

An independent assessment of a planted pine tree area for its potential to provide Growling Grass Frog habitat within the Pettavel Basin Water Storage area, Waurn Ponds, Victoria.

Prepared for Barwon Water and the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW)

2 March 2026



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This assessment has been prepared independently by Wild Research Pty Ltd for the sole purpose of providing an objective analysis to Barwon Water and the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW). Wild Research Pty Ltd confirms that we have no financial, commercial, or personal interests in Barwon Water, or any associated entities that could influence, or be perceived to influence, the findings or recommendations contained in this report. All conclusions are based solely on our professional judgement, expertise, and the information available at the time of preparation.

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Background:

Barwon Water hope to increase the potable water storage capacity of the Pettavel Basin Water Storage Facility located at Waurm Ponds, Victoria, by an additional 100ML to service future potable water demand in the Greater Geelong and Bellarine Peninsula region. Barwon Water manage the facility and own the Pettavel Basin site which is a 25-ha land parcel. The proposed expansion, and preferred option, involves installing a new water storage structure, called Basin No.3, at an area that has a 'borrow pit' wetland. The borrow pit is a constructed wetland that was formed during previous excavations to establish the current water storage facility. The facility currently consists of two other water storage structures (known as Basin No.1 and Basin No. 2). Growling Grass Frogs have been recorded at and are known to currently use the borrow pit. The Growling Grass Frog (*Litoria raniformis*; recently updated to *Ranoidea raniformis*) is a listed vulnerable species in Victoria and Australia, under the Victorian Flora and Fauna Guarantee Act 1988 (FFG Act) and Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) respectively. The proposed Barwon Water project triggered an EPBC Act Referral because it will remove habitat for this frog species and could contribute to the frog's population decline.

The project was referred to the Australian Department of Climate Change, Energy, the Environment and Water (DCCEEW) on 30 May 2024 (EPBC 2024/09840). The Project was deemed a controlled action on 28 June 2024 due to inevitable impacts on the Growling Grass Frog. To compensate for these impacts, Barwon Water has proposed to construct a new designated Growling Grass Frog wetland and terrestrial vegetation zone on the property as a First Party Offset Site. Originally the proposed offset strategy was to mitigate the loss of 2.14 ha of Growling Grass Frog habitat, by creating 2.07 ha of Growling Grass Frog habitat in another area of the Pettavel Basin property (SMEC 2025). DCCEEW have queried this proposed offset in part because the offset calculations have not yet included, or accounted for, a neighbouring planted pine tree stand on the property that they think could be used by Growling Grass Frogs. The planted pine trees line the northern boundary of the Pettavel Basin site. The impact calculations for the off-set originally only accounted for the 0.51 ha borrow pit wetland and the immediate surrounding 1.63 ha terrestrial habitat which is dominated by native flora species (SMEC 2025)(Map of site: Appendix 2 Figure A2.1).

DCCEEW indicated Barwon Water could engage an independent Growling Grass Frog expert to help determine if the pine tree stand should be included as part of the impacted terrestrial habitat offset calculations for the proposed project. Wild Research Pty Ltd was engaged by Barwon Water to provide the independent assessment. This report provides details about the assessment.

Approach:

We conducted an on-ground assessment of the planted pine tree stand to determine it's potential to provide terrestrial habitat for the Growling Grass Frog (here after GGF). The assessment included searching for habitat features that could provide temporary or longer-term shelter for GGF during movements between waterbodies in the landscape and over-wintering refugia. Bell frogs (GGFs and the closely related Green and Golden Bell Frog, *Litoria aurea*) are known to use a wide range of shelter types including logs, rocks, vegetative debris mounds

(such as leaf litter), and cracks in the substrate (Pyke 2002; Robertson et al. 2002; Hamer et al. 2003; Heard et al. 2012a; Clemann et al. 2013; White & Pyke 2015), and personal observations). We assessed the planted pine stand for these attributes (also referred to as shelters), and when found, recorded the shelter type, waypoint, measured the area of each shelter, and documented the quality of each shelter. Factors influencing the quality of each shelter type included the level of protection from potential predators (structural complexity), level of disturbance by introduced mammals (i.e. rabbits and foxes), and the potential to provide suitable microclimatic conditions (influenced by the amount (or depth) of substrate, the openness of the spaces beneath the shelter, and ability to hold or retain water/moisture).

We also considered the potential foraging value of the pine tree stand for GGF. GGFs use a "sit-and-wait" feeding strategy, meaning that they wait in areas for prey to move into their range (Robertson et al. 2002; Heard et al. 2004, 2012a). GGF can feed in wetland or terrestrial areas. Within wetlands, GGF are often found perching on and feeding within reeds, sedges, and semi-submerged or floating aquatic vegetation (Robertson et al. 2002; Heard et al. 2004, 2012a, personal obs.). When in terrestrial areas, GGF typically chose to wait in relatively open area on logs, low branches, rocks and sparsely vegetated and bare ground, and even on mounds of manure (Robertson et al. 2002; Heard et al. 2004, 2012a; personal obs.). These open areas likely allow GGF to easily observe potential prey coming toward them and those in the immediate surrounding area. For these reasons, GGF are expected to select and prefer areas where prey is relatively abundant. GGF eat a wide variety of invertebrates and will also eat vertebrates (including other, usually younger, GGF) (Robertson et al. 2002; Heard et al. 2004, 2012a).

