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Growling Grass Frog Management Plan

Pettavel Basin Upgrade Project

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Ecological Limitations

The site assessment was undertaken in November and December 2023. This is considered to be an optimal time of year for conducting targeted Growling Grass Frog surveys flora and fauna surveys as many ephemeral flora species are flowering and visible.

Use of Databases

The Victorian Biodiversity Atlas (VBA) database and other databases can be 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 (≤ 1km). Thus, the database search may not pick up some records of species that were made within the site historically.
- 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 ≤1980 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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1. Introduction

1.1 Background

SMEC Australia Pty Ltd (SMEC) was commissioned by CMP Consulting Group Pty Ltd (CMP) to develop a management plan for Growling Grass Frog (***Litoria raniformis***) for the Pettavel Basin Upgrade Project, Victoria (the Project) (Figure 1). The species is listed as Vulnerable under the federal ***Environment Protection and Biodiversity Conservation Act 1999*** (EPBC Act).

Targeted surveys for Growling Grass Frog were undertaken in the study site as part of the environmental assessment completed for the Project (SMEC 2024). A breeding population of Growling Grass Frog was detected within the borrow pit wetland, which is proposed to be removed and replaced with a new water retention basin. As part of the Project, a new wetland will be constructed prior to excavation of the borrow pit wetland. The new wetland will support the species habitat requirements for breeding, refuge and foraging habitat in accordance with industry standards for the species. Growling Grass Frog will be captured prior to and during excavation of the borrow pit wetland and relocated to the new wetland.

This document provides guidelines for the construction of a new Growling Grass Frog wetland, provides methodology for the capture and relocation of Growling Grass Frog, and outlines additional measures to minimise and mitigate potential impacts to the species.

The information contained in this plan will be incorporated and consolidated into a Construction Environment Management Plan (CEMP) for the Project, to be prepared by the successful civil contractor. A suitably qualified ecologist must be engaged to implement the actions described in this plan.

1.2 Description of proposed works

The Project aims to increase the water storage capacity of the existing Pettavel water storage facility through the construction of a new 100 ML basin (Basin No. 3). This new water storage is required to meet future demand of the growing populations of Armstrong Creek, Leopold the Bellarine and Surf Coast. The proposed work s are situated on a 25 ha parcel of land on the corner of Draytons Road and Reservoir Road, Waurn Ponds that has been used as a water storage facility by Barwon Water for over 70 years. The proposed works include the following:

- The existing borrow pit wetland will be removed, with Proposed Basin No. 3 constructed in its place.
- An overflow detention storage basin will be constructed to receive water overflow from Proposed Basin No. 3.
- A Growling Grass Frog wetland will be installed.

A description of each of these project components is provided below. A timeline of the proposed works is as follows (detailed timeline provided in Appendix 1):

- Construction of Growling Grass Frog wetland – September 2024.
- Planting wetland vegetation – October 2024.
- Construction of overflow detention storage – October 2024.
- Removal of borrow pit wetland and construction of Proposed Basin No. 3 – April 2025.

Borrow pit wetland

The Project area is located within the Pettavel Basin. Initially, the site was an earthen reservoir. The earthen reservoir was drained sometime prior to 1980 to transition the site to a water storage facility, and two water storage basins were constructed (Basin No. 1 and Basin No. 2).

The walls of the two basins were constructed using soil that was excavated from an area in the north of the site. This excavation left a hole known as a 'borrow pit'. With little disturbance in 20 years, the borrow pit has developed into a wetland system fringed with native vegetation. The borrow pit wetland supports a diversity of native flora and fauna species, including a breeding population of the EPBC Act-listed Growling Grass Frog.

Habitat surrounding the wetland is primarily mown pasture or introduced grasses with limited habitat value for native flora or fauna.

Proposed Basin No.3

Proposed Basin No.3 is proposed to be installed with existing inlet and outlet pipework extended to the eastern embankment and western embankments. A detailed overview of the proposed construction works is provided in Appendix 2. The new earthen basin will include the following functional requirements:

- Geomembrane liner and cover material to protect the potable water from contamination.
- Geosynthetic underlay to facilitate drainage and protect the liner.
- Extension of existing Basin No. 2 access track along the crest of the new embankment.
- New access track around all three basins to accommodate site operation and maintenance requirements, such as new above-ground control valves installed on the inlet pipework.
- An overflow weir structure and discharge at the north-west corner of the basin.

Growling Grass Frog wetland

As part of the Project, a new wetland will be installed, designed specifically to provide habitat for Growling Grass Frog. The wetland includes the following design aspects to serve as an alternative habitat for the Growling Grass Frog. Appendix 2 shows the proposed design of this wetland in relation to the overall Pettavel Basin No. 3 within the study site:

- Located adjacent to and operates in conjunction with the existing site drainage network, to facilitate the permanent submergent zone.
- Receives all site hydrology from north and west of Basin No.3, as well as the cover stormwater discharge from Basins No.2 and 3 and is expected to have a permanent hydroperiod. A hydrology assessment and sub catchment plan is provided in Appendix 2.
- Total surface area of 7,900m², including a:
  - Submergent vegetation zone of 2,400m² where the water is at least 2m deep.
  - Emergent vegetation zone of 1,200m² with semi-aquatic plantings and refuge habitat(s).
  - Terrestrial zone buffer surrounding 4,300m² emergent vegetation zone.
- Clay liner to facilitate the permanent submergent zone.
- Suitable aquatic and terrestrial habitat as per industry/DEECA guidelines – i.e. Vegetation, rock features, slopes, etc.
- A secondary terrestrial buffer zone will be construction to the west of this wetland, supporting approximately 11,000m² of rehabilitated and maintained grassy areas for the overflow detention storage basin.

Overflow detention storage basin

An earthen storage is required to detain discharge if the Basin No.3 overflow operates, and the footprint of this storage is shown in Figure 2. This overflow detention storage basin is proposed to be installed following the planting phase of the wetland, which means it can also be fenced off from the construction works associated with Basin No. 3. In addition, this means the area act as additional and protected secondary terrestrial habitat once the Growling Grass Frogs have been captured and relocated within this fenced area.

1.3 Growling Grass Frog

Conservation Status

EPBC Act: Vulnerable
FFG Act: Vulnerable



Image 1: Growling Grass Frog (Source: Dan Weller, SMEC, 2021).

