

**Results of a Growling Grass Frog
(*Litoria raniformis*) survey at
Mount Burr Swamp, after initial
restoration works in 2016**

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March 2017

This report may be cited as:

Bachmann, M. (2017) Results of a Growling Grass Frog (*Litoria raniformis*) survey at Mount Burr Swamp, after initial restoration works in 2016. Nature Glenelg Trust, Mumbannar, Victoria.

Acknowledgements:

- Neil Ellison – for sharing his intimate knowledge of site history and his father’s photos
- John Dodson – for sharing site images taken during his research from the 1970s
- Lachlan Farrington – for providing photos and maps where indicated
- Bryan Haywood – for advice on field survey methods
- Dale Bachmann – for field assistance during the active search survey

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EXECUTIVE SUMMARY

Preliminary hydrological restoration works (the installation of a temporary regulating structure) occurred at Mt Burr Swamp in August 2016, prior to settlement of Nature Glenelg Trust's purchase of the property on the 30th September 2016. With artificial drainage outflows prevented throughout the spring months, the wetland re-filled (up to >1m deep) for the first time in several decades, resulting in the immediate restoration of over 50 hectares of freshwater marsh habitat.

Since restoration works occurred, the predominant vegetation response in the swamp has been the re-establishment of a large bed of floating and emergent water ribbons *Triglochin procerum*, which is known to provide some of the most favourable conditions (based on recorded habitat use at other locations) for the Growling Grass Frog, *Litoria raniformis*. Additionally, being situated adjacent to a large, reserved wetland complex (Marshes Native Forest Reserve, to the south), the site has high prospects for natural recolonisation by a wide range of species during the long process of habitat restoration that is set to unfold on the property over the years ahead. Indeed, after the initial works, a number of incidental (especially calling) observations of *Litoria raniformis* occurred at Mt Burr Swamp from September 2016 onwards, during visits to the site for other purposes.

This report summarises the results of the first comprehensive, active search of the site that was conducted on Wednesday the 15th of February 2017, to confirm the species' presence and broadly assess population characteristics. Over a period of 2 ½ hours (from 22:15 until 00:41) on that evening, active searching resulted in the counting of 96 individual *Litoria raniformis*, around the swamp perimeter and in the inundated section of artificial drain between the regulating structure and the main swamp. The majority of frogs encountered around the swamp edge were smaller in size and included a number of metamorphs, while a higher proportion of larger adults were observed along the outlet drain. These results clearly demonstrate that the recently restored Mt Burr Swamp has rapidly re-created a significant area of breeding habitat suitable for this nationally threatened species of amphibian.

As funding is secured over the years ahead to enable restoration (reversal of artificial drainage) of the dozens of additional smaller swamps situated across the property, Mt Burr Swamp is likely (due to a significant 'neighbourhood' effect) to become a stronghold of increasing importance for the future conservation of the species in south-eastern Australia.

1 Introduction

Mt Burr Swamp is a modified wetland basin of 50-60 hectares in size, and is a central feature on a larger 300 hectare parcel of land that was developed as a private mixed farming enterprise over the past 60 years. The property is located in the lower South East of South Australia, east of Millicent and north-west of Mt Gambier, and lies adjacent to Marshes Native Forest Reserve (NFR), as shown in Figure 1.

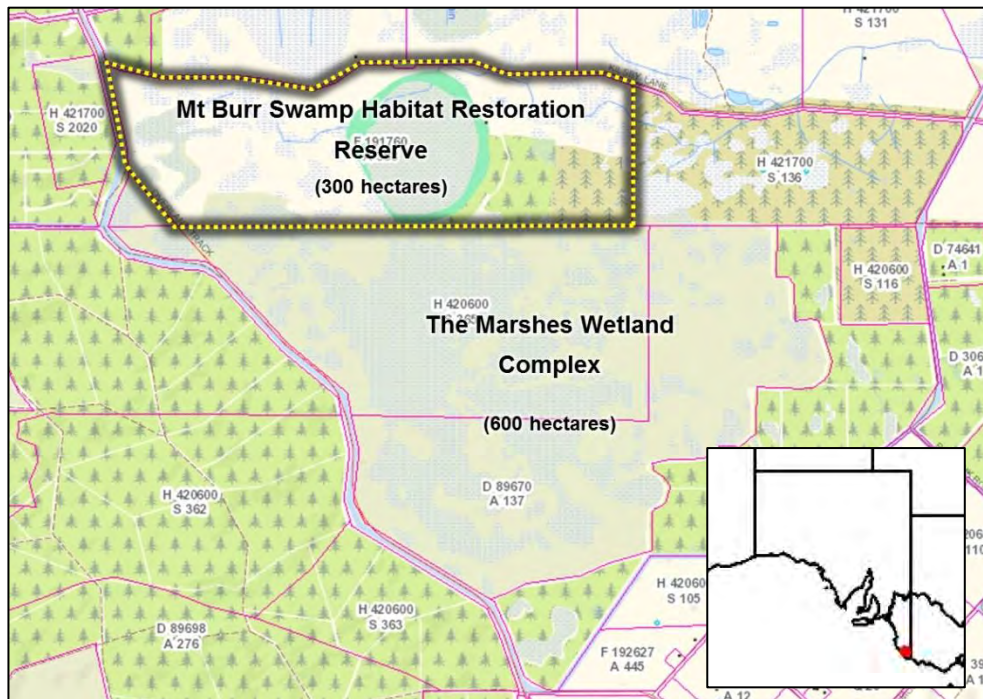


Figure 1 – location of Mt Burr Swamp

The Marshes is a large freshwater wetland complex, listed in the Directory of Important Wetlands in Australia (DIWA) and is one of 13 priority groundwater dependant ecosystems identified in the South East Regional NRM Plan (SENRM Board 2010). Marshes NFR provides verified habitat for no less than six nationally threatened fauna species¹, and is one of the most floristically diverse nature reserves in South Australia. Proposals that identified the restoration potential of Mt Burr Swamp, to enable expansion of the habitat in Marshes NFR, date back to the late 1970s (Jones 1978); but were not acted upon successfully until Nature Glenelg Trust (NGT) completed the purchase of the site on the 30th of September 2016. The land purchase was predominantly funded by partnerships that NGT entered into with the

¹ EPBC Act 1999 listed fauna species include Growling Grass Frog, Little Galaxias, Southern Brown Bandicoot, Southern Bent-wing Bat, South-eastern Red-tailed Black-cockatoo, Australasian Bittern

Native Vegetation Council (SA) and OneFortyOne Plantations, but was also supplemented by a successful public fundraising campaign that included significant donations from other NGOs, community groups, businesses and private individuals.

Although the property has now been purchased with the long-term goal of conservation and restoration in mind, the precise pathway and mechanisms employed for how that goal is fully achieved, and the timeframe over which this will occur, are still being determined. To inform this process, a property restoration and management plan is under development (as of March 2017), and the timing of its implementation will be subject to matters such as:

1. the availability of grant monies or other funding sources to support future works;
2. the timing of blue gum and pine plantation harvest on parts of the property under this commercial land use, a prerequisite before restoration can begin in those areas; and,
3. assessment of the likely post-restoration inundation extent of other drained wetland features, especially those in proximity to the plantation areas (as per point 2.)

Despite the restoration and management plan not yet being in place, an immediate priority action has already been implemented (in August 2016), with the restoration of an interim (higher) static water level in Mt Burr Swamp. Initial investigations undertaken by NGT during the purchase negotiation and site evaluation process identified the immediate restoration potential of this wetland feature, coupled with an absence of risks to other parts of the property that would initially need to remain under other land uses. The completion of this work has also enabled NGT to provide immediate, highly visual feedback to project supporters, while simultaneously informing them that the bulk of the restoration task remains a longer-term work in progress.

In the context of this early work and planning, the goal of this project is to assess the current and future potential value of Mt Burr Swamp to the conservation of the Growling Grass Frog (*Litoria raniformis*) in south-eastern Australia; one of several key indicators of project success.

The objectives of this project at Mt Burr Swamp were:

- to verify the presence of *Litoria raniformis*;
- to undertake a baseline population count via active search;
- to evaluate the initial response of *Litoria raniformis* to hydrological restoration; and,
- to assess post-restoration habitats and their value for *Litoria raniformis*.

2 Project background

2.1 The species – *Litoria raniformis*

Litoria raniformis is a comparatively large, ground-dwelling frog. It has a distinctive appearance (see Figure 2) and call, making identification relatively straightforward (Harley et al. 2005).



Figure 2 – The Growling Grass Frog or Southern Bell Frog (*Litoria raniformis*)

Litoria raniformis is known to occupy a variety of natural and artificial wetland habitats throughout its range, including permanent and ephemeral waterbodies that include swamps, lakes, streams, riverine floodplains, farm dams, garden ponds, quarries, drains and irrigation channels. In most circumstances, this species has a preference for permanent to semi-permanent waters that are still or slow-flowing and surrounded by dense aquatic vegetation (Pyke 2002; Robertson 2003).