Finally, we considered the relative position of the pine trees and their value as a dispersal corridor for GGF when moving between wetlands. Notably this includes that potential for the pine tree habitat to provide temporary shelter during dispersal and protection from predators. To achieve this, we undertook a mapping exercise to examine likely dispersal paths within the 300m and 500m dispersal range of GGF. GGF dispersal probability declines with distance, with movements more likely within 100m, occasional movements from 200-300m, and movements beyond 500m considered generally rare (Heard et al. 2010, 2012b, 2015; Hale et al. 2013; Garvey 2022). We undertook an on-ground assessment to look for areas (like waterbodies) within the pine tree stand that could influence GGF movement (dispersal time) and examined the overall vegetation structure (from the canopy to the ground layer) in order to rate the habitat's value for providing protection from predators.

Findings:

The planted pine trees are a narrow band of mainly Radiata Pine (*Pinus radiata*) with some Monterey Cypress (*Hesperocyparis macrocarpa*) trees that line the northern boundary of the Pettavel Basin site. These trees cover an approximate 1.95 ha area at the site. The pine tree stand is approximately 600m long and is variable in width from 11m to 51m. At their closest point the planted trees are ~38.5m from the edge of the borrow pit wetland.

Within the planted trees we found 33 features that could provide some form of shelter for GGFs (Figure 1, Appendix 1 Table A1.1). The features were determined to range in shelter quality from very low to moderate; with 1 shelter (or 3.0%) scored as very low quality, 17 shelters (51.5%)

scored as low quality, 6 shelters (21.2% scored low – moderate quality and 9 shelters (24.2%) scored as moderate quality (Figure 2). When combined the shelters cover a maximum of 0.28 ha. Although because most were considered to be of very low to low-moderate quality we think that the actual amount of habitat used by GGF is less the 0.28 ha. When the moderate quality habitat is combined it covers a 0.09 ha total area. These moderate quality features are more likely to be used by GGF at times, than the features of lower quality.

The shelters were predominately fallen logs (~63%), branches (~ 6%) and debris (~27%) or a combination of these structure types. The features also sometimes included rocks and grasses. Debris included pine needles, twigs, dry grass and leaf mater. Some features such as rotten logs, or shelters within a gully and low-lying area where water could collect, were considered to provide more suitable microclimates and microhabitats for sheltering frogs than dryer open (accessible) areas. Structurally complex areas (logs and fallen branches or logs and deep debris, or debris and branches) were considered to provide better shelter conditions and protections from potential predators than simpler features that tended to be more open (accessible).

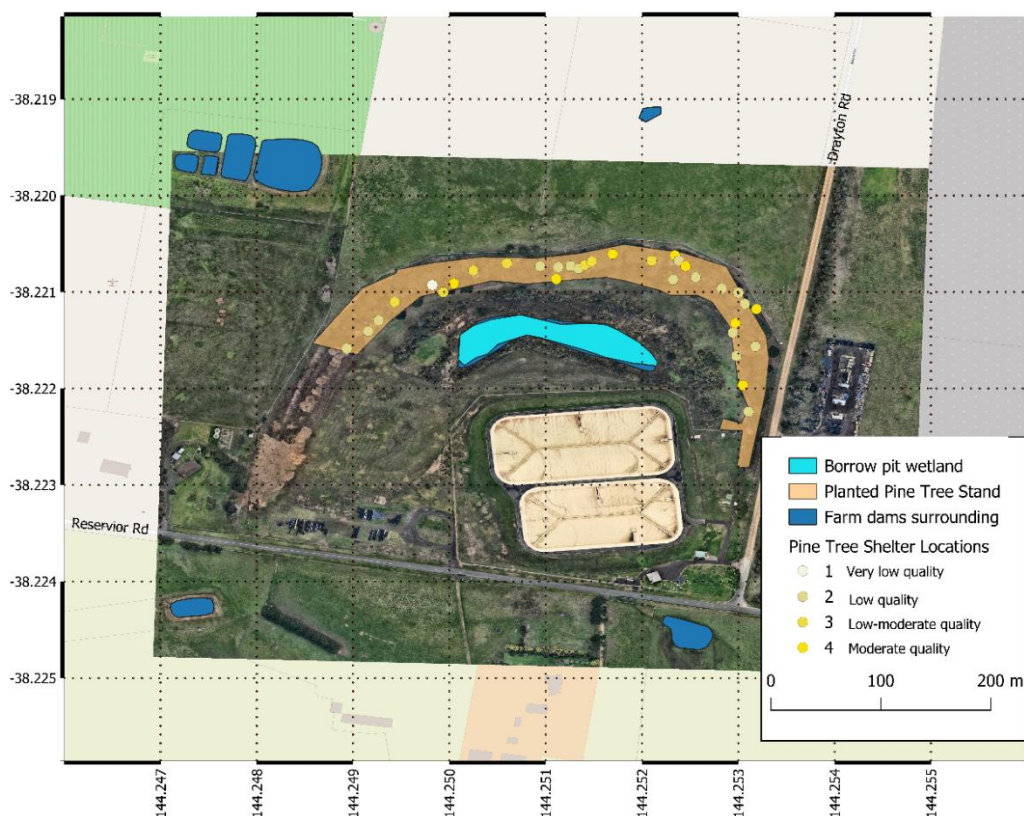


Figure 1. Map showing locations of features within the assessed pine tree stand at the Pettavel Basin Project area that could be used as shelter by GGF. The shelters are ranked from a very low quality to a moderate quality.

