

# Cowies Creek Amphibian Survey and Targeted Growling Grass Frog (*Litoria raniformis*) Survey, Summer 2009-2010.



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**Cover Photos:** Large Photo: Site 5 wetland within the study area, with constructed dam and council depot in background. Inset photos: Adult Growling Grass Frog observed at Site 3; Weedy instream vegetation at Site 10; Juvenile Growling Grass Frog observed at Site 1.

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## ABBREVIATIONS

AVW	Atlas of Victorian Wildlife
DEWHA	The Department of the Environment, Water, Heritage and the Arts
DSE	The Department of Sustainability and Environment
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
FFG Act	<i>Flora and Fauna Guarantee Act 1988</i>

## DISCLAIMER

The author advises that the information presented in this report, including any management advice, has been prepared with all due diligence and care, and based on the best available knowledge and research.

However the author takes no responsibility for any loss, injury or financial damage resulting from the reliance and/or application of management advice provided in the report.

## **SUMMARY**

Beacon Ecological was commissioned by the City of Greater Geelong to undertake a general amphibian survey, incorporating a targeted Growling Grass Frog survey, along the urban section of Cowies Creek, Geelong, Victoria.

### **Methods**

A review of the relevant Department of Sustainability and Environment (DSE) maintained fauna databases and available literature was undertaken. Field surveys for Growling Grass Frog and other frog species were undertaken on 21<sup>st</sup> - 22<sup>nd</sup> and 29<sup>th</sup> - 30<sup>th</sup> December 2009 and 6<sup>th</sup> - 7<sup>th</sup> January 2010. All observed frog species were documented and frog habitats present within the study area were described.

### **Results**

Growling Grass Frog were detected at eight survey sites within the study area during the present assessment. Four additional common frog species were also detected: Common Froglet, Southern Brown Tree Frog, Spotted Marsh Frog and Striped Marsh Frog.

Almost all frog species detected in the study area were found between the Geelong Ring Road and the Corio Leisure Centre on Anakie Road. Although frog species are likely to disperse along the creek and attempt to colonise habitats downstream, there do not appear to be any frog species that have established themselves in great numbers. This indicates that there may be factors which are impacting frog survival downstream of Anakie Road.

The wetland adjacent to the council depot at 299 Anakie Road provides high quality habitat and appears to be an important breeding site for Growling Grass Frog in the local area.

### **Potential Threats and Recommendations**

Potential threats and recommendations to mitigate these threats are outlined in Sections 4 and 5.

# 1 INTRODUCTION

## 1.1 Project Background

Beacon Ecological was commissioned by the City of Greater Geelong to undertake a general amphibian survey, incorporating a targeted Growling Grass Frog survey, along the urban section of Cowies Creek, Geelong, Victoria. This assessment serves two purposes. The general amphibian survey was to provide information to Council regarding the distribution of frog species along Cowies Creek. The completion of a targeted Growling Grass Frog survey was a condition of the Referral Decision relating to Referral 2009/5001 made under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The referral was submitted by Council to construct a stormwater harvesting dam at the Council Depot on Cowies Creek.

Two previous ecological reports prepared by Beacon Ecological relate to this project and deal with parts of the present study area:

Hynes, L. and Aboltins, A. *Flora and Fauna Survey for a Proposed Dam at Cowies Creek Reserve, 299 Anakie Road, Lovely Banks, Victoria*. Unpublished report prepared for City of Greater Geelong, July 2009.

Veltheim, I. 2009. *RE: Further Growling Grass Frog Advice Relating to Cowies Creek Downstream of 299 Anakie Road, Lovely Banks, Geelong, Victoria*. A letter report prepared for City of Greater Geelong, August 2009.

## 1.2 Scope of Works

The following tasks for the amphibian surveys were completed:

- A review of the relevant DSE maintained fauna databases (e.g. Atlas of Victorian Wildlife), available literature and previous ecological reports pertaining to the study area;
- Field surveys by a qualified zoologist to assess frog habitat and the presence or potential occurrence of frog species (including Growling Grass Frog) within the study area;
- A report was prepared presenting the findings of the assessment, including recommendations on how to manage potential threats and improve frog habitats within the study area.

### 1.3 Study Area

The study area is located at Cowies Creek, a narrow waterway which runs through the suburbs of Moorabool, Bell Post Hill, Lovely Banks and Norlane in Geelong, Victoria (Figure 2) (Melways Maps 430, 431, 441, 442). The study area is approximately 4.75 kilometres long, comprising the urban area of the creek from the newly constructed Geelong Ring Road (Melways 431 E11) to the mouth of the creek at Corio Quay (Melways 442 B4). The majority of the creek is publicly accessible, however the creek is fenced and inaccessible between the Princes Highway and Corio Quay Road where it runs through property owned by Ford Australia Ltd.

Two dams are present adjacent to the study area at the Geelong Ring Road (Figure 3). These dams were presumably installed during the construction of the Ring Road and drain into Cowies Creek when full. These dams were also surveyed during the present assessment.

A wetland is present adjacent to the council depot at 299 Anakie Road, Lovely Banks (Site 5, Figure 3). This wetland is known to support the nationally threatened Growling Grass Frog and was the subject of the 2009 referral and the report by Hynes and Aboltins (2009). A weir and culvert are present under the driveway to the council depot, which physically separates the wetland and creek upstream from the section of Cowies Creek downstream from the depot.

Further downstream, Cowies Creek runs into a large constructed lake at Seagull Paddock (Melways Map 441 K3).

Examination of aerial photography also indicates that two additional dams are adjacent to the study area on property owned by Ford Australia Ltd. These dams are located between the Princes Highway and Corio Quay Road and are to the north of the study area. However, Ford Australia Ltd. property was not accessed as part of this assessment.

Immediately adjacent to the study area, modified parkland vegetation surrounds the creek for the majority of its length. A walking track also runs parallel to the creek, from the Geelong Ring Road to downstream of Seagull Paddock Lake. The creek runs through residential and industrial areas, and stormwater from these surrounding areas drains into Cowies Creek at numerous points along its length.

Overall, the majority of the waterway is degraded and dominated by modified vegetation, particularly downstream of the wetland near Anakie Road.

## **2 METHODS**

### **2.1 Background Information Review**

The Atlas of Victorian Wildlife (AVW 2007) and the DSE online Biodiversity Interactive Map 3.0 (DSE 2009a) were reviewed as part of the current study. All previous frog records (including detailed Growling Grass Frog records) from the AVW within a ten kilometre radius of the study area were reviewed. Taxonomy of terrestrial and aquatic fauna follows the Atlas of Victorian Wildlife (AVW 2007). Local records from the Melbourne Water Frog Census ([www.melbournewater.com.au/frogs](http://www.melbournewater.com.au/frogs)) were also reviewed.

A literature review was undertaken which examined academic literature pertaining to amphibian species with special attention to the Growling Grass Frog, as well as previous ecological reports relating to the Growling Grass Frog in the local area. Federal and state documentation, Action Plans and Recovery Plans were also reviewed.

### **2.2 Methods for Targeted Growling Grass Frog and General Frog Survey**

Surveys were conducted by a zoologist with a knowledge of Growling Grass Frog and general frog biology and experience in conducting targeted and general frog surveys. Three night-time surveys, each taking 2 nights to complete, were conducted over a 17-day period from December 2009 to early January 2010, with a 7 day break between each survey.

Survey #1 was conducted on December 21<sup>st</sup> - 22<sup>nd</sup>, Survey #2 was conducted on December 29<sup>th</sup> - 30<sup>th</sup>, and Survey #3 on January 6<sup>th</sup> - 7<sup>th</sup>. Surveys were conducted between 21:30 and 03:00. Evening weather conditions during the surveys were generally cool to warm, with varying cloud cover and moon brightness (see Table A4, Appendix 4).

Surveys were conducted at 19 survey points along the 4.75 kilometre creekline (see Figure 3). Surveys at each point commenced with three minutes of Growling Grass Frog call-imitation, followed by three minutes of listening for a response from male frogs. A number of common frog species in addition to Growling Grass Frogs are known to respond to this call.

Spotlighting surveys involved two investigators with hand-held 30 watt spotlights walking along the creek bank, approximately 20 - 30 metres either side of the call-imitation point. When surveying small dams the entire dam was spotlit, whereas a time limit was placed on the larger waterbodies at the council depot wetland (30 minutes) and Seagull Paddock Lake (1 hour). Vegetation (fringing, emergent, floating and submerged), water, shelter (e.g. rocks) and the surrounding grassy banks were visually searched for the

presence of frogs. Any frogs or aquatic fauna observed or heard during the assessment were noted. When surveying the large lake at Seagull Paddock, additional Growling Grass Frog call imitation was conducted at various points along the bank.

Disease control measures were implemented during the spotlighting surveys to reduce the risk of potentially spreading disease such as Chytrid fungus along the creek. Surveys were undertaken in accordance with the NSW National Parks and Wildlife Service Hygiene Protocol for Controlling Diseases in Frogs (NSW NPWS 2001).

On each survey night, a reference site was visited where the occurrence of Growling Grass Frogs was known, to ensure that the species was active in the local area on each night of the targeted survey. The wetland at the council depot was known to support a population of Growling Grass Frog, and this was used as a reference site for the targeted survey. Growling Grass Frogs were heard calling at the reference site on every night of survey. Therefore, targeted surveys were conducted on nights when weather conditions were suitable and male frogs, if present, were likely to be calling within Cowies Creek.

### **2.3 Habitat Assessment**

Previous habitat assessments have been conducted along Cowies Creek, both for targeting Growling Grass Frog (Veltheim 2009) and for a general assessment by Hynes and Aboltins (2009). The assessment by Veltheim focused on the area from Anakie Road to Corio Quay. The assessment by Hynes and Aboltins (2009) assessed the creek between the Geelong Ring Road and the Corio Leisure Centre, but did not look at the dams near the Geelong Ring Road. The previous habitat assessments were undertaken when the wetland and other areas of the creek had a lower water level than the present assessment, which may have impacted upon habitats within the creek and adjacent waterbodies.

The present habitat assessment aimed to supplement the information provided by the previous assessments, providing further information on habitats for a range of potentially-occurring frog species and also covering areas not previously assessed in detail. The habitat assessment involved recording habitat features at the 18 survey points along the study area, focusing on features likely to be important for frogs, such as the presence of aquatic vegetation, shelter and predators, and making a visual assessment of water quality and depth. Habitat quality criteria are based on those used by Veltheim (2009) and are listed in Appendix 1.

## 2.4 Limitations

As some frog species have seasonal activity patterns, and as there are also interactions between species, some frog species may have been less active within the study area at the time of the field survey. For example, surveys were conducted outside of the breeding season of the Common Spadefoot Toad.

Steep embankments and very thick vegetation within the creek (particularly weeds and *Typha* species) made it difficult to access all parts of Cowies Creek. Therefore, cryptic frog species and species occurring at low densities may not have been detected during the spotlighting survey

Access was not gained to survey two dams on Ford Australia property or the fenced area of Cowies Creek between the Princes Highway and Corio Quay Road.

However, the survey effort and review of existing relevant information is considered sufficient to provide an assessment of the potential presence of frog species, and particularly Growling Grass Frog, within the study area.

### 3 RESULTS - HABITAT ASSESSMENT

Previous habitat assessments have been conducted along Cowies Creek for Growling Grass Frog by Veltheim (2009) and briefly by Hynes and Aboltins (2009). This present assessment supplements the previous assessments which were undertaken when the water level in the creek was lower and/or the wetland dry.

