet Briar			*	X	X		
<i>Rumex brownii</i>	Slender Dock				X	X		
<i>Rumex crispus</i>	Curled Dock			*	X	X		
<i>Rytidosperma erianthum</i>	Hill Wallaby-grass				X			
<i>Rytidosperma racemosum var. racemosum</i>	Clustered Wallaby-grass				X	X		X
<i>Rytidosperma richardsonii</i>	Straw Wallaby-grass	en			X	X		
<i>Rytidosperma setaceum</i>	Bristly Wallaby-grass				X	X		
<i>Salix sp.</i>	Willow			WoNS	X			
<i>Schinus molle</i>	Pepper Tree			*	X			
<i>Senecio quadridentatus</i>	Cottony Fireweed			P	X		X	
<i>Senna artemisioides</i>	Silver Cassia				X		X	
<i>Setaria parviflora</i>	Slender Pigeon-grass			*	X			
<i>Sida corrugata</i>	Variable Sida				X		X	

**Appendix A Threatened Flora**

<i>Silybum marianum</i>	Variegated Thistle			*	X		X	
<i>Solanum pseudocapsicum</i>	Madeira Winter-cherry			*	X			
<i>Solanum spp.</i>	Nightshade				X		X	
<i>Sonchus asper s.l.</i>	Rough Sow-thistle			*	X	X		
<i>Sonchus oleracea</i>	Common Sow-thistle			*	X	X		
<i>Spirodela punctata</i>	Thin Duckweed				X		X	X
<i>Tribulus terrestris</i>	Caltrop			*	X			
<i>Tricoryne elatior</i>	Yellow Rush-lily				X	X		X
<i>Trifolium angustifolium var. angustifolium</i>	Narrow-leaf Clover			*	X	X		
<i>Trifolium arvense var. arvense</i>	Hare's-foot Clover			*	X	X		
<i>Trifolium fragiferum var. fragiferum</i>	Strawberry Clover			*	X	X		
<i>Trifolium subterraneum</i>	Subterranean Clover			*	X	X		
<i>Verbena bonariensis</i>	Purple-top Verbena			*	X		X	
<i>Vitis vinifera</i>	Grapevine			*	X			
<i>Vittadinia cuneata</i>	Fuzzy New Holland Daisy			P	X	X		
<i>Vulpia myuros f. myuros</i>	Rat's-tail Fescue			*	X	X		
<i>Wahlenbergia fluminalis</i>	River Bluebell				X	X		
<i>Xanthium spinosum</i>	Bathurst Burr			*	X		X	

Table A2: Threatened flora species previously recorded within the study area

Scientific Name	Common Name	EPBC Act	FFG Act	No. Records	Last Record	Habitat description and likelihood of occurrence
<i>Allocasuarina luehmannii</i>	Buloke	-	vu	4	1999	Present adjacent to study site within plains woodland EVC 803.
<i>Amphibromus fluitans</i>	River Swamp Wallaby-grass	VU	-	Unknown	2011 (Aus Ecosystems)	Previously recorded within study site. Largely confined to permanent swamps, principally along the Murray River between Wodonga and Echuca. Most likely to be associated with higher quality occurrences of EVCs 653 and 810.
<i>Amyema linophylla subsp. orientalis</i>	Buloke Mistletoe	-	cr	3	2001	Present adjacent to study site within plains woodland EVC 803.
<i>Brachyscome muelleroides</i>	Mueller Daisy	VU	-	Unknown	2011 (Aus Ecosystems)	Previously recorded within study site. In Victoria confined to floodplains of the Murray River and its tributaries, from Tocumwal east to the Ovens River. Most likely to be associated with Sedgy Riverine Forest EVC 816.
<i>Cardamine moirensis</i>	Riverina Bitter-cress	-	en	Unknown	2011 (Aus Ecosystems)	Previously recorded within study site. In Victoria, occurring in the north and west in seasonally wet areas. Most likely to be associated with Floodway Pond Herbland EVC 810 and Aquatic Herbland EVC 653
<i>Hydrilla verticillata</i>	Hydrilla	-	vu	Unknown	2011 (Aus Ecosystems)	Previously recorded within study site. Occurs in still to slow-flowing freshwater of lakes and streams, to a depth of at least 3.5 m. Most likely to be associated with EVC 653 and margins of Lake Moodemere.
<i>Lepidium monoplacoides</i>	Winged Pepper-cress	EN	en	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of previous records within the study area. Uncommon in north-western quarter of State, mostly on heavy soils near lakes and watercourses.
<i>Myoporum montanum</i>	Waterbush	-	en	7	1986	Unlikely, not recorded within suitable habitat surveyed and remaining habitat is considered poor quality. Scattered across northern Victoria where uncommon to rather rare. Mostly in mallee and riparian woodland communities but also in rocky gorges.
<i>Nymphoides crenata</i>	Wavy Marshwort	-	en	Unknown	2011 (Aus Ecosystems)	Previously recorded within study site. Occurs in fresh, still to slow-flowing water to 1.5 m deep in swamps, lagoons, irrigation channels and streams, also frequent in temporarily inundated depressions. Most likely to be associated with Aquatic Herbland EVC 653 and Floodway pond Herbland EVC 810.
<i>Prasophyllum validum</i>	Sturdy Leek-orchid, Mount Remarkable Leek-orchid	VU	-	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of previous records within the study area.
<i>Rytidosperma richardsonii</i>	Straw Wallaby-grass	-	en	1	2017	Present within study site within Riverine Grassy Woodland EVC 295.
<i>Sclerolaena napiformis</i>	Turnip Copperburr	EN	-	N/A	N/A - PMST only	Unlikely, absence of suitable habitat and lack of previous records within the study area. Known only from a few populations in remnant grassland on clay-loam soils in north-central Victoria in