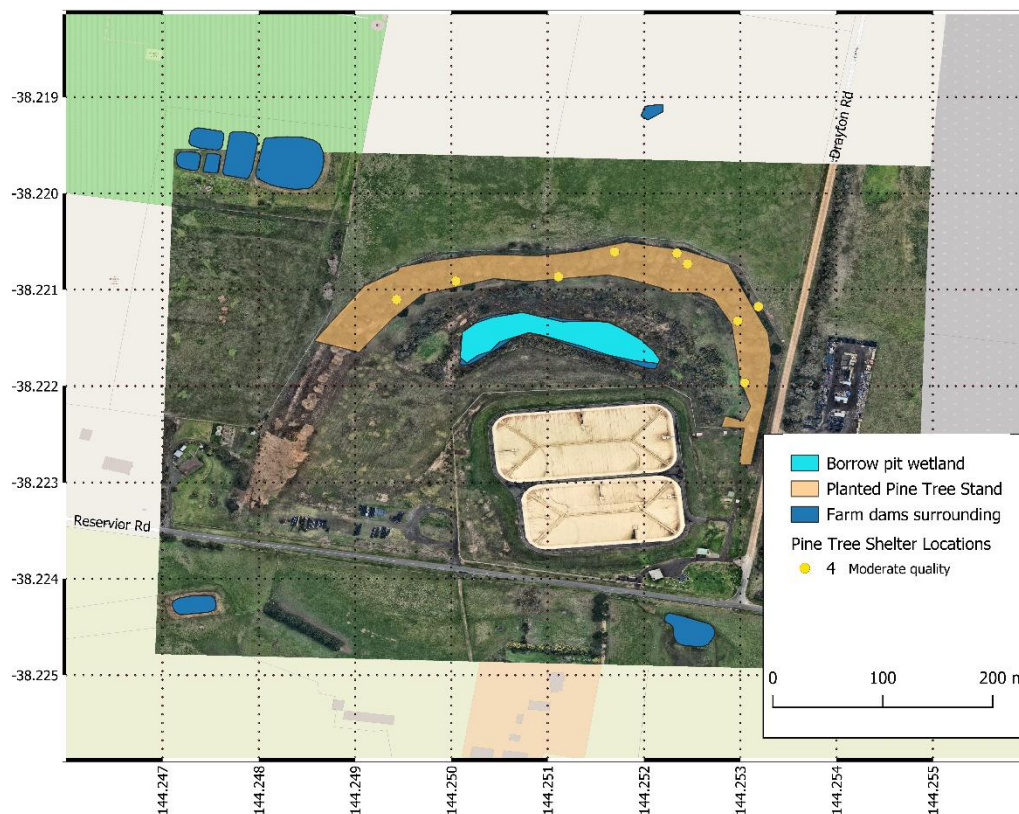


Figure 2. Map showing locations of the assessed pine tree stand at the Pettavel Basin Project area. The map highlights moderate quality shelter areas that have potential to be used by GGFs.

The planted pine tree stand generally had a very simplistic ground layer, that was predominately a thin layer of pine needles (Figure 3) with some tussock and weedy grasses present. Generally, the pine needle depth was classified as shallow, although pine needle depth varied and was found to be deeper near to some of the shelter structures. The pine needles away from the shelters are expected to provide little shelter or foraging value for GGF. Grasses near to shelters were considered to increase the shelter value. These mostly grasses were sparse elsewhere. Overall, the planted pine area was considered to provide very low foraging value for GGF. At this site GGF foraging is likely to occur mostly within the borrow pit wetland and on the banks immediately surrounding the wetland.

GGF are likely to disperse through (but not necessarily along) the planted pine tree area to reach neighbouring wetlands. The likely main (direct) dispersal pathways within a 500m radius of the borrow pit wetland are shown in Figure 4. Three wetlands are located within a 300m dispersal range of the borrow pit wetland, and these wetlands (assuming that they contain suitable habitat) are likely to be the main dispersal destinations. Because there are no waterbodies located within the planted pine area, and there are few suitable shelter opportunities, we expect that GGF are not reliant on the pine tree stand habitat for dispersal (or survival during dispersal). Furthermore, while the narrow pine tree stand habitat may provide some temporary shelter from potential aerial predators (i.e. birds, when frogs are located near shelter structures or under the tree canopy), they are also likely to increase the risk of predation. This is because the trees along extensive edges of the pine tree plantation provide multiple roosting opportunities for predatory bird species. There are few places within the pine tree stand for

dispersing frogs to be protected from other terrestrial predators (like snakes, or foxes) because the understory and ground layer within the pine tree stand is simple, sparse and generally open. Therefore, on balance the planted pine tree maybe a similar predation protective benefit and risk to GGF survivorship.



Figure 3. Representative examples of the simple ground layer within the planted pine stand at the Pettavel Basin Project area.