Water levels in the creek and adjacent waterbodies may fluctuate significantly over short periods of time. Water levels throughout the creek and dams upstream of Anakie Road were observed to drop significantly over the course of the survey. Evidence of periodic flooding events, such as build up of dead vegetation and soil, were seen at various locations between Anakie Road and Seagull Paddock Lake. However, at the time of the survey the creek consisted of a chain-of-ponds between the Geelong Ring Road and Seagull Paddock Lake. In this area deep, still pools of water were separated by vegetated creek bed (mostly weeds downstream of Anakie Road). At the site of the oxygen dissolver downstream of Seagull Paddock Lake clear water ran out of a large drain into the creek, and from this point to Corio Quay water flowed at a slow to moderate rate along the creek. In the vicinity of Corio Quay (near Site 18) there was a tidal influence with salt and freshwater mixing. Jellyfish were observed in the creek at Site 18.

During the present assessment high densities of introduced fish species, including Eastern Gambusia (*Gambusia holbrooki*), were present throughout the creek downstream of Anakie Road. However, fish were absent from the wetland near the council depot, the creek upstream of the wetland, and the two dams near the Geelong Ring road. Introduced fish species are potential predators of frogs, tadpoles and eggs. Eastern Gambusia in particular are thought to have been a factor in the decline of the Growling Grass Frog by preying on eggs, hatchlings and tadpoles. Eastern Gambusia is further discussed in Section 4 - Potential Threats.

#### *Habitat between the Geelong Ring Road and the Site 5 wetland*

At Site 1 at the Geelong Ring Road bridge, Cowies Creek has undergone a great deal of disturbance during the ring road construction. The creek in this area appears to have been completely reconstructed. Under the bridge the instream creek was lined with rocks, devoid of vegetation with patches of moist soil but no water. Planted vegetation along the creek bank is still at an early stage of growth, and stunted where the bridge shades the plants from sunlight. This area provides dispersal and shelter habitat and is of **low habitat quality** for all frog species in the local area.

At Site 2a, the dam next to the ring road, there were some emergent and fringing rushes and rocks present, however the majority of the dam lacked any aquatic vegetation and water was deep and of poor quality (turbid). This site is considered **low quality habitat for Growling Grass Frog** and low-moderate for Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

At Site 2b, planted fringing and emergent rushes, native grasses, and rocks were present, with poor-moderate quality water. The drainage line leading from this dam to Cowies Creek was dry at the time of the assessment and lacked any aquatic vegetation. This site is considered to be **moderate quality habitat for Growling Grass Frog** and moderate-high for Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

In the vicinity of Sites 3 and 4 there are multiple pools of water with quality varying from poor to moderate. Remnant Brackish Wetland (Ecological Vegetation Class 656) habitat is present here. Native planted and remnant fringing and emergent rushes, sedges, fringing weeds and introduced grasses, rocks and cracked soil, as well as scattered floating vegetation (algae) were present throughout this area. A patch of native Tangled Lignum (*Muehlenbeckia florulenta*) was also present. There were also areas of large boulders which would provide shelter and basking habitat for frogs. The area between Site 3 and Site 5 is considered to be **moderate quality habitat for Growling Grass Frog** and moderate-high for Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

#### *Habitat between the Site 5 wetland and Anakie Road*

Downstream from the Site 5 wetland and the culvert/weir under the council depot driveway Cowies Creek was weedy with rubbish present. Near the stormwater outlet was a thick patch of Common Reed *Phragmites australis*, and further downstream near an old footbridge a patch of Common Spike-sedge *Eleocharis acuta* was present. The remaining vegetation was predominantly exotic grasses and scattered rushes. The creek was dry with little to no open water other than under the old footbridge (where 5 juvenile Growling Grass Frogs were observed during the habitat assessment) or next to the culvert. This area of the creek is considered to be **low to moderate quality habitat** for Growling Grass Frog, Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

#### *Habitat at the Site 5 wetland and between Anakie Road and Corio Quay*

Within the rest of the study area, the findings of the present assessment largely concur with those of Veltheim (2009) who assessed the wetland near the council depot and the creek between Anakie Road and Corio Quay.

However, some habitat ratings have been slightly adjusted due to the additional information gathered during the present assessment. Overall, the creek downstream of the wetland is weedier, has undergone greater disturbance and is of lower habitat quality for frogs than the area upstream of the Site 5 wetland.

At the time of the present assessment the wetland (Site 5) was inundated with water and there was an abundance of newly-grown aquatic vegetation present. Due to the abundance of submerged and floating aquatic vegetation, fringing and emergent rushes and Water Ribbons, good quality water and absence of introduced fish species, the habitat quality rating of the wetland has been adjusted and is now considered **high quality habitat** for Growling Grass Frog, Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

The creek between Anakie Road and Peacock Avenue (near Sites 7-10) is considered **low to moderate quality habitat** for Growling Grass Frog, Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

The creek between Peacock Avenue (near Site 10) and Site 14 is considered **moderate quality habitat** for Growling Grass Frog, Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

Site 14, which was part of Section 3 of the assessment by Veltheim (2009) was considered high quality habitat. However the discovery of high numbers of introduced fish during the present assessment render it less suitable frog habitat (I. Veltheim, *pers. comm.*). Therefore, the quality rating has been adjusted to **moderate to high habitat quality** for Growling Grass Frog, Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

The upstream end of Seagull Paddock Lake near The Boulevard (Site 15) is considered **moderate quality habitat** for Growling Grass Frog, Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

Seagull Paddock Lake (Site 16) and the creek between Princes Highway and Corio Quay Road is considered **low to moderate quality habitat** for Growling Grass Frog, Common Froglet, Striped and Spotted Marsh Frogs and Southern Brown Tree Frog.

At Corio Quay (Site 18) the creek provides **low quality habitat** for all frog species.

## 4 RESULTS - FROG SURVEY

Within the Atlas of Victorian Wildlife (2007) there are no previous records of any frog species occurring along Cowies Creek.

However, the AVW reports that six frog species have been reported as occurring within 10 kilometres of the Cowies Creek study area: Common Froglet *Crinia signifera*, Common Spadefoot Toad *Neobatrachus sudelli*, Growling Grass Frog, Southern Brown Tree Frog *Litoria ewingii*, Spotted Marsh Frog *Limnodynastes tasmaniensis*, and Striped Marsh Frog *Limnodynastes peronii* (Table A2, Appendix 2). With the exception of the Growling Grass Frog, these are all common frog species. Five of these species were detected within the study area during the present assessment (Table A3, Appendix 3). Each of these species is discussed individually below.

In addition to the species discussed below, anecdotal evidence indicates that frogs are commonly heard calling from the two dams located on Ford Australia Ltd. property between the Princes Highway and Corio Quay Road. Frogs were heard most recently in early 2010, however it is not certain what frog species inhabit these dams.

## Growling Grass Frog *Litoria raniformis*



**Plate 1** – Adult Growling Grass Frog observed at Site 3 during the present assessment

The Growling Grass Frog is listed as a Vulnerable species under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*, is listed as a Threatened Taxon under the Victorian *Flora and Fauna Guarantee Act 1988*, and is considered Endangered in Victoria (DSE 2007b)

### **Biology of the Species**

The Growling Grass Frog is a large frog, reaching up to 100 millimeters in length, with females generally growing to a larger size than males. Colour varies from olive brown to bright emerald green, with large iridescent bronze-gold patches, a pale belly and bright blue coloring on the back of the legs and groin (Pyke 2002; Robinson 1998; Hero *et al.* 1991).

This species is generally thought to prefer permanent, still or slow-flowing water bodies and streams. However, ephemeral and semi-permanent habitats are also used and may be of greater importance than previously thought (Pyke 2002; Schultz 2008). The presence of aquatic vegetation for breeding and shelter is also preferred, particularly submerged and floating vegetation. For example, the species is often found in waterbodies with emergent and fringing rushes and sedges (e.g. *Juncus*, *Eleocharis* and *Bolboschoenus* spp.), Water Ribbons (*Triglochin procera*), and with areas of open water containing submerged and/or floating vegetation such as Floating Pondweed (*Potamogeton tricarinatus*) (Hamer and Organ 2008; Heard *et al.* 2008; Cogger 2000). Surrounding vegetation, rocks and/or fallen timber are also important habitat features. The presence of suitable waterbodies and streams in the surrounding landscape is also important for the species, which is unlikely to be present or persist in isolated water bodies (Hamer and Organ 2008).

The breeding season occurs from August to April. The peak in breeding and frog activity occurs between September and January (Hero *et al.* 1991; Robinson 1998; Wassens *et al.* 2008).

Although this species was once widespread throughout Victoria, it has undergone a decline over the past 20 years. A number of threats are thought to have contributed to this decline, including: the loss and widespread alteration, degradation and fragmentation of habitat; the construction of barriers to movement (e.g. roads, buildings, fences); disease (e.g. Chytrid fungus); predation by introduced species (e.g. Eastern Gambusia, Red Fox); and, the use of chemical pollutants (e.g. pesticides, herbicides) near waterbodies (DEWHA 2009b, Pyke 2002).

### **Previous records in the local area**

The AVW reports six previous records of Growling Grass Frog from within 10 kilometres of the study area (see Table A2 and Figure 1). These records are from the Belmont area, approximately nine kilometres from the study area. The most recent AVW record is from 1995.

Hynes and Aboltins (2009) recently observed Growling Grass Frogs at the wetland adjacent to the council depot during a flora and fauna assessment of the area. This was the first official record of Growling Grass Frog from within Cowies Creek. At the time of this June 2009 assessment the wetland was almost completely dry and the creek level was low. The creek was briefly assessed downstream as far as the Corio Leisure Centre, however no frogs of any species were seen or heard downstream of the wetland during the assessment.

The author also recently recorded Growling Grass Frog from approximately nine kilometres from the study area at Jerringot Wetlands, Belmont, and also additional records from the Cowies Creek wetland during site visits (Aboltins 2010)(Table A2).

Growling Grass Frog has also previously been found near the Breakwater Road Bridge over the Barwon River in 2009, near the Barwon River in Highton, and is likely to be present at various locations along the Barwon River and Reedy Lake systems (D. Burns personal communication; DEWHA 2002; T. Pescott personal communication).

There are no previous records of Growling Grass Frog in the City of Greater Geelong in the Melbourne Water Frog Census data.

### **Present assessment**

Growling Grass Frogs were detected at sites 1, 2a, 2b, 3, 4, 5, 6 and 7, which comprises Cowies Creek from the Geelong Ring Road to the Corio Leisure Centre (see Table A3 and Figure 4 for detailed results). The greatest number of frogs were present in the wetland adjacent to the council depot at 299 Anakie Road.

### **Likely distribution of Growling Grass Frog within the study area**

Growling Grass Frogs were detected at sites 1 - 7 and are likely to be present throughout this part of Cowies Creek.

Metamorphosing Growling Grass Frogs were seen in the dam at Site 2a and in the Site 5 wetland. Therefore breeding is occurring at these locations, and may also be occurring at other locations, where there is suitable habitat upstream of the wetland. The Site 5 wetland is likely to be an important breeding location for frogs along this section of Cowies Creek, indicated by the large number of frogs present, the male frogs heard calling (which were not heard elsewhere along the creek) and the high-quality breeding habitat present.

Juvenile frogs were also seen throughout this section of the creek, including at locations that were presently dry and of low to moderate habitat quality. It is possible that many of these juvenile frogs were in the process of dispersing when they were observed in these locations.

It is likely that the juvenile frogs seen at Site 6, and the subadult/adult at Site 7 originated from the wetland and were dispersing downstream in an attempt to find suitable habitat.

