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# Harvest Estate West Byron Urban Release Area

## Acid Frog Management Plan

Client : Tower Holdings Pty Ltd  
Prepared by : Australian Wetlands Consulting Pty Ltd  
Project # : 1-201243  
Date : September 2021

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**AWC**



# **Harvest Estate West Byron Urban Release Area**

## **Acid Frog Management Plan**

# Project Control

Project name: **Harvest Estate – West Byron Urban Release Area**  
Acid Frog Management Plan

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# 1 Introduction and Background

Australian Wetlands Consulting (AWC) has been engaged by Tower Holdings Pty Ltd to update the Acid Frog Management Plan (AFMP) for the proposed Harvest Estate Development which forms part of the West Byron Urban Development Area (WBURA).

Previously, AWC prepared an AFMP (AWC, 2020, Revision D) that was submitted as an approved document to the Land and Environment Court (Case title: Villa World Byron Pty Ltd v Byron Shire Council, Case number: 201900310612, dated 8 December 2020). This revised AFMP incorporates conditions specified in the Notice of Orders Made and makes some minor amendments to monitoring and management.

This revised plan outlines the two acid frog species present at the site, provides key responses (mitigation strategy) from the proponent to ensure the conservation of these frogs and provides key monitoring and management actions to ensure the long-term survival of the species across the subject site. Table 1-1 briefly outlines the broad structure of this AFMP.

“Acid Frogs” are known for their tolerance (and preference) for mildly acidic ground and water conditions and are found along Australia’s eastern seaboard. Whilst their geographic range largely unchanged since pre-European times, their area of occupancy has been significantly reduced due to land clearing, development and other anthropogenic impacts (Meyer et al., 2006). The scope of the AFMP is to cover State and Commonwealth listed acid frogs which are known to occur on the proposed development site, specifically:

- Wallum Sedgefrog (*Litoria olongburensis*)
  - Listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
  - Listed as Vulnerable under the NSW *Biodiversity Conservation Act 2016* (BC Act)
- Wallum Froglet (*Crinia tinnula*)
  - Listed as Vulnerable under the BC Act.

This AFMP has been prepared with reference to the:

- *National Recovery Plan for the Wallum Sedgefrog and other wallum dependent frog species* (Meyer et al., 2006) which aims to improve the conservation status of wallum from species through effective management, protection and rehabilitation of wallum from habitat
- *Byron Shire Development Control Plan* (BDCP 2014) which provides a framework to guide the future development of the WBURA
- Planit Consulting (2017) *Terrestrial Flora and Fauna Report, Harvest Estate, West Byron* Prepared for Villa World Byron Pty Ltd, which provided the raw species records across the subject site
- Planit Consulting (2020) *Acid Frogs Habitat Plan*, details the habitat creation areas, and protected frog habitat areas
- Planit Consulting (2020b) *Harvest Estate Threatened Species Management Plan*

- Planit Consulting (2018) *Acid Frog Rehabilitation Plan*
- NSW BioNet records of acid frogs, which provided supplementary species records across the subject site.

It is intended that the principles of this AFMP will be applied to the development under the approved development applications and with any future development plan – specifically any Construction Environmental Management Plan/s or site wide Environmental Management Plan/s.

Table 1-1 Structure of the AFMP

| Section | Section Title                                      | Content  |
|---------|--|--|
| 1       | <b>Introduction</b>                                | Introduction to the AFMP.  |
| 2       | <b>Species Profiles and Site Habitat</b>           | Provides an overview of the Wallum Sedgefrog and Wallum Froglet and habitat at the site.   |
| 3       | <b>Key Threats to Acid Frogs at the Site</b>       | Summarises the threats that likely compromise the viability and persistence of Wallum Sedgefrog and Wallum Froglet populations at the site.  |
| 4       | <b>Mitigation Strategies</b>                       | Summarises the proposed mitigation strategy which is made up of three key elements:<br>a) the conservation of existing habitats that are to be retained on the site<br>b) habitat creation and enhancement<br>c) diversion of stormwater from retained and created habitats. |
| 5       | <b>Monitoring, Reporting and Corrective Action</b> | Provides details of the monitoring and reporting regime that would be applied site wide and a discussion on potential corrective actions if they are required.   |
| 6       | <b>Conclusion</b>                                  | Provides a summary of the AFMP.  |

## 1.1 Response to Conditions of Consent

The previous iteration of the AFMP (AWC, 2020, Revision D) was approved as part of the Consent Conditions issued as part of the outcomes of the Land and Environment Court hearing (refer Section 1 above). The AFMP has been modified to accommodate the Consent Conditions (refer Table 1-2).

Table 1-2 Consent conditions and response regarding the AFMP

| Issue   | Response  | Refer Section   |
|---|---|---|
| <p><b>32. Acid Frog Management Plan (AFMP)</b><br/>Prior to the issue of the Subdivision Works Certificate for Stage 1-A, a modified AFMP shall be submitted to Council for approval including the following additions:</p> | <p>This document</p>  |   |
| <p>a. Details of proposed monitoring of pH and water levels of groundwater in and/or adjacent to wallum sedge frog and wallum froglet habitat and wetlands, before, during and post subdivision construction.</p>           | <p>Groundwater levels and pH will be monitored as part of the Groundwater Management Plan (AWC, 2021) with results to be provided to the project ecologist for Acid Frog management.</p> <p>pH, EC, water depth of surface water (expressed groundwater) is monitored at retained and construction frog habitat sites during the frog monitoring. Two surface water level loggers are deployed in existing frog habitat areas and will be retained.</p> | <p>Section 5 (pg. 18)<br/>Table 5-1 (pg. 18)<br/>Table 5-3 (pg. 21)</p> |
| <p>b. Updated monitoring provisions that detail monitoring to continue for at least 20 years including annual reporting.</p>  | <p>Monitoring is to continue for a 20 year period commencing with the construction phases.</p>  | <p>Section 5.2</p>  |

## 2 Species Profiles and Site Habitat

### 2.1 Introduction

This section of the AFMP provides information on the occurrence of the Wallum Sedgefrog and Wallum Froglet across the subject site, along with species specific biological and habitat information.

### 2.2 Wallum Sedgefrog

#### 2.2.1 Distribution and Biology

The Wallum Sedgefrog is a small, acid frog (about 3cm long) which is found in coastal “wallum habitats” (see below) from Fraser Island in southern Queensland to Yuraygir National Park in northern NSW. It has a long with a pointed snout and a call that is a very rapid buzz repeated several times. It is smooth light green or light brown above which below it is cream and granular. A dark brown streak runs from the nostril to the eye and then down the side of the body. From the eye, this streak is bordered below by a raised white stripe that breaks into a series of spots towards the flank.

The Wallum Sedgefrog breed during warmer months (spring, summer, and early autumn) (Ehmann 1997) after heavy rain or when water is abundant. Eggs are laid in still water at the base of submerged reed stems in waters with a pH as low as 3.5 (Meyer 2004; Hines and Meyer 2011; Anstis 2002). Wallum Sedgefrog has been recorded dispersing and recolonising over distances of approximately 500m (James 1997; Lewis and Goldingay 2005; Meyer et al. 2006), suggesting the species is capable of short movements if suitable movement corridors are available.

#### 2.2.2 Habitat Requirements

Wallum Sedgefrogs are found in “wallum habitats” which are characterised by acidic conditions and ephemeral wetlands. The Wallum Sedgefrog is likely to be found in undisturbed wallum heath or sedgeland environments and is not generally known to inhabit disturbed environments. Their lifecycle is adapted to the acidic pH (2.5 to 5.5) of these wetlands.

For breeding habitat, the Wallum Sedgefrog shows a clear preference for ephemeral (seasonally inundated) perched swamps with emergent sedges, with upright species such as *Baumea* spp. And *Schoenus* spp. preferred by adult frogs for perching.

#### 2.2.3 Occurrence On Site

The Wallum Sedgefrog has been recorded on the subject site at several locations shown in Figure 2-1. Species records (sourced from Planit 2017 and NSW BioNet Atlas) occur from a small fenced area of freshwater wetland (Planit 2017) in the west of the site (within Lot 6 DP1222674). The species has also been recorded in grassland close to an elongated patch of Wallum Sand Heath (Teatree Sp.) that spans the central portion of the site.

It should be noted that fenced habitat for the Wallum Sedgefrog within Lot 6 has declined in quality over the past 5 years, with a consolidated area of sedgeland dominated by *Machaerina rubiginosa* now invaded by Swamp Water Fern (*Telmatoblechnum indicum*) and sedge cover has reduced

significantly. Woody vegetation (*Acacia melanoxylon*, *Melaleuca quinquenervia*) is also increasing within this habitat area.

Identified areas of Wallum Sedgefrog habitat will be retained within residue land which will be returned to Council following achievement of restoration actions.

#### 2.2.4 Occurrence Off Site

The species has also been recorded at locations in close proximity to the site. The first is to the north-east in adjacent Lot 1 DP 780242 (and within the WBURA). The second site, with numerous records is the Byron Bay Sewage Treatment Plant (BBSTP), approximately 1 km north of the site.

### 2.3 Wallum Froglet

#### 2.3.1 Distribution and Biology

The Wallum Froglet found along the Queensland-New South Wales coast, from Littabella National Park (north of Bundaberg) to Kurnell in Sydney (Meyer *et al.* 2006; Hines *et al.* 1999). Due to recent anthropogenic habitat loss and disturbance, the distribution of this species is now highly fragmented (Hines *et al.* 1999; Meyer *et al.* 2006). It is a small (up to 2cm) ground-dwelling species with a pointed snout that projects beyond the lower jaw, horizontal pupils, and their call is a distinctive short high-pitched ringing 'tching..tching..', heard throughout the year, particularly following rain. They range from light grey or brown to dark grey above and usually white or light brown below (sparsely flecked or heavily mottled with darker patches). A fine median line of white dots often occurs on the underside on the throat that may continue across the belly. They have no webbing on their feet and toe pads are absent.

Wallum Froglets may breed at any time of year, depending on rainfall (Meyer *et al.* 2006). Typically, eggs are laid singly or in small clumps and attached to grass stems, sedges, twigs and branches in shallow water (<10 cm deep). Water at breeding sites is mostly ephemeral and consequently supports few fish (Meyer *et al.* 2006; Hines and Meyer. 2011). Depending on the time of year, tadpoles of the Wallum Froglet may complete their development from eight weeks to six months (Anstis. 2002; E. Meyer. unpub. data). Wallum Froglet tadpoles are benthonic feeding on detritus and bottom sediments, while adult frogs subsist on a diet of arthropods (Anstis. 2002; Meyer *et al.* 2006; Curtis *et al.* 2012).

#### 2.3.2 Habitat Requirements

The Wallum Froglet is commonly found in association with wet heath, seasonally-inundated acidic Melaleuca swamps and sedgeland (Meyer *et al.* 2006; Curtis *et al.* 2012). In undisturbed wallum habitat, Wallum Froglets occur sympatric with other 'acid' frog species including the Wallum Sedgefrog and Wallum Rocketfrog. In disturbed habitat, Wallum Froglets may be found in low-lying areas with sparse grass and sedge cover (Meyer *et al.* 1999; E. Meyer and M. Sanders unpub. obs.) including fire breaks and access tracks through wallum heath.

Like other 'acid' frog species, the Wallum Froglet is highly acid tolerant, breeding in waters as acidic as pH 3.2 (Hines and Meyer. 2011; Meyer. 2004). The Wallum Froglet is known to breed in shallow surface water along cleared tracks as well as borrow pits and drainage ditches (Meyer. 2010; Hines and Meyer. 2011). Non-breeding habitat usage is poorly documented in the Wallum Froglet, however, adult animals have been recorded some distance (many tens of metres) from breeding habitat in nearby Banksia woodland and/or open eucalypt forest (Meyer *et al.* 2006). Non-breeding animals have also been located amidst damp leaf litter and down crayfish burrows (Hines and Meyer. 2011).