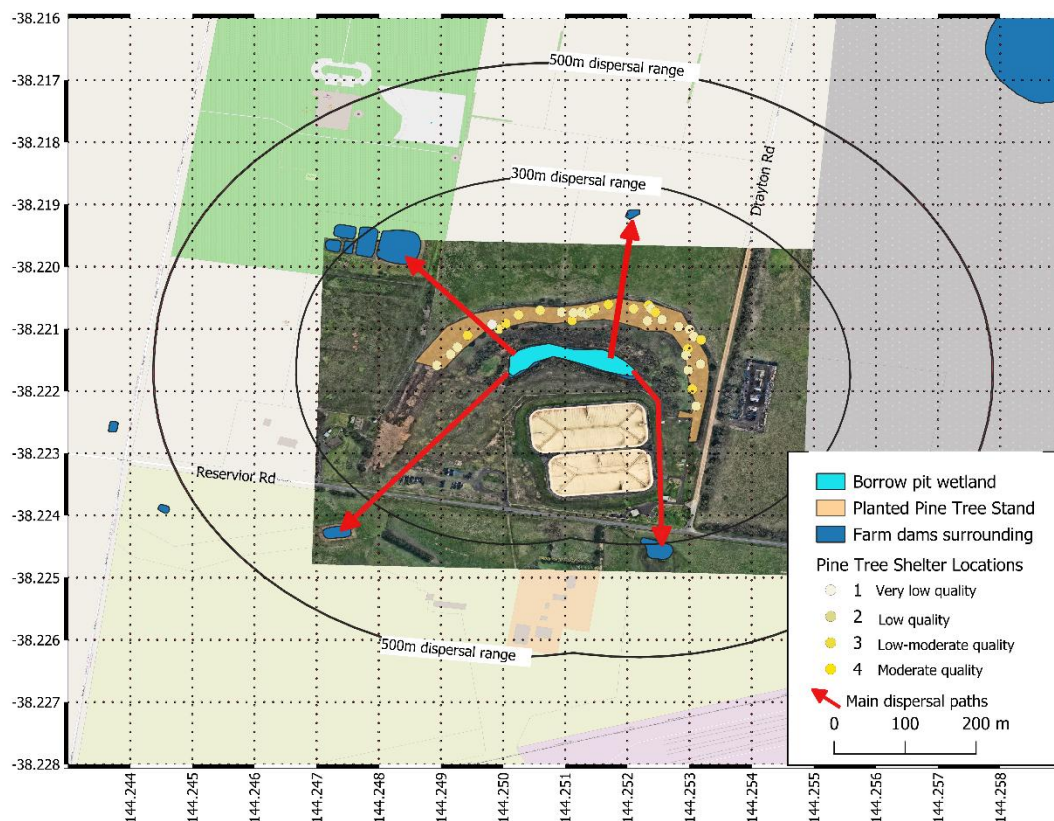


Figure 4. Maps showing the likely main (shortest/most direct) dispersal pathways (red arrows) of GGF at the Pettavel Basin Project area from the borrow pit wetland and within a 500m radius of the wetland. GGF movements within 300m of the borrow pit wetland are more likely, than those beyond 300m. The map highlights that some dispersal is likely to occur through the planted pine area, although there are few suitable shelter areas (of at least moderate quality) that have potential to be used by GGFs during dispersal events.

Are GGF Likely To Use The Pine Tree Stand?

Introduced pine tree stands generally support a lower abundance and diversity of fauna species compared native vegetated areas. Frogs may use the pine trees at times, and one common species (Brown Tree Frog *Litoria ewingii*) has been recorded within the area (SMEC 2024). However pine plantations are known to provide less suitable frog habitat compared to native vegetated areas, and fewer species are known to use pine plantations compared to native vegetated areas (Parris & Lindenmayer 2004). The abundance and diversity of invertebrates (and main prey of GGF) can be much lower in planted pine tree areas and is associated with changes in soil properties like nutrition and water content (Cifuentes-Croquevielle et al. 2020). Another underlying reason for lower levels of fauna diversity is because pine tree stands typically have a narrower range of microclimatic and microhabitat conditions that can support native fauna requirements (Parris & Lindenmayer 2004; Cifuentes-Croquevielle et al. 2020). Notably within pine plantations, the ground layer is mostly reduced to a simple bed of pine needles, there is very little ground or midstory vegetation, and the canopies of pine trees allow little light penetration. These issues are expected to be most pronounced in large monocultures, and maybe reduced for a narrow line of trees, like those at the Pettavel Basin site.

While some variation is expected between differing types of plantations, a recent Tasmanian study in a blue-gum monoculture plantation is expected to provide some insight into how GGF may use other monocultures like those formed from radiata pines. The Tasmania study found that GGF abundance was negatively associated with extent of blue gum plantation forest in the surrounding landscape (Garvey 2022). Radio-tracking at the Tasmanian site indicated that GGF will move through blue gum plantation forests to reach native forest areas (Garvey 2022). However, the recorded movements through plantation forest were typically brief (Garvey 2022). The main exception was that some individuals used moist areas (road-side ditches with water) within plantation forest for extended periods of time (approx. one hundred days in the Garvey 2022 study). We are not aware of clear evidence that indicates GGF will choose to occupy plantation forest over other native forest types or native vegetated areas when they lack water. The radio-tracking study also indicated that GGF had a closer affinity (tending to stay close to waterbodies) with wetlands that had higher aquatic vegetation cover, compared to wetlands that had low aquatic vegetation (Garvey 2022). Furthermore, in cleared agricultural landscapes adult GGF were found to move away from the immediate surrounding terrestrial and aquatic vegetation after breeding to adjacent native dry eucalypt woodland rather than use the cleared areas (Garvey 2022).