No frogs of any species were detected at sites 8 - 18. It is likely that Growling Grass Frogs from the wetland do attempt to disperse down the creek, and there is potential habitat of varying quality for Growling Grass Frogs present from the wetland to the downstream end of Seagull Paddock Lake. However, it appears that some factor or combination of factors deters or prevents Growling Grass Frogs and other frog species from establishing themselves downstream of Anakie Road.

Potentially limiting factors include the presence of predators, possible water pollution and barriers to dispersal. These potentially limiting factors are discussed further in Section 4 – Potential Threats.

## **Striped Marsh Frog**

## ***Limnodynastes peronii***

### ***Biology of the Species***

The Striped Marsh Frog is a large frog, reaching up to 75 millimeters in length. Colour is generally grey to light brown with a number of long, blotchy dark and light brown stripes. A lighter mid-dorsal stripe is often present (Hero *et al.* 1991; Robinson 2000).

Whilst this species is widespread along southern coast of Victoria, the western suburbs of Melbourne and the Geelong area are excluded from its known distribution. It is highly adaptable and can be found in a range of habitats. Striped Marsh Frog are often found in wetlands, swamps, lakes, dams, isolated water bodies, flooded drains and ditches, flooded grasslands, as well as residential ponds and pools, and in open and disturbed areas. It can also occur (although less often) in forests, woodlands, shrublands and in open and disturbed areas. Cover such as woody debris, rocks, leaf litter and aquatic vegetation provide shelter during the day (Hero *et al.* 1991; Robinson 2000).

This species breeds from August to March and calling males can be heard from August to June. Breeding occurs in slow moving or still water (Hero *et al.* 1991). Striped Marsh Frog also appear to be tolerant of polluted water (Robinson 2000).

### ***Previous records in the local area***

The AVW reports three previous records of Striped Marsh Frog from within 10 kilometres of the study area (see Table A2 and Figure 2). These records are from the Belmont area, approximately nine kilometres/metres from the study area. The most recent AVW record is from 1996.

Melbourne Water Frog Census data indicates that there is one previous record of Striped Marsh Frog in the City of Greater Geelong, at Point Lonsdale.

The small number of records of this species in the local area is likely partly due to the fact that Geelong is at the limit of this species' distribution, as well as the lack of survey effort that has been undertaken for amphibians in general in the local area.

### ***Present assessment***

One Striped Marsh Frog was detected within the study area during spotlighting surveys at Site 5, the wetland near the council depot (see Table A3 and Figure 6).

***Likely distribution of Striped Marsh Frog within the study area***

There is potential habitat for the Striped Marsh Frog throughout the study area, with the exception of near Corio Quay where salt water is present in the creek. However, because the study area is at the limit of this species' known distribution Striped Marsh Frog are unlikely to be present in high densities in the local area. Within the study area the species is most likely to occur in low densities from Anakie Road to the Geelong Ring Road.

## Spotted Marsh Frog

## *Limnodynastes tasmaniensis*



**Plate 2** – Adult Spotted Marsh Frog observed at Site 2a during the present assessment

### **Biology of the Species**

The Spotted Marsh Frog is a small-to-medium sized frog, reaching up to 45 millimeters in length. Colour is olive green to light brown with a number of darker blotchy markings. A lighter mid-dorsal stripe is also sometimes present (Hero *et al.* 1991; Robinson 2000).

This species is widespread throughout Victoria and it is highly adaptable, able to colonise permanent water bodies, ephemeral water bodies, flooded drains and ditches, and inundated areas. It is often found in vegetated streams, swamps and wetlands, and can be found in suburban environments. Cover such as woody debris, rocks, soil cracks, leaf litter and aquatic vegetation provide shelter during the day (Hero *et al.* 1991; Robinson 2000; Anstis 2002).

The breeding season occurs from August to March, and calling males can be heard from July to May. Breeding occurs in slow moving or still water (Anstis 2002; Hero *et al.* 1991).

### **Previous records in the local area**

The AVW reports seven previous records of Spotted Marsh Frog from within 10 kilometres of the study area, including the southern call race record (see Table A2 and Figure 2). These records are from the Sutherlands Creek, Belmont and Point Henry areas. The most recent AVW record is from 1998.

The author also recently recorded Spotted Marsh Frog approximately nine kilometres from the study area at Jerringot Wetlands, Belmont (Aboltins 2010)(Table A2).

There are no previous records of Spotted Marsh Frog in the City of Greater Geelong in the Melbourne Water Frog Census data.

### **Present assessment**

Spotted Marsh Frogs were detected at sites 1, 2a, 2b, 3 and 5, which comprises Cowies Creek from the Geelong Ring Road to the wetland near the council depot (see Table A3 and Figure 5 for detailed results). The greatest number of frogs detected were present in the Site 2a dam and the Site 5 wetland.

### **Likely distribution of Spotted Marsh Frog within the study area**

Spotted Marsh Frogs are likely to be present throughout Cowies Creek from the ring road to the Site 5 wetland.

A metamorphosing Spotted Marsh Frog was seen in the dam at Site 2a. Therefore breeding is occurring at this dam, and is also likely to be occurring at the other sites where males were heard calling.

No Spotted Marsh Frog were detected at sites 6 - 18, and no frogs of any species were detected at sites 8 - 18. It is likely that Spotted Marsh Frogs from the Site 5 wetland do attempt to disperse down the creek, and that they are present at various points along Cowies Creek. However, the species may be present at low densities making it harder to detect, particularly downstream of Anakie Road. There is suitable habitat of varying quality for Spotted Marsh Frogs throughout the study area from the Ring Road to the downstream end of Seagull Paddock Lake. However, it is possible that some factor or combination of factors may inhibit Spotted Marsh Frogs and other frog species from establishing themselves in larger numbers downstream of Anakie Road. Potentially limiting factors are discussed further in Section 4 – Potential Threats.

## **Common Spadefoot Toad**      *Neobatrachus sudelli*

### ***Biology of the Species***

The Common Spadefoot Toad is a small-to-medium sized frog, reaching up to 40 millimeters in length. Colour is tan to dark brown with a number of darker blotchy markings and lighter mid-dorsal stripe (Hero *et al.* 1991; Robinson 2000).

This species is found throughout the drier regions of Victoria in woodland, shrubland, mallee and grassland, as well as in disturbed areas. The Common Spadefoot Toad is a burrowing frog, laying buried for much of the time. The species becomes active after rain, breeding in dams, ponds and flooded areas (Hero *et al.* 1991; Anstis 2002).

The breeding season occurs from March to May and from August to October, with males calling from February to November, usually after prolonged rain periods. Breeding occurs in shallow, still water (Anstis 2002; Hero *et al.* 1991).

### ***Previous records in the local area***

The AVW reports nine previous records of Common Spadefoot Toad from within 10 kilometres of the study area (see Table A2 and Figure 2). These records are from the Sutherlands Creek area, approximately nine kilometres from the study area. The most recent AVW record is from 1962.

There are no previous records of Common Spadefoot Toad in the City of Greater Geelong in the Melbourne Water Frog Census data.

### ***Present assessment***

This species was not recorded within the study area during the present assessment.

### ***Likely distribution of Common Spadefoot Toad within the study area***

This species is not likely to be present within the study area as it is at the edge of its range and the habitat present is of low suitability.

## Common Froglet

## *Crinia signifera*

### **Biology of the Species**

The Common Froglet is a small frog reaching up to 30 millimeters in length. Colour and markings are extremely variable, ranging from light grey to dark brown/black with markings such as blotches or longitudinal stripes (Hero *et al.* 1991; Robinson 2000).

This species is widespread and common throughout most of Victoria, except for the north-west of the state. It is able to opportunistically use a range of permanent and ephemeral water bodies for breeding, such as ponds, dams, slow-moving streams, wetlands, swamps, flooded drains, ditches and inundated areas along roadsides, and is found in forest, woodland, grassland, farmland and suburban areas (Hero *et al.* 1991; Robinson 2000; Anstis 2002).

Breeding occurs throughout the year, and calling males can be heard year-round, particularly after rain (Anstis 2002; Robinson 2000; Hero *et al.* 1991).

### **Previous records in the local area**

The AVW reports 14 previous records of Common Froglet from within 10 kilometres of the study area (see Table A2 and Figure 2). These records are from the Lara, Gheringhap, Point Henry, Belmont and areas. The most recent AVW record is from 2002.

Hynes and Aboltins (2009) detected Common Froglet along Cowies Creek upstream of the wetland near the council depot (Site 5). At the time of this June 2009 assessment the wetland was almost completely dry and the creek level was low. The creek was briefly assessed downstream as far as the Corio Leisure Centre, however no frogs of any species were seen or heard downstream of the wetland during the assessment.

Common Froglet was also heard calling at Site 14 during the previous habitat assessment of the creek (I. Veltheim, *pers.comm.*)(Table A2, Figure 2).

The author also recently recorded Common Froglet approximately nine kilometres from the study area at Jerringot Wetlands, Belmont (Aboltins 2010)(Table A2).

Melbourne Water Frog Census data indicates that there are two previous records of Common Froglet in the City of Greater Geelong, near the Corio Quay and at Point Lonsdale.

### **Present assessment**

During Survey #1 Common Froglet was heard just downstream of Site 1 at the Geelong Ring Road bridge and at Site 3 within the creek (Table A3 and Figure 6). However, the species was not heard in the subsequent surveys.

### **Likely distribution of Common Froglet within the study area**

Common Froglet is likely to be present throughout the study area from the Geelong Ring Road to the Site 5 wetland.

No Common Froglets were detected at sites 4 - 18 during the present assessment. However, Common Froglet has previously been detected near Site 5 and Site 14 within the study area (Appendix 2). It is likely that Common Froglet is present at various points along Cowies Creek (and possibly in the dams upon Ford Australia property), but may be present at low densities in the creek making it harder to detect. There is suitable habitat for Common Froglet throughout the study area. However, it is possible that some factor or combination of factors may inhibit Common Froglet and other frog species from establishing themselves in larger numbers downstream of Anakie Road. Potentially limiting factors are discussed further in Section 4 – Potential Threats.

Common Froglet was heard at two sites during Survey #1 but was not heard in the subsequent surveys. In the previous flora and fauna assessment (Hynes and Aboltins 2009; author, personal observations) many were heard just upstream of the Site 5 wetland during the day. However, frogs and tadpoles of this species are likely to be preyed upon by Growling Grass Frog. There is a possibility that the abundance of this species may vary seasonally depending on the abundance and activity patterns of Growling Grass Frogs in the creek.

## Southern Brown Tree Frog

## *Litoria ewingii*

### **Biology of the Species**

The Southern Brown Tree Frog is a small-to-medium sized frog, reaching up to 45 millimeters in length. Colour and markings are variable. There is usually a wide band running down the back that is brown or grey in colour, with the sides pale cream, tan or orange. The groin and back of the thigh are reddish-orange to yellow and are sometimes spotted with black (Hero *et al.* 1991; Robinson 2000).

This species is widespread and common throughout the southern and eastern parts of Victoria. It utilises many habitats and can be found calling long distances from water. It is found in woodland, forest, heathland and farmland ,as well as in suburban gardens. This species uses a range of permanent and ephemeral water bodies for breeding, such as ponds, dams, lakes, wetlands, swamps and flooded roadside ditches (Hero *et al.* 1991; Robinson 2000; Anstis 2002).

Breeding occurs throughout the year, and calling males can be heard year-round, particularly after rain (Anstis 2002; Robinson 2000; Hero *et al.* 1991).