Description

Growling Grass Frog is also commonly known as the Southern Bell Frog, Green and Golden Frog and Warty Swamp Frog. The species is a large diurnal frog that can be distinguished by its bright to olive-green colour, warty back (with brown blotches in the adult), dorso-lateral fold, and distinct tympanum (ear) (DCCEEW 2024).

Growling Grass Frogs generally breed between November to March, following local flooding and a rise in water levels. This rise in water levels triggers breeding males to begin calling for females (DCCEEW 2024). Eggs are laid within days of breeding and tadpoles hatch between 2–4 days later (DCCEEW 2024). The metamorphosis stage of the tadpoles generally takes approximately three months, however, may take up to 12 months in exceptional circumstances (DCCEEW 2024). In Victoria, most tadpoles have emerged as frogs by the end of May (SWIFFT 2024).

Growling Grass Frog can be a highly mobile species, capable of moving up to 1 km over a 24-hour period (DCCEEW 2024). When restricted to small, permanent waterbodies, dispersal is low where they tend to move shorter distances indicating high site fidelity. Conversely, when occupying ephemeral waterbodies, Growling Grass Frog are likely to disperse more and travel further distances to reach other suitable wetland habitat (SWIFFT 2024).

Growling Grass Frog are carnivorous where their diet ranges from invertebrates, small fish, small reptiles and other amphibians, even Growling Grass Frog young in rare circumstances (DCCEEW 2024).

Distribution and habitat

Growling Grass Frog is distributed across south-eastern Australia, being found in New South Wales (Riverina area), Victoria, Tasmania, and south-eastern South Australia. In Victoria, the species has isolated populations in the greater Melbourne area and across areas in south-western Victoria (SWIFFT 2024). Growling Grass Frog has experienced a significant range reduction in recent decades where this species is now considered locally extinct in most areas of Victoria (DCCEEW 2024).

Growling Grass Frog occur in still or slow-moving waterbodies with emergent and fringing vegetation and mats of floating or submerged plants (SWIFFT 2024). They can inhabit artificial waterbodies, such as farm dams, irrigation channels and disused quarries. High quality habitat includes abundant aquatic vegetation and minimal tree canopy cover, with open areas for basking (SWIFFT 2024). Grass and shrub cover on the banks are also important for the emerging froglets to gain protection from predators and to acquire insect prey as a food source (SWIFFT 2024).

Species occurrence in the locality

There are four previous records for Growling Grass Frog from within 10km of the study site, most recently from 2019. Surveys were undertaken between November 2023 and January 2024 in the borrow pit wetland within the site (SMEC 2024), with a breeding population of Growling Grass Frog detected (Figure 2).

Key threats

The principal threats to Growling Grass Frog include habitat loss and Chytridiomycosis disease through the following impacts (SWIFFT 2023):

- Draining, filling or barriers to movement of waterbodies;
- Reduced water quality and increased salinity, phosphate and nitrate concentrations;
- Loss of terrestrial habitat through heavy stock grazing; and
- Introduced fish and climate change.

2. Growling Grass Frog Management Plan

The Growling Grass Frog Management Plan is divided into three separate construction phases; pre-construction, construction and post-construction. A timeline of actions described in this plan is provided in Appendix 1.

2.1 Pre-construction phase

The following measures are to be implemented prior to construction commencing.

2.1.1 EPBC Act referral

A referral under the EPBC Act will be submitted in March 2024. The proposed timelines described above and in Appendix 2 have been developed based on an assumption that the Project is deemed not to be a controlled action, with a response provided by the Minister in May 2024. The submission of the EPBC Act referral and the Minister's decision are noted as hold points in Appendix 1.

2.1.2 Site induction

All site personnel (including sub-contractors) are required to attend a compulsory site induction that includes an environmental component prior to commencing work on-site. This is so that all personnel involved in the Project are aware of sensitive environmental values present on site, specifically Growling Grass Frog and its habitat.

Records of all environment inductions will be maintained and kept on-site. The Site Supervisor may authorise amendments to the induction at any time, as well as refresher training. Possible reasons for changes to the induction may include project scope adjustment and legislative changes, or as part of corrective actions following an incident.

2.2 Construction phase

2.2.1 Growling Grass Frog wetland

The construction of a new wetland is proposed to compensate for the loss of Growling Grass Frog habitat associated with the Project. The wetland must be designed in accordance with the Growling Grass Frog habitat design standards provided in Section 3.1.

The new wetland is to be constructed in advance of the excavation of the borrow pit wetland such that there is alternative Growling Grass Frog habitat available on site when the borrow pit wetland is removed. This will be achieved as follows (details in Appendix 1):

- September 2024: Construction of new Growling Grass Frog wetland (details in Section 3.1).
- October 2024: Vegetation planting and habitat installation (details in Section 3.1). This must be conducted by a suitably qualified contractor with experience in the creation of habitat for Growling Grass Frog.
- October 2024: Construction of overflow detention storage basin.
- January, April, July and October 2025: Monitoring and management of wetland during the vegetation establishment phase. Occurs every three months for the first year to ensure that plantings achieve the densities outlined in the design standards (details in Section 3.2). This must be conducted by a suitably qualified contractor with experience in the monitoring of habitat for Growling Grass Frog.
- March 2025: Growling Grass Frog capture and relocation prior to habitat removal, during wetland dewatering and during habitat removal (details in Section 2.2.4.2).
- April 2025: Removal of the borrow pit wetland.

A case study demonstrating the rapid establishment of a constructed wetland is supplied in Appendix 3. The wetland was planted in September 2019 and plants were in an advanced state of establishment by April 2020 (information supplied by Australian Ecosystems).