Based on the available evidence, GGF are unlikely to preferentially use the planted pine tree terrestrial habitat at the Pettavel Basin Project site. However, without a detailed study, we cannot exclude some occasional use of the site by GGF. In particular GGF may at times use some of the planted pine features and attributes for shelter, most likely during dispersals between the borrow pit wetland and neighbouring sites within the 300m to 500m radius of the borrow pit wetland. We think it is unlikely that GGFs would use the pine tree shelter sites over winter or use the area for foraging. On both accounts this is because the shelter and foraging opportunities are generally poor within the planted pine area, and there are much better options for shelter and foraging within the borrow pit wetland site.

How Could The Removal Of The Planted Pine Tree Area Effect GGF At The Site?

The impacts of removing the pine tree terrestrial habitat are likely to include:

- 1) A small reduction in protective shelter opportunities when GGF undertake terrestrial movements/dispersals between wetlands. We estimate that removal of the pine plantation could reduce the available GGF shelter habitat by between 0.09 ha and 0.28 ha.
- 2) A very small reduction in GGF overwintering opportunities. We estimate that removal of the pine plantation could reduce the available GGF shelter habitat by between 0.09 ha and 0.28 ha. This is the same area that GGF may use during terrestrial dispersals between wetland sites, as discussed above.
- 3) A negligible reduction in terrestrial GGF foraging habitat. This is because there is likely to be a low abundance of prey for GGF within the planted pine area and because GGF are likely to preferentially select foraging sites within the borrow pit wetland and on the banks immediately surrounding the wetland. To compensate for a minor loss of GGF foraging habitat we suggest including the full 0.28 ha of structures discussed in the above points.

The removal of the planted pine tree area is expected to have a very small (or low) impact on GGF at the Pettavel Basin Project site, particularly when compared to the removal of a

functioning wetland and the immediate surrounding native terrestrial habitat. In fact, if the pine plantation is removed and replaced (offset) by more suitable GGF terrestrial habitat this could increase GGF foraging and shelter opportunities and contribute to GGF population persistence. A more thorough assessment of the movement of GGF across the site is required to fully understand how the species uses the planted pine area. However, **based on current available information we recommend that the total impact should be calculated based on the loss of 0.28 ha of potential GGF shelter habitat.**

Following this assessment, Barwon Water considers that the total impacted GGF habitat area is now 2.81ha, up from the original total 2.14 ha calculated area (SMEC 2025). The new calculation accounts for the borrow pit wetland (0.51 ha), the native terrestrial vegetation across the site and the shelter sites within the pines (buffered by 5m) (2.3 ha terrestrial habitat) (Figure 5). To counter this, Barwon Water has subsequently increased the proposed offset site from 2.07 ha to 3.2 ha. The new offset proposal includes 0.63 ha of dedicated aquatic habitat associated with the proposed GGF wetland and 2.67 ha of terrestrial, overwintering and dispersal habitat including a swale and two additional semi-permanent waterbodies (Figure 6).