### **Previous records in the local area**

The AVW reports one previous record of Southern Brown Tree Frog from within 10 kilometres of the study area, recorded in 1998 (see Table A2 and Figure 2). This record is from the Point Henry area, approximately ten kilometres from the study area.

Hynes and Aboltins (2009) detected Southern Brown Tree Frog within Cowies Creek upstream of the wetland (see Table A2 and Figure 2). At the time of this June 2009 assessment the wetland was almost completely dry and the creek level was low. The creek was briefly assessed downstream as far as the Corio Leisure Centre, however no frogs of any species were seen or heard downstream of the wetland during the assessment.

The author also recently recorded Southern Brown Tree Frog approximately nine kilometres from the study area at Jerringot Wetlands, Belmont (Aboltins 2010)(Table A2).

There are no previous records of Southern Brown Tree Frog in the City of Greater Geelong in the Melbourne Water Frog Census data.

### **Present assessment**

Southern Brown Tree Frog was not detected within the study area during the present assessment.

### **Likely distribution of Southern Brown Tree Frog within the study area**

Southern Brown Tree Frog was previously recorded near the Site 5 wetland (Hynes and Aboltins 2009). It is likely that Southern Brown Tree Frog is present at various points along Cowies Creek (and possibly in the dams upon Ford Australia property) but may be present at low densities in the creek making it harder to detect, particularly downstream of Anakie Road. There is suitable habitat for Southern Brown Tree Frog throughout the study area from the Ring Road to the downstream end of Seagull Paddock Lake. However, it is possible that some factor or combination of factors may inhibit Southern Brown Tree Frog and other frog species from establishing themselves in larger numbers downstream of Anakie Road. Potentially limiting factors are discussed further in Section 4 – Potential Threats.

Frogs and tadpoles of this species may also be preyed upon by Growling Grass Frog (Pyke 2002). There is a possibility that the abundance of this species upstream of Anakie Road may vary seasonally depending on the abundance and activity patterns of Growling Grass Frogs in the creek.

## **4 POTENTIAL THREATS**

A number of potential threats to frog species that reside in the Cowies Creek study area are outlined below.

### **Loss and degradation of habitat**

Since European settlement, the removal of native vegetation and modification of land for agricultural uses as well as urban and suburban development has occurred throughout the Geelong region. The degradation and removal of wetlands and creeks has a direct and detrimental effect on local frog populations that require these areas for breeding, shelter and food.

The clearance and modification of native vegetation and alteration of the landscape near water bodies and waterways can lead to changes water quality and hydrology (e.g. changes in flooding frequency)(DSE 2007a). Clearance and modification of native vegetation and changes in water quality and hydrology can promote weed encroachment into wetlands and waterways, and alter vegetation composition and structure. The degradation of habitat can render it unsuitable for use by many frog species.

Habitat loss and fragmentation is considered to be the main threat to populations of the Growling Grass Frog (DEWHA 2010). However, generalist frog species that do not require specialised habitats (e.g. Common Froglet, Spotted Marsh Frog) are more tolerant of habitat modification and are often able to survive in disturbed and modified habitats.

### **Barriers and impediments to movement**

The construction of barriers to movement has a detrimental effect upon frogs by reducing their ability to disperse or move around the landscape between habitats. Many frog species undertake movements between shelter, foraging and breeding sites as an integral part of their life history. Barriers and impediments to movement can include the construction of roads, the development of surrounding land, and the removal of intermediate habitats used to 'island-hop' between habitats of greater quality, or the alteration of habitats to such an extent that they are no longer suitable. Dense, weedy vegetation can also impede frog movement within a waterway.

Barriers and impediments to movement may prevent dispersal of frogs, or increase the distance required to travel between various habitats, leading to the isolation of those habitats. This can lead to local extinctions at water

bodies and waterways that are isolated, that cannot then be recolonised by dispersing frogs and that are subject to random environmental and demographic events, such as drought, disease, inbreeding and overpopulation (DSE 2007a; Hels and Buckwald 2001). It is likely that barriers and impediments to movement will reduce the long-term viability of an isolated population. However, the detrimental effects may not be observed for many years.

For example, Growling Grass Frog has been recorded travelling up to one kilometre within 24 hours (DEWHA 2010; Schultz 2008). The spatial arrangement of water bodies in the local area and the ability to travel between these water bodies is known to be an important factor influencing the presence and persistence of Growling Grass Frog at a site (DEWHA 2009b; Hamer and Organ 2008).

The construction of the Geelong Ring Road is likely to have impacted upon frog species in the study area, including the nationally Vulnerable Growling Grass Frog. The Ring Road now acts as a barrier to dispersal between the study area and potential frog habitats located on the western side of the Ring Road. To reach the western side of the road, frogs from the study area must pass under the Ring Road bridge, where there is little vegetation and water present. Construction of the Ring Road has also impacted upon frog habitat within Cowies Creek, which appears to have been completely reconstructed in the vicinity of the Ring Road bridge.

### **Water pollution**

Frogs are susceptible to water pollutants due to their semi-permeable skins, and toxic chemicals can cause death, illness and developmental abnormalities in frogs (DEWHA 2010). However, the long-term impacts of chemicals on frogs, such as the Growling Grass Frog, requires further research (DEWHA 2009b, Anstis 2002). Some frog species, such as the Striped Marsh Frog, appear to be able to tolerate polluted water more than others (Robinson 2000).

Cowies Creek downstream of Anakie Road is closely surrounded by industrial and residential areas and there are many bridges crossing the creek here. Chemicals and refuse are likely to wash into the creek from roadways and via stormwater drains, and litter was observed in the creek during the assessment. During the spotlighting survey a resident was also observed dumping bread into the creek, and it is likely that other refuse is regularly dumped by residents. Rotting vegetation (e.g. *Typha* spp. and algae) may also contribute to water pollution.

## Disease and introduced predators

Chytrid Fungus (*Batrachochytrium dendrobatidis*) is listed as a Key Threatening Process under the EPBC Act 1999 and as a Potentially Threatening Process under the Victorian FFG Act 1988. Chytrid is a water-borne fungus that causes the disease Chytridiomycosis, which has been implicated in the decline of some frog species, including the Growling Grass Frog (DEWHA 2010; DSE 2007a). Chytridiomycosis is widespread in some frog populations in eastern Australia, and Growling Grass Frog, Southern Brown Tree Frog and Spotted Marsh Frog are some of the species that have previously been found to have Chytrid fungus infections (DEH 2006). However, the incidence and impact of Chytrid Fungus on frogs in the study area and surrounds is unknown.

Many introduced fish species are capable of preying on small frogs, eggs or tadpoles, including Eastern Gambusia (*Gambusia holbrooki*). Eastern Gambusia is a Declared Noxious Aquatic Species under the Victorian Fisheries Act 1995. It is a small, carnivorous fish species (females reach up to 60 millimetres) which originates from North and Central America. Eastern Gambusia are aggressive predators that are known to prey on a range of aquatic organisms, including frog eggs and hatchlings. They also attack and nip the fins of tadpoles which can lead to death (Rowe *et al.* 2008). Although direct evidence of Eastern Gambusia leading to the decline of Growling Grass Frog is lacking (DEC 2005, DEWHA 2009b, Rowe *et al.* 2008), Eastern Gambusia have been implicated as a factor in the decline of this species in Australia, and may lead to a reduction in numbers or the absence of the species from a waterbody (Tyler 1997, DEWHA 2009b, Anstis 2002, Pyke 2002, Rowe *et al.* 2008). During the present assessment Eastern Gambusia and many other introduced fish species were found in large numbers throughout the creek between Anakie Road and Corio Quay. Very large fish were seen in Seagull Paddock Lake, which is known to be stocked with Rainbow Trout for recreational fishing and is also likely to contain other introduced fish species which may prey upon frogs, eggs and tadpoles, or may reduce habitat suitability (DEWHA 2009b).

Red Foxes (*Canis vulpes*) and Cats (*Felis catus*) are also likely to prey upon frog species in the study area, including the Growling Grass Frog (DEWHA 2009b). Domestic cat predation is likely to be more prevalent in residential areas where domestic cats are present in higher numbers and dumping of cats may occur. At least one domestic cat was observed in the study area during the surveys.

## 5 RECOMMENDATIONS

The following recommendations may assist in improving frog habitats and conserving frog species in the study area:

- Undertake further survey of Cowies Creek focusing on the upstream section north-west of the Geelong Ring Road to determine the presence and distribution of frog species, in particular the Growling Grass Frog, in the upper reaches of Cowies Creek.
- Prevent further degradation of frog habitats within the study area and undertake habitat restoration along the creek. Priority areas for protection and improvement are where Growling Grass Frog and other frog species are currently known to be present. Specifically, priority areas are the wetland, creek and dams upstream of Anakie Road.
- Prevent the establishment of introduced fish species (such as *Gambusia*) in the wetland near the council depot (Site 5), in the creek upstream from the wetland, and within the dams near the Geelong Ring Road. Maintaining the ephemeral hydrology of the wetland is likely to help prevent the establishment of introduced fish species. Maintaining the weir wall under the driveway to the council depot at 299 Anakie Road ensures the wetland holds water during rain events, and also prevents fish from travelling upstream to the wetland.
- Monitor the constructed dam at the council depot to ensure that introduced fish species do not become established. This dam drains into the wetland when it is full. If fish become established within the dam, draining the dam to remove the fish is recommended. However, infested water should not be allowed to drain into the wetland or Cowies Creek.
- Interpretive signage is recommended along the creek, particularly along the walking track near the council depot wetland, upstream from the wetland, and past the Geelong Ring Road. Signage should inform the public of the presence of a nationally significant species and deter people from dumping introduced fish, weeds and refuse into the creek.
- Investigate the possibility of removing introduced fish species from the creek where they have become established. However, it is very difficult to remove species such as *Gambusia* from a waterway once they have become established. If introduced fish can be removed from the creek, there is also the possibility that they may become re-established

within the creek via stormwater drains or fish released by the general public. Methods such as electric fishing or draining of ponds within the creek may help reduce or remove fish from the creek. However, it is unlikely that fish can be removed from the Seagull Paddock Lake due to its size and the stocking of the lake with fish for recreational fishing. Prior to any attempts to remove introduced fish from Cowies Creek, it is recommended that an aquatic survey be undertaken to confirm the species present and ensure that no native fish species are impacted upon. Information on the control of introduced fish species can be found in Rowe *et al.* 2008 (see references).

- Water quality testing is recommended to determine whether pollution may be impacting on frog species downstream of Anakie Road.
- Install litter traps in stormwater drains to reduce litter in Cowies Creek.
- Undertaken collection and removal of litter and rotting vegetation from Cowies Creek.
- Remove and control weeds. When undertaking weed control within the creek, frog-friendly techniques, such as hand-weeding, should be used. If required, a 'frog sensitive' herbicide (e.g. Roundup Bi-active) should be used as an alternative to other conventional herbicides in the parkland around the creek. Weed removal should be done gradually, as it may be disruptive to frogs, and native aquatic plants more suitable for Growling Grass Frog should be progressively planted to replace some of the weeds removed (see Appendix 5 for a list of suitable native plants).
- Following weed removal, revegetation can be undertaken. Native aquatic plants are recommended for planting in and around the Cowies Creek. This will provide potential habitat for the Growling Grass Frog and other frogs species, and may also assist in improving water quality. A list of suitable plant species can be found in Appendix 5, and further information on wetland design can be found in Melbourne Water 2005 (see references). The vegetation planted within and around the creek should include a diversity of aquatic and semi-aquatic vegetation. This should include fringing, emergent, floating and submerged vegetation. *Typha* species should not be planted. As a guide, a density of at least six semi-aquatic and terrestrial plants per square metre and three aquatic plants per square metre should be considered. Some scattered areas free of fringing vegetation along the banks and scattered open areas of water free of aquatic plants should also be provided. Temporary netting should also be considered

for installation over aquatic plants, particularly immediately after planting to prevent damage to plants by waterfowl. As the vegetation becomes established this netting can be progressively removed.