Appendix A Threatened Flora

Scientific Name	Common Name	EPBC Act	FFG Act	No. Records	Last Record	Habitat description and likelihood of occurrence
						the Echuca-Nathalia area, and between Donald and Stawell in the west
<i>Senecio macrocarpus</i>	Large-fruit Fireweed, Large-fruit Groundsel	VU	cr	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of previous records within the study area. Largely confined to <i>Themeda</i> grasslands on loamy clay soils derived from basalt near Melbourne, west to Skipton area. Also known from auriferous ground near Stawell.
<i>Swainsona recta</i>	Small Purple-pea	EN	-	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of previous records within the study area. Previously recorded in Victoria from low hill country in north and north-east but known only from 1 recent (1995) collection near Glenrowan.

# Appendix B Threatened Fauna

## Key to table:

- EPBC Commonwealth Environment Protection and Biodiversity Conservation Act 1999
- FFG Victorian Flora and Fauna Guarantee Act 1988

## Likelihood:

- **Present:** Species confirmed present in the study site based on direct observation, specialist knowledge or relevant reports pertaining to the site
- **Likely:** Suitable habitat available to support species populations/individuals, numerous previous records or specialist knowledge of the study site
- **Possible:** Suitable habitat may be available to support species populations/individuals, and some previous records in proximity to the study site
- **Unlikely:** No suitable habitat to support species populations/individuals, or absence/lack of species records in proximity to the study site

## Status of species:

- CR Critically Endangered under the EPBC Act
- EN Endangered under the EPBC Act
- VU Vulnerable under the EPBC Act
- Mi Migratory under the EPBC Act
- Ma Marine under the EPBC Act
- cr Critically Endangered under the FFG Act
- en Endangered under the FFG Act
- vu Vulnerable under the FFG Act
- \* Introduced

## Table B1: Fauna species recorded during the site assessment

**Note:** The following species were recorded across the study site. Due to the mobile nature of most of these species it is likely that any one species utilises all suitable habitat across the study site including within impact areas.

Common Name	Scientific Name	Taxon	EPBC	FFG	Mi/Ma
Red-bellied Black Snake	<i>Pseudechis porphyriacus</i>	Reptiles	-	-	-
Eastern Snake-necked Turtle	<i>Chelodina longicollis</i>	Reptiles	-	-	-
Broad-shelled turtle	<i>Chelodina expansa</i>	Reptiles	-	en	-
Murray River turtle	<i>Emydura macquarii</i>	Reptiles	-	cr	-
Boulenger's Skink	<i>Morethia boulengeri</i>	Reptiles	-	-	-
Eastern Brown Snake	<i>Pseudonaja textilis</i>	Reptiles	-	-	-
Common blue-tongued Lizard	<i>Tiliqua scincoides</i>	Reptiles	-	-	-
Long-eared Bat	<i>Nyctophilus</i> sp.	Mammals	-	-	-
Water Rat	<i>Hydromys chrysogaster</i>	Mammals	-	-	-
Common Brush-tailed Possum	<i>Trichosurus vulpecula</i>	Mammals	-	-	-
Eastern Ring-tailed Possum	<i>Pseudocheirus peregrinus</i>	Mammals	-	-	-
Black-tailed Wallaby	<i>Wallabia bicolor</i>	Mammals	-	-	-
European Brown Hare	<i>Lepus europaeus</i>	Mammals	-	*	-
Domestic Cat (feral)	<i>Felis catus</i>	Mammals	-	*	-
Ride's Free-tailed Bat	<i>Ozimops ridei</i>	Mammals	-	-	-
Southern Free-tailed Bat	<i>Ozimops planiceps</i>	Mammals	-	-	-
White-striped Free-tailed Bat	<i>Austronomus australis</i>	Mammals	-	-	-
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Mammals	-	-	-
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Mammals	-	-	-
Eastern Grey Kangaroo	<i>Macropus giganteus</i>	Mammals	-	-	-
Platypus	<i>Ornithorhynchus anatinus</i>	Mammals	-	vu	-
European Rabbit	<i>Oryctolagus cuniculus</i>	Mammals	-	*	-
Little Broad-nosed Bat	<i>Scotorepens greyii</i>	Mammals	-	-	-
Large Forest Bat	<i>Vespadelus darlingtoni</i>	Mammals	-	-	-
Little Forest Bat	<i>Vespadelus vulturnus</i>	Mammals	-	-	-
Red Fox	<i>Vulpes vulpes</i>	Mammals	-	*	-
Common Yabby	<i>Cherax destructor destructor</i>	Invertebrate	-	-	-
Unspecked Hardyhead	<i>Craterocephalus stercusmuscarum fulvus</i>	Fish	-	-	-