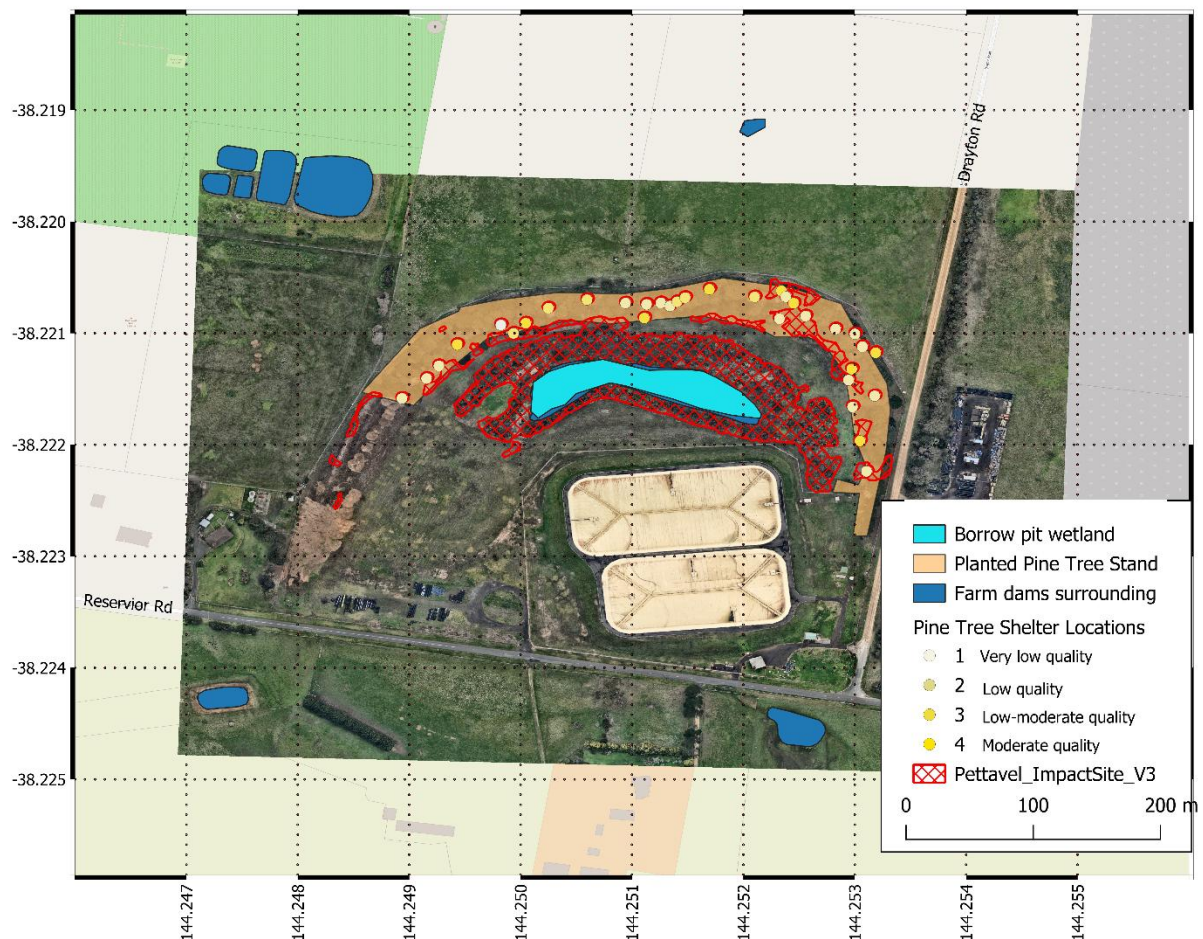


Figure 5. Map of the Barwon Water Pettavel site verifying that new calculated impacted area includes all identified shelter sites.