- The removal of dead *Typha* (also known as Cumbungi) may be considered. Growling Grass Frog prefers open areas of water with floating and submerged vegetation, and some emergent and fringing vegetation. Areas of the creek that are choked with dead *Typha* do not provide quality habitat for the species. Rotting *Typha* may also contribute to water pollution. Removal of dead *Typha* in places to provide open areas of water is likely to improve suitability of habitat, and potentially facilitate frog movement along the creek. *Typha* removal should be done gradually, and native aquatic plants more suitable for native frogs species should be progressively planted to replace some of the *Typha* removed. (Note: *Typha* present in the study area may be a native species and its removal may also impact on other native flora and fauna present. A permit under the Planning and Environment Act 1987 is likely to be required to remove *Typha* from the study area).
- Planting of native aquatic vegetation in and around the dams adjacent to the Geelong Ring Road could also improve frog habitat and water quality at these locations.
- At the Geelong Ring Road bridge, the planting of shade-tolerant aquatic species may also improve frog habitat here.
- Any revegetation or landscaping works should be undertaken using native species of local provenance with follow up weed control essential (see Appendix 5 for a list of suitable plant species).
- A large number of trees or large shrubs should not be planted within 20 metres of Cowies Creek or nearby water bodies, as the shading of wetlands can render them unsuitable for Growling Grass Frog.
- The provision of terrestrial habitat around the banks of the creek should also be included. For example, small scattered rock piles and large woody debris (hollow branches/logs) could be provided as terrestrial shelter for frogs. Large rocks could also be added to pools within the creek to provide emergent rock habitats for frogs.