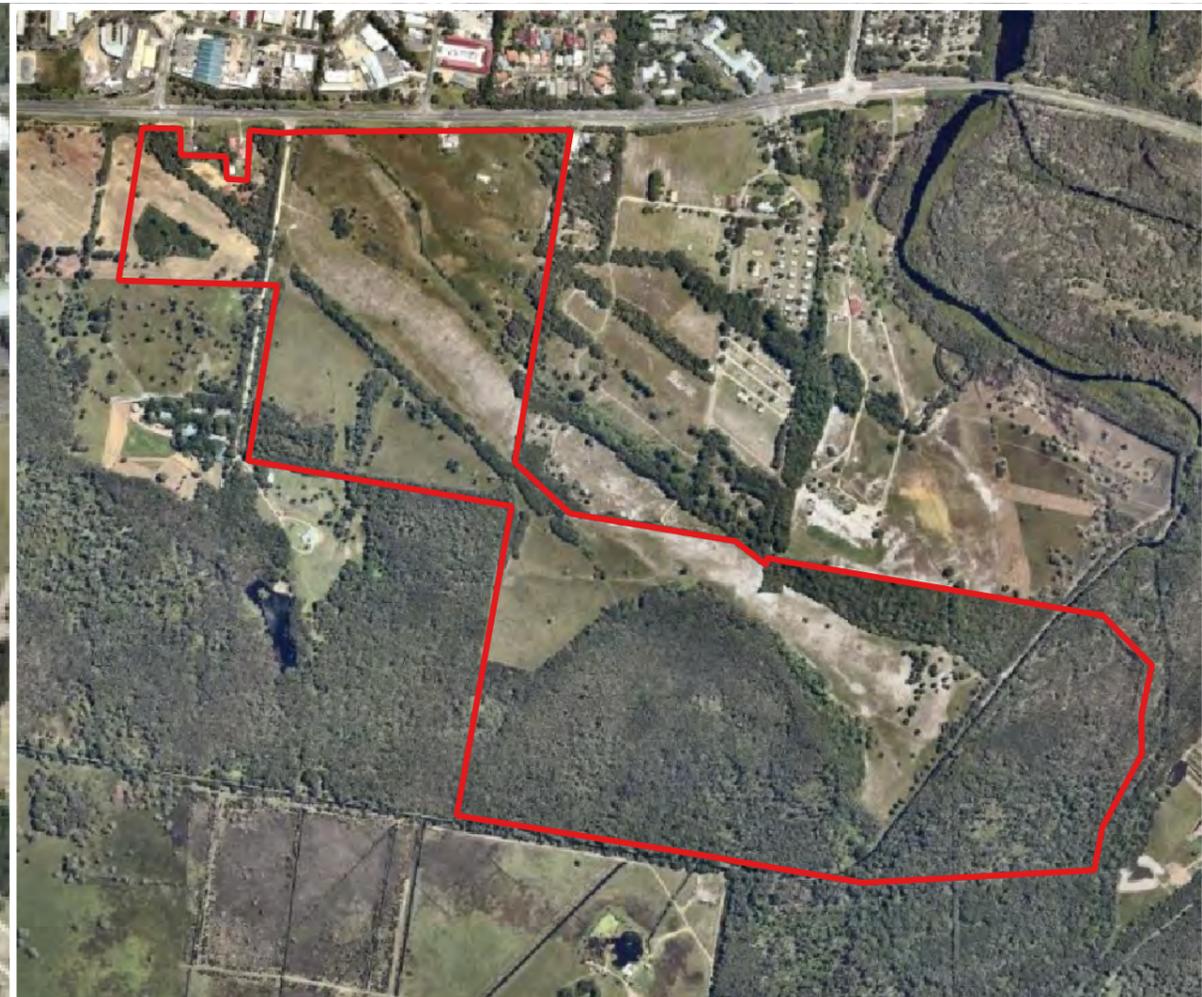
### 2.3.3 Occurrence on site

Wallum Froglets have been recorded in association with fenced habitat in the west of the site (as per the Wallum Sedgefrog), in addition to numerous records associated with the central swale drain and adjacent grassland areas to the south (refer Figure 2-1). Several isolated records also occur within land not subject to residential subdivision at Lot 227 DP 755695. As per comments on fenced habitat within Lot 6, the central drain is becoming increasingly overgrown with woody vegetation (predominantly *Acacia melanoxylon*) and habitat is essentially restricted to the drain itself any an adjacent areas of fernland.

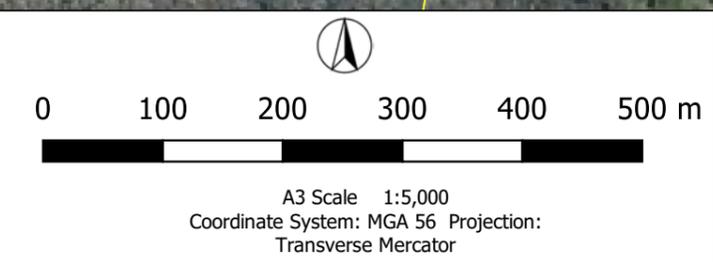
Wallum Froglet habitat within residue land will be managed for restoration and returned to Council. Lot 227 DP 755695 will be retained in private ownership and management of Wallum Froglet habitat on this property will remain the responsibility of the landowner.

### 2.3.4 Occurrence Off Site

The Wallum Froglet has been recorded within other areas of the WBURA (e.g. adjacent Lot 2 DP 542178 [Belongil Fields Caravan Park] and Lot 1 DP 780242) and a population is known to occur at Byron Bay Sewage Treatment Plant and part of Habitat Estate approximately 1 km north of the site.



|             |   |
|-------------|---|
| Source:     | Aerial Photograph: Nearmaps, 2020<br>WF & WSF Bionet: Bionet database, 2020<br>WF & WSFPLANIT (2016): PLANIT 2016   |
| Disclaimer: | Care was taken in the creation of this map. AWC should be consulted as to the suitability of the information shown here in prior to the commencement of any works based on the information provided. AWC cannot accept any responsibility for errors, omissions or positional accuracy. There are no warranties expressed or implied as to the suitability of this map for a particular purpose. However, notification of any errors will be appreciated. |
| Date        | 19/06/2020  |



|                   |                    |
|-------------------|--------------------|
| Legend            |                    |
| Acid Frog Records |                    |
| ●                 | WF - BioNet        |
| ●                 | WF- PLANIT (2016)  |
| ●                 | WSF - BioNet       |
| ●                 | WSF- PLANIT (2016) |

**Figure 2-1:**  
**Wallum Sedgefrog and Wallum Froglet recorded across the subject site**

## 3 Key Threats to Acid Frogs at the Site

### 3.1 Introduction

Threats that will likely compromise the viability and persistence of the Wallum Sedgefrog and Wallum Froglet across the site may include:

- Destruction, fragmentation and degradation of suitable habitat for agriculture, housing and infrastructure, drainage projects and transport corridors (Ingram and McDonald 1993; Hines et al. 1999)
- Changes to surface and groundwater hydrology resulting in decreased and/or increased persistence of surface waters (Meyer et al. 2006)
- Changes in water quality (i.e., increased salinity, reduced acidity, increased nutrient levels, reduced dissolved oxygen levels, and increased turbidity) due to soil disturbance and run-off from development (Meyer et al. 2006)
- Use of biocides for weed and mosquito control programs (Meyer et al. 2006)
- Mortality on roads adjacent to breeding habitat (Goldingay and Taylor 2006)
- Predation from introduced fish (i.e. *Gambusia holbrooki*) (Hines et al. 1999)
- Weed spread (Meyer et al 2006)
- Introduced pathogens (i.e. *Batrachochytrium dendrobatidis*) (Meyer et al. 2006)
- Competition from ecologically similar frog species such as the Beeping Froglet (*Crinia parinsignifera*) following disturbance of wallum habitat (Meyer et al. 2006)
- Inappropriate fire management (Meyer et al. 2006).

### 3.2 Development Specific Threats

The most significant threats to the Wallum Sedgefrog and the Wallum Froglet associated with the proposed development of the site (as informed by Meyer et al, 2006) are:

- Habitat removal (due to in-filling of known breeding habitat); discussed further in Section 4.2.1
- Changes to soil hydrology within areas of remaining habitat adjoining developed land
- Degradation of water quality (due to contaminated runoff/soil disturbance)
- Weed spread
- Mortality on roads
- Predation by Cane Toads.

Without effective mitigation, these impacts are likely to result in a substantive net loss of Wallum Sedgefrog and the Wallum Froglet habitat within the site. It is noted that while Cane Toads occur at the site, use of acidic water within acid frog habitat for breeding is unlikely, based on monitoring experiences at the 'Aura' development (Caloundra South), where substantial habitat restoration has been completed for the Wallum Sedgefrog.

The following recognised threats are unlikely to impacts acid frog habitat at the site:

- Habitat invasion by Mosquito fish: all drainage areas of the site are ephemeral and dry out completely for a period of time in a typical year. This renders habitat for Mosquito fish as unviable in the long term.
- Chytrid fungus: the extent to which Chytrid affects local frog populations is unknown. The fungal pathogen *Batrachochytrium dendrobatidis* (Bd) has been detected in Wallum Sedgefrogs (and *L. freycineti*), including records from nearby Tyagarah Reserve (pers.com. Mark Hero 2018). While this highlights the potential ability of Bd to be a concern for acid frogs in natural coastal wallum habitats, where water is naturally 'acidic' and oligotrophic (Simpkins et al. 2017), effective management of Chytrid within acid frog populations is beyond the scope of this report. Rather, management actions will focus on hygiene measures during the construction stage to minimise the potential for introducing chytrid to the site.
- Inappropriate fire management: fire has been absent from the site for decades due to agricultural regimes. The development of the site will apply appropriate Asset Protection Zones (APZs) to reduce the risk of bushfire. The likelihood of fire affecting acid frog habitats is therefore negligible.

## 4 Mitigation Strategies

### 4.1 Introduction

The mitigation measures provided in this section of the report are considered appropriate for the collective protection of the Wallum Sedgefrog and Wallum Froglet. The over-arching mitigation objective is to deliver an outcome that maintains or improves functioning populations of both species.

To ensure the long-term viability of the population of Wallum Sedgefrog and Wallum Froglet, the core elements of the proposed mitigation strategy are:

- Retained existing habitat (discussed in Section 4.2.1)
  - A total of 3.0 hectares of habitat currently occurs across the site with 2.95 ha of this existing habitat being retained following development
- Lost habitat: 0.0527 hectares will be lost adjacent a primary road
- Created habitat (refer Section 4.2.4)
  - 4.77 hectares of movement/foraging habitat will be formed through vegetation management
  - 0.64 hectares of breeding habitat (ponds) will be created
- Provide fauna underpass connecting the two habitat polygons, including sections of frog fencing to facilitate effective movement
- No direct stormwater discharge to habitat areas, resulting in no direct stormwater entering habitat during or after the construction (refer to Section 5.3)
- Implement management measures such as sediment and erosion control, water quality monitoring, weed management, frog fencing, frog friendly fauna crossings
- Ensure that the habitat being re-created, rehabilitated and conserved is located within a conservation regime in perpetuity
- The design and implementation of rehabilitation and habitat re-creation will be informed by additional soil and groundwater assessment
- An adaptive management approach would be taken to ensure that results of monitoring informs future management decisions
- Currently, amphibian chytridiomycosis (exotic disease caused by the chytrid fungus *Batrachochytrium dendrobatidis*) is not reported to be a threat to wallum frog species (Meyer et al. 2006), nevertheless, it is recommended that steps are undertaken to minimise the likelihood of chytrid fungus entering the habitat of the Wallum Sedgefrog and Wallum Froglet including:
  - Avoid artificially created waterbodies (defined as ponds/wetlands that have permanent water) across the development, noting that chytridiomycosis affects mostly amphibian species associated with permanent water
  - Prevention of regular external catchment flows entering frog habitat, noting that regular catchment inflows into frog habitat may transport chytridiomycosis from outside of the development
- Maintaining and/or creating an ephemeral acidic wetland will be key to negating the possible threats of both the cane toad and mosquito fish on existing acid frog population at the site:
  - Ephemeral wetlands will disrupt the potential populations of the mosquito fish

- Acidic waters (pH <5.2) are unfavourable to cane toads and cane toad breeding
- No artificially created waterbodies (defined as ponds/wetlands that have permanent water) across the development will minimise the habitat created of additional habitat suitable for both cane toad and mosquito fish
  - All WSUD devices are ephemeral, meaning they will dry out between rainfall events and thus not be habitable by either cane toads or mosquito fish
  - Prevention of regular external catchment surface flows from entering frog habitat will ensure external transport of both cane toad tadpoles and mosquito fish will not occur

These strategies have been developed to protect both the Wallum Sedgefrog and Wallum Froglet **during** and **following** the construction of the development.