2.2.2 Frog exclusion fencing

Frog exclusion fencing must be installed between the habitat to be removed and the new Growling Grass Frog wetland to deter frogs from entering construction zones for Basin No.3. The appropriate location for frog fencing is shown in Figure 2 (and will extend to the property boundary or as directed by an ecologist). The following describes the requirements for frog fencing:

- Frog fencing should be at least 0.5 m high (up to 1 m where possible) and have an overhanging lip (between horizontal to 45° downwards) of at least 100 mm on the side facing the wetland, to prevent frogs from climbing over the fence.
- The bottom of the fence should be buried at least 100 mm into the soil.
- The frog fence should consist of a single piece of material from the top of the lip to the bottom of the buried section to ensure there are no holes through which frogs could pass.
- Permanent frog fencing should use opaque sheeting (e.g., high-density polyethylene). Where drainage needs to be achieved through the fence it can have small perforations, with a maximum diameter of 10 mm to prevents the movement of juvenile frogs.
- Temporary frog fencing should use standard sediment fencing (i.e., geotextile/silt fence).
- Frogs will use adjacent vegetation and structures to climb up and over the fence:
  - Vegetation within one metre of the fence must be kept lower than 0.5 metres in height. Only low-growing grasses should be planted at this location, or ideally no vegetation if possible.
  - Structures or refugia (e.g. logs or rock piles) must be placed at least one metre away from the fence.
  - Litter or other debris caught in fencing should be removed as it could assist frogs to climb over.
- Frog fencing can be stand-alone or affixed to another fence.

2.2.3 Management of Chytrid fungus

Given the proposed construction works will be undertaken in an area with a known population of Growling Grass Frog, the potential for humans and associated equipment to aid in the transmission and spread of diseases, specifically Chytrid fungus (***Batrachochytrium dendrobatidis***), must be treated with appropriate caution.

The following hygiene information has been developed using recommendations and associated reference documents (Phillott et al. 2010; Murray et al. 2011). The following hygiene precautions are required to minimise the possibility of transfer of disease from personnel, footwear, equipment and/or vehicles.

2.2.3.1 Training

All workers and sub-contractors will need to be fully committed to implementing the following controls. All workers and sub-contractors will undergo inductions and awareness training to ensure compliance with these protocols.

2.2.3.2 Sites and duration

All sites within the wetland must be treated individually with respect to hygiene protocols, the movement of personnel or equipment must implement the methods outlined below and applies during pre-construction, construction and site rehabilitation phases at each site. Wetlands or streams separated by dry land should be considered separate sites. Any obvious break, barrier or change in habitat should be treated as a separate site.

2.2.3.3 Soil and water

Utilising town water for construction works is an appropriate measure to reduce risk of chytrid transfer between sites.

This will also apply to use of topsoil on site: any soil extracted must be re-used at the same site or removed completely. No topsoil from natural or offsite sources is to be brought onto site to further reduce the risk of chytrid transfer to sites.

2.2.3.4 Clothing and footwear

It is expected that staff and equipment will arrive on site at the commencement of works free of any soil or mud. This basic hygiene protocol must also be undertaken when travelling or relocating between sites. Hands, arms, knees etc. will be cleaned to remove debris and washed or wiped with a suitable disinfectant.

All site personnel must clean and disinfect their footwear before entering and exiting each site at the boot-wash station. That is, direct removal of any soil and using a foot dip station soaked for 1 minute in water and disinfectant solution (1% bleach or 0.075% phytoclean) (Phillott et al. 2010; Murray et al. 2011). Footwear cleaning and biosecurity measures must be undertaken daily every time a person arrives or departs a site. Clothing that has significant contact with the environment must also be changed and cleaned before reuse at site (i.e. machine washed for 30 mins at 60°C).

2.2.3.5 Vehicles, plant and equipment

All vehicles, plant and equipment must be cleaned of all soil, vegetation and debris, and disinfected prior to entering and/or exiting site. Disinfection will include tracks or wheels, wheel arches and any other part of the vehicle that may come in contact with soil. No construction machinery or site personnel are to enter site once established unless appropriate biosecurity measures have been implemented.

Once washed, vehicles will then be considered 'clean' for the duration of the works, if they leave then they will be required to re-wash on the next time of entry to the site (or between sites). Any equipment (tools) that are used are to be wiped clean of any mud or soil and disinfected with water and disinfectant solution (1% bleach or 0.075% phytoclean) before starting at a given site (and cleaned again between sites). Disinfection must be carried out at a safe distance from water bodies to minimise the risk of chemical contamination.

2.2.3.6 Records

All plant and vehicle wash-downs will be recorded in a wash-down logbook for compliance purposes. Regular compliance checks and spot checks for adherence to the above hygiene controls will be undertaken by the Site Supervisor, Environmental Manager or nominated site auditor.

2.2.4 Growling Grass Frog capture and relocation

The procedures for Growling Grass Frog capture and relocation are described below. Frogs will be captured in the **source habitat** (the borrow pit wetland) and relocated to the **recipient habitat** (the supplementary Growling Grass Frog wetland).

The following actions must be undertaken prior to any capture and relocation activities:

- The suitability of the recipient habitat to support Growling Grass Frog must first be verified by assessing vegetative characteristics using standard assessment criteria for Growling Grass Frog habitat, assessing water quality parameters and conducting surveys to ensure that exotic fish species are not present. New species habitat must be to an appropriate standard before any capture and relocation of Growling Grass Frog proceed.
- Obtain necessary permits and approvals:
  - Approval to capture, collect and relocate Growling Grass Frog will be required from the Department of Energy, Environment and Climate Action (DEECA) under the Victorian ***Wildlife Act 1975***.
  - DEECA must be informed when the translocation of Growling Grass Frog is to commence.

2.2.4.1 Capture, hold and release procedures

The following capture, hold and release procedures must be followed at all times during the capture and relocation of Growling Grass Frog:

- Capture and relocation must be undertaken by a suitably qualified and experienced ecologist or ecologist.
- Standard hygiene protocols must be adhered to when capturing Growling Grass Frogs (e.g., Murray et al. 2011) to prevent disease transmission.
- Single-use gloves will be used for all frogs to prevent the transfer or pathogens during capture and handling.
- Captured frogs must be held in secure containers or plastic sample bags with adequate air supply for as short a period as possible.
- Captured frogs must be re-located as soon as possible to the recipient wetland. As only on-site relocation will be undertaken, frogs will be transported on foot in their container or sample bags to the recipient wetland.
- Frogs must be released into suitable habitat in the recipient wetland margins, within or adjacent to sheltering habitat such as dense vegetation, rocks or logs.
- All frogs will be visually monitored after release to ensure that they do not show signs of stress or injury. If individuals show such signs, they will continue to be monitored until adequate recovery is evident. If recovery does not become apparent the individual may be re-captured and transported to a veterinarian or wildlife carer for further assessment.