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## FIGURES

Figure 1 : Previous Growling Grass Frog Records within 10 km of the Study Area

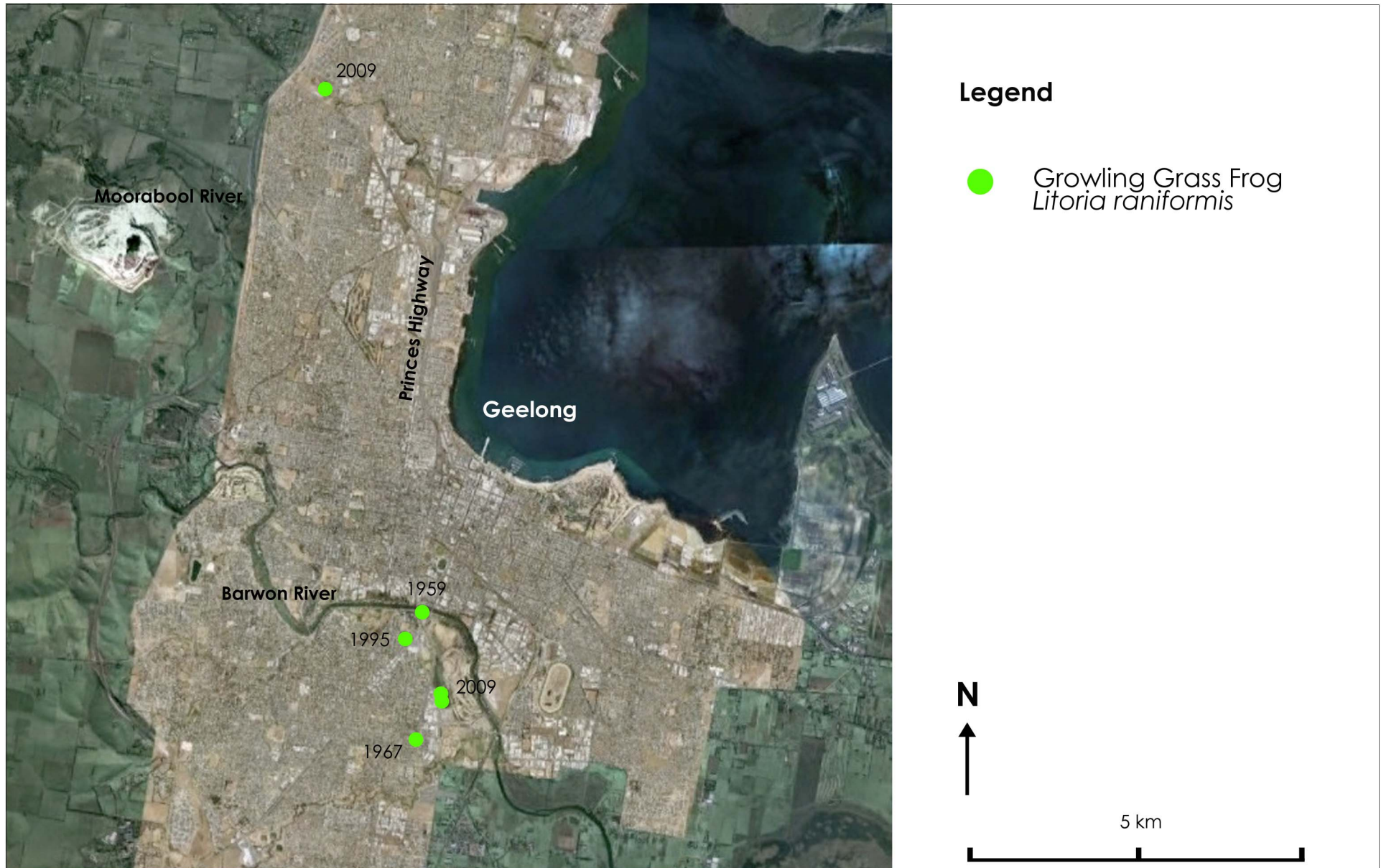


Figure 2 : Previous Frog Records within 10 km of the Study Area

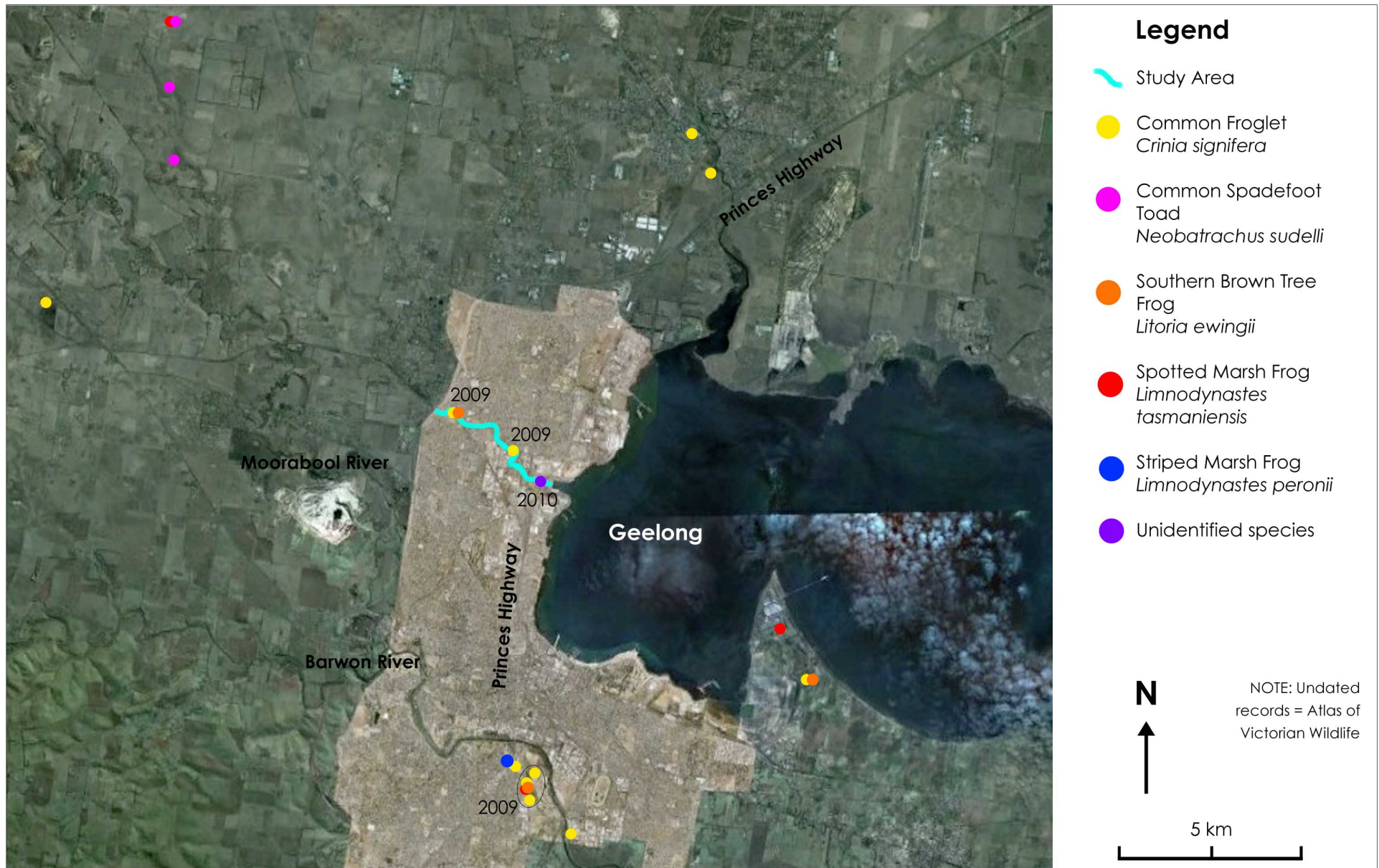


Figure 3 : Survey Sites within Study Area

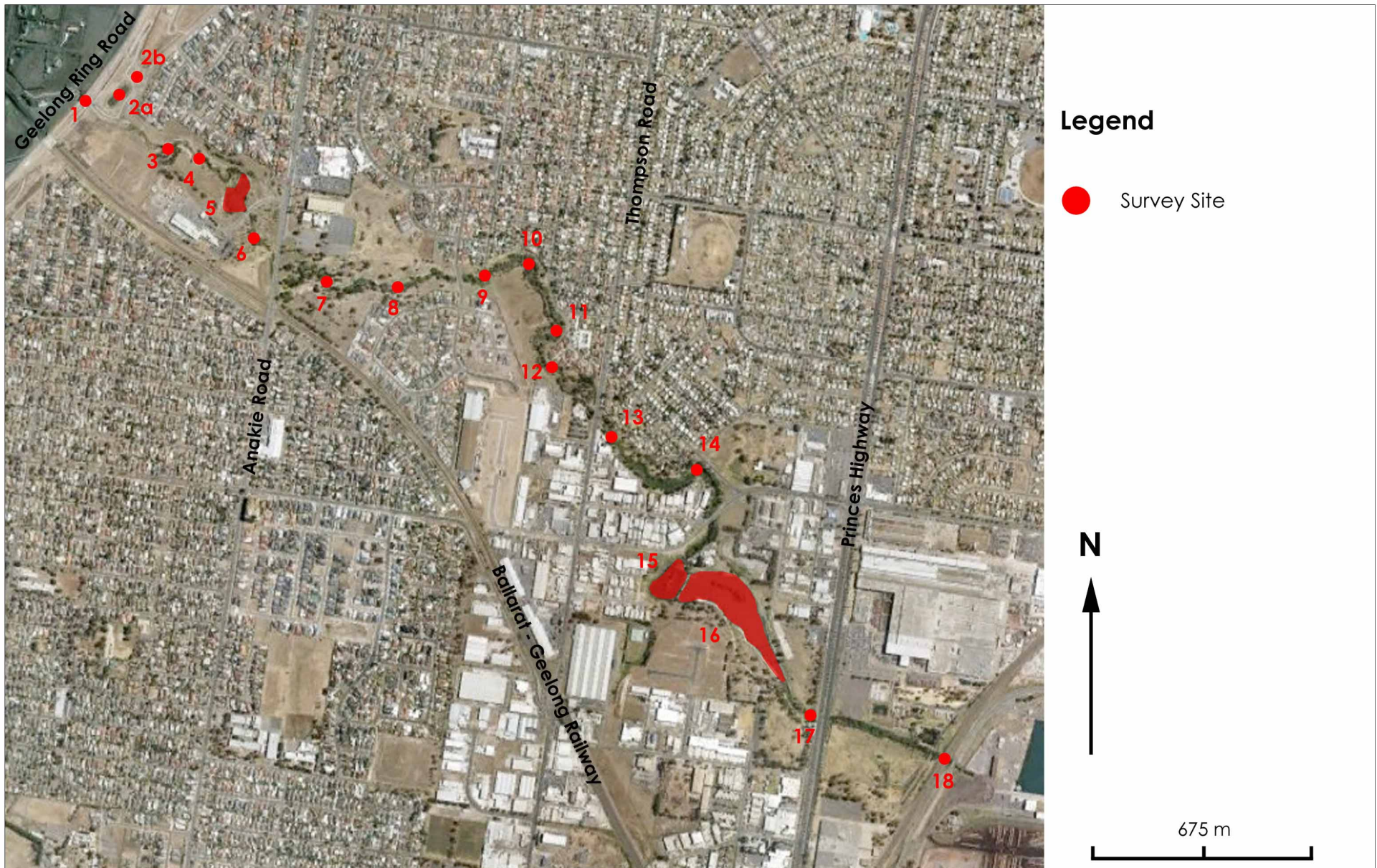


Figure 4 : Growling Grass Frog detected during the present assessment

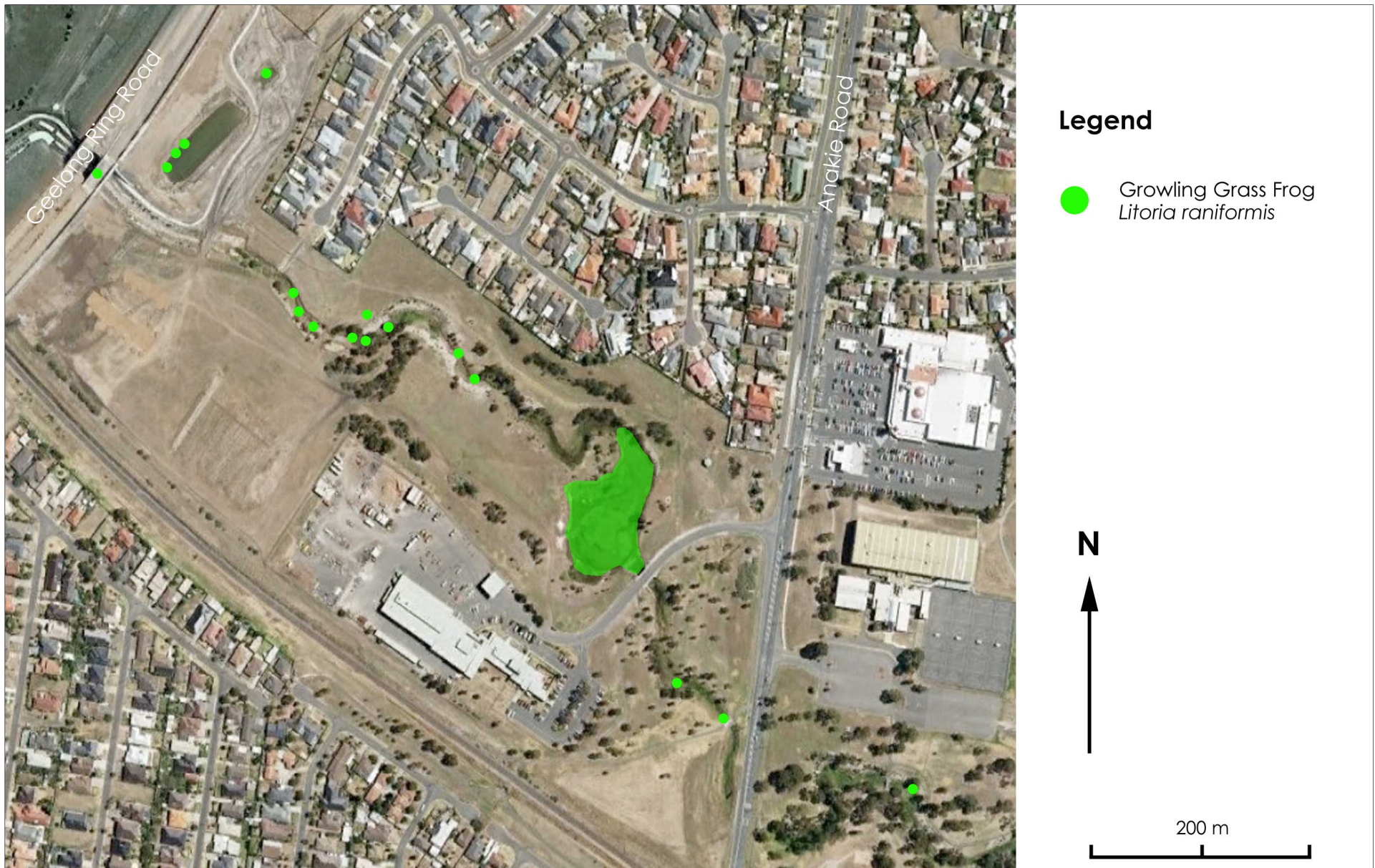


Figure 5 : Spotted Marsh Frog detected during the present assessment

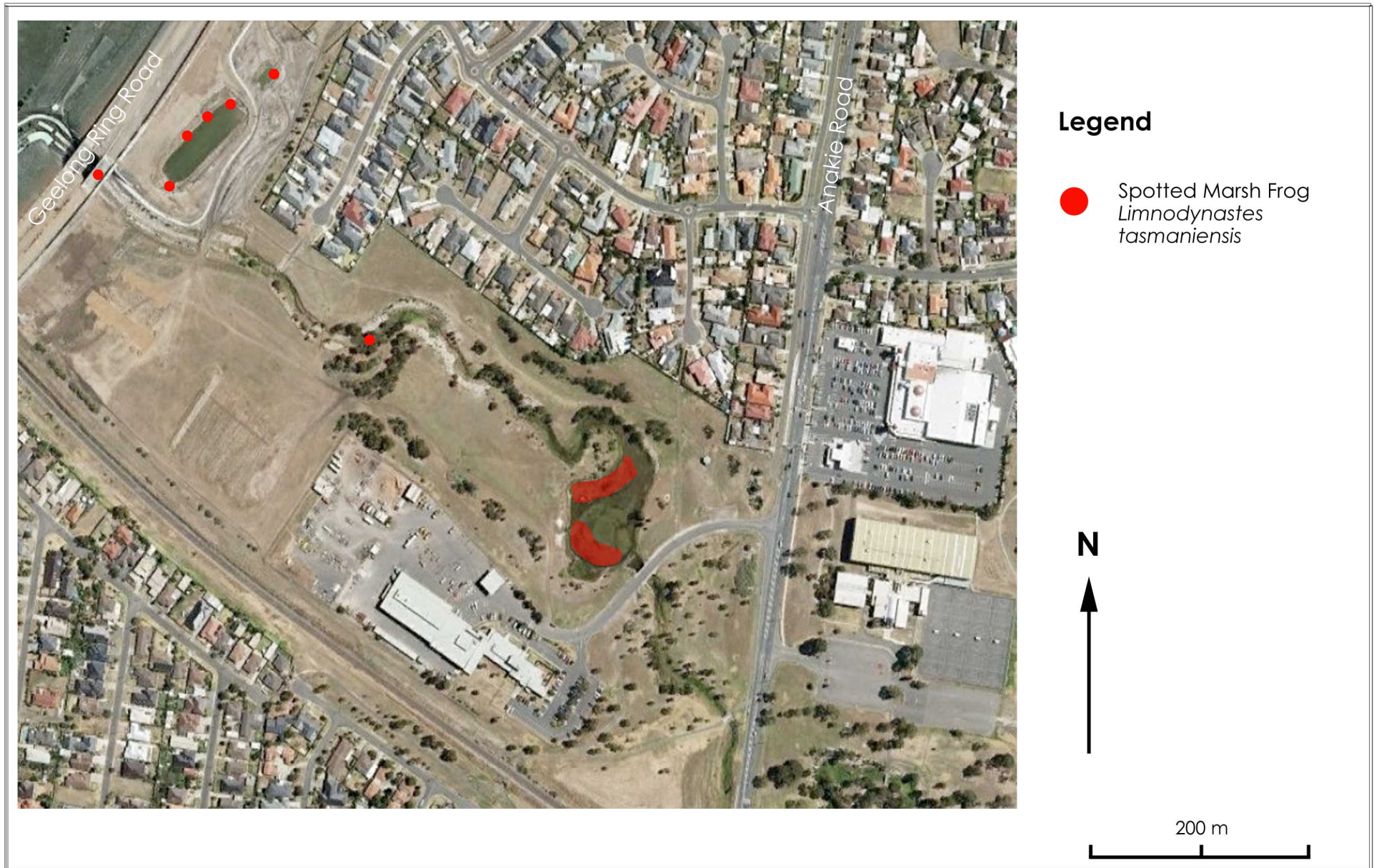
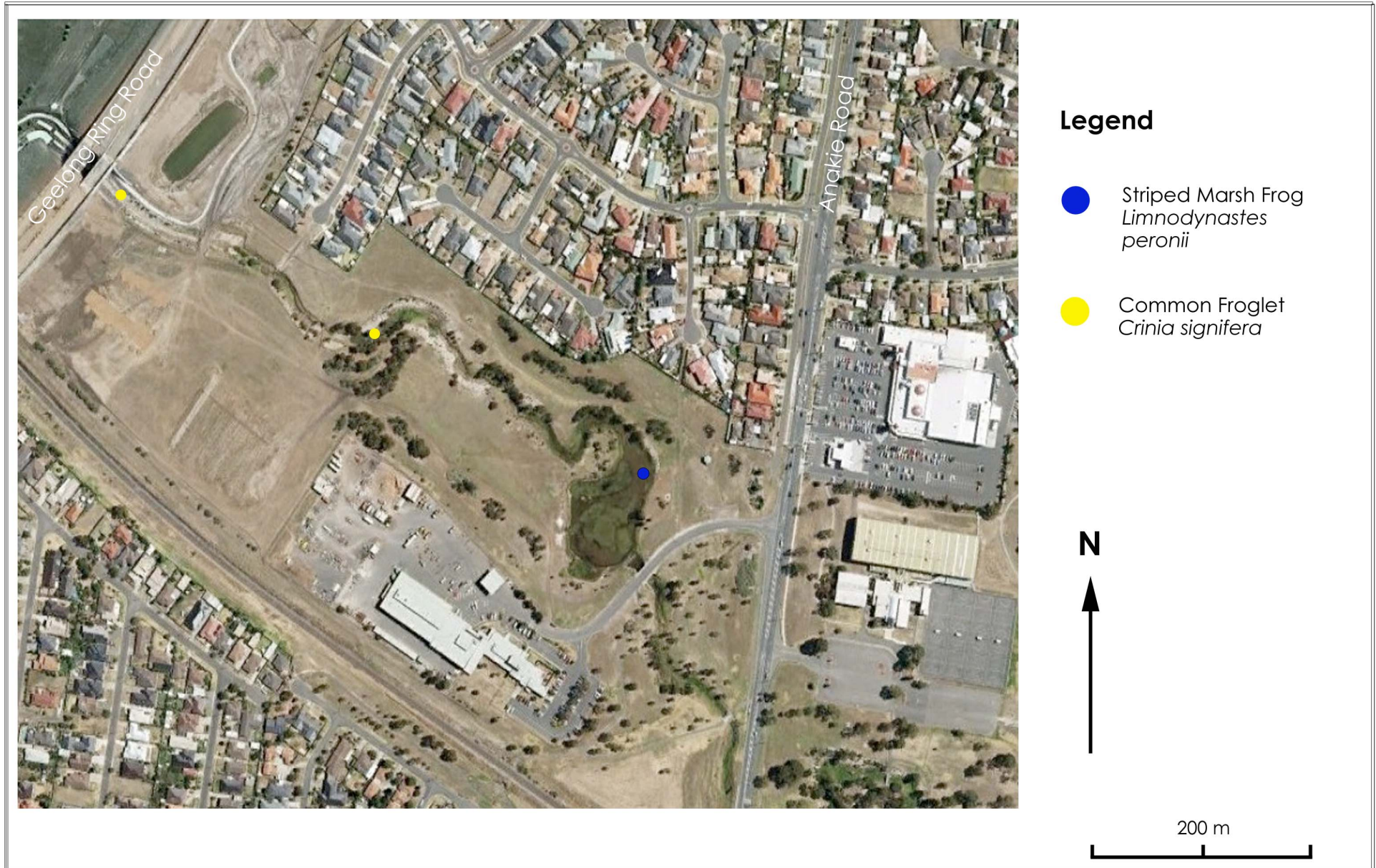