## 4.2 Post Development Mitigation Strategies

### 4.2.1 Habitat Retention

A total of 2.95 ha of habitat will be retained (refer Figure 4-2) comprised of:

- 0.71 hectares located in the western polygon
- 0.96 hectares located in the south-western polygon
- 1.28 hectares in the central, linear drainage line portion

To maintain the values of the retained habitat, the following management and mitigation measures will be implemented:

- Inclusion of Water Sensitive Urban Design features that ensure the diversion of stormwater and surface runoff away from retained (and created) habitat (to maintain low pH, ensure habitat stability and limit introduction of competitor/predatory species and chytrid fungus)
- Maintaining natural groundwater hydroperiod and other water chemistry aspects (particularly pH and tannin levels) of retained habitat areas
  - This will be achieved via the use of 'leaky' stormwater devices within the development to maximise infiltration into the shallow groundwater that feeds the acid frog habitat
- Maintaining vegetation communities within retained habitat areas through weed management measures and management of woody vegetation\* (refer below)
- Provision of a vegetated movement corridor to connect the western and central areas of retained habitat
- Ensure community education, signage, vegetation planting and physical barriers occur to deter inappropriate recreational activities in frog conservation areas
- Taking practical measures to reduce lighting in proximity to areas of retained acid frog habitat.

**\*Woody vegetation management**

Intervention to minimise the encroachment of woody shrubs and trees (eg. *Acacia melanoxylon*, *Melaleuca quinquenervia*) into areas of retained habitat (Lot 6 and the central drain) may be required over time to maintain habitat values. As noted, woody plant cover has increased substantially over the past ten years and will reduce the quality of acid frog in these areas over time from shading and crowding. Thinning and removal of woody vegetation is recommended in both these areas and could be completed immediately following approval of this plan and/or gaining any necessary approvals. This approach has been taken at the Habitat Estate with the support of Council where juvenile *Melaleuca quinquenervia* are routinely removed to maintain areas of open water/sedgeland. The majority of *Acacia melanoxylon* would be recommended for removal at both sites by mulching down with a tritter (side arm slasher), or manual removal with a chainsaw and poisoning of stumps. Any woody debris would be removed from habitat areas and mulched.

Retained acid frog habitat will be monitored to ensure no unacceptable impact from the development. Monitoring will be conducted in accordance with Section 5 of this document, with data reported against the Performance Criteria (outlined in Section 5.4 and Section 5.5).

**4.2.2 Stormwater Management**

The management of stormwater post development directs all water away from the retained and created acid frog habitat. This is achieved using swales running parallel with the roads, which have been designed to protect the hydroperiod (wetting / drying regime) of the retained habitat polygons. These key design features include:

- Leaky base to promote infiltration to the shallow groundwater, to maintain shallow groundwater while not compromising the pH levels of the groundwater (movement of rainwater through soil matrix rich in organic matter can reduce water pH and increase tannin levels)
  - This will also ensure that habitat for mosquito fish, cane toads and other frog species is not favourable
- Conveyance capacity of all ARI events up to and including the 5 year ARI event (to be confirmed)
  - This will ensure that the wetland habitats will maintain an ephemeral nature and not improve habitat conditions for other, native competitor frogs
  - This will also ensure that within the retained wallum habitat, conditions for mosquito fish, cane toads and other frog species continue to be less favourable
  - Additionally, this will ensure any upstream catchment sources of cane toads, mosquito fish and/or chytrid fungus is minimised
- Lined conveyance swale adjacent to prevent infiltration of conveyed stormwater to the central retained habitat area

**4.2.3 Groundwater Considerations**

Habitat creation requires groundwater expression over a sufficient duration to ensure that breeding conditions for acid frogs occur (i.e. 30-100 days; as per Meyer *et al.*, 2006). Seven monitoring bores have been installed at the site to enable a detailed understanding of groundwater behaviour within and across the site. Detailed design plans of the acid frog habitat will be informed by the data gathered from these bores (i.e. excavation depths) along with key soil data gathered from the proposed habitat recreation area.

Groundwater monitoring data (level and quality) undertaken as part of the *Groundwater*

*Management Plan* (AWC, 2021c) will be provided to the project ecologist with regard acid frog management.

#### 4.2.4 Habitat Creation and Embellishment

Development of the site as per the amended concept would result in the loss of 0.0527ha of acid frog habitat located at the western end of the Wallum Sand Heath (Teatree sp.) community that spans the central portion of the subject site. To off-set the habitat loss, and account for any possible decline in the habitat values of the retained habitat, 0.64 hectares of compensatory breeding habitat (ponds) will be created (as shown in Figure 4-2). Appendix A provides the *Acid Frogs Habitat Plan* drawing set as prepared by Planit (2020) showing the general layout of created habitat breeding ponds. These ponds will be formed within a landscape rehabilitation area and provide acid frog movement and foraging habitat with a total area of 4.77 hectares. Table 4-1 summarises the retained and created habitats.

Table 4-1 Wallum Sedgefrog and Wallum Froglet habitat to be retained and created at the site

| Area     | Location   | Area (ha)   | Comments  |
|----------|--|-------------|---|
| Retained | North west   | 0.71        | Both species recorded within this habitat, all of which will be retained.   |
|          | Central (drain)                                      | 1.28        | Both species recorded close to/or within this habitat and only a minor area (0.0527ha) requires removal.                          |
|          | South west   | 0.96        | Wallum Froglet detected in this area  |
|          | <b>Total</b>   | <b>2.95</b> |   |
| Impacted | Spans the far western edge of the centre of the site | 0.0527      | Both species recorded close to/or within this habitat; only a minor area (0.05ha) requires removal.                               |
| Created  | Breeding ponds                                       | 0.64        | Areas selected as they provide good regeneration potential and is adjacent to habitat where the Wallum Froglet has been recorded. |
|          | Movement / foraging habitat                          | 4.77        |   |
|          | <b>Total</b>   | <b>5.41</b> |   |

Factors critical to the success of constructed Wallum Sedgefrog and Wallum Froglet habitat areas at the site include:

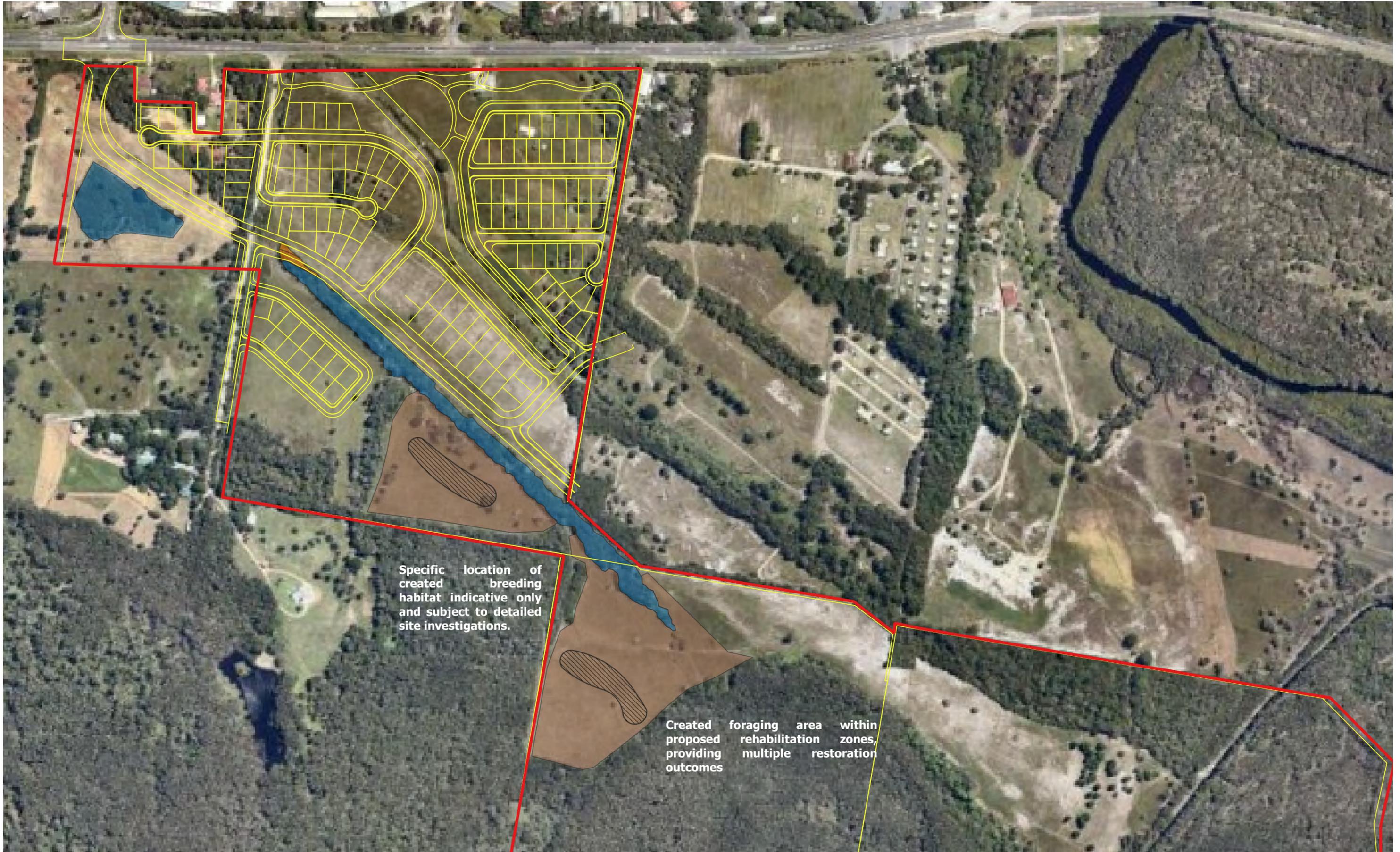
- Proximity to known acid frog habitat areas
- Appropriate excavation depths such that groundwater is intercepted and a 'window' for groundwater expression is created at depths corresponding to the depths of existing habitat areas
  - Maximum water depth of any habitat areas should be no greater than 0.3 metres
- Delivery of water to ponds via groundwater to ensure a pH less than 5
- Translocation and/or provision with suitable vegetation
- The need for signage so habitat areas are not impacted by trampling or disturbance
- Groundwater dynamics in the post-development scenario are unchanged.

All habitat areas to be constructed/restored will be subject to detailed design, which will be informed by site soil and hydrology investigations which are ongoing. It is anticipated that

construction methodology will use the most up to date understanding of acid frog habitat creation, with much of this information sourced from AWC’s experience in creating similar habitat in SE QLD, as shown in Figure 4-1.



Figure 4-1: Constructed acid frog habitat completed by AWC in SE QLD

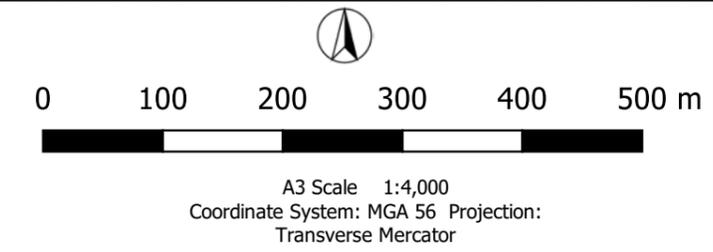


Specific location of created breeding habitat indicative only and subject to detailed site investigations.