**Appendix B Threatened Fauna**

Flatheaded Gudgeon	<i>Philypnodon grandiceps</i>	Fish	-	-	-
Redfin	<i>Perca fluviatilis</i>	Fish	-	*	-
Oriental Weatherloach	<i>Misgurnus anguillicaudatus</i>	Fish	-	*	-
European Carp	<i>Cyprinus carpio</i>	Fish	-	*	-
Eastern Gambusia	<i>Gambusia holbrooki</i>	Fish	-	*	-
Goldfish	<i>Carassius auratus</i>	Fish	-	*	-
Western Carp Gudgeon (Species Complex)	<i>Hypseleotris klunzingeri</i>	Fish	-	-	-
Plumed Egret	<i>Ardea intermedia plumifera</i>	Birds	-	cr	-
Eastern Shrike-tit	<i>Falcunculus frontatus</i>	Birds	-	-	-
Oriental Dollarbird	<i>Eurystomus orientalis</i>	Birds	-	-	-
Superb Fairy-wren	<i>Malurus cyaneus</i>	Birds	-	-	-
Black-faced Cuckoo-shrike	<i>Coracina novaehollandiae</i>	Birds	-	-	-
White-bellied Cuckoo-shrike	<i>Coracina papuensis</i>	Birds	-	-	-
Grey Shrike-thrush	<i>Colluricincla harmonica</i>	Birds	-	-	-
Reed-Warbler	<i>Acrocephalus australis</i>	Birds	-	-	-
Australian Owlet-nightjar	<i>Aegotheles cristatus</i>	Birds	-	-	-
Yellow-rumped Thornbill	<i>Acanthiza chrysorrhoa</i>	Birds	-	-	-
Striated Thornbill	<i>Acanthiza lineata</i>	Birds	-	-	-
Yellow Thornbill	<i>Acanthiza nana</i>	Birds	-	-	-
Buff-rumped Thornbill	<i>Acanthiza reguloides</i>	Birds	-	-	-
Eastern Spinebill	<i>Acanthorhynchus tenuirostris</i>	Birds	-	-	-
Collared Sparrowhawk	<i>Accipiter cirrocephalus</i>	Birds	-	-	-
Brown Goshawk	<i>Accipiter fasciatus</i>	Birds	-	-	-
Common Myna	<i>Acridotheres tristis</i>	Birds	-	*	-
Australian King-Parrot	<i>Alisterus scapularis</i>	Birds	-	-	-
Grey Teal	<i>Anas gracilis</i>	Birds	-	-	-
Pacific Black Duck	<i>Anas superciliosa</i>	Birds	-	-	-
Australasian Darter	<i>Anhinga novaehollandiae</i>	Birds	-	-	-
Red Wattlebird	<i>Anthochaera carunculata</i>	Birds	-	-	-
Wedge-tailed Eagle	<i>Aquila audax</i>	Birds	-	-	-
Great Egret	<i>Ardea alba</i>	Birds	-	-	Ma
White-necked Heron	<i>Ardea pacifica</i>	Birds	-	-	-
Dusky Woodswallow	<i>Artamus cyanopterus</i>	Birds	-	-	-

**Appendix B Threatened Fauna**

Hardhead	<i>Aythya australis</i>	Birds	-	vu	-
Musk Duck	<i>Biziura lobata</i>	Birds	-	vu	-
Sulphur-crested Cockatoo	<i>Cacatua galerita</i>	Birds	-	-	-
Little Corella	<i>Cacatua sanguinea</i>	Birds	-	-	-
Long-billed Corella	<i>Cacatua tenuirostris</i>	Birds	-	-	-
Fan-tailed Cuckoo	<i>Cacomantis flabelliformis</i>	Birds	-	-	-
Yellow-faced Honeyeater	<i>Caligavis chrysops</i>	Birds	-	-	-
European Goldfinch	<i>Carduelis carduelis</i>	Birds	-	*	-
Azure Kingfisher	<i>Ceyx azureus</i>	Birds	-	-	-
Australian Wood Duck	<i>Chenonetta jubata</i>	Birds	-	-	-
Silver Gull	<i>Chroicocephalus novaehollandiae</i>	Birds	-	-	-
Swamp Harrier	<i>Circus approximans</i>	Birds	-	-	-
Brown Treecreeper	<i>Climacteris picumnus</i>	Birds	-	-	-
White-winged Chough	<i>Corcorax melanorhamphos</i>	Birds	-	-	-
White-throated Treecreeper	<i>Cormobates leucophaea</i>	Birds	-	-	-
Australian Raven	<i>Corvus coronoides</i>	Birds	-	-	-
Little Raven	<i>Corvus mellori</i>	Birds	-	-	-
Pied Butcherbird	<i>Cracticus nigrogularis</i>	Birds	-	-	-
Grey Butcherbird	<i>Cracticus torquatus</i>	Birds	-	-	-
Black Swan	<i>Cygnus atratus</i>	Birds	-	-	-
Laughing Kookaburra	<i>Dacelo novaeguineae</i>	Birds	-	-	-
Varied Sittella	<i>Daphoenositta chrysoptera</i>	Birds	-	-	-
Mistletoebird	<i>Dicaeum hirundinaceum</i>	Birds	-	-	-
White-faced Heron	<i>Egretta novaehollandiae</i>	Birds	-	-	-
Black-shouldered Kite	<i>Elanus axillaris</i>	Birds	-	-	-
Black-fronted Dotterel	<i>Euseyonis melanops</i>	Birds	-	-	-
Galah	<i>Eolophus roseicapilla</i>	Birds	-	-	-
Brown Falcon	<i>Falco berigora</i>	Birds	-	-	-
Nankeen Kestrel	<i>Falco cenchroides</i>	Birds	-	-	-
Australian Hobby	<i>Falco longipennis</i>	Birds	-	-	-
Peregrine Falcon	<i>Falco peregrinus</i>	Birds	-	-	-
Eurasian Coot	<i>Fulica atra</i>	Birds	-	-	-
Dusky Moorhen	<i>Gallinula tenebrosa</i>	Birds	-	-	-