2.2.4.2 Capture and relocation prior to habitat removal

The following describes the capture and relocation actions that must be undertaken prior to the removal of habitat:

- To ensure the safe relocation of as many frogs as possible, the preliminary capture and relocation of Growling Grass Frog will be undertaken during the active period of Growling Grass Frog (September to March), and approximately two weeks prior to the scheduled removal of the source habitat.
- Three days must be spent looking for and capturing adult and sub-adult frogs within the source habitat. Each survey should be conducted for a minimum of 90 minutes and occur when the temperature is above 13ºC and preferably within 24 hours of rain. The survey must consist of nocturnal spotlight searches and daytime searches of habitat and shelter sites (e.g., under dense vegetation, under logs and rocks).
- Immediately following the above relocation actions (i.e., within 24 hours), the source habitat must be dewatered to capture any remaining individuals (Section 2.2.4.3).
- The capture, hold and release procedures described in Section 2.2.4.1 must be followed at all times.

2.2.4.3 Capture and relocation during wetland dewatering

The following describes the capture and relocation actions that must be undertaken during dewatering of the source habitat wetland:

- Wetland dewatering of the source habitat should be undertaken immediately after capture and relocation has been completed (Section 2.2.4.2).
- Prior to commencement of dewatering, appropriate water filters should be fitted to the hoses to prevent aquatic fauna, including frogs, tadpoles and fish, from being sucked up. This could be a mesh placed over or around the water pump inlet and/or hose to effectively exclude fauna.
- Where possible, water should be extracted from close to the water's surface and at least 5 m away from submerged aquatic vegetation to reduce the likelihood of fauna being sucked into the pump.

- The depth of the wetland should be lowered in stages (approx. 15 cm increments). At each stage, the ecologist will actively search soil, vegetation and other ground debris (e.g., rocks and logs) to capture frogs and other fauna, and will use a dip net to capture aquatic fauna as the water is reduced. The ecologist will complete a final rigorous search once the wetland is empty.
- Dewatering is to cease when frogs and/or tadpoles are detected and only commence after capture by a qualified ecologist.
- Once empty, the wetland must be left for two weeks before habitat can be removed. This will give remaining fauna an opportunity to self-relocate.
- If rains partially refill the wetland, the water should be immediately pumped out. If the substrate beneath the wetland is permeable soils, an excavator can be used dig or scrape a hole at the wetland's deepest point to breach the clay liner, enabling rainwater to drain into the ground.
- The capture, hold and release procedures described in Section 2.2.4.1 must be followed at all times.

2.2.4.4 Capture and relocation during habitat removal

The following describes the actions that must be undertaken during the removal of the source habitat, which includes the borrow pit wetland and any vegetation within 30 m of the wetland:

- The removal of the source habitat can be undertaken two weeks after wetland dewatering.
- The vegetation and topsoil are to be carefully removed by an excavator operator who will be briefed by the ecologists on salvage methods. The excavation of the wetland will involve removing terrestrial habitat in the following stages:
  - Prior to commencement of excavation, the ecologist will actively search soil, vegetation and other ground debris (e.g. rocks and logs) for frogs and other fauna.
  - The excavator will scrape the vegetation such that plants are uprooted, enabling the ecologist to search for frogs at the base of plants. The excavator will lift any large rocks and/or logs surrounding the wetland, allowing the ecologist to conduct a thorough search beneath these refugia.
  - The excavator will then scrape the topsoil to a depth of approximately 30 cm, with the ecologist observing closely for excavated or disturbed frogs. The excavator will spread or sprinkle the excavated material in an adjacent area to allow the ecologist to search for frogs in the material.
  - If removal of habitat is expected to take more than one day, a search of habitat and stockpiles will be undertaken each morning before excavation of vegetation and topsoil removal begins.
- Excavation is to cease when frogs and/or tadpoles are detected and only commence after capture by a qualified ecologist.
- The capture, hold and release procedures described in Section 2.2.4.1 must be followed at all times.

2.3 Post construction phase

2.3.1 General

The following general actions must be undertaken post construction:

- Where possible, reinstate disturbed areas to their pre-construction condition, with the exception of water bodies that will be permanently removed. Highly degraded and weedy sites do not need to be reinstated.
- Implement ongoing weed management as required.
- Remove temporary frog fencing.

2.3.2 Growling Grass Frog habitat monitoring and management

Monitoring and management of the constructed wetland must be undertaken to ensure that habitat remains suitable for Growling Grass Frog. Monitoring and management of the supplementary Growling Grass Frog wetland must be undertaken in accordance with requirements in Section 3.

3. Growling Grass Frog habitat design standards

Constructed Growling Grass Frog wetlands should align as far as feasible with the best practice design standards, primarily ***Growling Grass Frog Habitat Design Standards: Melbourne Strategic Assessment*** (DELWP 2017) and ***Design, construction and establishment of constructed wetlands: design manual*** (Melbourne Water 2017).

3.1 Habitat design

Table 1 summarises the Growling Grass Frog habitat design standards (DELWP 2017) and describes how the proposed Project design responds to those standards.

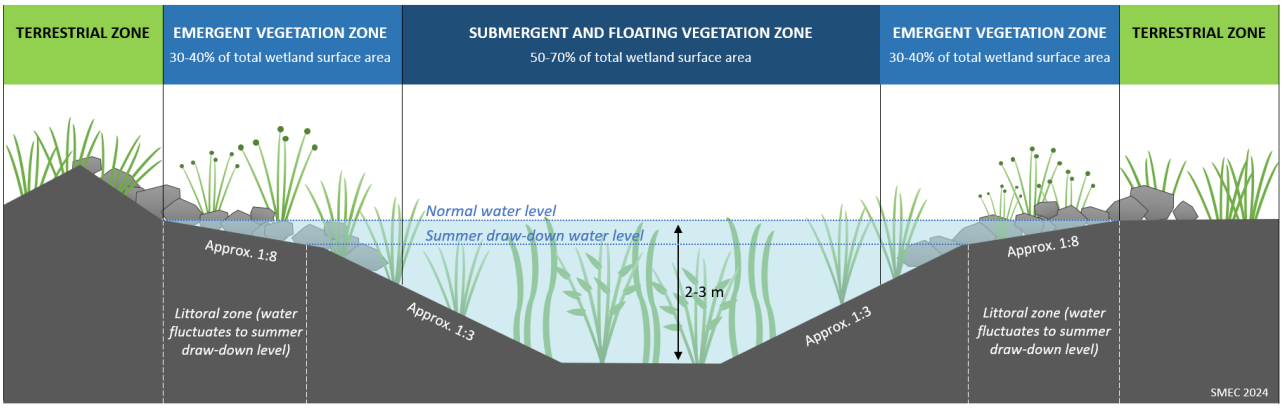
Wetland construction, vegetation planting and habitat installation should be conducted by a suitably qualified contractor with experience in the creation of habitat for Growling Grass Frog.