The decline and disappearance of *Litoria raniformis* across much of its former range is likely to be due to the following threatening processes (from Harley et al 2005; Clemann and Gillespie 2012):

- habitat loss (e.g. wetland drainage), degradation and fragmentation
- alteration to natural hydrological regimes
- tadpole predation by exotic introduced fish
- infection by chytridiomycosis disease
- creation of artificial barriers to movement and dispersal
- accumulation of biocides in aquatic habitats
- increased levels of ultraviolet-B (UV-B) radiation

The destruction, degradation and fragmentation of wetland habitats for agriculture and urban development are probably the most significant factors amongst this list (Harley et al. 2005). As a result of these threatening processes, *Litoria raniformis* is listed as nationally ‘vulnerable’ under the *Environment Protection and Biodiversity Conservation Act 1999*, and owing to the rapid decline of this species across south-eastern Australia during the past few decades, all extant populations are considered to be of high conservation significance.

A key action in the National Recovery Plan for the species, addressed by this project is the final component of the fourth action, under Objective 3:

3.4 Investigate the response of Southern Bell Frog to translocation, the creation of artificial habitats, and / or the re-creation or rehabilitation of habitat

2.2 The site – Mount Burr Swamp

Within the broad distribution of *Litoria raniformis*, there are two apparently distinct biogeographical groups, differentiated by variances in biology and ecology (Clemann and Gillespie 2012). Mount Burr Swamp is situated in far south-eastern South Australia, near the western edge of the southern biogeographical grouping, which also includes populations in south-eastern NSW, the bulk of Victoria and Tasmania.

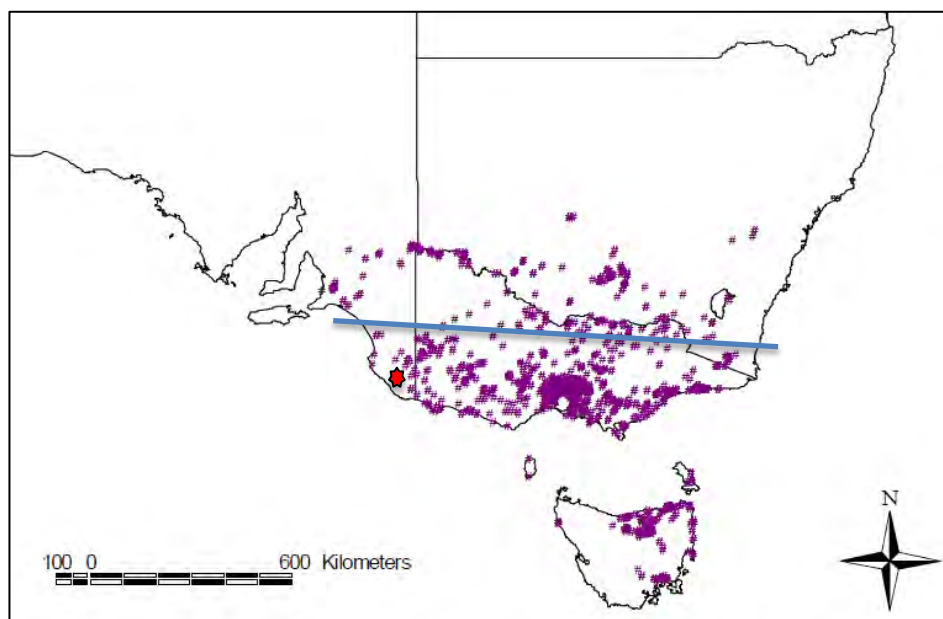


Figure 3 – *Litoria raniformis* distribution, showing the approximate location of the division between the northern and southern biogeographical groups. Mt Burr Swamp is indicated by a red star.
Adapted from Clemann and Gillespie 2012.

The Mt Burr Swamp property was sold (as a scrub block) by the South Australian Government to Geoffrey (Geoff) Ellison (the father of the previous owner Neil Ellison) on the 24th August 1945, as it was considered unsuitable (too wet) for the state government to develop along with large tracts of neighbouring state-owned land being converted to Monterey Pine (*Pinus radiata*) plantations during that era (Neil Ellison pers. comm.).

As illustrated by the sequence of aerial photos presented in Figure 4, the property was progressively cleared, drained and developed as a farm from 1954 onwards – starting with the most naturally open area (in the north-west). This was initially to improve grazing for sheep and later cattle, while some areas of private forestry plantation were also established from the 1990s onwards. This process of development led to the current condition of the site.