**Appendix B Threatened Fauna**

Peaceful Dove	<i>Geopelia placida</i>	Birds	-	-	-
Western Gerygone	<i>Gerygone fusca</i>	Birds	-	-	-
Magpie-lark	<i>Grallina cyanoleuca</i>	Birds	-	-	-
Australian Magpie	<i>Gymnorhina tibicen</i>	Birds	-	-	-
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	Birds	-	en	Ma
Whistling Kite	<i>Haliastur sphenurus</i>	Birds	-	-	-
Welcome Swallow	<i>Hirundo neoxena</i>	Birds	-	-	-
Buff-banded Rail	<i>Hypotaenidia philippensis</i>	Birds	-	-	-
Pink-eared Duck	<i>Malacorhynchus membranaceus</i>	Birds	-	-	-
Noisy Miner	<i>Manorina melanocephala</i>	Birds	-	-	-
Brown-headed Honeyeater	<i>Melithreptus brevirostris</i>	Birds	-	-	-
White-naped Honeyeater	<i>Melithreptus lunatus</i>	Birds	-	-	-
Rainbow Bee-eater	<i>Merops ornatus</i>	Birds	-	-	Ma
Little Pied Cormorant	<i>Microcarbo melanoleucos</i>	Birds	-	-	-
Restless Flycatcher	<i>Myiagra inquieta</i>	Birds	-	-	-
Red-browed Finch	<i>Neochmia temporalis</i>	Birds	-	-	-
Southern Boobook	<i>Ninox boobook</i>	Birds	-	-	-
Nankeen Night-Heron	<i>Nycticorax caledonicus</i>	Birds	-	-	-
Crested Pigeon	<i>Ocyphaps lophotes</i>	Birds	-	-	-
Olive-backed Oriole	<i>Oriolus sagittatus</i>	Birds	-	-	-
Golden Whistler	<i>Pachycephala pectoralis</i>	Birds	-	-	-
Rufous Whistler	<i>Pachycephala rufiventris</i>	Birds	-	-	-
Spotted Pardalote	<i>Pardalotus punctatus</i>	Birds	-	-	-
Striated Pardalote	<i>Pardalotus striatus</i>	Birds	-	-	-
House Sparrow	<i>Passer domesticus</i>	Birds	-	*	-
Australian Pelican	<i>Pelecanus conspicillatus</i>	Birds	-	-	-
Fairy Martin	<i>Petrochelidon ariel</i>	Birds	-	-	-
Tree Martin	<i>Petrochelidon nigricans</i>	Birds	-	-	-
Great Cormorant	<i>Phalacrocorax carbo</i>	Birds	-	-	-
Little Black Cormorant	<i>Phalacrocorax sulcirostris</i>	Birds	-	-	-
Pied Cormorant	<i>Phalacrocorax varius</i>	Birds	-	-	-
Little Friarbird	<i>Philemon citreogularis</i>	Birds	-	-	-
Noisy Friarbird	<i>Philemon corniculatus</i>	Birds	-	-	-

**Appendix B Threatened Fauna**

Yellow-billed Spoonbill	<i>Platalea flavipes</i>	Birds	-	-	-
Royal Spoonbill	<i>Platalea regia</i>	Birds	-	-	-
Crimson Rosella	<i>Platycercus elegans</i>	Birds	-	-	-
Eastern Rosella	<i>Platycercus eximius</i>	Birds	-	-	-
Tawny Frogmouth	<i>Podargus strigoides</i>	Birds	-	-	-
Little Grassbird	<i>Poodytes gramineus</i>	Birds	-	-	-
Australasian Swamphen	<i>Porphyrio melanotus</i>	Birds	-	-	-
Red-rumped Parrot	<i>Psephotus haematonotus</i>	Birds	-	-	-
White-plumed Honeyeater	<i>Ptilotula penicillata</i>	Birds	-	-	-
Australian smelt	<i>Retropinna sp.1</i>	Birds	-	-	-
Grey Fantail	<i>Rhipidura albiscapa</i>	Birds	-	-	-
Willie Wagtail	<i>Rhipidura leucophrys</i>	Birds	-	-	-
White-browed Scrubwren	<i>Sericornis frontalis</i>	Birds	-	-	-
Weebill	<i>Smicronis brevirostris</i>	Birds	-	-	-
Australasian Shoveler	<i>Spatula rhynchotis</i>	Birds	-	vu	-
Spotted Dove	<i>Spilopelia chinensis</i>	Birds	-	*	-
Diamond Firetail	<i>Stagonopleura guttata</i>	Birds	-	vu	-
Pied Currawong	<i>Strepera graculina</i>	Birds	-	-	-
Common Starling	<i>Sturnus vulgaris</i>	Birds	-	*	-
Australasian Grebe	<i>Tachybaptus novaehollandiae</i>	Birds	-	-	-
Australian Shelduck	<i>Tadorna tadornoides</i>	Birds	-	-	-
Australian White Ibis	<i>Threskiornis molucca</i>	Birds	-	-	-
Straw-necked Ibis	<i>Threskiornis spinicollis</i>	Birds	-	-	-
Sacred Kingfisher	<i>Todiramphus sanctus</i>	Birds	-	-	-
Common Blackbird	<i>Turdus merula</i>	Birds	-	*	-
Barn Owl	<i>Tyto alba</i>	Birds	-	-	-
Masked Lapwing	<i>Vanellus miles</i>	Birds	-	-	-
Silvereye	<i>Zosterops lateralis</i>	Birds	-	-	-
Sloane's Froglet	<i>Crinia sloanei</i>	Amphibia ns	EN	en	-
Spotted Marsh Frog (race unknown)	<i>Limnodynastes tasmaniensis</i>	Amphibia ns	-	-	-
Southern Bullfrog (ssp. unknown)	<i>Limnodynastes dumerilii</i>	Amphibia ns	-	-	-