Created foraging area within proposed rehabilitation zones, providing multiple restoration outcomes



|             |   |
|-------------|---|
| Source:     | Aerial Photograph: Nearmaps, 2020<br>Impacted habitat: PLANIT 2020<br>Retained habitat: PLANIT 2020<br>Created foraging habitat: AWC, 2020<br>Created breeding habitat: PLANIT 2020   |
| Disclaimer: | Care was taken in the creation of this map. AWC should be consulted as to the suitability of the information shown here in prior to the commencement of any works based on the information provided. AWC cannot accept any responsibility for errors, omissions or positional accuracy. There are no warranties expressed or implied as to the suitability of this map for a particular purpose. However, notification of any errors will be appreciated. |
| Date        | 19/6/2020   |



| Legend |                          |
|--------|--------------------------|
|        | Impacted habitat         |
|        | Retained habitat         |
|        | Created foraging habitat |
|        | Created breeding habitat |

**Figure 4-1:**  
**Site layout including development layout, retained acid frog habitat, lost acid frog habitat and created acid frog habitat**

#### 4.2.5 Translocation of Material

Translocation of existing Wallum vegetation from within the development footprint is a method of habitat creation when proximity and availability of suitable material exists. Following preliminary preparation translocation of material to habitat areas may commence. Translocation of suitable material from donor areas by using 'slabs' of sedges removed with a posi-track and slab bucket or similar, is a proven methodology and may also be beneficial in translocating individuals directly into habitat areas. Removal of donor vegetation of a minimum depth of 300mm of organic matter is necessary to ensure that root systems and rhizomes are 'captured'.

Ideally donor material shall be removed and placed directly into receiving ponds, or temporarily placed on the site and watered daily until placed within habitat areas (a maximum of 3 days in-situ care is recommended to reduce stress to slabbed donor material). Following placement within receiving habitat areas, these areas must be flooded, and this treatment repeated for a minimum of five consecutive days. Water used for flooding must be sourced from the central drain and treated (town) water must not be used. Following initial aftercare, habitat areas shall be watered once weekly for a minimum four (4) week period, with this increased to a six (6) week period if works occur during the summer months. This methodology of the habitat translocation will be refined and finalised during the detailed design phase of the created acid frog habitat.

There is 0.0527 hectares of habitat to be removed as part of the proposed construction of the road system, this material could be translocated to the created breeding habitat areas.

### 4.3 Mitigation During Construction

To prevent construction impacts to retained habitats, the following mitigation measures will be implemented during the construction phase:

- Buffers:
  - Establish and maintain a (preferably 30m) buffer between existing habitat and construction activities
  - Where this buffer cannot be achieved, physical separation using a combination of bunds and swales is required
  - It is acknowledged that a 30m buffer between existing habitat and construction activities is the generalised best practise, however such a buffer is not necessarily required to protect habitat from development related impacts; it is more important to protect habitat from both surface and groundwater impacts which can be effectively managed via physical separation using a combination of bunds and swales
- Batters:
  - Any batters from earthworks activities that encroach within 30m of wallum habitat must be covered with a minimum of 100mm of mulch
  - These areas will be revegetated with key wallum heath species post construction
- Stormwater:
  - All stormwater runoff from the development and discharge from the WSUD systems up to 5 year ARI event (to be confirmed) must be directed around created and retained habitat to maintain pH and ensure habitat stability (i.e. limit the introduction of competitor/predatory species)
  - This will be achieved by constructing and maintaining swale drains and bunds to ensure no discharge of urban surface waters to acid frog habitat

- Establish and maintain a movement corridor from the western-retained habitat to the central-retained habitat, including the re-creation of acid frog foraging and movement habitats
- Maintain natural groundwater hydro period and other water chemistry aspects (particularly pH and tannin levels) of retained habitat areas
- Maintain and enhance vegetation communities within retained habitat areas through, for example, weed management or management of woody native vegetation
- Deter inappropriate recreational activities in retained frog habitat through signage, vegetation planting and physical barriers
- Ensure lighting design in proximity to retained habitat reduces spill.

#### 4.4 Summary

The mitigation and management measures outlined in this AFMP, are considered appropriate for the long-term viability of Wallum Sedgefrog and Wallum Froglet at the site.

The successful implementation of the measures proposed would deliver:

- 0.64 ha of compensatory breeding habitat (ponds) + 4.77ha of movement/foraging habitat within the environmental zone located to the southeast of the subject site
- Conserve and enhance certain areas of existing habitat conducive to Wallum Sedgefrog and Wallum Froglet
- Maintenance of habitat connectivity for Wallum Sedgefrog and Wallum Froglet populations to allow for movement within and outside the site

## 5 Monitoring, Reporting and Corrective Action

### 5.1 Introduction

Monitoring will be undertaken to determine the success of the AFMP. The purpose of monitoring is to:

- Document the persistence of Wallum Sedgefrogs and Wallum Froglets within areas of known (retained) and created habitat
- Determine whether acid frogs are utilising areas of created habitat
- Determine that suitable pH occurs within all areas of retained and created habitat
- Record water depth and quality
- Determine the presence/influence of Cane Toads
- Determine the presence of weed species within acid frog habitats.

Results of the monitoring will be used to adapt management practices appropriately with such practices to include weed control, habitat enhancement and pest control.

### 5.2 Monitoring Requirements

For monitoring to be successful, the various phases of development must be defined and the roles and responsibilities for each phase clearly identified. Additionally, baseline monitoring is required prior to any works commencing (refer Section 5.3). The monitoring requirements for the phases of development (Baseline, Pre-Construction, Construction, Occupation), are outlined in Table 5-1. Management of the majority of frog habitat zones will become the responsibility of Council after the initial restoration works are completed by the developer. Monitoring will be the responsibility of the developer for 20 years. Acid frog habitat retained and created on Lot 227 will remain in private ownership and managed by the property owner.

Monitoring locations are shown on Figure 5-1.

Table 5-1 Monitoring requirements for development phases

| Phase            | Monitoring requirements  | Responsibility                                       |
|------------------|--|--|
| Baseline         | <ul style="list-style-type: none"> <li>• Vegetation assessment of existing habitat</li> <li>• Water quality</li> </ul>   | Developer/Ecologist and/or appointed contractors     |
| Pre-Construction | <ul style="list-style-type: none"> <li>• 'No-go' areas maintained, and frog habitat protected</li> <li>• Implementation and maintenance of sediment and erosion controls</li> </ul>  | Site foreman/ Ecologist and/or appointed contractors |
| Construction     | <ul style="list-style-type: none"> <li>• 'No-go' areas maintained, and frog habitat protected</li> <li>• Water quality</li> <li>• Weed control</li> <li>• Implementation and maintenance of sediment and erosion controls</li> </ul> | Site foreman/ Ecologist and/or appointed contractors |
| Occupation       | <ul style="list-style-type: none"> <li>• Water quality</li> <li>• 'No-go' areas maintained, and frog habitat protected</li> <li>• Weed control</li> <li>• Pest species control</li> </ul>  | Byron Shire Council                                  |

### 5.3 Baseline Monitoring

Baseline frog monitoring has commenced with two events undertaken, the first in April 2021 where two individuals of the Wallum Sedgefrog were recorded, and the second in August 2021 where no acid frogs were detected. The monitoring reports are provided in Appendix B.

Water quality and hydroperiod monitoring has also been completed at eight locations approximately fortnightly across the site since May 2020 (refer Appendix C). Results show water quality, particularly pH, is within the preferred range of acid frogs and is relatively consistent. The data set is considered sufficient to provide a clear picture of baseline water quality and as such the water quality component of the baseline monitoring at a fortnightly frequency can cease. Water quality monitoring will continue as part of the frog monitoring and as part of the overall surface water monitoring of the site (refer AWC 2021c).

### 5.4 Performance Criteria

To track the success of the AFMP and the planned mitigation measures, performance criteria are required to determine success or otherwise. Recommended performance criteria for the monitoring period are summarised in Table 5-2 and may be adapted for pre-construction, construction and occupation periods of the development.

Performance criteria must consider prevailing climatic conditions which may adversely affect created habitat and Wallum Sedgefrog/Froglet populations. There is a strong possibility that no individuals will be detected during low rainfall periods.

Table 5-2 Summary of nominated performance criteria

| Item  | Performance Criteria  | Responsibility  |
|---|---|---|
| <b>Retained habitat areas</b>                 |   |   |
| Water quality                                 | Water chemistry is between a pH range of 3 – 5.   | Appointed ecologist/consultant  |
| Wetland hydroperiod                           | Ponding of water for a minimum period of 6 weeks under >60 <sup>th</sup> ile rainfall conditions between January and May. | Appointed ecologist/consultant  |
| Vegetation                                    | Native vegetation continues to persist and is not degraded or disturbed.  | Appointed ecologist/consultant  |
| Weed control                                  | Environmental weeds comprise < 10% total within each habitat area.  | Appointed contractor for implementation of the VMP  |
| Wallum Froglet / Wallum Sedgefrog populations | Existing/known habitat areas continue to be utilised by Wallum Froglet / Wallum Sedgefrog.                                | Appointed ecologist/consultant  |
| Cane Toads                                    | No observed breeding / tadpoles within retained habitat.  | Appointed ecologist/consultant. If breeding / tadpoles observed, create and implement a control plan. |
| <b>Constructed habitat areas</b>              |   |   |
| Water quality                                 | As above.   | Appointed ecologist/consultant  |
| Wetland hydroperiod                           | Ponding of water for a minimum period of 6 weeks under >60 <sup>th</sup> ile rainfall conditions between January and May. | Appointed ecologist/consultant  |
| Weed control                                  | Environmental weeds comprise < 10% total within each identified frog compensation area per precinct.                      | Appointed contractor for implementation of the VMP  |
| Habitat establishment                         | Survival rate of greater than 90% of all plantings and/or translocated material.  | Appointed contractor for implementation of the VMP  |
| Wallum Froglet / Wallum Sedgefrog populations | Utilisation by Wallum Froglets / Wallum Sedgefrog and persistence at constructed habitat areas over time.                 | Appointed ecologist/consultant  |
| Cane Toads                                    | No observed breeding / tadpoles within created habitat.   | Appointed ecologist/consultant. If breeding / tadpoles observed, create and implement a control plan. |

## 5.5 Monitoring Schedule and Reporting

Monitoring of retained and constructed habitat areas will be completed three times annually (i.e. every four months) for a period of 20 years. Monitoring will be completed at eight nominated sites within retained and constructed habitat areas (refer Figure 5-1). Monitoring will be completed at the ecologists discretion within the 4 moth 'window', and aim to optimise species detection based on climatic conditions conducive (eg. temperature/season, rainfall triggers).

Monitoring requirements include:

- Nocturnal survey for both acid frog species
- Call playback\* to elicit response at each location
  - Calls to be broadcast for three minutes followed by a five minute listening period for each species
  - An estimate of responding individuals will be recorded
- Records of any incidental frog species (including Cane Toads)
- Records of Mosquito Fish
- Weather conditions recorded (temperature, relative humidity, rainfall)

- Water quality sampled if standing water present (Dissolved Oxygen, Turbidity, pH, Electrical Conductivity)

\*The project ecologist may also elect to use alternative methods of acid frog detection, for example Song Meters (or similar) to remotely record frogs at the site. If an alternative monitoring method is proposed, a case must be presented to Council for approval prior to commencement. This approach is justified given the substantial monitoring time for the project (20 years) during which better technologies and methodologies may be more effective and/or efficient.

**NOTE:** Monitoring of created habitat is to commence as soon as ponds are complete with monitoring as described for retained habitat.

An example of the monitoring pro-forma (Appendix D) is attached.

A brief summary of each monitoring event will be completed, and a detailed annual report provided to Council.

Frog and associated water quality monitoring will be undertaken three times a year for a total of 20 years (refer Table 5-3).

Table 5-3 Development phase monitoring schedule

| Monitoring Type           | Development Phase  |                              |                              |
|---------------------------|--|------------------------------|------------------------------|
|                           | Baseline   | Construction                 | Occupation                   |
| Water quality             | Commenced May 2020, ceased August 2021<br><br>Will continue to be collected as part of the frog monitoring | Three times yearly           | Three times yearly           |
| Frog                      | Three times yearly   | Three times yearly           | Three times yearly           |
| Groundwater levels and pH | Completed as part of the GWMP (AWC, 2021c).  | As per the GWMP (AWC, 2021c) | As per the GWMP (AWC, 2021c) |
| Reporting                 | Annual   | Annual                       | Annual                       |

## 5.6 Corrective Actions

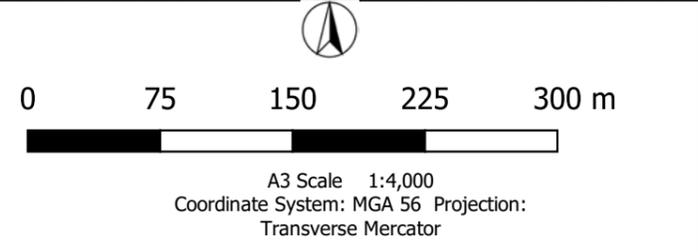
If prevailing climatic conditions are considered suitable for frog activity and no Wallum Sedgefrogs or Wallum Froglets are recorded within habitat areas within two years following monitoring commencement, more intensive sampling should be considered.