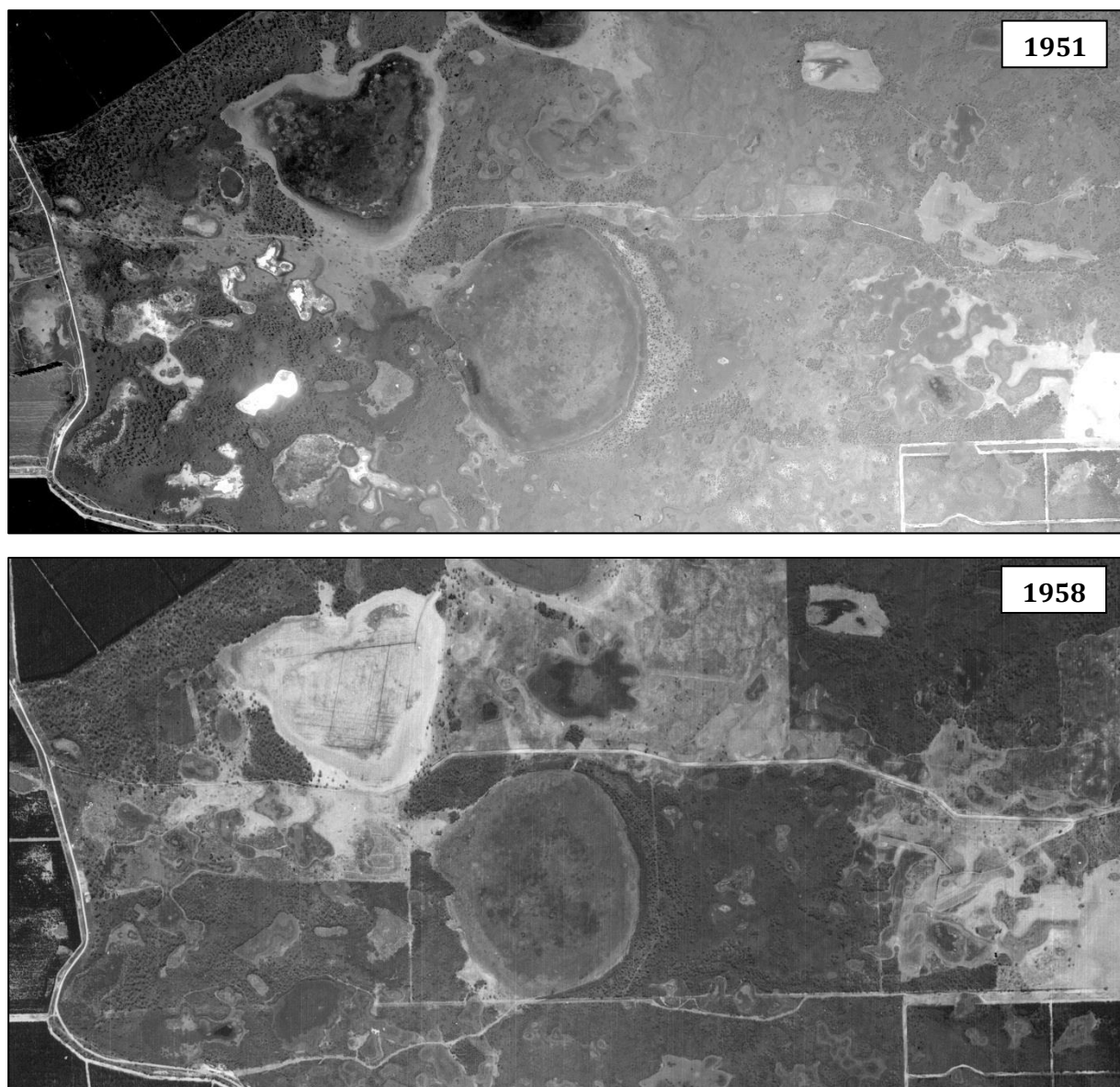


Figure 4 (part 1) – development of Mt Burr Swamp & surrounds, 1951 to 1958

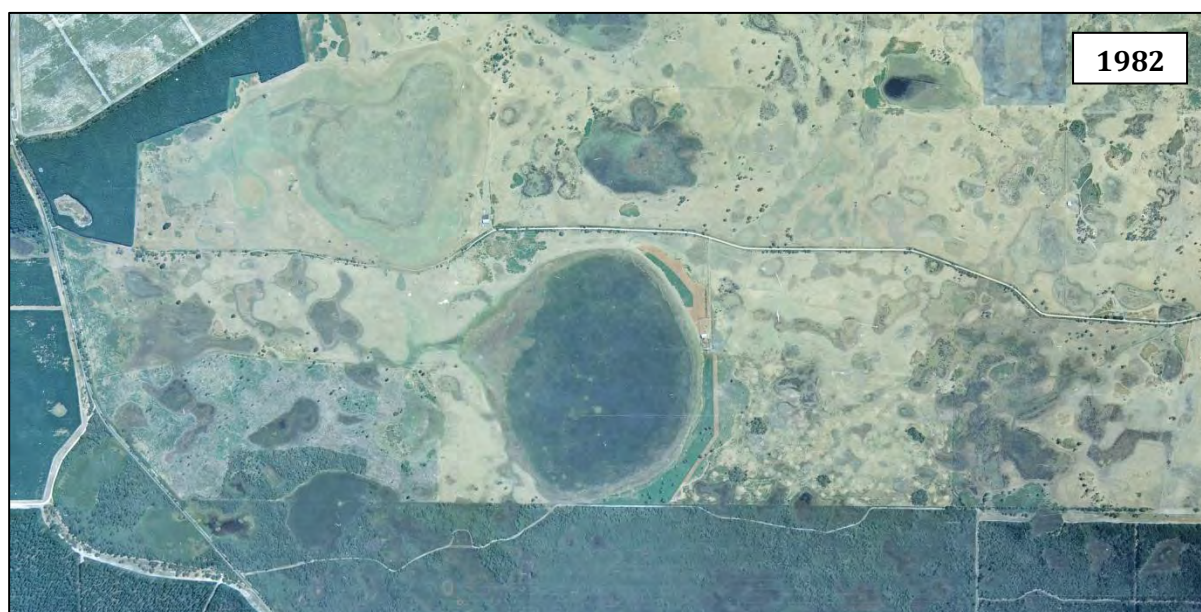


Figure 4 (part 2) – development of Mt Burr Swamp & surrounds, 1978 - 1987



Figure 4 (part 3) – development of Mt Burr Swamp & surrounds, 1992 - 2010



2012



2013



2014



2015

Figure 4 (part 4) – development of Mt Burr Swamp & surrounds, 2012 - 2015

With the exception of a patch of uncleared scrub near the south-western corner, the property now retains only fragments of its original native vegetation. The conversion of much of the property to pasture was also assisted by the progressive construction and maintenance of a comprehensive artificial private drainage network across the property. This network of drains flows from west to east via Mt Burr Swamp (due to the property being situated on the inland, eastward sloping side of the Mt Burr Range) and has one main outlet (and a secondary smaller outlet) that leaves the eastern end of the property before joining the Mount Burr Heath Drain (a formal government scheme) further downstream – see Figure 5.

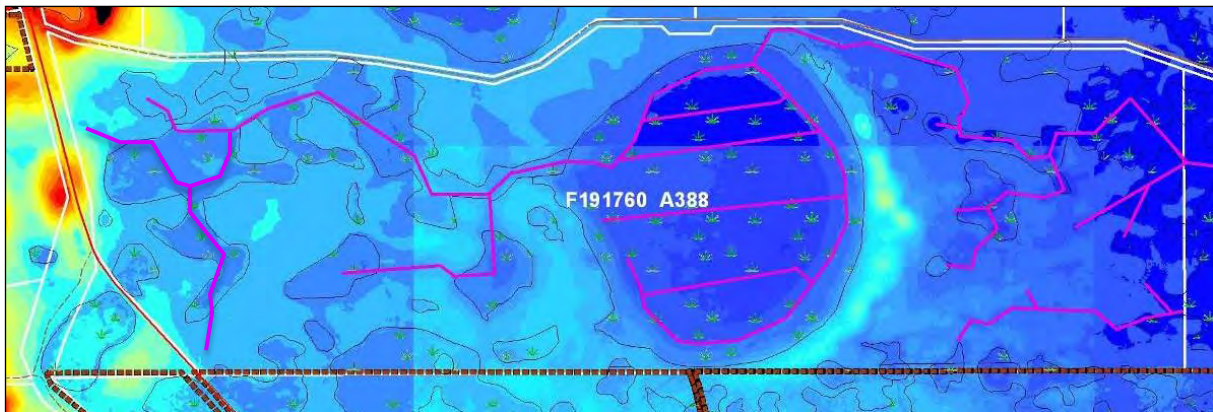
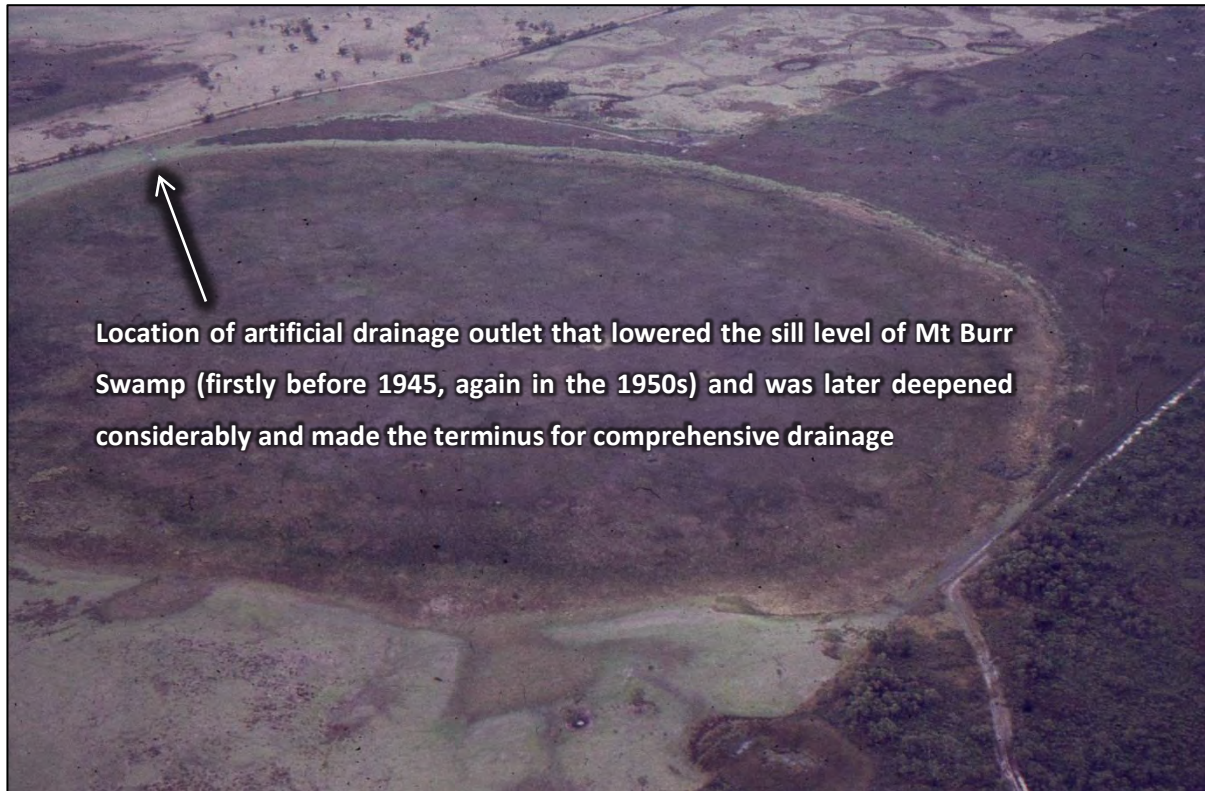


Figure 5 – Digital Elevation Model showing wetland features (thin black outlined polygons) and artificial drains (purple lines) that flow from west to east (left to right) across the property

The ultimate destination of flows from this artificial drainage catchment is the Bakers Range Drain, which eventually discharges into the ocean at Beachport, via Drain M and Lake George. Despite now being connected to a wider ‘catchment’ via the artificial drainage network, it is worth noting (particularly in the context of the biology of *Litoria raniformis*) that most of the wetlands in this general area were originally landlocked, still waterbodies; largely dependent on groundwater and only temporarily connected by shallow overland flows during wetter periods. Evidence of this original pattern of inundation and water movement can still be seen in the earliest (1951) image in Figure 4. To better illustrate the contrast in present (post-drainage) and historic (pre-comprehensive drainage) conditions, we are fortunate to be able to refer to a study by Dodson and Wilson (1975), who stated that at the time of their field work from 1965-1970, Mt Burr Swamp was a semi-permanent peat wetland that “normally contains 1-1.5 m of water, depending on the season”; however, they also stated that “the swamp dried out in the recent drought years of 1967 and 1972”. Notably, these occasions were long after initial drainage works; i.e. an artificial outlet that had (on at least two occasions) already lowered the original wetland sill (maximum retention) level – see Figure 6.