Table 1: Growling Grass Frog habitat design standards

Design feature	Summary of design standard (DELWP 2017)	Proposed Project design
Size	Constructed wetlands should be designed to be as large as is practicable taking into account the physical constraints of each site. The surface area of the wetland should be at least 0.3 ha, preferably >0.7 ha. Where space is limited the surface area can be reduced to 0.15 ha, however this is not ideal.	The proposed new wetland has a total surface area of 3,600m² (0.36 ha).
Shape	Wetlands should generally be shaped to maximise the area of deep water for submerged and floating vegetation, while providing extensive vegetated and/or rocky margins. Wetlands must be wide enough to meet the required slope and depths.	As shown in Figure 2, the wetland is shaped to maximise the area of deep water.
Depth and gradient	Wetland must incorporate a variety of slopes and depths to achieve the following zones (Figure 1). **Submergent and floating vegetation zone:** Water depth must be at least 1.5–2 m (greater depth is preferred if there is a risk that water levels will reduce significantly through summer). The excavated depth may need to be 3 m or more to ensure the water depth is maintained over time, to address sedimentation, evaporation, etc. Slope approx. 1:3 to achieve appropriate depth. Should constitute at least 50% (preferably 60–70%) of the total wetland surface area. Opportunities to provide rockery/basking habitat on the edge of this zone will be provided in this zone in consultation with a suitably qualified contractor. **Emergent vegetation zone:** Includes a littoral zone with fluctuating water levels (i.e., dropping to summer draw-down level). This zone will include species refuge habitat (i.e. rocks, logs and vegetation). Slope at bank approx. 1:8, increasing to approx. 1:3. Bank slope of 1:8 should be wide enough to accommodate the summer draw-down water level. Should constitute approx. 30-40% of the total wetland surface area. **Terrestrial zone:** Remains dry year-round.	The proposed new wetland has a total surface area of 7,900m² (0.79 ha), including a: • Submergent vegetation zone of 2,400m² (0.24 ha) where the water is at least 2m deep (66% of total wetland area) and 1:3 slope. • Emergent vegetation zone of 1,200m² (0.12 ha) (33% of wetland area) with a 1:8 slope. • Terrestrial zone buffer of 4,300m² (0.43 ha) surrounding the wetland, designed to remain dry year-round. • Secondary terrestrial zone buffer of 11,000m² (1.1 ha) associated with the overflow detention storage basin.
Hydroperiod	Should have a permanent hydroperiod (i.e., maintains appropriate water depth year-round). At a minimum should hold appropriate water depth over the breeding season (September to February).	The proposed new wetland receives all site hydrology from north and west of Basin No.3, as well as the cover stormwater discharge from Basins No.2 and 3. The wetland is expected to have a permanent hydroperiod.

Design feature	Summary of design standard (DELWP 2017)	Proposed Project design
	A permanent hydroperiod is important for a wetland constructed at Pettavel Basin as the wetland is isolated and there is no alternative habitat with a permanent hydroperiod in the local area.	A hydrology assessment and sub catchment plan is provided in Appendix 2.
Wetland lining	Clay liner to prevent leakage. Topsoil to enable vegetation planting.	The proposed new wetland will have a clay liner. Topsoil will be laid on top of the liner to enable vegetation planting.
Water source	A supply of suitable water (e.g., groundwater, treated stormwater, directed overland flows) must be identified to ensure appropriate water levels are maintained. Water supply options must meet water quality standards in Table 2 of DELWP (2017) and must prevent the introduction of predatory exotic fish (such as Eastern Gambusia).	See information above about ***Hydroperiod***.
Aquatic habitat	Wetlands must be vegetated with a variety of emergent, submergent and floating species. A suggested species list and planting densities is provided in DELWP (2017). Plants should be indigenous to the local area and where possible of local provenance. Planting density should result in establishment of dense (target 50%) cover of submergent/floating vegetation and patches of emergent vegetation. As a guide, planting densities to create patches of emergent vegetation are generally 4 – 6 plants per square metre. Planting densities for patches of submergent vegetation can be lower. Littoral and shallow water areas should include extensive rock piles. At least 20% of the perimeter of constructed wetlands should be rocky.	Aquatic habitat will meet the standard described in DELWP (2017). Species chosen for wetland plantings will be based on those noted in DELWP (2017) and Australian Ecosystems (2017; Appendix 3). Specific consideration will be given to the local conditions and plants local to the Geelong region, with plantings guided by qualified ecologists with specific expertise in wetland habitat establishment.
Terrestrial habitat	Terrestrial zone immediately surrounding the wetland should include extensive rock piles. At least 20% of the perimeter of constructed wetlands should be rocky. Vegetation within 10 m of wetland should be tussock-forming grasses and sedges. Plants should be indigenous to the local area and where possible of local provenance. Vegetation between 10-100 m of wetland should be short, mown grass with an open structure (e.g., 20% cover). The following buffers should be maintained: • Development (roads, buildings) should be >50 m from wetland. • Paths, recreation areas, minor infrastructure should be >30 m from wetland. • No mulch within 50 m of wetland. • No shrubs within 10 m of wetland. Shrub cover of <10% within 100 m of wetland.	A terrestrial zone of up to 10 m and 4,300m^2 (0.43 ha) in area will surround the wetland (Figure 2). The terrestrial zone will include rocks and tussock-forming grasses and sedges to meet the standard described in DELWP (2017). Vegetation between >10-100 m of the wetland will largely be short, mown grass. The overflow detention basin to the west of the wetland will be planted with terrestrial zone habitats, and will provide secondary terrestrial foraging and refuge habitat for the species (Figure 2).