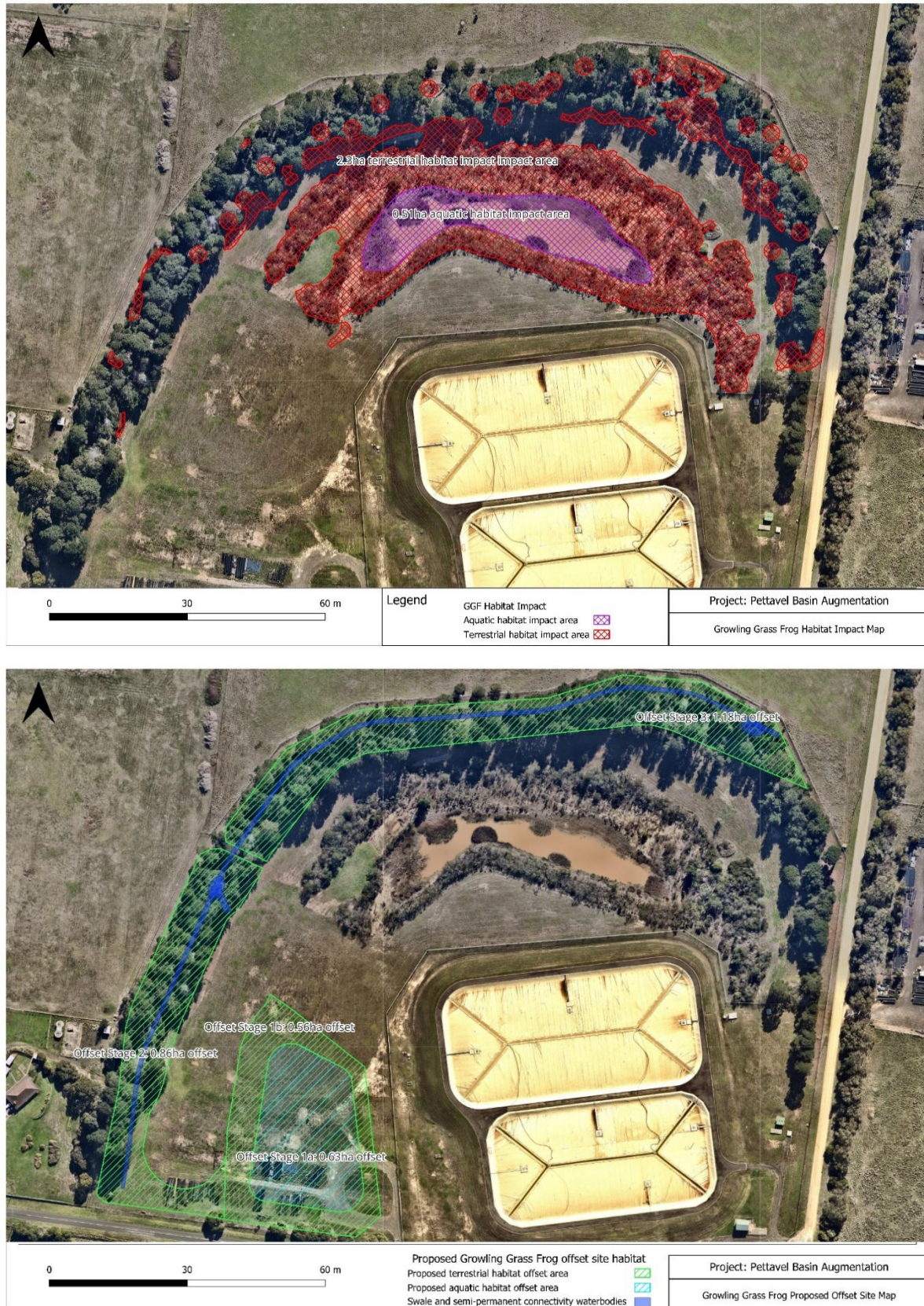


Figure 6. New calculation for impacted area (top panel) at the Barwon Water Pettavel site and the proposed offset area (bottom panel). Figures supplied by Barwon Water.

Opportunities To Optimize the Offset And Outcomes For GGF.

The removal of the planted pine trees is likely a relatively minor issue for GGF at the Pettavel Basin site and is unlikely in isolation to have a significant impact on the frog population.

While reviewing the project proposal, we identified several opportunities to further refine the proposed offset to optimize outcomes for GGFs at the site. Importantly there are currently no thoroughly documented and scientifically robust assessments of how offset projects impact GGF populations. Additional design considerations and management interventions, beyond those outlined in the project proposal documentation, are likely required to ensure that a robust and resilient self-sustaining GGF population can establish and persist at a newly constructed site. This project could become an important case study to examine, and demonstrate, the benefits of a well-designed first party offset for GGFs. Below we highlight some risks that were identified while reviewing the project documentation and provide recommendations to help ensure that any GGF population changes can be accurately assessed and the Pettavel GGF population can thrive at the site.

Risks and Recommendations:

- 1) A single wetland waterbody has been proposed for the offset. GGF are known to require a network of waterbodies within their dispersal range to ensure populations can persist. (Heard et al. 2012b, 2015). Multiple interconnected wetlands are needed to support and sustain GGF metapopulation dynamics (Heard et al. 2012b, 2015). The current proposed wetland (single waterbody) design may not adequately support metapopulation dynamics of the GGF population. This will be influenced by the attributes of wetlands on surrounding properties and their ability to provide suitable habitat for GGF. The proposed new wetland site will increase dispersal distances that GGF will need to make to some existing neighbouring wetlands. The Growling Grass Frog Habitat Design Standards highlight the importance of providing clusters of interconnected wetlands, not isolated ponds, to maintain long-term GGF population viability (DELWP 2017). Barwon Water could increase the GGF's probability persistence at sites by adding additional waterbodies to increase dispersal, foraging and breeding opportunities for GGF and to mitigate key threats (i.e. disease caused by chytrid fungus, and predation and competition issues caused by Mosquito Fish (*Gambusia holbrooki*). **We recommend adding two or more additional waterbodies to support and sustain GGF metapopulation dynamics.** These wetlands could be smaller semi-permanent waterbodies and should be designed so that they can be easily and periodically to be drained to manage aquatic vegetation and remove Mosquito Fish (if present).
- 2) The proposed rabbit proof fencing could be a barrier to adult GGF movement. The Growling Grass Frog Habitat Design Standards highlight that fencing must not create a physical barrier to GGF movement (DELWP 2017). While rabbit proofing maybe required to help establish new vegetation at the offset site, this must be designed, and modified, to enable GGF movement when the wetland is established, and before (or soon after) GGF are translocated to the new site. **We recommend implementing a rabbit control program throughout the new GGF wetland establishment phase but modifying the rabbit proof fencing design to ensure that GGF can move freely between wetlands.** Designs that allow GGF to pass through a permanent rabbit proof fence should be considered.

- 3) The new proposed wetland includes rock structures that will help protect GGF from chytrid. However, there is further opportunity to enhance this important component of a specialised GGF wetland. **We recommend incorporating some additional chytrid prevention structures, like ‘frog saunas’, that could have a dual benefit of reducing chytrid risk and providing additional shelter habitat.**
- 4) We note that DCCEEW highlighted that previous versions of the GGF population monitoring plan were vague. **To further increase the robustness of the current GGF monitoring plan we recommend developing a rigorous before and after impact study to assess changes in the GGF population, ensure that the project can be thoroughly evaluated, and that any issues for the GGF population can be rapidly detected and remedied.** This should include a robust assessment of the GGF population size at the borrow pit before GGF are moved and similar thorough monitoring at the new site following translocations of GGF to the new site and decommissioning of the borrow pit wetland. **We recommend that the population monitoring program should be designed, and results should be assessed, by or in collaboration with an independent biostatistician and GGF expert.**
- 5) While not considered in current documentation, additional interventions may be required to facilitate GGF dispersal and maintain gene flow, to ensure the long-term viability of the Pettavel Basin GGF population. Notably remaining isolated GGF populations are at a high risk of inbreeding and genetic diversity loss (Hale et al. 2013; Keely et al. 2015). **We recommend a genetic assessment of the GGF population before and after the new water storage construction to support the assessment of changes in the GGF population and to inform future population management requirements.**

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Appendix 1

Table A1.1 Examples of the shelters of varying quality that could be used by GGF across the planted pine area at the Pettavel Basin site.