Location of artificial drainage outlet that lowered the sill level of Mt Burr Swamp (firstly before 1945, again in the 1950s) and was later deepened considerably and made the terminus for comprehensive drainage

Figure 6 – Oblique aerial view (looking north-east) over Mt Burr Swamp: this image was taken long after the sill level was lowered for a second time in the 1950s, but prior to comprehensive drainage and development. Photo: John Dodson, circa 1974.

Geoff Ellison (1983a) noted that this outlet from Mt Burr Swamp was already present when he purchased the property in 1945 and, as confirmed by the imagery, it was deepened when he started developing the property in the 1950s (see fresh spoil visible at the outlet location in the 1958 image, Figure 4). However despite these early changes, which would have reduced the depth and duration of inundation, the remnant aquatic habitat in the swamp at the time of Dodson’s work was still in excellent condition, as shown in Figure 7.



Figure 7 – Images of Mt Burr Swamp aquatic habitat circa 1974. Photos: John Dodson

Two key events occurred after that time which caused a more dramatic change in the future trajectory in the condition of the swamp. Development and drainage works on the property (along with adjacent land to the north) intensified, and in the aftermath of the Ash Wednesday Bushfires on 16th February 1983, the artificially drained (dehydrated) top layer of peat in Mt Burr Swamp caught fire from embers blown across from the stringybark heath in Marshes Native Forest Reserve after the wind changed direction (Neil Ellison, pers. comm.).

Prior to the fire, Geoff Ellison described the swamp as being “largely covered by rush and some water weeds” (Ellison, 1983b), broadly consistent with the photographs in Figure 7.

However after the fire, which (being in peat) continued to burn until an early season break in March 1983, Geoff Ellison stated that “the peat has in many places burnt down to a depth of two feet” and “most of the rush has been burnt right out including their roots and has been replaced by the large broad-leaved swamp weed or type of ribbon grass” (Ellison, 1983b).

The appearance of the swamp was captured a year after the fire by Geoff Ellison, as shown in Figure 8, and illustrates the dramatic change in condition, consistent with his description.



**Figure 8 – Left: Mt Burr Swamp: 8th January 1984; Right: Mt Burr Swamp: 26th February 1984.
Photos by Geoff Ellison, courtesy of Neil Ellison**

At this time, the floristics of Mt Burr Swamp was greatly changed, with increased areas of open water and *Triglochin* persisting, a plant favoured by Geoff Ellison’s stock (Ellison, 1983b).

Over subsequent years Mt Burr Swamp was even more comprehensively drained and sown to pasture. However this activity and trampling by stock led to peat subsidence (a gradual lowering of the swamp bed) and then later, reduced frequency of drain maintenance (especially after purchase negotiations began in February 2012) saw the wetland again experience periods of shallow, temporary inundation in recent years (after periods of heavy rain), as can be seen in the 2014 aerial image (Fig 4). Such conditions would have played a role in enabling *Triglochin procerum* to persist across the lowest parts of the swamp, despite the absence of sustained, deep inundation (the preferred ecological requirements of the species).

2.3 The landscape context surrounding Mt Burr Swamp

A cursory review of the aerial imagery over time (Figure 4) also reveals the significant degree of wetland loss in the surrounding landscape: both on the other parts of the wider Mt Burr Swamp property, but also on the private properties to the north and east. This was during an era when an identical pattern of drainage, clearance and development – facilitated by more modern, efficient machinery (i.e. bulldozers and excavators) – was being repeated across a vast area of wetland dominated landscapes in south-eastern Australia. It provides a clear demonstration (and salient reminder) of how this threatening process, the most significant threat facing *Litoria raniformis*, unfolded incrementally but pervasively over recent decades.

However, in contrast to that wider trend, Marshes NFR still retained a significant number and diverse range of high value wetlands, immediately to the south of Mt Burr Swamp. Crucially, these conservation values have persisted despite threats to the water security of this reserve; including the proximal effects of drains on adjacent agricultural land (including Mt Burr Swamp) and hydrological impacts (recharge interception / groundwater use) associated with large tracts of commercial plantation nearby. In fact, viewed in a wider regional context of many wetlands not having their water requirements reliably met, this is one of few geographic areas (in the SENRM region) where restoration remains feasible based on current hydrological conditions. The site is situated at the top of a catchment, is supported by a local perched aquifer system and receives reliable seasonal rainfall capable of annually filling local swamps.

These characteristics (i.e. excellent prospects for success) support the high priority assigned to securing Mt Burr Swamp; justifying the long and arduous five-year period of negotiation and fundraising that ultimately led to the site being secured for a future transition to conservation.

2.4 Initial restoration works at Mount Burr Swamp

Preliminary hydrological restoration works (the installation of a temporary regulating structure) occurred in August 2016 with the consent of the previous owner, prior to settlement of Nature Glenelg Trust's purchase of the property on the 30th September 2016. The works were designed to kick-start habitat restoration within (but also be initially restricted to) Mt Burr Swamp, the largest wetland feature on the property. The works were also supported by the recommendations of several past studies or reports that identified the significance of the Marshes wetland complex, the direct relationship between surface drainage and sustainable groundwater management in this area, and the likely ecological benefits (see: Slater and Farrington 2010; Slater & Hammer 2009; SEWC 1984; Jones 1978).



Figure 9 – The temporary regulating structure of the artificial outlet drain from Mt Burr Swamp.
A-C: 11th August 2016. D: 27th September 2016

With artificial drainage outflows prevented from August 2016, supported by excellent subsequent spring rainfall, the wetland filled (up to >1m deep) for the first time in several decades, resulting in the immediate restoration of over 50 hectares of deep freshwater marsh habitat, as shown in Figures 10 and 11. This project provides a perfect new case study site for

testing wetland habitat response to hydrological reinstatement, and for assessing the capability of a key indicator/target species, *Litoria raniformis*, to utilise the newly recreated (apparently suitable) habitat for breeding. As previously described, this activity is consistent with Action 3.4 from the species' National Recovery Plan (Clemann and Gillespie 2012).



Figure 10 – The restoration of Mt Burr Swamp (from winter 2016)



Figure 11 – Mt Burr Swamp (left) before drain regulation: December 2015 and (right) after drain regulation: November 2016 (courtesy of Charles Prime, LC Aerial)

3 Materials and Methods

3.1 Frog surveys

After a number of incidental observations between September 2016 and February 2017, also shared in the results, a compressive active search of Mt Burr Swamp was planned for mid-February 2017. Despite coming to the end of the most likely window of time for detecting calling *Litoria raniformis*, this timing of an active search does have the advantage of being more likely to encounter evidence of successful breeding and recruitment (e.g. metamorphs).

A single dedicated visit for active searching of the wetland took place on the evening of Wednesday the 15th of February 2017 (and into the early hours of Thursday the 16th of February), to confirm the species' presence and broadly assess population characteristics. The particular date was chosen because it has been a warm day and a mild change was passing through overnight. Previous experience with the species indicated that this might provide conditions conducive to calling and/or emergence.

After arriving on-site at 22:00 hours SA (Australian Central Daylight Savings - ACDS) time, a single 15 minute period of call playback was undertaken in an area of emergent aquatic vegetation near the eastern margin of the swamp, seeking to elicit a calling response. Recorded *Litoria raniformis* calls were played for one minute (using a portable loudspeaker plugged into a smartphone), followed by silence for 2 minutes to assess calling activity.

After unsuccessful call playback, on the basis of advice from expert zoologists experienced in *Litoria raniformis* surveys, the entire wetland margin of Mt Burr Swamp was actively searched, using headlamps and a spotlight. This survey of the swamp perimeter lasted for just over 2 hours, from 22:15 to 00:20 hours ACDS Time.

Prior to leaving the site, approximately half of the length of the artificial drain, upstream of the temporary regulating structure, was also surveyed. This subsequent survey lasted for 16 minutes, from 00:25 to 00:41 hours ACDS Time, on Thursday the 16th of February.

At both survey locations, if a *Litoria raniformis* remained still for long enough, it was photographed *in situ*, with associated GPS data captured with each image. Any frogs that were disturbed before they could be photographed had their location manually recorded.

3.2 Habitat assessment

Although NGT has initiated a wider native vegetation monitoring program at Mt Burr Swamp, habitat assessment for *Litoria raniformis* at Mt Burr Swamp (for the purposes of this report) involved a very basic mapping and classification exercise, to summarise the preliminary floristic response to initial restoration works, and testing of water salinity.

The mapping task involved interpretation of November 2016 aerial photography, coupled with a ground-truthing visit in February 2017, at which time representative habitats from within the swamp were photographed.

4 Results

4.1 Evidence of a *Litoria raniformis* population at Mt Burr Swamp

Incidental Observations

A number of incidental observations (calling or sightings) of *Litoria raniformis* have been made over the first season since restoration commenced, as summarised in Table 1.