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Smooth Toadlet	<i>Uperoleia laevigata</i>	Amphibia ns	-	-	-
Southern Brown Tree Frog	<i>Litoria ewingii</i>	Amphibia ns	-	-	-
Eastern Sign-bearing Froglet	<i>Crinia parinsignifera</i>	Amphibia ns	-	-	-
Common Froglet	<i>Crinia signifera</i>	Amphibia ns	-	-	-
Striped Marsh Frog	<i>Limnodynastes peronii</i>	Amphibia ns	-	-	-
Peron's Tree Frog	<i>Litoria peronii</i>	Amphibia ns	-	-	-
Common Spadefoot Toad	<i>Neobatrachus sudellae</i>	Amphibia ns	-	-	-

Table B2: Threatened and marine/migratory fauna species previously recorded within the study area

Common Name	Scientific Name	EPBC Act	FFG Act	Mi/Ma	No. Records	Last Record	Habitat Description and likelihood of occurrence
<b>Amphibians</b>							
Brown Toadlet	<i>Pseudophryne bibronii</i>	-	en	-	4	1964	Unlikely, lack of previous recent records within study site. Occurs in dry forest, woodland and grassland habitat, where they shelter under leaf litter in damp depressions.
Growling Grass Frog	<i>Litoria raniformis</i>	VU	vu	-	-	N/A – PMST only	Unlikely, previous targeted surveys failed to detect species. Occurs in still or slow-flowing waterbodies with a high cover of emergent and submerged vegetation. Can be found in agricultural and pastoral land with permanent waterbodies providing there is sufficient cover of emergent, fringing or submerged vegetation.
Sloane's Froglet	<i>Crinia sloanei</i>	EN	en	-	Unknown	2011 (Aus Ecosystems)	Likely, previously recorded within study site. Recorded from widely scattered sites in the floodplains of the Murray-Darling Basin, with the majority of records in the Darling Riverine Plains, NSW South Western Slopes and Riverina bioregions in New South Wales. It is typically associated with periodically inundated areas in grassland, woodland and disturbed habitats.
<b>Birds</b>							
Apostlebird	<i>Struthidea cinerea</i>	-	vu	-	9	2018	Likely, recent records within study area and suitable habitat present across study site.
Australasian Bittern	<i>Botaurus poiciloptilus</i>	EN	cr	-	-	N/A- PMST only	Unlikely, lack of suitable wetland habitat within the study site. Suitable habitat may develop as water levels recede. Frequents wetlands with dense reedbeds, and other vegetation in water such as cumbungi, lignum, rushes and sedges.
Australasian Shoveler	<i>Spatula rhynchotis</i>	-	vu	-	27	2019	Likely, recent records within study area and suitable habitat present across study site. Prefers large, deep open freshwater lakes and dams with dense vegetated margins for breeding.
Australian Painted-snipe	<i>Rostratula australis</i>	EN	cr	-	-	N/A – PMST only	Possible, suitable wetland habitat within the study site. Inhabits many different types of shallow, brackish or freshwater terrestrial wetlands. Suitable wetlands usually support a mosaic of low, patchy vegetation, as well as lignum and canegrass.

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Common Name	Scientific Name	EPBC Act	FFG Act	Mi/Ma	No. Records	Last Record	Habitat Description and likelihood of occurrence
Barking Owl	<i>Ninox connivens</i>	-	cr	-	3	1996	Possible, previously recorded in study area and suitable woodland habitat present. Occurs in open woodlands and open forests, including Box Ironbark and riparian River Red Gum habitats, as well as some foothill habitats on granitic slopes.
Black Falcon	<i>Falco subniger</i>	-	cr	-	2	2000	Likely, previously recorded within study area and suitable woodland habitat present within study site. Found along tree-lined watercourses and in isolated woodlands, mainly in arid and semi-arid areas. It roosts in trees at night and often on power poles by day.
Blue-billed Duck	<i>Oxyura australis</i>	-	vu	-	11	2019	Likely, recently recorded within study area and suitable wetland habitat present within the study site. Prefers large, deep open freshwater lakes and dams with dense vegetated margins for breeding.
Brolga	<i>Antigone rubicunda</i>	-	en	-	3	2019	Likely, recently recorded within study area and suitable wetland habitat present within the study site. Prefers large open wetlands, grassy plains, coastal mudflats and irrigated croplands and, less frequently, mangrove-studded creeks and estuaries.
Common Greenshank	<i>Tringa nebularia</i>	-	en	-	-	N/A - PMST only	Unlikely, lack of suitable wetland and mudflat habitat. Occur both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops.
Common Sandpiper	<i>Actitis hypoleucos</i>	-	vu	Mi/Ma	-	N/A - PMST only	Unlikely, lack of suitable wetland and mudflat habitat. Found on intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters.
Curlew Sandpiper	<i>Calidris ferruginea</i>	CR	cr	Mi/Ma	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of records for this species from within the study area. Found on intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters.
Diamond Dove	<i>Geopelia cuneata</i>	-	vu	-	2	1979	Possible, suitable habitat present within study site. Prefers open savannah or open riparian woodland.
Diamond Firetail	<i>Stagonopleura guttata</i>	-	vu	-	5	2019	Present within study site. Found in open grassy woodland, heath and farmland or grassland with scattered trees.
Eastern Curlew, Far Eastern Curlew	<i>Numenius madagascariensis</i>	CR	cr	Mi/Ma	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of records for this species from within the study area. Found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons.
Eastern Great Egret	<i>Ardea alba modesta</i>	-	vu	-	8	2018	Unlikely, lack of suitable wetland habitat. Prefer shallow water but may be seen on any watered area, including damp grasslands.
Fork-tailed Swift	<i>Apus pacificus</i>	-		Mi/Ma	-	N/A - PMST only	Possible, flyover only. The Fork-tailed Swift is a non-breeding visitor to all states and territories of Australia, widespread but sparsely scattered in all regions of Victoria. almost exclusively aerial, flying from less than 1 m to at least 300 m above ground and probably much higher.