Figure 6 : Striped Marsh Frog and Common Froglet detected during the present assessment



## APPENDIX 1

### A1. Ecological Significance Assessment

Criteria used for defining site significance are listed below and are based on the *Standard Criteria for sites of Biological Significance in Victoria* (Amos 2004). Criteria for definitions of ecological significance are also provided.

#### Nationally Significant

**Sites are of national significance** if they support:

- Known habitat for nationally significant taxa listed as Critically Endangered or an important site for a taxon listed as Vulnerable or Conservation Dependent.
- Areas with unusually high native species richness, vegetation, habitat types or communities that are exceptional when compared to sites nationally.
- Corridors or habitat components that are important at a national scale. i.e. forms a link with nationally significant vegetation such as a National Park, and/or Ramsar Wetlands.
- Breeding sites, nesting or nursery or other sites where individuals aggregate for a defined part of their life cycle which comprises  $\geq 1\%$  of national breeding population of species.
- Areas regularly used by migratory taxon which is nationally threatened or  $\geq 1\%$  of world or national, population of taxon.
- Known or potential feeding sites of a nationally significant nomadic/migratory/mobile taxon within the known range of a taxon which is known to be reliant on defined dispersed feeding sites and where the taxon is nationally Critically Endangered, Endangered or Vulnerable.

**Species of national significance** are flora or fauna listed as Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable or Rare under the EPBC Act or under the relevant National Action Plan.

**Ecological Communities of national significance** are those listed as Critically Endangered, Endangered or Vulnerable under the EPBC Act

#### State Significant

**Sites are of state significance** if they support:

- Known habitat of a nationally significant taxon listed as Vulnerable, or Conservation Dependent.

- Areas that support, or regularly support individuals of a taxon or a community listed under the Flora and Fauna Guarantee Act 1988 or the DSE *Advisory List of Rare or Threatened plants* in Victoria (DSE 2005)
- Sites that contain vegetation which would have a vegetation significance rating of 'Very High' or 'High' if assessed using the DSE *Vegetation Quality Assessment Manual* (DSE 2004).
- Areas with unusually high native species richness, vegetation, habitat types or communities that are exceptional when compared to sites on a statewide basis.
- Corridors or habitat components that are important at a state scale. i.e. forms a link with state significant vegetation such as State Parks and/or Flora and Fauna Reserves.
- Known or potential feeding sites of a nomadic/migratory/mobile taxon within the known range of a taxon which is known to be reliant on defined dispersed feeding sites and where the taxon is state Endangered or Vulnerable or Data Deficient.
- Breeding sites, nesting or nursery or other sites where individuals aggregate for a defined part of their life cycle which comprises  $\geq 1\%$  of state breeding population of species.
- Areas regularly used by migratory taxon, which is threatened in Victoria, or  $\geq 1\%$  of State population of taxon.

**Species of state significance in Victoria** are flora or fauna listed as Extinct, Extinct in the Wild, Critically Endangered, Endangered, Vulnerable or Conservation Dependent in the *Advisory List of Rare or Threatened Plants* (DSE 2005), the *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE 2007b), or the *Advisory List of Threatened Invertebrate Fauna in Victoria* (DSE 2009b); species listed as Near Threatened, Conservation Dependent or Least Concern under the relevant National Action Plan; and/or species listed under the Victorian FFG Act).

**Ecological Communities of state significance in Victoria** are those listed as threatened under the FFG Act 1988

### Regionally Significant

**Sites are of regional significance** if they support:

- Sites that contain vegetation which would have a vegetation significance rating of 'Medium' if assessed under the DSE *Vegetation Quality Assessment Manual* (DSE 2004).
- Sites with unusually high native species richness, vegetation, habitat types or communities that are exceptional when compared to sites regionally.
- Corridors or habitat components that are important at a regional scale.

- Breeding sites, nesting or nursery or other sites where individuals aggregate for a defined part of their life cycle which comprises  $\geq 5\%$  of bioregional breeding population of species.
- Sites regularly used by migratory taxon, which is declining in the bioregion, or  $\geq 5\%$  of bioregional population of taxon.
- Known or potential feeding sites of a nomadic/migratory/mobile taxon within the known range of a taxon which is known to be reliant on defined dispersed feeding sites and where the taxon is regionally significant.

**Species of regional significance in the Victorian Volcanic Plain Bioregion** are flora or fauna species considered rare by the author; flora listed in any relevant regional Native Vegetation Plan, Victorian Environmental Assessment Council Reports; or fauna or listed as Near Threatened or Data Deficient in the *Advisory List of Threatened Vertebrate Fauna in Victoria* (DSE 2007b) or the *Advisory List of Threatened Invertebrate Fauna in Victoria* (DSE 2009b).

**Ecological Communities of regional significance in the Victorian Volcanic Plain Bioregion** are those listed as an Endangered, Vulnerable or depleted ecological vegetation class within a particular bioregion in the relevant catchment Native Vegetation Plan.

### Locally Significant

**Sites are of local significance** if they support:

- Sites that contain vegetation which would have a vegetation significance rating of 'Low' if assessed under the DSE Vegetation Quality Assessment Manual (DSE 2004).
- Known or potential feeding site of a nomadic/migratory/mobile taxon within the known range of a taxon which is known to be reliant on defined dispersed feeding sites and where the taxon utilises a feeding resource that is particularly limited in the local area
- Breeding sites, nesting or nursery or other sites where individuals aggregate for a defined part of their life cycle which comprises  $\geq 25\%$  of local breeding population of species.
- Sites regularly used by migratory taxon, which is locally declining, or  $\geq 25\%$  of local population of taxon.
- Corridors or habitat components that are important at a local scale.

All species and communities are considered locally significant due to the depletion of native flora and fauna throughout the Victorian Volcanic Plain.

## A2 Vegetation Condition Criteria

### **Good Condition**

Vegetation of good condition is likely to support a diverse range of native floristic and structural components. Cover of introduced species is likely to be low and relevant ecosystem processes likely to be intact.

### **Moderate Condition**

Vegetation of moderate condition is likely to support some range of floristic and structural components with greater than 25% cover of introduced species. Some ecosystem processes may be present or disrupted in some way.

### **Poor Condition**

Vegetation of poor condition is likely to be dominated by introduced species with a low presence of native floristic and structural components. Relevant ecosystem processes are likely to be absent.

## A3 Habitat Quality Criteria

### High Quality

Habitat of high quality is likely to be dominated by native flora species and supports relevant native structural features with few introduced flora species present. Habitat features present include ground debris such as litter, rocks, logs and intact ground cover as well as hollow bearing trees if relevant. The habitat supports, or is likely to support significant fauna species, and habitat links to other remnant ecosystems are intact.

High quality habitat for the Growling Grass Frog would include the presence of still or slow flowing wetland habitats (e.g. creeks and ponds) with extensive submerged and floating vegetation, as well as emergent and fringing aquatic vegetation. Ground debris, such as rocks and/or fallen timber, are likely to be present. Contiguous habitat with permanent and semi-permanent water bodies, with suitable well vegetated dispersal corridors and high to moderate water quality, are also important features of high quality habitat for this species (DEWHA 2010; DEWHA 2009b).

### Moderate Quality

Habitat of moderate quality supports some native floristic and structural component, however introduced species may be prevalent in some areas. Some habitat elements such as ground debris and hollow bearing trees may be present. The area supports potential habitat for significant species and some form of habitat links with remnant ecosystems may be present.

For the Growling Grass Frog, moderate quality habitat is likely to have a moderate cover of native aquatic vegetation, some isolation of permanent and semi-permanent water bodies, with some habitat linkages present. There is also likely to be a low to moderate cover of rocks and/or fallen timber. Some disturbance is likely to be evident, including weed invasion and moderate water quality.

### Low Quality

Habitat of low quality is likely to be dominated by introduced flora species and support few native floristic and structural components. Habitat elements such as ground debris and tree bearing hollows are likely to be absent. The area is unlikely to support or there is no suitable habitat for any significant fauna species and habitat links to other remnant ecosystems are likely to be absent.

For the Growling Grass Frog, low quality habitat is likely to consist of isolated wetlands with little or no aquatic vegetation, poor linkages between wetland habitats, poor water quality and the lack of permanent water bodies or other suitable breeding wetlands. The presence of predators (e.g. introduced fish predators) may also reduce the habitat quality of a water body.