Table 1: Observations of *Litoria raniformis* at Mt Burr Swamp

Date / Time	Observer	# of Growlers / method	Notes
27-09-2016 / 1030-1330 hrs	Mark Bachmann (NGT)	Few (2-9) / calling	Heard from shearing shed. Recording made of calling, posted on NGT website
30-09-2016 / 1300 hrs	Bryan Haywood (NGT)	Few (2-9) / calling	Heard from shearing shed
08-10-2016 / 1500-1700 hrs	Lauren Veale* (NGT)	Few (2-9) / calling	Heard while setting fish nets* in the swamp
30-11-2016 / 1300 hrs	Mark Bachmann (NGT)	Few (2-9) / calling	Heard from shearing shed
23-12-2016 / 1430 hrs	Lachlan Farrington (NGT)	Few (2-9) / calling	Heard while walking through swamp
23-01-2017 / 0900 hrs	Neil & Helen Ellison (former owners / grazing leasees)	Highly abundant (50+) / calling	Heard in deafening chorus from the southern side of the swamp
21-02-2017 / 1800 hrs	Lachlan Farrington (NGT)	Abundant (20 counted) / sighting	Observed in the 30m section of drain upstream of the structure

Abundance categories: One = 1, Few = 2-9, Many = 10-15, Abundant = 16-50, Highly abundant = 50+

* Despite no fish captures in the nets, this visit led to the discovery of a population (3 individuals detected) of Little Galaxias (*Galaxiella toourtkoourt*) in Mt Burr Swamp by NGT's Nick Whiterod - while dip-netting the eastern edge of the swamp on the 9th of October 2016.

Call Playback on the 15th February 2017

No *Litoria raniformis* were detected calling on the night of the survey, despite being heard on a number of previous occasions (see Table 1), and virtually no other species of frogs were heard calling on what was generally a very quiet and still evening at the site.

Active Search on the 15th February 2017

The subsequent full perimeter active search of Mt Burr Swamp was completed in perfect conditions and resulted in the physical detection of 46 individual *Litoria raniformis*, of all sizes, including metamorphs – see examples shown in Figure 12. Thirty-five of these frogs were successfully photographed with GPS references, and location data for the remainder was manually recorded. Only five striped marsh frogs (*Limnodynastes peronii*) were encountered as incidental frog observations, during the comprehensive survey of the swamp margin.

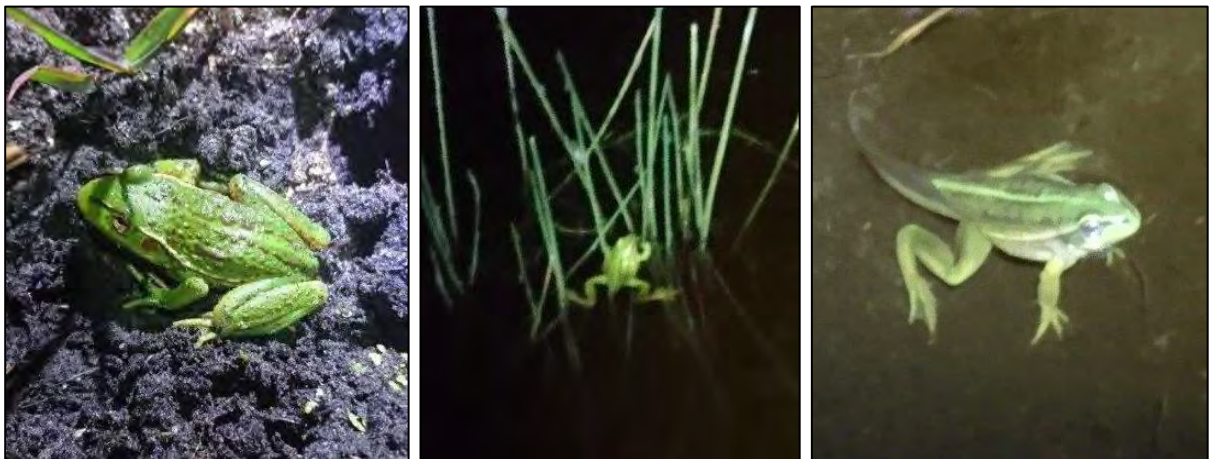


Figure 12 – Three of the 35 frogs photographed during the active search of Mt Burr Swamp, which included adult frogs (left) and metamorphs (centre and right)

To summarise the results, *Litoria raniformis* were concentrated in three main areas of Mt Burr Swamp (as also shown over the page in Figure 13):

1. an extended zone around the southern edge of the swamp;
2. a small area of the west side of the swamp, just south of the drain entry point; and,
3. in the vicinity of where the main drain exits the swamp on its north-eastern edge.

During the survey, these areas visually appeared to be slightly less turbid and have marginally more fringing, emergent or aquatic vegetation cover than the rest of the wetland fringe. It should be noted that this is in the context of the entire margin of the swamp still being quite disturbed (grazed, pugged and poorly vegetated) at the time of the survey.

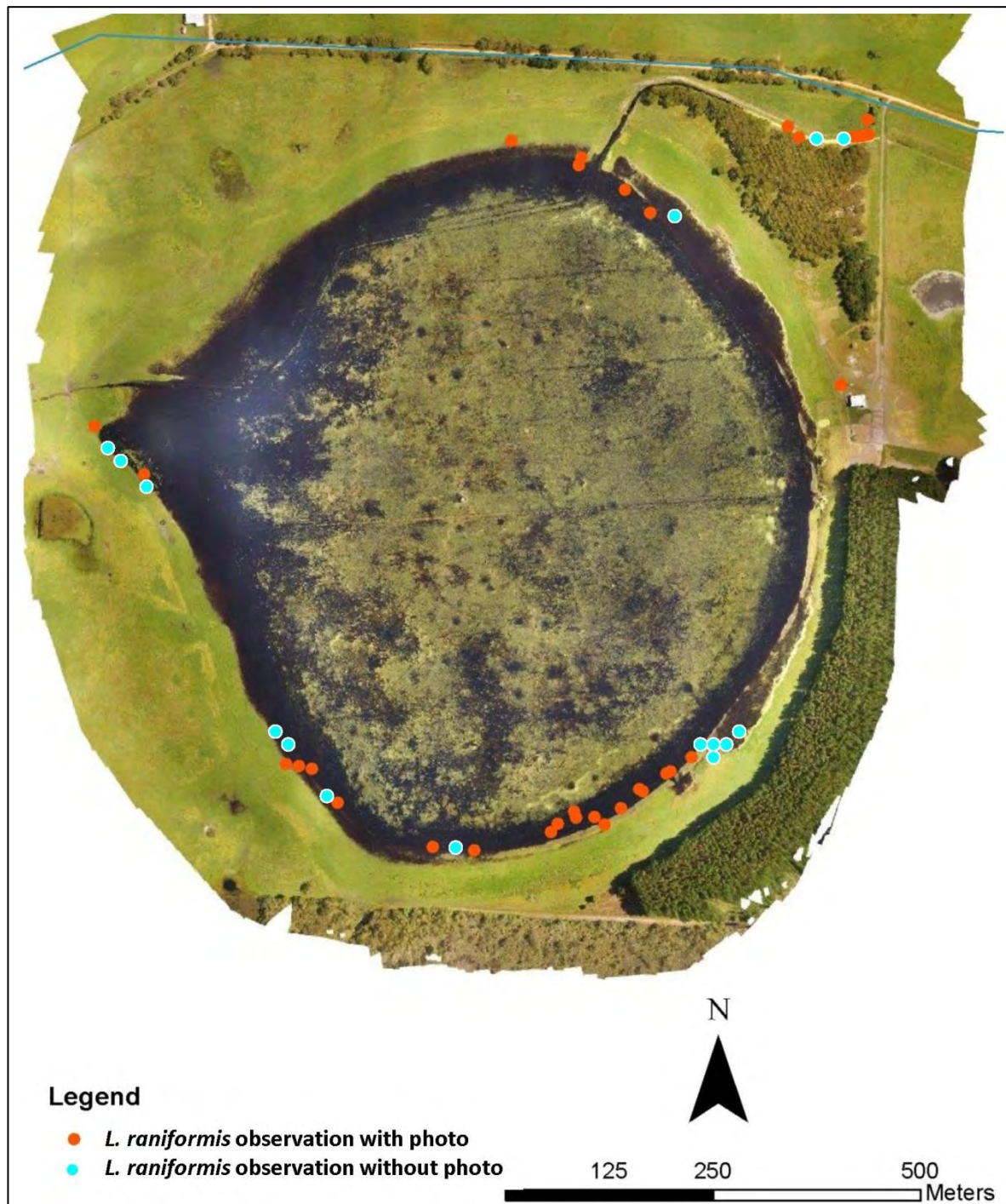


Figure 13 – Location of 96 *Litoria raniformis* observed at Mt Burr Swamp on the 15th February 2017.
 Map produced by Lachlan Farrington and Mark Bachmann

While leaving the swamp and heading back to the car, an additional single frog was seen moving through open pasture, inside the gate near the shearing shed.