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Common Name	Scientific Name	EPBC Act	FFG Act	Mi/Ma	No. Records	Last Record	Habitat Description and likelihood of occurrence
Freckled Duck	<i>Stictonetta naevosa</i>	-	en	-	6	2005	Likely, previously recorded with study area and suitable wetland habitat present within study site. Prefers large, deep open freshwater lakes and dams with dense vegetated margins for breeding.
Grey Falcon	<i>Falco hypoleucos</i>	VU	vu	-	-	N/A - PMST only	Unlikely, suitable habitat present however not previously recorded within study area. Usually restricted to shrubland, grassland and wooded watercourses of arid and semi-arid regions, although it is occasionally found in open woodlands near the coast.
Grey Goshawk	<i>Accipiter novaehollandiae</i>	-	en	-	1	1978	Unlikely, suitable habitat present however not recently recorded within study area. Found in most forest types, especially tall closed forests, including rainforests.
Grey-crowned Babbler	<i>Pomatostomus temporalis</i>	-	vu	-	37	2021	Likely, recently recorded within study area and suitable habitat present within study site. Found in open forests and woodlands, favouring inland plains with an open shrub layer, little ground cover and plenty of fallen timber and leaf litter.
Hardhead	<i>Aythya australis</i>	-	vu	-	38	2019	Likely, recently recorded within study area and suitable wetland habitat present within the study site. Prefers large, deep open freshwater lakes and dams with dense vegetated margins for breeding.
Hooded Robin	<i>Melanodryas cucullata</i>	-	vu	-	2	2001	Possible, suitable habitat present adjacent to study site. Found in lightly timbered woodland, mainly dominated by acacia and/or eucalypts.
Latham's Snipe, Japanese Snipe	<i>Gallinago hardwickii</i>	-		Mi/Ma	-	N/A - PMST only	Unlikely, lack of suitable wetland habitat. Suitable habitat may develop as water levels recede. Latham's Snipe are seen in small groups or singly in freshwater wetlands on or near the coast, generally among dense cover. They are found in any vegetation around wetlands, in sedges, grasses, lignum, reeds and rushes and also in saltmarsh and creek edges on migration. They also use crops and pasture.
Little Eagle	<i>Hieraaetus morphnoides</i>	-	vu	-	14	2009	Likely, previously recorded within study area and suitable woodland habitat present within study site. Found in Mid and Lower Murray Valley where wetlands and irrigated farmlands adjoin River Red Gum woodlands and forests. Little Eagles are absent from areas of high urbanisation and dense forests, and more abundant in open woodland.
Magpie Goose	<i>Anseranas semipalmata</i>	-	vu	-	7	2019	Likely, recently recorded within study area and suitable wetland habitat present within the study site. Frequents floodplains and wet grasslands. Some individuals may be seen at quite long distances inland.
Musk Duck	<i>Biziura lobata</i>	-	vu	-	14	2007	Present within study site. Prefers large, deep open freshwater lakes and dams with dense vegetated margins for breeding.
Painted Honeyeater	<i>Grantiella picta</i>	VU	vu	-	-	N/A - PMST only	Unlikely, whilst suitable woodland habitat present adjacent to study site the species has not been previously recorded in the