An additional corrective action (which may become more relevant over time) is the removal of woody shrubs and trees from areas of retained habitat. Species such as *Acacia melanoxylon*, *Melaleuca quiquenervia* can become more established within these areas and shade out waterbodies and the ground layer and displace groundcover vegetation. Review of the extent of woody vegetation at Lot 6 and the central drain should be completed every five years and removal of trees and shrubs completed to reduce cover canopy where required.

In the event of the failure of compensatory habitat areas to establish, an adaptive response should be maintained, with the developer having the option to complete further habitat works following advice from the project ecologist.



|             |   |
|-------------|---|
| Source:     | Imagery: Nearmaps<br>Layout: Harvest Estate<br>AF Habitat and Monitoring Locations: AWC   |
| Disclaimer: | Care was taken in the creation of this map. AWC should be consulted as to the suitability of the information shown here in prior to the commencement of any works based on the information provided. AWC cannot accept any responsibility for errors, omissions or positional accuracy. There are no warranties expressed or implied as to the suitability of this map for a particular purpose. However, notification of any errors will be appreciated. |
| Date        | 18-6-21   |



|                          |                    |
|--------------------------|--------------------|
| Legend                   |                    |
| AF Habitat               |                    |
| Impacted                 | (Red fill)         |
| Retained                 | (Light Green fill) |
| Created                  | (Dark Green fill)  |
| Created breeding habitat | (Hatched fill)     |
| AF monitoring sites      | (Red star)         |
| Layout                   | (Yellow line)      |

**Figure 5-1:**  
**Acid Frog Monitoring Locations**



## 6 Conclusion

This AFMP for Harvest Estate has been developed to identify areas of habitat to be retained and embellished as part of the proposed development. The Plan nominates construction procedures, prescribes habitat translocation and creation methods, and sets out a methodology for monitoring to determine whether Key Performance Indicators have been achieved. It is recommended that all prescriptions in this Plan are incorporated within a site-specific Construction Environmental Management Plan (CEMP) to guide the construction process.

If effectively implemented, this plan will achieve retention and creation of Wallum Sedgefrog and Wallum Froglet breeding habitat at the site comprising:

- Retention of 2.95 hectares of existing habitat
- Creation of 0.64 hectares of breeding habitat (ponds)
- Creation of 4.77 hectares of movement/foraging habitat

These areas are to be protected under an appropriate covenant and the proponent is responsible for the management and monitoring of these areas for a minimum of 20 years.

## 7 References

- AWC (2021) *Acid Frog retained and created habitat monitoring – Harvest Estate – April 2021*. A report to Tower Holdings.
- AWC (2021b) *Acid Frog retained and created habitat monitoring – Harvest Estate – August 2021*. A report to Tower Holdings.
- AWC (2021c) *Harvest Estate Groundwater Management Plan*. A report to Tower Holdings.
- James, C.J. (1997) *Molecular Systematics and Physolgeography of the Litoria bicolour Species Group (Anura: Hylidae) from Eastern Australia*. PhD Thesis, University of Queensland.
- Lewis, B.D. and Goldingay, R.L. (2005) *Population monitoring of the vulnerable Wallum Sedgefrog (Litoria olongburensis) in north-eastern New South Wales*. Australian Journal of Zoology 53.185-194.
- Meyer, E., Hero, J-M., Shoo, L., Lewis, B. (2006) *National Recovery Plan for the Wallum Sedgefrog and Other Wallum-dependent Frog Species*. Report to Department of the Environment and Water Resources, Canberra. Queensland Parks and Wildlife Service, Brisbane.
- Planit Consulting (2020) *Acid Frogs Habitat Plan (Revision B, 16.6.20)*. A drawing set prepared as part of the *Threatened Species Management Plan* for Tower Holdings Pty Ltd
- Planit Consulting (2020b) *Harvest Estate Threatened Species Management Plan*. Version 1.3 (26.08.2020) A report prepared for Villa World Byron Pty Ltd.
- Planit Consulting (2018) *Acid Frog Rehabilitation Plan (Revision B, 04/05/2018)*. A report prepared for Villa World Byron Pty Ltd.

# Appendix A

## Acid Frogs Habitat Plan (Planit, 2020)

(4 sheet drawing set)

# WEST BYRON URBAN RELEASE AREA

## ACID FROGS HABITAT PLAN

Prepared by Planit Consulting Pty Ltd JUNE 2020

### DRAWING SCHEDULE

SHEET 01  
SHEET 02  
SHEET 03  
SHEET 04

TITLE & DRAWING SCHEDULE  
ZONING PLAN  
SECTIONS  
POND PLAN AND DETAILS



PROJECT AREA

#### WARNING

##### BEWARE OF UNDERGROUND SERVICES

Note that the location shown of existing underground services is indicative only and may not be accurate at the time of landscape works. No guarantee is given that all existing services are shown. Determination of the exact position and extent of underground services is the responsibility of the Contractor and is to be confirmed on site prior to commencement of work.

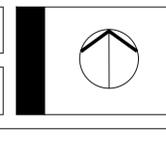
#### GENERAL NOTES:

1. Before commencement of works it is the responsibility of the Landscape Contractor to contact dial before you dig (ph. 1100 or web 1100.com.au) for information on services in the area shown on the plan.
2. The Contractor shall verify the location and depth of all services prior to commencing on site.
3. The Contractor shall be liable for any damage to services during landscape works.
4. The Contractor shall verify the location of any existing trees shown to be retained and protect them during works.
5. All trees shall be planted in locations shown on the plan.
6. Any change to plant species must have the approval of the Landscape Architect.
7. Construction certification for all structural elements is to be provided prior to practical completion being granted.

|                |   |
|----------------|---|
| PROJECT:       | <b>THREATENED SPECIES MANAGEMENT PLAN</b> |
| DRAWING TITLE: | <b>TITLE &amp; DRAWING SCHEDULE</b>       |

|    |                               |          |    |    |    |
|----|-------------------------------|----------|----|----|----|
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| 02 | LANDSCAPE OPW FOR INFORMATION | 16.06.20 | AH | AH | LT |
|    |                               |          |    |    |    |
|    |                               |          |    |    |    |

|         |                        |         |          |
|---------|------------------------|---------|----------|
| JOB NO: | J5644                  | DWG NO: | J5644_01 |
| SCALE:  |                        |         |          |
| CLIENT: | Tower Holdings Pty Ltd |         |          |



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Telephone: 07 5526 1500  
ABN: 20 099 261 711  
Email: admin@planitconsulting.com.au

REFER TO SHEET 002

FROG FENCING EITHER SIDE OF CULVERT

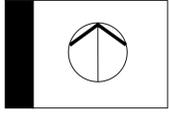
**LEGEND**

-  SUBJECT LAND
-  PROTECTED FROG HABITAT ZONES
-  FROG FENCING
-  MANAGED PRIVATE OPEN SPACE
-  HABITAT CREATION AREAS FOR ACID FROGS
-  PROPOSED DWELLING  
TOTAL: 4

|                |  |
|----------------|--|
| PROJECT:       | <b>THREATENED SPECIES MANAGEMENT PLAN</b>    |
| DRAWING TITLE: | <b>HABITAT CREATION AREAS FOR ACID FROGS</b> |

|    |   |          |    |    |    |
|----|---|----------|----|----|----|
| 01 | LANDSCAPE MANAGEMENT PLAN FOR INFORMATION | 13.05.20 | AH | AH | JA |
| 02 | LANDSCAPE OPW FOR INFORMATION             | 16.06.20 | AH | AH | LT |
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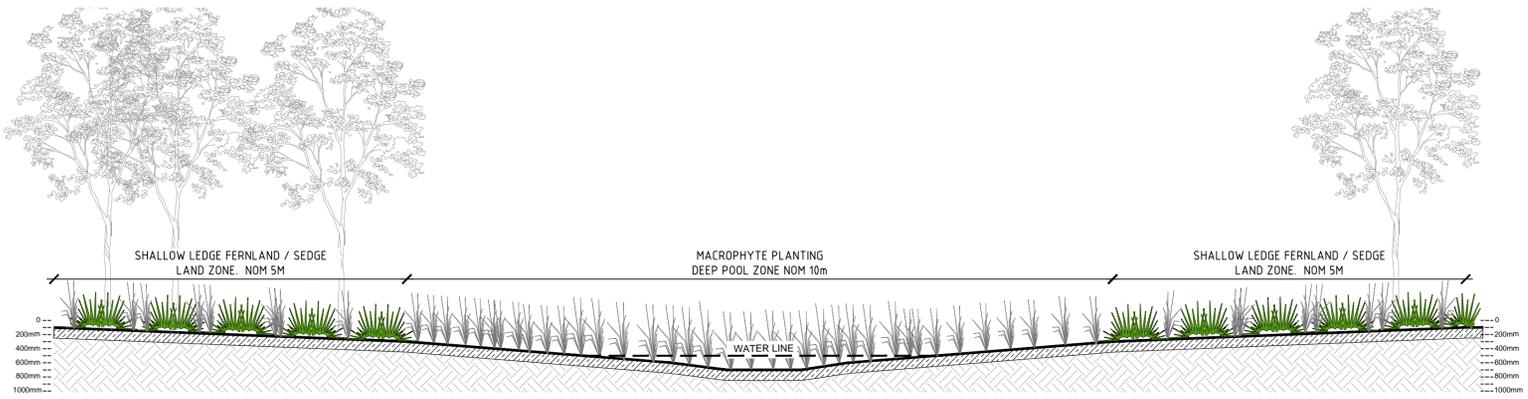
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| CLIENT: | Tower Holdings Pty Ltd |         |          |