The vast majority of animals observed around the main swamp, were smaller frogs or metamorphs. It was estimated that only 10-15% of frogs observed were of larger physical size, having clearly reached the reproductive adult stage of their development.

Prior to departing the site, a final active search was completed along a portion of the drain upstream of the restoration structure, resulting in the detection of a further 50 frogs in 16 minutes (as also shown in Figure 13). After reaching 50 frogs, the count within this area was terminated. Less than half of the length of the drain length back to the swamp had been covered at the time the survey was concluded. Forty-four of these 50 frogs were successfully photographed, see Figure 14 for examples.



Figure 14 – Four of the 44 frogs photographed during the active search of the Mt Burr Swamp drain, along an inundated (static) section upstream of the weir structure

As a result of the operation of the weir structure, the drain provided still water and excellent cover habitat. This was the case both within the water, as a result of a dense covering of *Lemna* sp. (duckweed), and along the bank margins (which are fenced and ungrazed), with cover provided by fringing grass tussocks, as shown in Figure 15.



Figure 15 – (Left): Static water in the Mt Burr Swamp Drain upstream of the weir structure, showing complete coverage of duckweed (light green colour) and grass tussocks along the drain banks. (Right): One of the many frogs observed floating in the water with only their heads exposed.

A much greater proportion of the frogs sighted in this area appeared to be larger size adults, and these individuals were often observed (and photographed) sitting on the banks, out of the water. The remaining frogs were mostly observed floating in the water (with only their heads exposed), as shown in Figure 15.

4.2 Habitat assessment

Wetland vegetation communities

Water quality throughout the site at the time of survey was consistent and fresh (400 $\mu\text{S}/\text{cm}$), while the result of the coarse habitat mapping exercise, showing inundated communities or other wetland associated native vegetation, is illustrated in Figure 16.

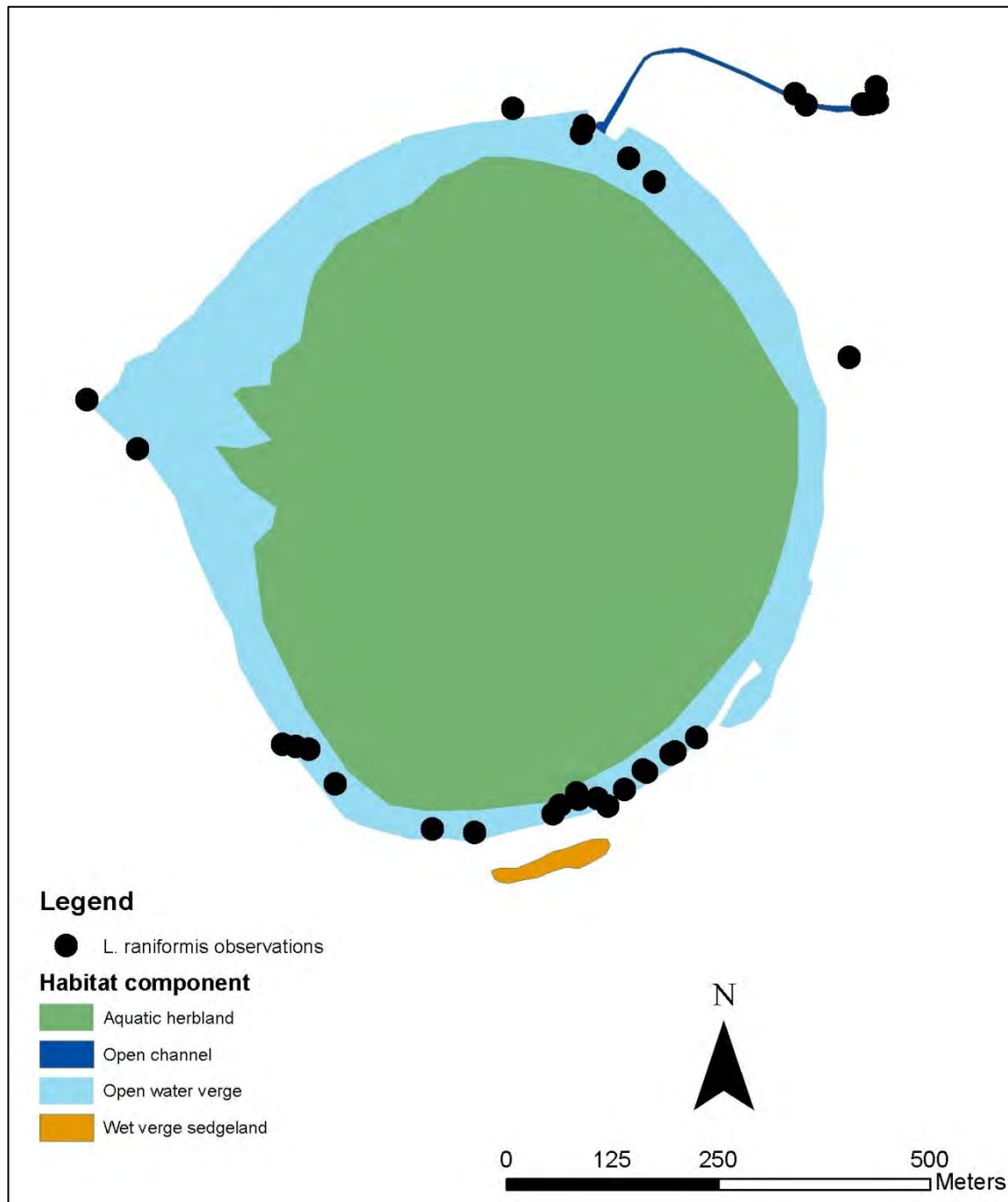


Figure 16 – A coarse representation of the wetland habitats of Mt Burr Swamp, observed during the first season after restoration and prior to stock exclusion occurring.

Map produced by Lachlan Farrington

Representative examples of the communities mapped in Figure 16 are shown in Figures 17-20.



Figure 17 – Recovering aquatic herbland at Mt Burr Swamp, currently dominated by Triglochin procerum and Lemna sp.



Figure 18 – Open channel with complete covering of Lemna sp., upstream of the regulating structure



Figure 19 – Open water verge at Mt Burr Swamp, a zone of the wetland expected to undergo a dramatic change in condition over the years ahead. Photo by Lachlan Farrington



Figure 20 – Small patch of remnant wet verge sedgeland at Mt Burr Swamp, dominated by Carex sp.

5 Discussion

5.1 *Litoria raniformis* population at Mt Burr Swamp

A minimum known breeding population of 96 *Litoria raniformis*

The results of the survey clearly indicate that, despite the restoration process only commencing when the trial structure was installed in August 2016, Mt Burr Swamp is immediately providing habitat suitable for supporting a breeding population of *Litoria raniformis*. Both the number of frogs observed and population demographics (evidence of recent recruitment), indicate that once restoration works are made permanent, Mt Burr Swamp has excellent prospects for becoming an ongoing refuge site in the landscape; providing secure habitat for a self-sustaining population of this nationally vulnerable species.

To illustrate this point, the wetland was still holding a depth of up to 60 cm of water across a large portion of its surface area in March 2017, as shown in Figure 21.



Figure 21 – Inundation across the southern half of Mt Burr Swamp on the 6th of March 2017.

Considering that only the wetland fringe was searched, and the vast area of emergent aquatic vegetation (the large *Triglochin* reed-bed) present across the interior of the swamp, it is worth remembering that the population count results are only likely to represent a small fraction of a total number of *Litoria raniformis* currently occurring at the site.

5.2 Habitat recovery at Mt Burr Swamp

Grazing management of Mt Burr Swamp

The immediate restoration priority for Mt Burr Swamp was reinstatement of a sustainable water regime, and the reported outcomes so far, for both *Litoria raniformis* and its habitat in the swamp, are as a result of that activity alone. While longer-term plans for the restoration and management of the property are being devised, Nature Glenelg Trust has temporarily leased the property back to the previous owner, meaning that the bulk of the property continues to be grazed by cattle. NGT is determined to not create future management problems by dramatically changing current practices on the property before: (a) the proper plans are in place and (b) the necessary resources secured, to facilitate the staged transition from production to environmental restoration, and ultimately perpetual conservation.

As a result, and despite Mt Burr Swamp being already (on paper) excluded from the formal lease area, at the time of writing (March 2017) this wetland has also continued to be grazed because the required fences are not yet in place, as shown in Figure 22.



Figure 22 – The site has been grazed by livestock for over 60 years, but plans are in place to exclude grazing from Mt Burr Swamp in time for winter 2017.

However, plans are underway to see the wetland fully fenced off in time for winter 2017, with electric fencing construction along the (currently unfenced) western side of the swamp scheduled for autumn 2017.

Management practices and the initial distribution of (post-restoration) habitats

It is clear from the map presented in Figure 16 that the initial (post-restoration) distribution of habitats in Mt Burr Swamp is closely linked to past management practices and the sequence of events that immediately pre-date NGT's purchase of the site.