Figure 1: Growling Grass Frog habitat design (based on Figure 2 in DELWP 2017)





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Member of the Surbana Jurong Group

SMEC AUSTRALIA PTY LTD
ABN 47 065 475 149

0 20 40 60 80 100
Meters

Scale:1:2,000 @ A3
GDA2020 MGA Zone 55

LEGEND

- Study site
- Deep Water Zone (2m)
- Frog Exclusion Fencing
- Basin Footprint

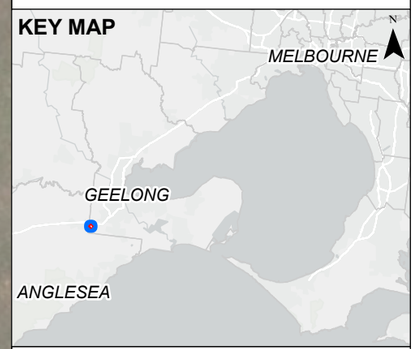
Growling Grass Frog Habitat Design

- Submergent and Floating Vegetation Zone
- Emergent Vegetation Zone
- Terrestrial Zone
- Secondary Terrestrial Habitat

Basin/Wetland Construction Footprint

- Proposed Basin No.3
- Overflow Detention Storage Basin

KEY MAP



SOURCES:
1. Roads and Waterways © DEECA 2024
2. Basemap © Light Gray Base: Vicmap, Esri, TomTom, Garmin, FAO, NOAA, USGS
World Imagery: Source: Esri, Maxar, Earthstar Geographics, and the GIS User Community

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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:	Pettavel Augmentation Project
PROJECT NO:	30049187
FIGURE NO:	2
FIGURE TITLE:	Species Habitat Creation
CREATED BY:	RS17486
DATE:	19/03/2024
VERSION:	1

X:\GIS\VIC\PROJECTS\30049187 - Pettavel Augmentation Project\02_Maps\30049187_ENV_002_GrowingGrassFrogTechMemo\30049187_ENV_002_GrowingGrassFrogTechMemo.aprx\30049187_ENV_002_Figure2_FocusedFrogOasisDesign

3.2 Habitat monitoring and management

Monitoring and management of the constructed wetland must be undertaken to ensure that habitat remains suitable for Growling Grass Frog. Once the wetlands have been constructed and vegetation has been established, it is expected that the wetland will be largely self-sufficient. The following must be undertaken:

- Monitoring of the wetland must be completed by a qualified assessor, experienced in the assessment of created wetlands and revegetated habitat.
- Monitoring should take place at the following frequency following construction of the wetland (and associated revegetation). Monitoring should be conducted by a suitably qualified contractor with experience in the creation of habitat for Growling Grass Frog:
  - Every three months for the first year during the vegetation establishment phase to ensure that plantings achieve the densities outlined in the design standards.
  - Every six months for the second and third year.
  - Annually for the fourth and fifth year.
- Information about the following will be recorded during monitoring, with the results provided in a brief report or memo:
  - Percent cover of aquatic and terrestrial vegetation, with reference to the targets described in Table 1.
  - Comment on the success of revegetation, including whether any failed plantings are observed or should be replaced.
  - Establishment of exotic weed species.
  - Establishment of native weedy species that may be over-represented in the wetland and inhibit the establishment of other native species (e.g., Common Reed ***Phragmites australis*** and bulrushes ***Typha*** spp.).
  - If permanent frog exclusion fencing was installed, check fencing for any holes or defects that mean it may not be functioning as intended.
  - Site photographs, taken at the same location(s) to enable comparison over time.
  - Recommendations for additional revegetation, replacement of failed plantings, weed control, biomass reduction or other habitat rectification to ensure habitat is optimal for Growling Grass Frog and meeting relevant targets.
- Within two weeks of receipt of each monitoring report, the land manager must implement the management recommendations to ensure habitat is optimal for Growling Grass Frog.

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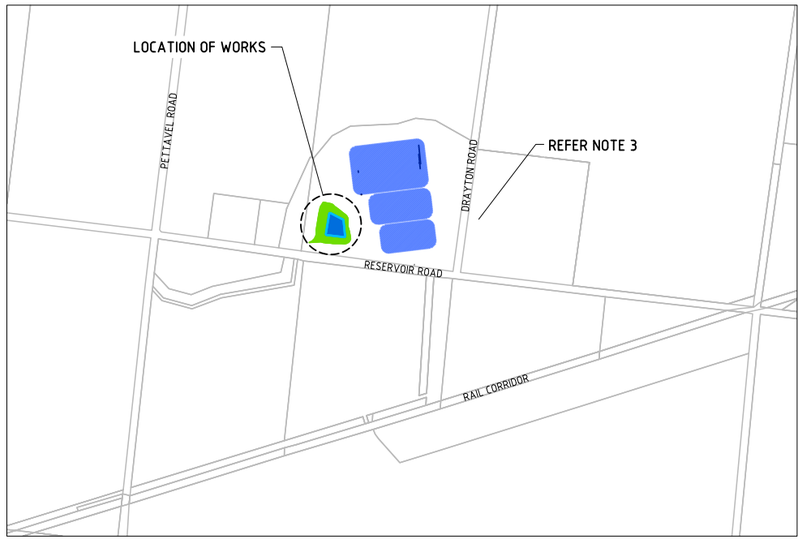
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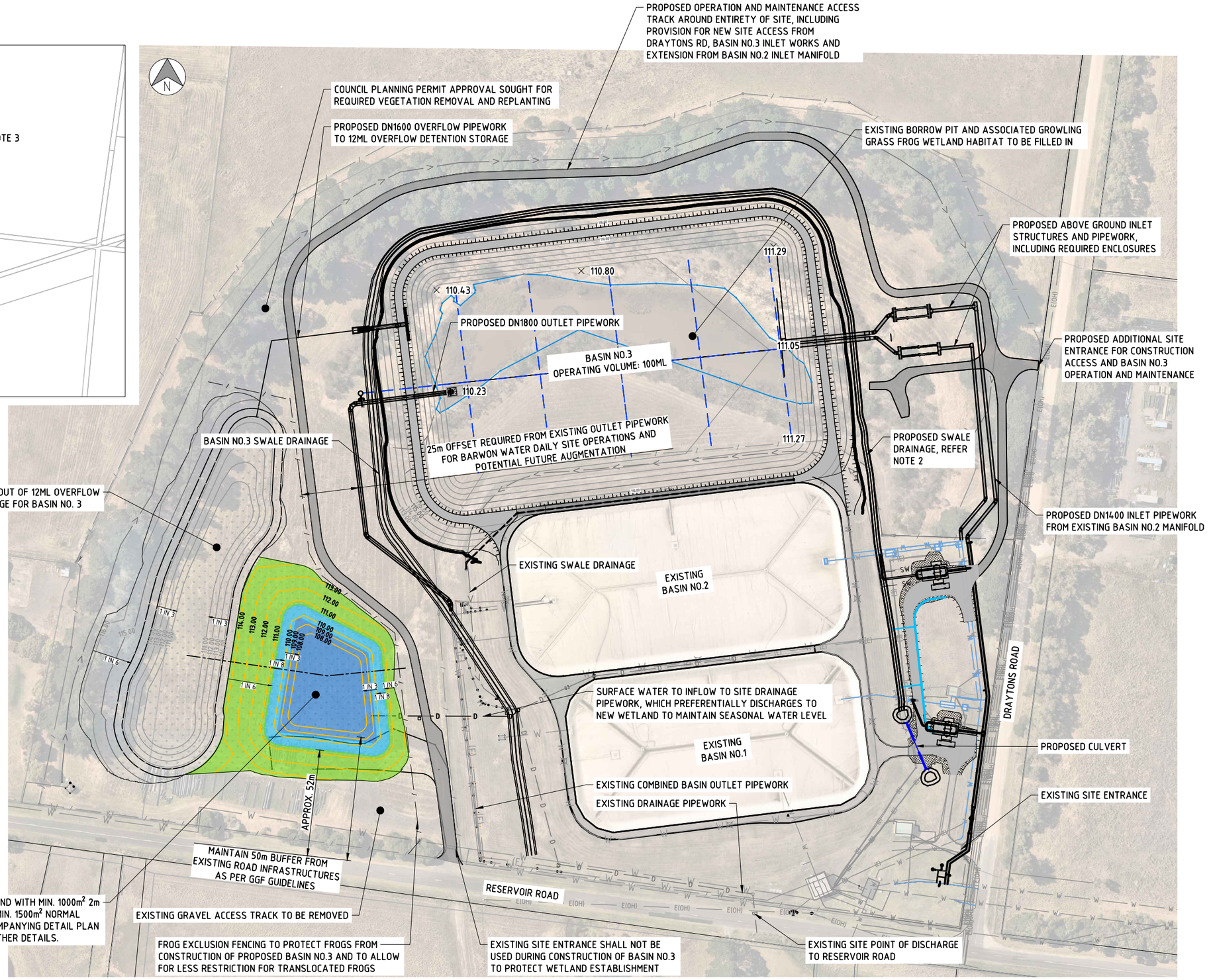
Appendix 1: Project timeline