			
Very-low Quality	Low Quality	Low-Moderate Quality	Moderate Quality
Site No. 6	Site No. 22	Site 14	Site 4
Type: small logs/branches)	Type: small logs/branches/fallen bark	Type: logs, branches, debris	Type: Logs, branches, debris
Structure: simple	Structure: simple	Structure: small number of overlapping logs/branches	Structure: moderate number of overlapping logs/branches
Highly disturbed (rabbit burrows/activity risk of attracting predators.)	Low disturbance (some rabbit activity risk of attracting predators)	Low disturbance	Low disturbance
Very shallow debris (pine needle) depth (<50mm)	Shallow debris (pine needle) depth (50 – 150mm)	Shallow -Moderate debris (pine needle) depth (100-200mm).	Moderate debris (pine needle) depth (200- 300mm)
Few shelter opportunities/ High predator exposure	Few shelter opportunities/ High predator exposure	Low – moderate shelter opportunities, some protected areas under logs./ High -moderate predator exposure	Moderate shelter opportunities, some protected areas under logs./ Low – Moderate predator exposure
Some branching that could be used for perching	Some branching that could be used for perching	Some branching that could be used for perching	Extensive branching that could be used for perching.
Very poor microclimatic conditions	Very poor microclimatic conditions	Poor microclimatic conditions	Moderate microclimatic conditions, expect site to retain some moisture.

Appendix 2

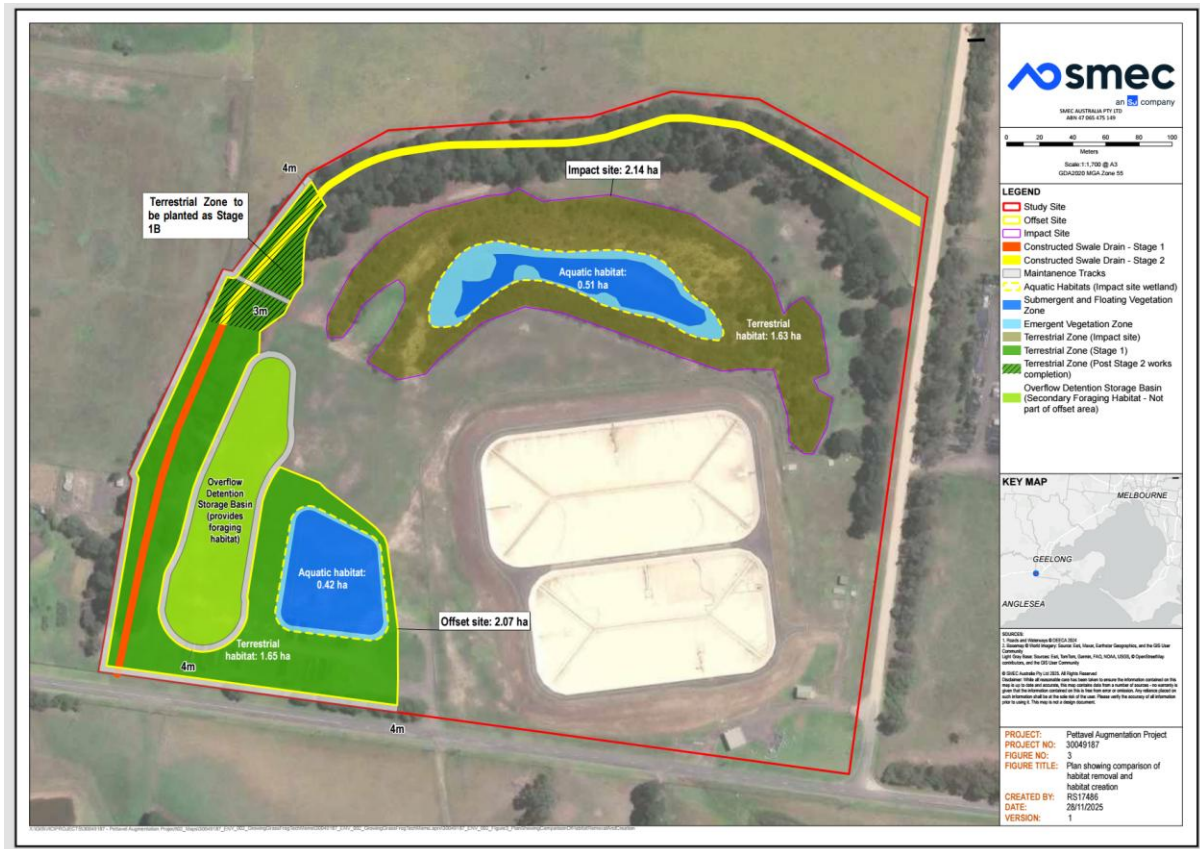


Figure A2.1. Original calculated areas of the impacted Wetland and Terrestrial habitat at the Pettavel Basin Project site and proposed first party off set area. Reproduced from SMEC (2025) Growing Grass Frog Offset and Management Plan, Pettavel Basin Augmentation Project. Prepared by SMEC Australia Pty Limited for Barwon Water and CMP Consulting Group Pty Ltd.