The area of the swamp presently dominated by an emergent *Triglochin procerum* aquatic reed-bed corresponds with the deepest part of the swamp that continued to experience limited temporary inundation over recent years (up to approximately 20-30 cm depth) – assisted by the cessation of drain maintenance over the past 5 years, during the extended period of negotiation that led to NGT's purchase of the site. Hence, in a sense, this core area of the swamp was already 'primed' for restoration, and as such, has since responded extremely quickly and favourably (see Figure 23) with the reintroduction of much deeper inundation (up to >1m) since initial restoration works were completed in August 2016.



Figure 23 – Example view over the large, deepest portion of the swamp, where early vegetation response has been dramatic, despite decades of drainage and grazing not yet being excluded.

Predictably and in contrast, the newly submerged margin of the swamp, which has not experienced any form of inundation for decades, has responded differently. Prior to re-inundation, this severely dehydrated zone of peat consisted almost entirely of introduced pasture grasses and retained little of its remnant wetland flora. After restoration, sustained inundation of this zone resulted in the rapid elimination of pasture species, initially creating a band of largely open water around the swamp margin.

As water levels in the swamp slowly drop over the summer months, it is leaving behind bare mudflats in this zone, as shown in Figure 24.



Figure 24 – With pasture grasses eliminated by inundation, a new, temporary mudflat zone of variable width has formed around the margin of the deepest parts of the swamp.

Once stock grazing is fully excluded from the swamp in 2017, and after several seasonal inundation cycles, this zone is expected to undergo a dramatic natural process of wetland floral regeneration thanks to the release of propagules within the swamp. In retrospect, it is perhaps not surprising that during the frog survey of the swamp margin, *Litoria raniformis* were only encountered in those few places where additional wetland flora has persisted or responded in this zone; especially concentrated along the southern margin of the swamp. It is here (Figure 25) where a flooded section of drain has sustained more emergent native flora and deeper inundation, closer to the newly inundated wetland edge.



Figure 25 – Example Litoria raniformis observation habitat from the survey of Mt Burr Swamp, along the bank of the drain that hugs the southern edge of the wetland (image taken in early March 2017)

5.3 Future prospects for *Litoria raniformis* at Mt Burr Swamp

Habitat recovery for *Litoria raniformis*

As described in the previous section (5.2), the process of habitat recovery suitable for *Litoria raniformis* has only just begun at Mt Burr Swamp. Despite the fact that (at the time of writing) grazing has not been excluded from the main swamp and no additional proactive conservation measures beyond the establishment of a new water regime have yet been initiated, the early results of both habitat recovery and the *Litoria raniformis* population at the site are extremely promising for the future.

The imminent (2017) exclusion of grazing and completion of the restoration and management plan for the property are key steps that will facilitate further improvements in site condition. For instance, the property plan is likely to include recommendations for immediate investment (subject to funding availability) in peripheral revegetation that will improve connectivity (especially native vegetation cover) between the swamp and Marshes NFR (see Figure 26) and consolidation of drain regulation works to permanently secure increases in water retention height within the swamp achieved in 2016/17. These measures will consolidate early gains and deliver ongoing improvements in habitat condition that will greatly benefit *Litoria raniformis* at the site.



Figure 26 – Looking west along the property boundary, illustrating the short distance between Marshes NFR (left) and the southern edge of Mt Burr Swamp (right)

Absence of aquatic-based threats to *Litoria raniformis*

Initial aquatic surveys of Mt Burr Swamp in October 2016 (conducted by NGT's Lauren Veale and Nick Whiterod), were notable for an absence potential key threatening processes to *Litoria raniformis* from within the water column. No predatory or introduced fish species are present in Mt Burr Swamp; indeed the only native small-bodied native freshwater fish species recorded in the wetland is another nationally vulnerable species, the Little Galaxias (*Galaxiella toourtkoourt*), shown in Figure 27.



Figure 27 – One of three Little Galaxias (*Galaxiella toourtkoourt*) detected by Nick Whiterod while dip-netting in Mt Burr Swamp on the 9th of October 2016

However, the wider catchment to which Mt Burr Swamp is artificially connected, via the Mt Burr Heath Drain, then the Bakers Range Drain and finally Drain M, does sustain established populations of introduced fish species (e.g. Redfin and Gambusia); hence the completion of restoration works that permanently re-isolate the wetland from sustained artificial drainage flows (as a potential immigration pathway) are a vital measure for protecting its long-term ecological integrity.

As previously described in this report, the wider Marshes wetland complex (to which Mt Burr Swamp belongs) originally consisted of a vast swathe of largely (for much of the year) landlocked swamps interspersed by wet heath and woodland communities, and where lateral subsurface (groundwater) flows and discharge (rather than channelised, sustained surface flows along watercourses) defined this area's prevailing eco-hydrological character.

The 'neighbourhood effect' and long-term prospects for *Litoria raniformis*

It is also worth considering here that NGT's long-term plans for the property will, with time, involve restoration of the natural sill level (maximum retention height) of all wetlands on the property, both upstream (west) and downstream (east) of Mt Burr Swamp. While many of the densely vegetated wetlands across the property escape easy definition (due to their level of cover) in the 1951 aerial image, the chain of more permanently inundated swamps on the western portion of the property are clearly visible (from sunlight reflection), see Figure 28.

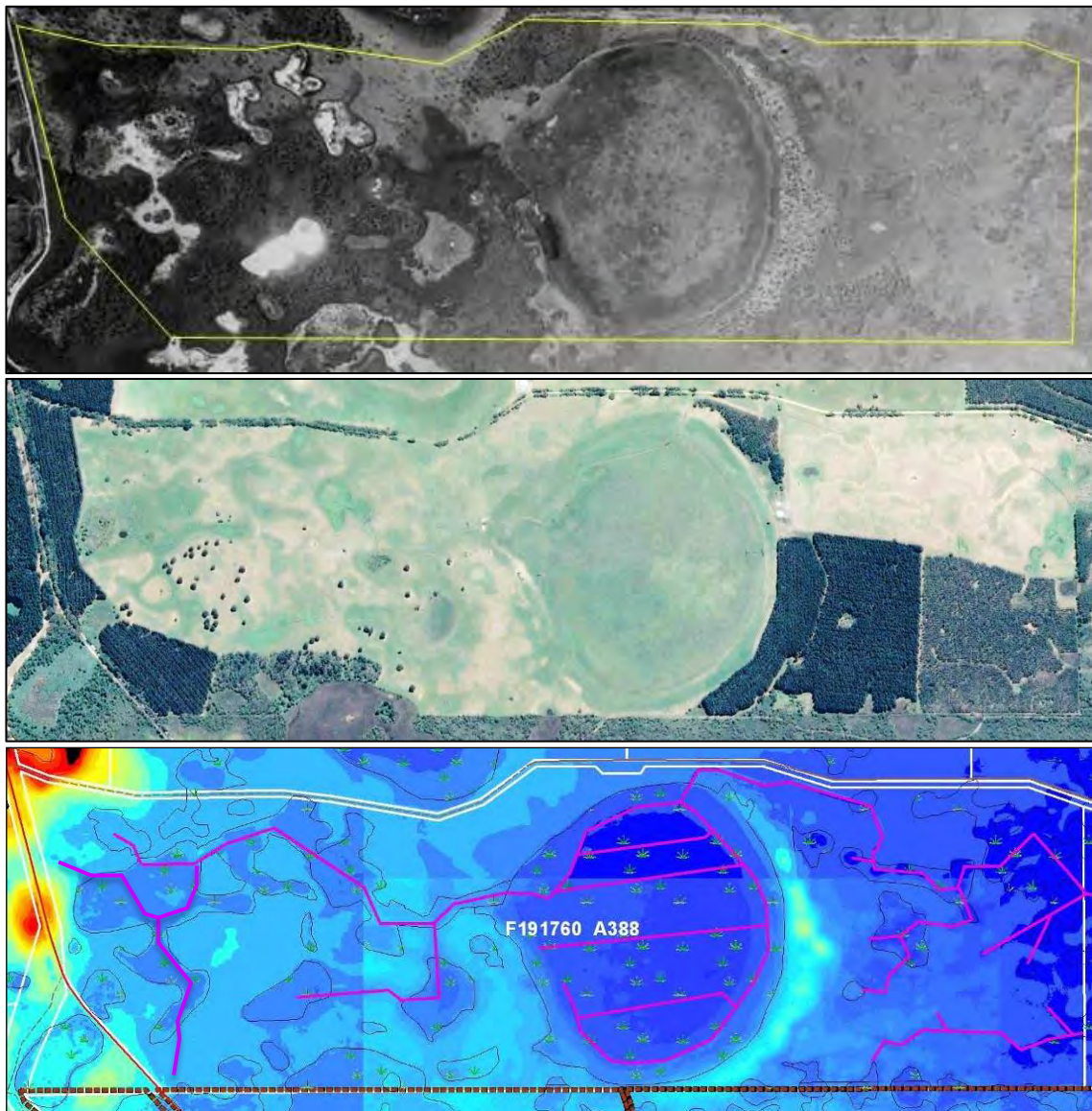


Figure 28 – A direct comparison of aerial images taken in summer 1951 and 2015, followed by the digital elevation model of the property and overview of the artificial drainage network.