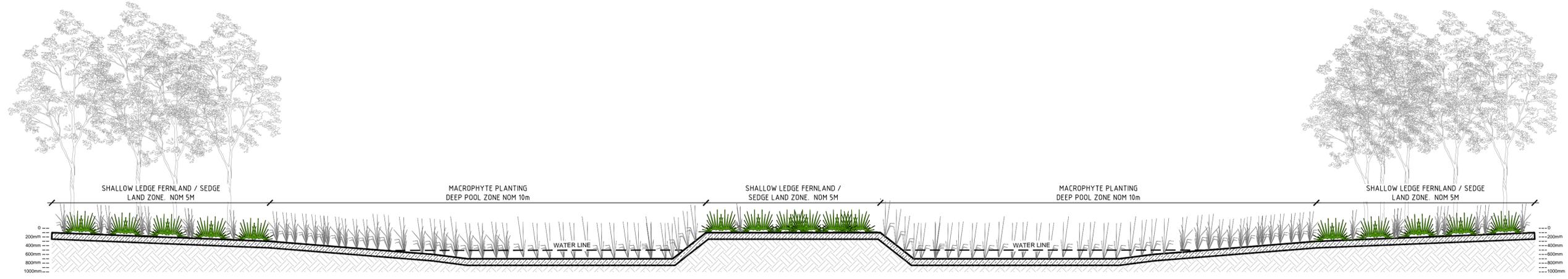
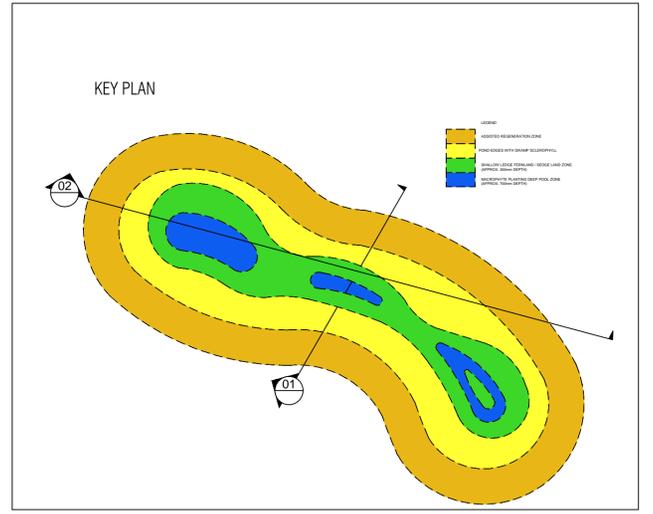
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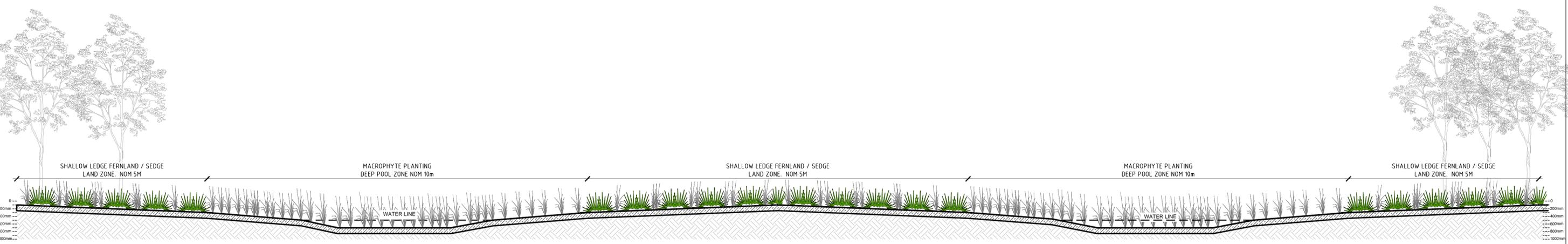
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PO Box 206  
Nobby Beach QLD 4218  
Telephone: 07 5526 1500  
ABN: 20 099 261 711  
Email: admin@plantconsulting.com.au



**01** TYPICAL SECTION - PLANTING IN PONDS (RANGING 50m2 - 150m2)  
1:50 @ A1



**02** TYPICAL SECTION - PLANTING IN PONDS (RANGING 150m2 - 350m2)  
1:50 @ A1



**03** TYPICAL SECTION - PLANTING IN PONDS (RANGING 150m2 - 350m2)  
1:50 @ A1

|                |                                    |
|----------------|------------------------------------|
| PROJECT:       | THREATENED SPECIES MANAGEMENT PLAN |
| DRAWING TITLE: | SECTIONS & DETAILS                 |

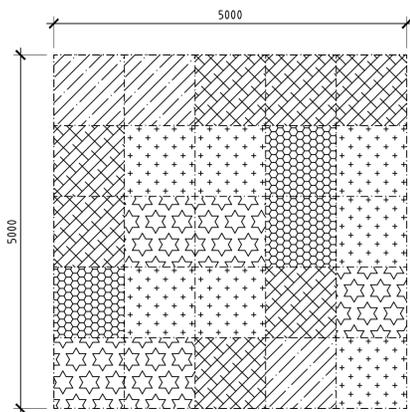
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|----|---|----------|----|----|----|
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| 02 | LANDSCAPE OPW FOR INFORMATION             | 16.06.20 | AH | AH | LT |
|    |   |          |    |    |    |
|    |   |          |    |    |    |

|         |                        |         |          |
|---------|------------------------|---------|----------|
| JOB NO: | J5644                  | DWG NO: | J5644_03 |
| SCALE:  | AS SHOWN               |         |          |
| CLIENT: | Tower Holdings Pty Ltd |         |          |

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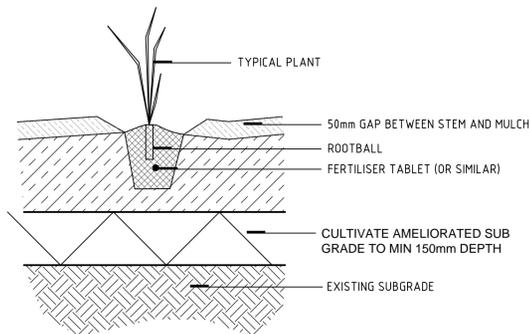


- LEGEND**
- Baumea articulata (B) (Jointed Twig-Rush)
  - Baumea rubiginosa (B) (Twig Rush)
  - Juncus usitatus (B) (Common Rush)
  - Lepironia articulata (B) (Lepironia)
  - Baumea juncea (Slender Twig-Rush)

SPECIES TO BE CLUMPED IN GROUPS OF APPROXIMATELY 5-10 PLANTS. NO TREES TO BE PLANTED IN THE FROG PONDS.

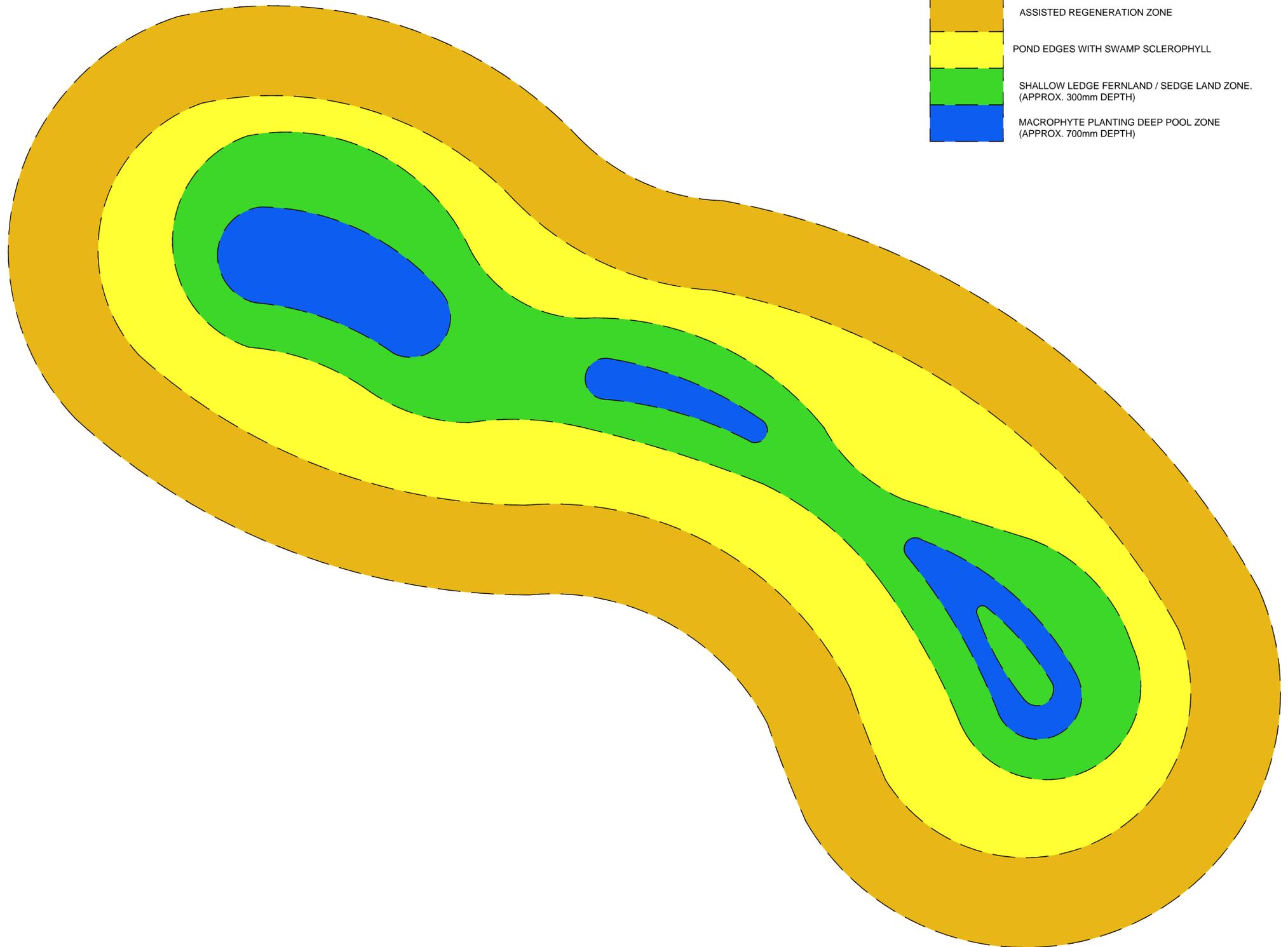
SPECIES AROUND PONDS TO REFLECT A SWAMP SCLEROPHYLL COMMUNITY WITH SEDGE AND FERNLAND SPECIES.

**01** WSF FROG POND PLANTING MOSAIC  
NTS

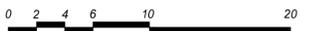


**02** PLANTING - TYPICAL DETAIL  
1:10 @ A1

**03** TYPICAL ACID FROG HABITAT POND PLAN  
1:250 @ A1



- LEGEND**
- ASSISTED REGENERATION ZONE
  - POND EDGES WITH SWAMP SCLEROPHYLL
  - SHALLOW LEDGE FERNLAND / SEDGE LAND ZONE. (APPROX. 300mm DEPTH)
  - MACROPHYTE PLANTING DEEP POOL ZONE (APPROX. 700mm DEPTH)



|                |   |
|----------------|---|
| PROJECT:       | <b>THREATENED SPECIES MANAGEMENT PLAN</b> |
| DRAWING TITLE: | <b>DETAILED POND PLAN &amp; DETAILS</b>   |

| NO | DESCRIPTION                               | DATE     | BY | CHECKED | APP'D |
|----|---|----------|----|---------|-------|
| 01 | LANDSCAPE MANAGEMENT PLAN FOR INFORMATION | 13.05.20 | AH | AH      | JA    |
| 02 | LANDSCAPE OPW FOR INFORMATION             | 16.06.20 | AH | AH      | LT    |
|    |   |          |    |         |       |
|    |   |          |    |         |       |

|         |                        |         |          |
|---------|------------------------|---------|----------|
| JOB NO: | J5644                  | DWG NO: | J5644_04 |
| SCALE:  | AS SHOWN               |         |          |
| CLIENT: | Tower Holdings Pty Ltd |         |          |

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## Appendix B

### Acid Frog retained and created habitat monitoring – Harvest Estate

April 2021 (AWC, 2021)

August 2021 (AWC, 2021b)

# Technical Memorandum

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To: Anthony Aiossa (Tower Holdings Pty Ltd)  
Andrew Wells (Planit)

---

From: Eli Dutton

---

Date: 22 June 2021

---

Pg/Attach.: 4

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Job ref: 1-201143\_08\_01a\_Harvest\_AF\_April 2021

---

## Acid Frog retained and created habitat monitoring – Harvest Estate–April 2021.

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As outlined in the Harvest Estate West Byron Urban Release Area Acid Frog Management Plan 2020, monitoring of retained acid frog habitat is to be undertaken on a 4 monthly basis to monitor the continued utilisation of the site by the two acid frogs previously recorded being:

- Wallum Sedgefrog (*Litoria olongburensis*)
  - Listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*
  - Listed as Vulnerable under the *NSW Biodiversity Conservation (BC) Act 2016*
- Wallum Froglet (*Crinia tinnula*)
  - Listed as Vulnerable under the *NSW Biodiversity Conservation (BC) Act 2016*

Once vegetation translocation is completed monitoring of created habitat will also commence. This report provides the results of the April 2021 monitoring event.

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### **Monitoring Methodology**

Monitoring of retained habitat areas will be conducted three times annually (i.e. every four months) and will consist of, but not limited to:

- Nocturnal survey and counting of Wallum Froglets within the two retained habitat areas;
- Call playback used to elicit response;
- Water quality sampled if standing water present;
- Records of incidental species records at the site to be included;
- Basic weather conditions recorded (temperature, relative humidity, rainfall).

Monitoring of created habitat areas is to commence as soon as vegetation translocation is completed with monitoring as described for retained habitat.