Appendix B Threatened Fauna

Common Name	Scientific Name	EPBC Act	FFG Act	Mi/Ma	No. Records	Last Record	Habitat Description and likelihood of occurrence
							study area. Occurs in box-gum woodland and box-ironbark forests with high presence of mistletoe for foraging.
Pectoral Sandpiper	<i>Calidris melanotos</i>	-		Mi/Ma	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of records for this species from within the study area. Suitable habitat may develop as water levels recede. In Australasia, the Pectoral Sandpiper prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands.
Plains-wanderer	<i>Pedionomus torquatus</i>	CR	cr	-	-	N/A - PMST only	Unlikely, no previous records and lack of suitable habitat. Inhabits open, sparse swards and grasslands. Now mostly restricted to the Victorian Northern Plains. Does not persist in areas of improved pasture or if grass cover becomes too thick.
Plumed Egret	<i>Ardea intermedia plumifera</i>	-	cr	-	1	2006	Likely, previously recorded within study area and suitable wetland habitat present within the study site. Can be found at wetlands throughout the northern third of the continent as well as the eastern third. Mostly a denizen of the shallows in terrestrial wetlands, it prefers freshwater swamps, billabongs, floodplains and wet grasslands with dense aquatic vegetation, and is only occasionally seen in estuarine or intertidal habitats.
Regent Honeyeater	<i>Anthochaera phrygia</i>	CR	cr	-	1	2014	Possible, presence of suitable woodland habitat comprising suitable foraging trees and previous records within study area. Occurs in dry open forest or woodlands comprising Ironbark, Yellow Box, White and Yellow Gum.
Satin Flycatcher	<i>Myiagra cyanoleuca</i>	-		Mi/Ma	-	N/A - PMST only	Unlikely, lack of suitable habitat and no previous records. Satin Flycatcher is widespread in eastern Australia. Satin Flycatchers inhabit heavily vegetated gullies in eucalypt-dominated forests and taller woodlands, and on migration, occur in coastal forests, woodlands, mangroves and drier woodlands and open forests.
Sharp-tailed Sandpiper	<i>Calidris acuminata</i>	-		Mi/Ma	-	N/A - PMST only	Unlikely, lack of suitable wetland habitat. Suitable habitat may develop as water levels recede. Sharp-tailed Sandpiper are widespread in most regions of Victoria, especially in coastal areas, but they are sparse in north-east and north-central Victoria. They forage and roost at the edge of the water of wetlands or intertidal mudflats, either on bare wet mud or sand, or in shallow water and require dense vegetation or shelter to roost.
Superb Parrot	<i>Polytelis swainsonii</i>	VU	en	-	-	N/A - PMST only	Unlikely, whilst suitable woodland habitat present within and adjacent to study site the species has not been previously recorded in the study area. Occurs along timbered waterways and nearby well-watered woodlands, particularly River Red-gum.
Swift Parrot	<i>Lathamus discolor</i>	CR	cr	-	-	N/A - PMST only	Unlikely, whilst suitable woodland habitat present within and adjacent to study site the species has not been previously recorded in the study area.. Migrates to mainland Australia in

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Common Name	Scientific Name	EPBC Act	FFG Act	Mi/Ma	No. Records	Last Record	Habitat Description and likelihood of occurrence
White-bellied Sea-Eagle	<i>Haliaeetus leucogaster</i>	-	en	-	29	2019	winter. Forages in dry sclerophyll forests and woodlands, suburban parks and gardens and flowering fruit trees. Presumed present within study area due to recent records and suitable habitat. Commonly found in coastal and near coastal areas of Australia. Normally seen perched high in a tree or soaring over waterways and adjacent land.
White-throated Needletail	<i>Hirundapus caudacutus</i>	VU	vu	Mi/Ma	3	1994	Possible, this highly aerial species may use the airspace above the study area for foraging, and possibly use woodland habitat for roosting on an occasional basis. This species is highly aerial and occurs over a variety of habitat types. White-throated Needletail enters Australia during summer from its winter breeding grounds throughout northern Asia. Their migration path runs along both sides of the Great Dividing Range and can travel as far south as Tasmania.
Yellow Wagtail	<i>Motacilla flava</i>	-	-	Mi/Ma	-	N/A - PMST only	Unlikely, lack of previous records for this species from within the study area. Widespread wagtail, favouring wet meadows, marshland, grassy and muddy lakeshores. Occurs in fields and often near livestock during migration.
<b>Fish</b>							
Flathead Galaxias, Beaked Minnow, Flat-headed Galaxias, Flat-headed Jollytail, Flat-headed Minnow	<i>Galaxias rostratus</i>	CR	vu	-	1	2010	Unlikely, previous targeted surveys in 2011 and 2022 failed to detect this species. Occurs in Murray system in still or gently flowing waters, lakes, billabongs and backwaters. Substrate of coarse sand and mud with debris and near aquatic vegetation.
Freshwater Catfish	<i>Tandanus tandanus</i>	-	en	-	1	2014	Unlikely, previous targeted surveys in 2011 and 2022 failed to detect this species. Endemic to the Murray-Darling Basin, translocated population in the Yarra River.
Murray Cod	<i>Maccullochella peelii</i>	VU	en	-	78	2010	Unlikely to occur within Sunday Creek, Lake Moodemere or Northern Marshes, previous targeted surveys in 2011 and 2022 failed to detect this species.  Present within the Murray River. Endemic to the Murray-Darling Basin, translocated population in the Yarra River.
Trout Cod	<i>Maccullochella macquariensis</i>	EN	en	-	-	N/A - PMST only	Unlikely to occur within Sunday Creek, Lake Moodemere or Northern Marshes, previous targeted surveys in 2011 and 2022 failed to detect this species. Assumed present within the Murray River. Endemic to the Murray-Darling Basin.
<b>Invertebrates</b>							