The eventual reinstatement of this whole series of swamps within the Mt Burr Swamp property will recharge local groundwater, as well as increase availability and sustainability of suitable habitats for *Litoria raniformis* in the landscape. In turn, this will reinforce the general

viability of the *Litoria raniformis* meta-population across the Marshes wetland complex. This positive 'neighbourhood effect' is crucial for frogs and many other wetland species to persist in the landscape, considering the dynamic conditions expected to occur at any individual wetland site through time. Conversely, the loss of this neighbourhood effect, via the cumulative destruction or degradation of suitable wetland habitats across large areas of the landscape, is one of the key drivers responsible for *Litoria raniformis* experiencing severe declines across its range. The Mt Burr Swamp project aims to tip the balance of a positive neighbourhood effect back in favour of species like *Litoria raniformis*, as illustrated in Figure 29.

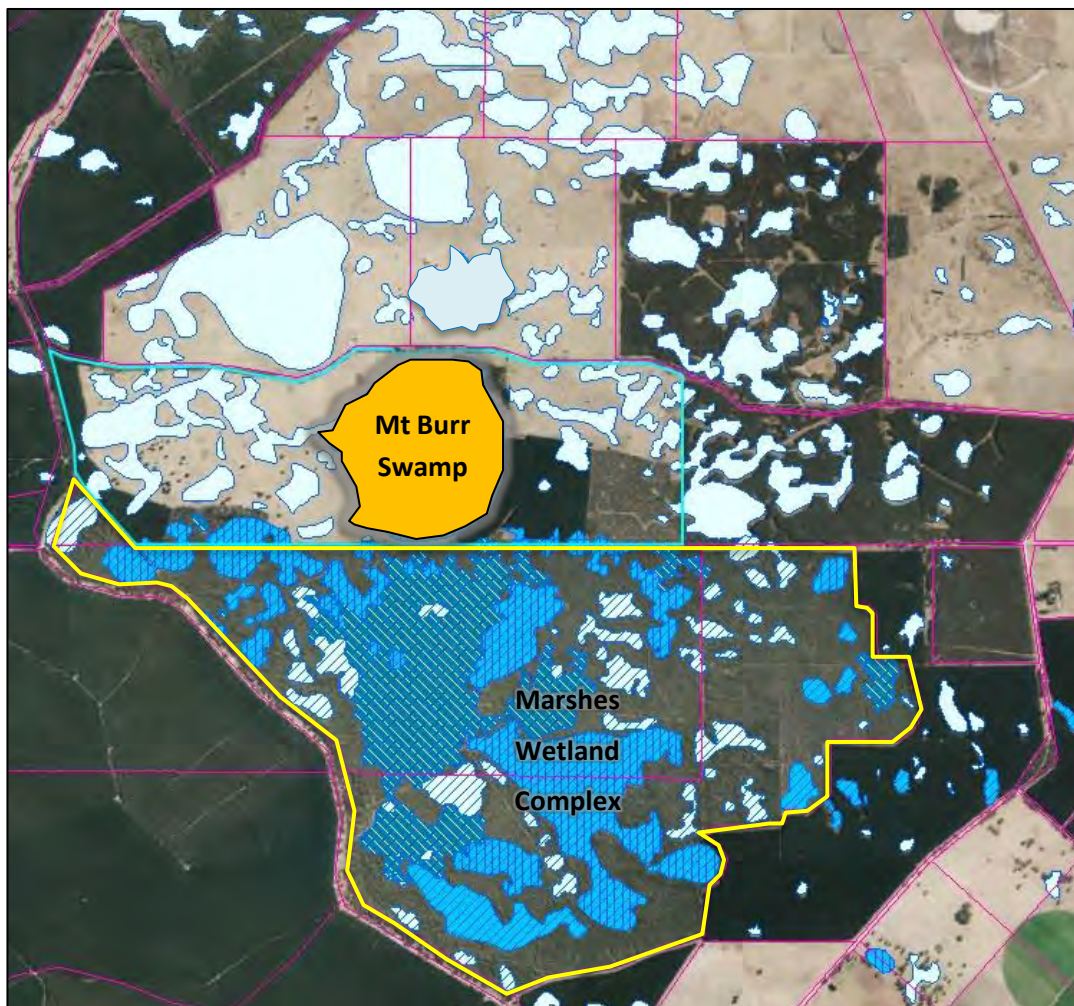


Figure 29 – The original extent of wetlands around Mt Burr Swamp (NGT property = blue line). High value wetlands within the Marshes DIWA site are indicated (see shaded/hatched polygons located within the yellow line). Most of the remaining private wetlands (pale blue polygons - northern half of image) are now highly modified or degraded, with the majority directly impacted by artificial drainage.

5.4 Mt Burr Swamp and the *Litoria raniformis* National Recovery Plan

Classification of Mt Burr Swamp as an ‘Important Population’

The following passage, of high relevance to this report, is taken directly from the National Recovery Plan for *Litoria raniformis* (Clemann and Gillespie, 2012):

The criteria for an ‘Important Population’ of the species are outlined in the EPBC Act Policy Statement for the species (DEWHA 2009a, 2009b). ‘Important Population’ is defined below (DEWHA 2009a, 2009b):

‘Much of the habitat for L. raniformis has been isolated or fragmented, restricting the opportunity for important population processes such dispersal and colonisation. As such, any viable population is considered to be an important population for the persistence and recovery of the species.

For this species, a viable population is one which is not isolated from other populations or waterbodies, such that it has the opportunity to interact with other nearby populations or has the ability to establish new populations when the suitability or availability of waterbodies changes. Interaction with nearby populations and colonisation of newly available waterbodies occurs via the dispersal of individual frogs across suitable habitat.’

‘In addition, a population of L. raniformis could be considered an important population if it is near the limit of the species’ range (for example small isolated populations in South Australia), is well-studied or has a history of monitoring, and hence provides opportunity for greater understanding of the species and its conservation status through the collection of long-term data’.

In the context of the discussion in this report and the National Recovery Plan, Mt Burr Swamp clearly meets the criteria for being considered an ‘important population’ of high conservation significance that is contributing to the national recovery of the species. The site represents a large, newly established breeding population that is contiguous with a larger wetland complex that also sustains the species, and is therefore ‘viable’ according the above criteria.

Additionally, since the local extinction of an isolated, outlying population at Rocky Swamp approximately 150 km to the north-west (in the West Avenue Range Watercourse, near Kingston in the South East of SA) a decade ago, Mt Burr Swamp is now also situated near the far western edge of the national distribution of the southern population group of *Litoria raniformis*. This emphasises the value of a secure Marshes meta-population. To learn more of the history and past characteristics of the Rocky Swamp population, refer to Harley (2006).

Responding to Action 3.4 from the National Recovery Plan

As described in Section 2.1, the project at Mt Burr Swamp will continue to provide vital information on the efficacy of Action 3.4 from the *Litoria raniformis* National Recovery Plan:

3.4 Investigate the response of Southern Bell Frog to translocation, the creation of artificial habitats, and / or the re-creation or rehabilitation of habitat

Even on the basis of the early results presented in this report, it is clear that wetland habitat restoration, through reversal of artificial drainage at strategically selected sites in the landscape, has enormous potential for aiding the national recovery of *Litoria raniformis*. Considering that the process of habitat recovery at Mt Burr Swamp has only just begun, more data in support of this initial observation will be collected over the years ahead, as annual monitoring of the population at Mt Burr Swamp is undertaken. It is currently NGT's intention for Mt Burr Swamp to become a long-term monitoring and case study location, capable of making a wider contribution to the scientific understanding (and hence national recovery) of *Litoria raniformis*. NGT also hopes that this project will inspire more practical action to restore wetlands at strategic sites. It is clear that the reversal of artificial drainage must be more widely implemented as a core recovery method for all wetland dependent threatened species.

6 Conclusion

This initial survey for *Litoria raniformis* at Mt Burr Swamp successfully met its stated aims. It:

- verified the presence of a viable, 'important population' of the species at the site;
- resulted in a baseline total population count of 96 individual frogs, both around the wetland margin and along the drain banks upstream of the new regulating structure;
- included significant evidence of breeding and recruitment, demonstrating an initial, positive response to the first season of hydrological restoration works; and,
- provided a baseline overview of habitat quality for the species, enabling future comparison as the process of ecological recovery unfolds over the years ahead.

Mt Burr Swamp clearly has a vital role to play in both (a) increasing and (b) securing the *Litoria raniformis* population in the Marshes wetland complex (near the western limit of the species' mainland extent), directly and significantly contributing to the species' national recovery.

7 References

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