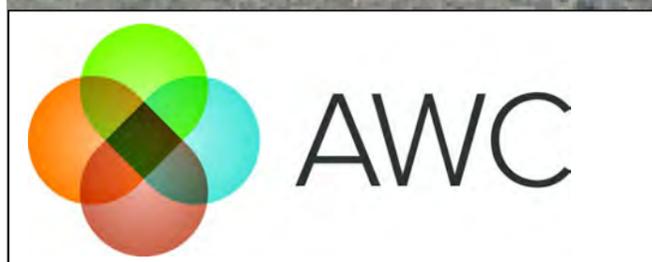
Monitoring was initiated in April 2021 and will continue on a 4-monthly basis. Locations of the monitoring sites is shown in Figure 1-1.

### **Results**

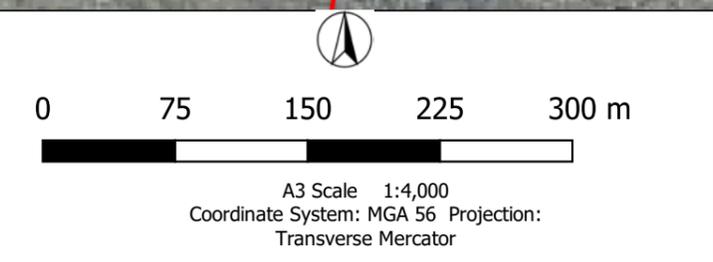
Monitoring was undertaken on the 26<sup>th</sup> and 28<sup>th</sup> of April 2021. The lowest pH recorded was 3.32 with the highest being 4.15. 1mm of rain was recorded at the Cape Byron Lighthouse weather station during the preceding week of the survey. Rainfall recorded at the Cape Byron Lighthouse during the survey period was 2.6 mm on the first day and 5.4mm on the second day. No Wallum Froglets were recorded during the monitoring event. The Wallum Sedge Frog was visually recorded at AF-01a on the 28<sup>th</sup> of April. Four (4) incidental amphibian species were recorded during the monitoring event. The monitoring results are shown below in **Table 1-1**. No monitoring was undertaken at AF-06 and AF-05 as acid frog habitat creation had not commenced at the site at the time of monitoring.

### **Discussion**

Climatic conditions, pH and conductivity readings were found to be generally within the range required for acid frog presence. The acid frog monitoring results reveal very low levels of acid frog activity during the monitoring event. However, the monitoring was undertaken at the end of the Wallum Sedge Frog calling period and before the Wallum Froglet calling period, which are generally being winter callers. In addition, the weather up until the survey period had been very dry and the drains were found to have no water in them during the first night of survey. The retained Wallum Sedge Frog habitat had Wallum Sedge frogs present which confirms that the Wallum Sedge Frog is still present at the site.



|             |   |
|-------------|---|
| Source:     | Imagery: Nearmaps<br>Layout: Harvest Estate<br>AF Habitat and Monitoring Locations: AWC   |
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| Date:       | 18-6-21   |



|                          |                    |
|--------------------------|--------------------|
| Legend                   |                    |
| AF Habitat               |                    |
| Impacted                 | [Red outline]      |
| Retained                 | [Light green fill] |
| Created                  | [Dark green fill]  |
| Created breeding habitat | [Hatched pattern]  |
| AF monitoring sites      | [Red star]         |
| Layout                   | [Yellow line]      |

**Figure 1-1:**  
**Monitoring Locations**

Table 1 April 2021 Monitoring Results

| Date: 26-4-21 |                       |              |                    |        |      |                    |          |            |               |                                       |
|---------------|-----------------------|--------------|--------------------|--------|------|--------------------|----------|------------|---------------|---------------------------------------|
| Site          | Wallum Sedge Frog Y/N | Number       | Wallum Froglet Y/N | Number | PH   | Conductivity us/cm | Air Temp | Humidity % | Rainfall (mm) | Incidentals                           |
| AF-01         | N                     | N/A          | N                  | N/A    | N/A  | N/A                | 20.4     | 68         | 2.6           |                                       |
| AF-01a        | N                     | N/A          | N                  | N/A    | 3.63 | 165                | 20.4     | 68         | 2.6           |                                       |
| AF-02         | N                     | N/A          | N                  | N/A    | N/A  | N/A                | 20.4     | 68         | 2.6           |                                       |
| AF-03         | N                     | N/A          | N                  | N/A    | N/A  | N/A                | 20.4     | 68         | 2.6           | Common Froglet                        |
| AF-03a        | N                     | N/A          | N                  | N/A    | N/A  | N/A                | 20.4     | 68         | 2.6           | Common Froglet                        |
| AF-04         | N                     | N/A          | N                  | N/A    | N/A  | N/A                | 20.5     | 68         | 2.6           |                                       |
| AF-05         | N/A                   | N/A          | N/A                | N/A    | N/A  | N/A                | N/A      | N/A        | 2.6           | N/A                                   |
| AF-06         | N/A                   | N/A          | N/A                | N/A    | N/A  | N/A                | N/A      | N/A        | 2.6           | N/A                                   |
| Date: 28-4-21 |                       |              |                    |        |      |                    |          |            |               |                                       |
| Site          | Wallum Sedge Frog Y/N | Number       | Wallum Froglet     | Number | PH   | Conductivity us/cm | Air Temp | Humidity % | Rainfall (mm) | Incidentals                           |
| AF-01         | N                     | N/A          | N                  | N/A    | N/A  | N/A                | 17       | 92         | 5.4           |                                       |
| AF-01a        | Y                     | 2 (juvenile) | N                  | N/A    | 3.35 | 160                | 17       | 92         | 5.4           | Dusky Toadlet, Striped Marsh Frog x 2 |
| AF-02         | N                     | N/A          | N                  | N/A    | N/A  | N/A                | 16.6     | 92         | 5.4           | Striped Marsh Frog, Rocket Frog       |
| AF-03         | N                     | N/A          | N                  | N/A    | 4.05 | 98                 | 16.7     | 92         | 5.4           | Common Froglet, Striped Marsh Frog    |
| AF-03a        | N                     | N/A          | N                  | N/A    | 4.15 | 91                 | 16.6     | 94         | 5.4           | 2 x Rocket Frog, Common Froglet       |
| AF-04         | N                     | N/A          | N                  | N/A    | 3.32 | 170                | 17       | 92         | 5.4           | Dusky Toadlet                         |
| AF-05         | N/A                   | N/A          | N/A                | N/A    | N/A  | N/A                | N/A      | N/A        | 5.4           | N/A                                   |
| AF-06         | N/A                   | N/A          | N/A                | N/A    | N/A  | N/A                | N/A      | N/A        | 5.4           | N/A                                   |

# Technical Memorandum

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To: Anthony Aiossa (Tower Holdings Pty Ltd)  
Andrew Wells (Planit)

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From: Eli Dutton

---

Date: 26 August 2021

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Pg/Attach.: 4

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Job ref: 1-201143\_08\_02a\_Harvest\_AF\_August 2021

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## Acid Frog retained and created habitat monitoring – Harvest Estate–August 2021.

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As outlined in the Harvest Estate *West Byron Urban Release Area Acid Frog Management Plan 2020*, monitoring of retained acid frog habitat is to be undertaken on a 4 monthly basis to monitor the continued utilisation of the site by the two acid frogs previously recorded being:

- Wallum Sedgefrog (*Litoria olongburensis*)
  - Listed as Vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act)
  - Listed as Vulnerable under the *NSW Biodiversity Conservation Act 2016* (BC Act)
- Wallum Froglet (*Crinia tinnula*)
  - Listed as Vulnerable under the BC Act.

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w. [awconsult.com.au](http://awconsult.com.au)

### Monitoring Methodology

Under the approved Plan, monitoring of retained habitat areas is to be conducted three times annually (i.e. every four months) and include:

- Nocturnal survey and counting of acid frogs within the retained habitat areas
- Call playback used to elicit response
- Water quality sampled if standing water present
- Records of incidental species records at the site to be included
- Basic weather conditions recorded (temperature, relative humidity, rainfall).

Monitoring was initiated in April 2021 and will continue on a 4-monthly basis. Locations of the monitoring sites is shown in Figure 1-1.

Monitoring of six sites within areas of retained habitat was completed. Monitoring of created habitat areas will commence as soon as works within these areas is completed.

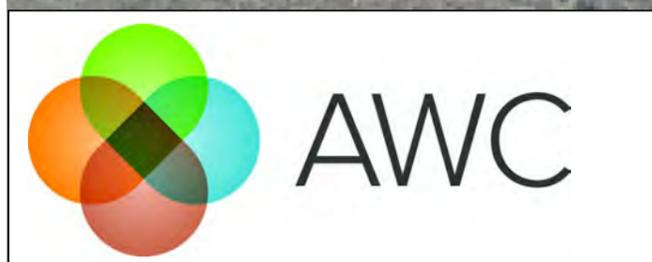
### Results

Monitoring was undertaken on the 23<sup>rd</sup> and 24<sup>th</sup> of August 2021. No standing water was present at any of the monitoring locations during the survey period. A total of 6.4mm of rain was recorded at the Cape Byron Lighthouse weather station during the preceding week of the survey. Rainfall recorded at the Cape Byron Lighthouse during the survey period was 0 mm on the first day and 0.4mm on the second day. No Wallum Froglets or Wallum Sedge Frogs were recorded during the monitoring events. Two incidental amphibian species were recorded during the monitoring event. Monitoring results are shown below in **Table 1-1**. As noted, no monitoring was undertaken at AF-06 and AF-05 as acid frog habitat creation has not yet commenced.

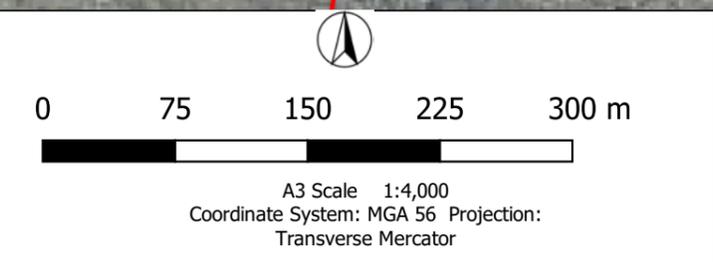
### Discussion

Due to overall low rainfall and low temperatures and humidity on the second night of survey, climatic conditions were generally not conducive for acid frogs and hence the potential for calling males was substantially reduced. Furthermore, as mentioned above the weather up until the survey period had been very dry due to nominal rainfall as a result the retained habitat and associated drains had no standing water present during the survey period.