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Common Name	Scientific Name	EPBC Act	FFG Act	Mi/Ma	No. Records	Last Record	Habitat Description and likelihood of occurrence
Golden Sun Moth	<i>Synemon plana</i>	VU	vu	-	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of records for this species from within the study area. Occurs in grassland dominated by wallaby grasses ( <i>Rytidosperma</i> spp.) or Chilean Needle Grass ( <i>Nassella neesiana</i> ).
<b>Mammals</b>							
Koala	<i>Phascolarctos cinereus</i>	VU	-	-	-	N/A - PMST only	Unlikely, No previous records within study area. Inhabit eucalypt woodlands and forest.
Grey-headed Flying-fox	<i>Pteropus poliocephalus</i>	VU	vu	-	-	N/A - PMST only	Unlikely, suitable habitat present adjacent to the study site however no previous records in study area. Widely distributed across eastern Australia feeding on nectar from a variety of eucalypt species and fruits in rainforest habitats and farmland.
Platypus	<i>Ornithorhynchus anatinus</i>	-	vu	-	1	1982	Assumed present within Sunday Creek. Platypus is endemic to Australia and is dependent on rivers, streams and bodies of freshwater. They feed in both slow-moving and rapid (riffle) parts of streams, but show preference to coarser bottom substrates, particularly cobbles and gravel. When not foraging, the Platypus spends most of the time in its burrow in the bank of the river, creek or a pond.
Spot-tailed Quoll, Spotted-tail Quoll, Tiger Quoll	<i>Dasyurus maculatus maculatus</i>	EN	en	-	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of records for this species from within the study area. Occurs in forested areas with suitable denning sites (i.e. rocky outcrops, caves, hollow logs etc.).
Corben's Long-eared Bat	<i>Nyctophilus corbeni</i>	VU	-	-	-	N/A - PMST only	Unlikely, absence of suitable habitat and lack of records for this species from within the study area. Most common in box, ironbark and cypress pine woodland on the western slopes and plains. Its stronghold seems to be the Pilliga Scrub. It roosts in tree hollows, crevices and under loose bark. It is a slow flying agile bat that hunts for non-flying prey, especially caterpillars and beetles.
Yellow Bellied Sheathtail Bat	<i>Saccolaimus flaviventris</i>	-	vu	-	1	2008	Possible, suitable roosting habitat is present within the study site and the species has been previously recorded within the study area. Yellow-bellied sheath-tailed bats are a cavity-roosting species and are generally reliant on old-growth forest hollows. However, they have been known to opportunistically use abandoned animal burrows and human structures, and roost under dry clay and rock, though generally only solitary bats have been observed to do this.
<b>Reptiles</b>							
Broad-shelled Turtle	<i>Chelodina expansa</i>	-	en	-	22	2022 (Austral)	Present within study site. Found in permanent bodies of fresh water in the Murray-Darling River system.
Murray River Turtle		-	cr	-	82	2022 (Austral)	Present within study site. Found in permanent bodies of fresh water in the Murray-Darling River system.

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Common Name	Scientific Name	EPBC Act	FFG Act	Mi/Ma	No. Records	Last Record	Habitat Description and likelihood of occurrence
Pink-tailed Worm-Lizard	<i>Aprasia parapulchella</i>	VU	en	-	-	N/A - PMST only	Unlikely, habitat may occur adjacent to the study site however there have been no previous records within the study area. Habitat includes primary and secondary grassland, grassy woodland and woodland communities, and the species usually inhabits sloping sites that contain rocky outcrops or scattered, partially buried rocks.

Table 14: Significant impact assessment for Murray Cod (Austral 2022)

Significant impact criteria	Response
<b>Lead to a long-term decrease in the size of an important population of a species.</b>	The proposed action <b>will not</b> decrease the overall breeding capacity of Murray cod. The proposed action will not lead to a long-term decrease in the size of an important population of a species.
<b>Reduce the area of occupancy of an important population.</b>	The area proposed to be impacted is less than one percent of the current area of occupancy for Murray cod. It is also understood that the current natural flood regime will not be impeded by the proposed action. Natural flooding will allow the movement of fish into, and out of the study area post implementation of the proposed action. The proposed action <b>will not</b> reduce the area of occupancy of an important population.
<b>Fragment an existing important population into two or more populations.</b>	The proposed action <b>will not</b> fragment an existing important population into two or more populations.
<b>Adversely affect habitat critical to the survival of a species.</b>	Whilst Murray cod may intermittently breed in this area the habitat that is proposed to be impacted is <b>not considered habitat critical to the survival of the species</b> . Natural flooding will allow the movement of fish into, and out of the study area post implementation of the proposed action which will allow Murray cod to breed within the study area post implementation of the proposed action.
<b>Disrupt the breeding cycle of an important population.</b>	Whilst Murray cod may intermittently breed within the study area the habitat within the study area is not considered 'critical breeding habitat'. Natural flooding will allow the movement of fish into, and out of the study area post implementation of the proposed action which will allow Murray cod to breed within the study area post implementation of the proposed action. The proposed action <b>will not</b> disrupt the breeding cycle of an important population.
<b>Modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.</b>	The proposed action will impact only a small area of 'non-critical habitat'. Natural flooding will allow the movement of fish into, and out of the study area post implementation of the proposed action allowing Murray cod to continue to utilise the study area. The proposed action <b>will not</b> modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.
<b>Result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.</b>	The proposed action <b>will not</b> result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.
<b>Introduce disease that may cause the species to decline.</b>	The proposed action <b>will not</b> introduce disease that may cause the species to decline.
<b>Interfere substantially with the recovery of the species.</b>	The proposed action <b>will not</b> interfere substantially with the recovery of the species.

# Appendix C    **Native Vegetation Removal Report**

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