Action	Date	2024												2025												2026											
		J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D
Pre-construction Phase:																																					
EPBC Act referral submission **(HOLD POINT)**	Mar-2024																																				
EPBC Act referral outcome **(HOLD POINT)**	May-2024																																				
Contract initiation phase **(HOLD POINT)**	Jun-2024																																				
Site inductions	Jun-2024																																				
Construction Phase:																																					
Construction of supplementary wetland	Sep-2024																																				
Vegetation planting and habitat installation	Oct-2024																																				
Construction of overflow detention storage basin	Oct-2024																																				
Install temporary frog exclusion fencing	Nov-2024																																				
Monitoring and management of wetland, vegetation establishment (Year 1 - 1)	Jan-2025																																				
Monitoring and management of wetland, vegetation establishment (Year 1 - 2)	Apr-2025																																				
Monitoring and management of wetland, vegetation establishment (Year 1 - 3)	Jul-2025																																				
Monitoring and management of wetland, vegetation establishment (Year 1 - 4)	Oct-2025																																				
GGF capture and relocation prior to habitat removal	Mar-2025																																				
GGF capture and relocation during dewatering of the borrow pit wetland	Mar-2025																																				
GGF capture and relocation during removal of the borrow pit wetland	Apr-2025																																				
Post-construction Phase:																																					
Ongoing monitoring and management of wetland (Year 2 - 1)	Apr-2026																																				
Ongoing monitoring and management of wetland (Year 2 - 2)	Oct-2026																																				
Ongoing monitoring and management of wetland (Year 3 - 1)	Apr-2027																																				
Ongoing monitoring and management of wetland (Year 3 - 2)	Oct-2027																																				

Appendix 2: Proposed Works Overview



LOCALITY PLAN
SCALE NTS



SITE LAYOUT - 210-240 RESERVOIR ROAD, WAURN PONDS VIC 3217
SCALE 1:1000

NOTES:

1. THE PURPOSE OF THIS FIGURE IS TO DEMONSTRATE FEASIBILITY OF THE ALTERNATIVE GROWLING GRASS FROG WETLAND HABITAT AND CONVEY DESIGN INTENT. IT IS NOT FOR CONSTRUCTION PURPOSES. DETAILED DESIGN IS TO OCCUR FOLLOWING ACCEPTANCE OF THE WORKS UNDER THE EPBC ACT REFERRAL PROCESS.
2. THE ENTIRETY OF PETTAVEL SITE REQUIRES EARTHWORKS DISTURBANCE, REGRADING AND ASSOCIATED VEGETATION REMOVAL TO FACILITATE CONSTRUCTION FOOTPRINT, CONSTRUCTION OFFSET AND REVISED DRAINAGE REQUIREMENTS TOWARD RESERVOIR RD.
3. BARWON WATER LAND ACROSS DRAYTONS RD TO BE USED FOR CONSTRUCTION SITE FACILITIES, LAYDOWN, MATERIAL STOCKPILING AND DRYING.

0 10 20 30 40 50m
SCALE IN METRES (1:1000 AT A1)

DESIGNED BY:	H. HUANG	04.03.2024
CHECKED BY:	B. NICHOLSON	04.03.2024
APPROVED BY:	B. NICHOLSON	04.03.2024

PRELIMINARY - NOT FOR CONSTRUCTION

Figure A **Revision A**
BW-230330 PETTAVEL BASIN NO. 3
PROPOSED SITE LAYOUT SKETCH

\\cmp-file\Company\Projects\BW-230330- Pettavel Basin No 3\8. CAD\8.4 Sketches\FIG-A & FIG-B working files - GGF Concept\X_SURFACE - GGF Sketch for F&F.dwg

Appendix 3: Case Study

Australian Ecosystems provided the following information to demonstrate how constructed wetlands can be established very rapidly if they are planted out with the appropriately sized plant stock and planted at the right time of year.