The monitoring results did not record any acid frog activity at the site within the six sites surveyed. However, this result cannot be considered definitive as the monitoring survey conditions were not optimal. Further survey in warmer months and following suitable climatic conditions provides greater opportunities for detection of both species.



|             |   |
|-------------|---|
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| Date:       | 18-6-21   |



|                          |                    |
|--------------------------|--------------------|
| Legend                   |                    |
| AF Habitat               |                    |
| Impacted                 | [Red outline]      |
| Retained                 | [Light green fill] |
| Created                  | [Dark green fill]  |
| Created breeding habitat | [Hatched pattern]  |
| AF monitoring sites      | [Red star]         |
| Layout                   | [Yellow line]      |

**Figure 1-1:**  
**Monitoring Locations**

Table 1 August 2021 Monitoring Results

| Date: 23-4-21 |                       |        |                    |        |     |                    |          |            |                         |
|---------------|-----------------------|--------|--------------------|--------|-----|--------------------|----------|------------|-------------------------|
| Site          | Wallum Sedge Frog Y/N | Number | Wallum Froglet Y/N | Number | PH  | Conductivity us/cm | Air Temp | Humidity % | Incidentals             |
| AF-01         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 19.7     | 74         |                         |
| AF-01a        | N                     | N/A    | N                  | N/A    | N/A | N/A                | 19.6     | 78         |                         |
| AF-02         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 19.6     | 76         |                         |
| AF-03         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 19.6     | 76         |                         |
| AF-03a        | N                     | N/A    | N                  | N/A    | N/A | N/A                | 19.7     | 73         | Eastern Dwarf Tree Frog |
| AF-04         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 19.7     | 73         | Rocket Frog             |
| AF-05         | N/A                   | N/A    | N/A                | N/A    | N/A | N/A                | N/A      | N/A        | N/A                     |
| AF-06         | N/A                   | N/A    | N/A                | N/A    | N/A | N/A                | N/A      | N/A        | N/A                     |
| Date: 24-4-21 |                       |        |                    |        |     |                    |          |            |                         |
| Site          | Wallum Sedge Frog Y/N | Number | Wallum Froglet     | Number | PH  | Conductivity us/cm | Air Temp | Humidity % | Incidentals             |
| AF-01         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 15.1     | 49         |                         |
| AF-01a        | N                     | N/A    | N                  | N/A    | N/A | N/A                | 15.1     | 49         |                         |
| AF-02         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 13       | 49         |                         |
| AF-03         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 13.5     | 49         |                         |
| AF-03a        | N                     | N/A    | N                  | N/A    | N/A | N/A                | 13.5     | 49         |                         |
| AF-04         | N                     | N/A    | N                  | N/A    | N/A | N/A                | 15.1     | 49         |                         |
| AF-05         | N/A                   | N/A    | N/A                | N/A    | N/A | N/A                | N/A      | N/A        | N/A                     |
| AF-06         | N/A                   | N/A    | N/A                | N/A    | N/A | N/A                | N/A      | N/A        | N/A                     |

## Appendix C

### Acid Frog Habitat (Water Quality) Monitoring Results

|                             | 25/05/2020              | 9/06/2020  | 29/06/2020    | 7/07/2020 | 27/07/2020 | 14/08/2020                                       | 31/08/2020                        | 26/10/2020 | 13/11/2020 | 1/12/2020 | 16/12/2020        | 16/02/2021        | 3/03/2021 | 16/03/2021 | 1/04/2021 | 19/04/2021 | 4/05/2021 | 17/05/2021 | 7/06/2021 | 19/07/2021 | 5/08/2021                         | 20/08/2021                        |
|-----------------------------|-------------------------|--|---------------|-----------|------------|--|-----------------------------------|------------|------------|-----------|-------------------|-------------------|-----------|------------|-----------|------------|-----------|------------|-----------|------------|-----------------------------------|-----------------------------------|
| <b>pH</b>                   |                         |  |               |           |            |  |                                   |            |            |           |                   |                   |           |            |           |            |           |            |           |            |                                   |                                   |
| AF1                         | 3.30                    |  | 4.02          |           | 4.02       |  |                                   |            |            |           | 3.68              | 3.85              | 3.35      | 3.63       | 3.61      | 3.67       | 3.92      | 3.81       | 3.54      | 4.12       |                                   |                                   |
| AF1a                        |                         | 3.68   | 3.76          | 3.98      | 3.44       | 3.40   | 3.42                              |            |            |           | 3.84              | 3.35              | 3.48      | 3.55       | 3.43      | 3.48       | 3.81      | 3.88       | 3.64      | 3.92       | 3.91                              | 3.81                              |
| AF2                         | 4.17                    |  | 4.38          |           | 3.69       |  |                                   |            |            |           | 4.66              | 3.80              | 4.51      | 4.70       | 4.16      | 4.01       | 4.22      | 3.94       |           |            |                                   |                                   |
| AF3                         | 3.78                    | 3.90   | 3.55          | 4.06      | 3.17       | 3.62   |                                   |            |            |           | 3.60              | 5.34              | 4.05      | 4.17       | 4.50      | 3.99       | 4.00      | 3.99       |           | 4.02       |                                   |                                   |
| AF3a                        |                         | 4.11   | 3.61          | 4.14      | 3.22       | 3.80   |                                   |            |            |           | 3.72              | 3.81              | 4.00      | 3.91       | 3.92      | 3.79       | 3.98      | 4.01       | 4.12      | 3.88       |                                   |                                   |
| AF4                         | 3.81                    | 4.01   | 3.81          | 4.13      | 3.77       | 4.26   |                                   |            |            |           | 3.78              | 4.20              | 3.81      | 4.48       | 4.21      | 4.10       | 3.88      | 4.14       |           | 3.72       |                                   |                                   |
| AF5                         | 3.90                    | 4.09   | 3.77          | 4.05      | 3.77       | 3.88   |                                   |            |            |           | 3.93              |                   | 3.75      | 3.99       | 3.85      | 3.84       | 3.91      | 3.92       | 4.01      | 3.84       |                                   |                                   |
| AF6                         | 4.16                    |  | 3.60          |           | 4.22       |  |                                   |            |            |           | 4.19              |                   | 3.77      | 3.83       | 3.88      | 3.66       | 4.01      |            |           | 3.99       |                                   |                                   |
| <b>Conductivity (µS/cm)</b> |                         |  |               |           |            |  |                                   |            |            |           |                   |                   |           |            |           |            |           |            |           |            |                                   |                                   |
| AF1                         | 89                      |  | 129           |           | 53         |  |                                   |            |            |           | 99                | 84                | 145       | 112        | 99        | 134        | 141       | 133        | 234       | 135        |                                   |                                   |
| AF1a                        |                         | 143  | 187           | 268       | 82         | 125  | 163                               |            |            |           | 73                | 202               | 151       | 149        | 151       | 140        | 171       | 142        | 194       | 172        | 229                               | 192                               |
| AF2                         | 91                      |  | 118           |           | 120        |  |                                   |            |            |           | 85                | 175               | 116       | 121        | 121       | 111        | 160       | 143        |           |            |                                   |                                   |
| AF3                         | 97                      | 113  | 115           | 112       | 106        | 96   |                                   |            |            |           | 174               | 68                | 170       | 104        | 98        | 147        | 175       | 110        |           | 156        |                                   |                                   |
| AF3a                        |                         | 127  | 121           | 119       | 98         | 91   |                                   |            |            |           | 154               | 198               | 120       | 88         | 111       | 114        | 131       | 89         | 89        | 99         |                                   |                                   |
| AF4                         | 80                      | 169  | 96            | 94        | 96         | 141  |                                   |            |            |           | 123               | 73                | 162       | 124        | 120       | 167        | 171       | 184        |           | 125        |                                   |                                   |
| AF5                         | 120                     | 109  | 146           | 187       | 89         | 133  |                                   |            |            |           | 104               |                   | 158       | 100        | 120       | 132        | 150       | 143        | 120       | 135        |                                   |                                   |
| AF6                         | 314                     |  | 306           |           | 228        |  |                                   |            |            |           | 272               |                   | 155       | 301        | 240       | 145        | 170       |            |           | 162        |                                   |                                   |
| <b>Depth (mm)</b>           |                         |  |               |           |            |  |                                   |            |            |           |                   |                   |           |            |           |            |           |            |           |            |                                   |                                   |
| AF1                         | 30                      |  | 45            |           | 92         |  |                                   |            |            |           | 375               | 60                | 52        | 250        | 280       | 110        | 120       | 159        | 100       | 190        |                                   |                                   |
| AF1a                        |                         | 335  | 295           | 238       | 334        | 265  | 72                                |            |            |           | 156               | 330               | 214       | 355        | 360       | 230        | 310       | 189        | 150       | 245        | 40                                | 29                                |
| AF2                         | 38                      |  | 15            |           | 104        |  |                                   |            |            |           | 250               | 75                | 52        | 50         | 55        | 32         | 41        | 12         |           |            |                                   |                                   |
| AF3                         | 55                      | 65   | 87            | 86        | 128        | 56   |                                   |            |            |           | 130               | 250               | 100       | 90         | 100       | 59         | 80        | 157        |           | 80         |                                   |                                   |
| AF3a                        |                         | 358  | 323           | 278       | 353        | 292  |                                   |            |            |           | 358               | 250               | 155       | 203        | 220       | 190        | 120       | 120        | 96        | 150        |                                   |                                   |
| AF4                         | 40                      | 75   | 35            | 18        | 89         | 40   |                                   |            |            |           | 89                | 210               | 45        | 60         | 100       | 59         | 30        | 42         |           | 50         |                                   |                                   |
| AF5                         | 245                     | 24   | 236           | 130       | 205        | 122  |                                   |            |            |           | 230               |                   | 61        | 160        | 190       | 94         | 72        | 102        | 54        | 48         |                                   |                                   |
| AF6                         | 45                      |  | 66            |           | 340        |  |                                   |            |            |           | 260               |                   | 15        | 130        | 150       | 105        | 115       |            |           | 35.00      |                                   |                                   |
| <b>Notes:</b>               | AF1a & 3a not installed | AF2 & 6 dry; AF1a & 3a sampled 11/6/20 when WL loggers installed | Initiated AF7 |           |            | AF1, AF2, AF6 dry; WL logger at 3a malfunctioned | AF1a only site with pooling water | All dry    | All dry    | All dry   | Wet weather event | Wet weather event |           |            |           |            |           | AF6 dry    |           | AF2 dry    | AF1a only site with pooling water | AF1a only site with pooling water |
| Shaded = Dry                |                         |  |               |           |            |  |                                   |            |            |           |                   |                   |           |            |           |            |           |            |           |            |                                   |                                   |

## Appendix D

### Acid Frog Monitoring Pro-forma - Harvest Estate

| Acid Frog Monitoring Pro-forma - Harvest Estate |                                     |
|---|-------------------------------------|
| Date  |                                     |
| Rainfall  | (circle): nil/slight/moderate/heavy |
| Temp.   |                                     |
| Rel. humidity                                   |                                     |
| Recorder  |                                     |
| Construction phase                              |                                     |

Print at A3 size

|                            | Site ID                           | AF-01 | AF-01a | AF-02 | AF-03 | AF-03a | AF-04 | AF05 | AF-06 | Site ID                           |
|----------------------------|-----------------------------------|-------|--------|-------|-------|--------|-------|------|-------|-----------------------------------|
| Water Quality              | pH                                |       |        |       |       |        |       |      |       | pH                                |
|                            | DO                                |       |        |       |       |        |       |      |       | DO                                |
|                            | Temp.                             |       |        |       |       |        |       |      |       | Temp.                             |
|                            | EC                                |       |        |       |       |        |       |      |       | EC                                |
|                            | Turbidity                         |       |        |       |       |        |       |      |       | Turbidity                         |
|                            | Depth (mm)                        |       |        |       |       |        |       |      |       | Depth (mm)                        |
| Call Playback (count)      | Wallum Froglet                    |       |        |       |       |        |       |      |       | Wallum Froglet                    |
|                            | Wallum Sedgefrog                  |       |        |       |       |        |       |      |       | Wallum Sedgefrog                  |
| Other species (count)      | <i>Adelotus brevis</i>            |       |        |       |       |        |       |      |       | <i>Adelotus brevis</i>            |
|                            | <i>Crinia parinsignifera</i>      |       |        |       |       |        |       |      |       | <i>Crinia parinsignifera</i>      |
|                            | <i>Crinia signifera</i>           |       |        |       |       |        |       |      |       | <i>Crinia signifera</i>           |
|                            | <i>Limnodynastes dumerilii</i>    |       |        |       |       |        |       |      |       | <i>Limnodynastes dumerilii</i>    |
|                            | <i>Limnodynastes peroni</i>       |       |        |       |       |        |       |      |       | <i>Limnodynastes peroni</i>       |
|                            | <i>Limnodynastes tasmaniensis</i> |       |        |       |       |        |       |      |       | <i>Limnodynastes tasmaniensis</i> |
|                            | <i>Litoria fallax</i>             |       |        |       |       |        |       |      |       | <i>Litoria fallax</i>             |
|                            | <i>Litoria nasuta</i>             |       |        |       |       |        |       |      |       | <i>Litoria nasuta</i>             |
|                            | <i>Litoria peroni</i>             |       |        |       |       |        |       |      |       | <i>Litoria peroni</i>             |
|                            | <i>Litoria tyleri</i>             |       |        |       |       |        |       |      |       | <i>Litoria tyleri</i>             |
|                            | <i>Rhinella marina</i> *          |       |        |       |       |        |       |      |       | <i>Rhinella marina</i> *          |
|                            |                                   |       |        |       |       |        |       |      |       |                                   |
|                            |                                   |       |        |       |       |        |       |      |       |                                   |
| Notes: (Mosquito Fish etc) |                                   |       |        |       |       |        |       |      |       |                                   |



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