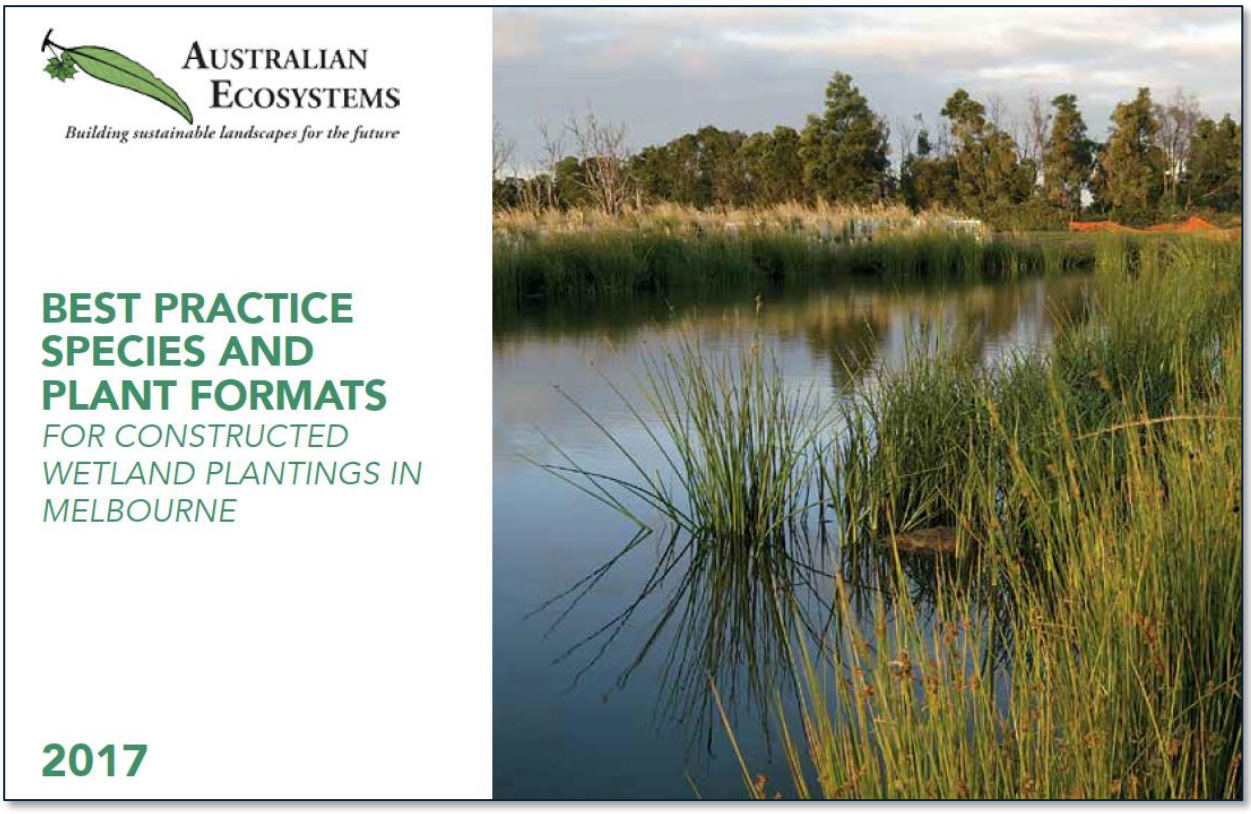
Factors contributing to rapid growth of aquatic plants are day length and water temperature. If plants can be installed in early Spring as the day is lengthening and water is starting to warm up, the plants grow very rapidly throughout the Spring and Summer period and can be fully established by the end of the following Autumn.

The example provided is a wetland in Clyde, which was established as follows and shown in the images below:

- Plant stock was propagated over Spring 2018 / Summer 2019 in 600cc sized plant containers.
- The wetland was planted with the propagated plants in September 2019.
- The wetland plants were in an advanced state of establishment by April 2020.

September 2019 Nearmap image supplied by Australian Ecosystems.	
November 2019 Nearmap image supplied by Australian Ecosystems.	
April 2020 Nearmap image supplied by Australian Ecosystems.	

Appendix 4: Plant species for wetland revegetation



Disclaimer: This booklet has been 100% independently designed, produced, commissioned and funded by Australian Ecosystems as a contribution to improving practices in wetland planting projects.

Best practice plant formats for constructed wetlands in Melbourne call for >90cm3 plants (such as 93cc HIKO stock) in ephemeral zones, and 600cc larger format plants in shallow marsh, deep marsh and submerged marsh zones.

HIKO plants are an efficient and effective plant size for establishing vegetation cover in ephemeral marsh zones, allowing for ease of handling and planting of stock. They are smaller than 200cc standard forestry tubestock, commonly called "tubestock". Best practice constructed wetlands require ephemeral wetland batters to be planted with HIKOs at a minimum of 6 plants per square meter.

600cc format plants are very effective plant formats for shallow, deep and submerged marsh zones. Constructed wetlands can often be hostile to plant establishment, where new plantings can experience rapid pulsing of water levels, turbid water, wave action, waterfowl grazing, sedimentation and extended high water levels. 600cc large format plants have tall strong stems, and large well developed root systems and rhizomes (storage organs) which give plants the best chance of establishment in these conditions. Best practice constructed wetland plantings require shallow marsh, deep marsh and submerged marsh plantings to be established at a minimum of 2 plants per square meter in shallow and deep marsh zones, and 1 plant per square meter in submerged marsh zones.



Hiko 93cc format

600cc format

SPECIES	PAGE
Baumea rubiginosa	4
Carex appressa	5
Carex tereticaulis	6
Cyperus lucidus	7
Juncus amabilis	8
Juncus flavidus	9
Juncus kraussii	10
Juncus pallidus	11
Lomandra longifolia	12
Poa labillardierei	13
Baumea articulata	14
Bolboschoenus caldwellii	15
Bolboschoenus fluviatilis	16
Bolboschoenus medianus	17
Cladium procerum	18
Cycnogeton procerum syn. Triglochin procerum	19
Eleocharis acuta	20
Schoenoplectus tabernaemontani	21
Eleocharis sphacelata	22
Myriophyllum crispatum	23
Potamogeton ochreatus	24
Vallisneria australis	25

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