## APPENDIX 2

### Table A2: Previous Records of Frog Species from within 10 kilometres of the Study Area.

**Table A2.** Previous records of frog species from within 10 kilometres of the study area.

COMMON NAME	SCIENTIFIC NAME	LATITUDE	LONGITUDE	DATE OF RECORD	LOCATION
Growling Grass Frog	<i>Litoria raniformis</i>	38°10'59"S	144°21'00"E	8-Sep-67	Belmont
Growling Grass Frog	<i>Litoria raniformis</i>	38°09'54"S	144°21'04"E	4-Dec-59	Koroit Creek, Geelong
Growling Grass Frog	<i>Litoria raniformis</i>	38°09'54"S	144°21'04"E	-	Koroit Creek, Geelong
Growling Grass Frog	<i>Litoria raniformis</i>	38°09'54"S	144°21'04"E	-	Koroit Creek, Geelong
Growling Grass Frog	<i>Litoria raniformis</i>	38°10'07"S	144°20'53"E	15-Oct-95	Belmont Common swamp, Geelong
Growling Grass Frog	<i>Litoria raniformis</i>	38°10'07"S	144°20'53"E	17-Oct-95	Belmont Common swamp, Geelong
Growling Grass Frog*	<i>Litoria raniformis</i>	38° 5'25.76"S	144°20'1.05"E	15-Jun-09	Cowies Creek Wetland
Growling Grass Frog*	<i>Litoria raniformis</i>	38° 5'25.76"S	144°20'1.05"E	29-Jun-09	Cowies Creek Wetland
Growling Grass Frog#	<i>Litoria raniformis</i>	38°10'34.35"S	144°21'16.23"E	2-Dec-09	Jerringot Wetlands
Growling Grass Frog#	<i>Litoria raniformis</i>	38° 5'25.76"S	144°20'1.05"E	2-Dec-09	Cowies Creek Wetland
Growling Grass Frog#	<i>Litoria raniformis</i>	38°10'35.11"S	144°21'15.24"E	15-Dec-09	Jerringot Wetlands
Growling Grass Frog#	<i>Litoria raniformis</i>	38°10'36.63"S	144°21'15.87"E	20-Dec-09	Jerringot Wetlands
Common Froglet	<i>Crinia signifera</i>	38°03'50"S	144°12'51"E	06-Jul-1889	
Common Froglet	<i>Crinia signifera</i>	38°10'07"S	144°20'53"E	3-Apr-81	Belmont Common swamp, Geelong
Common Froglet	<i>Crinia signifera</i>	38°10'17"S	144°21'22"E	7-Jul-89	
Common Froglet	<i>Crinia signifera</i>	38°02'04"S	144°24'24"E	10-May-90	
Common Froglet	<i>Crinia signifera</i>	38°01'32"S	144°24'04"E	10-May-90	
Common Froglet	<i>Crinia signifera</i>	38°10'07"S	144°20'53"E	28-Sep-91	Belmont Common swamp, Geelong
Common Froglet	<i>Crinia signifera</i>	38°10'12"S	144°21'02"E	4-May-92	Belmont Common Wetland

COMMON NAME	SCIENTIFIC NAME	LATITUDE	LONGITUDE	DATE OF RECORD	LOCATION
Common Froglet	<i>Crinia signifera</i>	38°10'07"S	144°20'53"E	15-Oct-95	Belmont Common swamp, Geelong
Common Froglet	<i>Crinia signifera</i>	38°10'07"S	144°20'53"E	17-Oct-95	Belmont Common swamp, Geelong
Common Froglet	<i>Crinia signifera</i>	38°10'07"S	144°20'53"E	10-Sep-96	Belmont Common swamp, Geelong
Common Froglet	<i>Crinia signifera</i>	38°08'59"S	144°26'05"E	1-May-98	Aloca Revegetation site
Common Froglet	<i>Crinia signifera</i>	38°10'38"S	144°21'17"E	19-Sep-00	Belmont Common swamp, Geelong
Common Froglet	<i>Crinia signifera</i>	38°11'07"S	144°22'01"E	26-Jul-02	Waurm Ponds Creek, Belmont
Common Froglet	<i>Crinia signifera</i>	38°10'38"S	144°21'17"E	11-Aug-02	Belmont Common swamp, Geelong
Common Froglet*	<i>Crinia signifera</i>	38° 5'23.05"S	144°19'58.70"E	15-Jun-09	Cowies Creek
Common Froglet^	<i>Crinia signifera</i>	38° 5'52.60"S	144°20'58.87"E	7-Aug-09	Site 14 Cowies Creek
Common Froglet#	<i>Crinia signifera</i>	38°10'25.38"S	144°21'12.64"E	2-Dec-09	Jerringot Wetlands
Common Froglet#	<i>Crinia signifera</i>	38°10'25.38"S	144°21'12.64"E	15-Dec-09	Jerringot Wetlands
Common Froglet#	<i>Crinia signifera</i>	38°10'25.38"S	144°21'12.64"E	20-Dec-09	Jerringot Wetlands
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'54"S	144°15'04"E	19-Oct-62	11.2 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Common Spadefoot Toad	<i>Neobatrachus sudelli</i>	38°01'54"S	144°15'04"E	19-Oct-62	14.4 km S. of Anakie

COMMON NAME	SCIENTIFIC NAME	LATITUDE	LONGITUDE	DATE OF RECORD	LOCATION
Southern Brown Tree Frog	<i>Litoria ewingii</i>	38°08'59"S	144°26'05"E	1-May-98	Alcoa Revegetation site
Southern Brown Tree Frog*	<i>Litoria ewingi</i>	38° 5'23.79"S	144°19'59.17"E	30-Jun-09	Cowies Creek
Southern Brown Tree Frog#	<i>Litoria ewingi</i>	38°10'34.35"S	144°21'16.23"E	20-Dec-09	Jerringot Wetlands
Spotted Marsh Frog SCR	<i>Limnodynastes tasmaniensis SCR</i>	38°03'50"S	144°12'51"E	06-Jul-1889	
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38°00'00"S	144°15'00"E	19-Oct-62	9.6 km S. of Anakie
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38°10'07"S	144°20'53"E	15-Oct-95	Belmont Common swamp, Geelong
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38°10'07"S	144°20'53"E	17-Oct-95	Belmont Common swamp, Geelong
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38°10'07"S	144°20'53"E	10-Sep-96	Belmont Common swamp, Geelong
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38°08'19"S	144°25'38"E	8-Apr-98	Alcoa Wetlands
Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38°08'19"S	144°25'38"E	8-Apr-98	Alcoa Wetlands
Spotted Marsh Frog#	<i>Limnodynastes tasmaniensis</i>	38°10'34.35"S	144°21'16.23"E	15-Dec-09	Jerringot Wetlands
Spotted Marsh Frog#	<i>Limnodynastes tasmaniensis</i>	38°10'34.35"S	144°21'16.23"E	20-Dec-09	Jerringot Wetlands
Striped Marsh Frog	<i>Limnodynastes peronii</i>	38°10'07"S	144°20'53"E	15-Oct-95	Belmont Common swamp, Geelong
Striped Marsh Frog	<i>Limnodynastes peronii</i>	38°10'07"S	144°20'53"E	17-Oct-95	Belmont Common swamp, Geelong
Striped Marsh Frog	<i>Limnodynastes peronii</i>	38°10'07"S	144°20'53"E	10-Sep-96	Belmont Common swamp, Geelong

Sources: Atlas of Victorian Wildlife; \* Hynes and Aboltins 2009; ^ Veltheim 2009; # Aboltins 2010

## APPENDIX 3

### Table A3: Frog Species Recorded in the Study Area during the Present Assessment.

**Table A3.** Frog species detected during the present assessment (21<sup>st</sup> – 22<sup>nd</sup>, 29<sup>th</sup> – 30<sup>th</sup> December 2009 and 6<sup>th</sup> – 7<sup>th</sup> January 2010).

SURVEY SITE	DATE	SURVEY NO.	COMMON NAME	SCIENTIFIC NAME	LATITUDE	LONGITUDE	SEEN/HEARD	NUMBER SEEN/HEARD
1 - Ring Road	21/12/09	1	Common Froglet	<i>Crinia signifera</i>	38° 5'17.14"S	144°19'43.39"E	H	1 adult male
	7/1/10	3	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'16.52"S	144°19'42.48"E	S	3 juveniles
	21/12/09	1	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'16.52"S	144°19'42.48"E	S	1 adult male
	29/12/09	2	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'16.52"S	144°19'42.48"E	S	1 adult male
	7/1/10	3	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'16.52"S	144°19'42.48"E	S	1 adult
2a - Dam	21/12/09	1	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'15.69"S	144°19'45.63"E	S	1 adult
	29/12/09	2	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'15.93"S	144°19'45.35"E	S	1 subadult
	7/1/10	3	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'16.36"S	144°19'45.05"E	S	2 metamorphs
	21/12/09	1	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'14.61"S	144°19'47.39"E	S & H	5 adults seen, 7 heard
	29/12/09	2	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'15.51"S	144°19'45.81"E	S & H	1 adult seen, 4 heard
	7/1/10	3	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'14.97"S	144°19'46.53"E	S & H	2 adults seen, 1 metamorph seen, 1 heard
	29/12/09	2	Unidentified tadpole	<i>Limnodynastes/Litoria sp.</i>	38° 5'14.97"S	144°19'46.53"E	S	1 tadpole

SURVEY SITE	DATE	SURVEY NO.	COMMON NAME	SCIENTIFIC NAME	LATITUDE	LONGITUDE	SEEN/ HEARD	NUMBER SEEN/HEARD
2b - Dam	7/1/10	3	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'13.80"S	144°19'48.66"E	S	1 juvenile
	7/1/10	3	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'13.83"S	144°19'48.99"E	S	1 adult
3 - Creek	21/12/09	1	Common Froglet	<i>Crinia signifera</i>	38° 5'20.80"S	144°19'52.65"E	H	10+ adult males
	21/12/09	1	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'20.88"S	144°19'51.03"E	S	4 adults, 1 juvenile
	29/12/09	2	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'20.14"S	144°19'49.81"E	S	5 adults
	7/1/10	3	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'20.86"S	144°19'51.79"E	S	5 adults
	7/1/10	*	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'20.56"S	144°19'53.09"E	S	2 juveniles
	21/12/09	1	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'20.94"S	144°19'52.43"E	H	2 adult males
4 - Creek	7/1/10	3	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'21.98"S	144°19'56.22"E	S	2 adults
5 - Wetland	21/12/09	1	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'25.44"S	144°20'1.25"E	S & H	47 adults seen, 5 heard, 2 metamorphs seen
	29/12/09	2	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'25.44"S	144°20'1.25"E	S & H	41 adults seen, 6 heard, 2 juveniles seen
	7/1/10	3	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'25.44"S	144°20'1.25"E	S & H	40 seen, 5 heard
	7/1/10	*	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'25.44"S	144°20'1.25"E	S	2 juveniles
	21/12/09	1	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'25.44"S	144°20'1.25"E	S & H	1 seen, 10+ heard
	29/12/09	2	Spotted Marsh Frog	<i>Limnodynastes tasmaniensis</i>	38° 5'25.44"S	144°20'1.25"E	H	8 adult male
	29/12/09	2	Striped Marsh Frog	<i>Limnodynastes peronii</i>	38° 5'24.56"S	144°20'2.41"E	H	1 adult male
6 - Creek	21/12/09	1	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'30.02"S	144°20'3.60"E	S	1 adult, 1

SURVEY SITE	DATE	SURVEY NO.	COMMON NAME	SCIENTIFIC NAME	LATITUDE	LONGITUDE	SEEN/ HEARD	NUMBER SEEN/HEARD
	29/12/09	2	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'30.95"S	144°20'5.33"E	S	1 juvenile
	7/1/10	*	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'30.95"S	144°20'5.33"E	S	5 juveniles
7 - Creek	30/12/09	2	Growling Grass Frog	<i>Litoria raniformis</i>	38° 5'32.85"S	144°20'12.20"E	S	1 subadult/ adult

\*Frogs observed during daytime habitat assessment

## APPENDIX 4

### Table A4: Weather Conditions During Spotlight Surveys

**Table A4.** Weather conditions within the study area during spotlighting surveys December 2009 - January 2010.

Date	Survey Start/End Time	Temp (°C)	Dew Point (°C)	Relative Humidity (%)	Wind Direction	Wind Speed (km/h)	Rain (mm)	Moon	Cloud
21/12/09	Start 11:20pm	15.5	13.0	85	S	7	0	Not bright	None
22/12/09	End 1:10am	14.6	13.0	90	SW	11	0	Not bright	None
22/12/09	Start 9:50pm	15.8	12.5	81	SSE	11	0	Not bright	Little-none
23/12/09	End 2:50am	13.4	11.6	89	NW	6	0	Not bright	Little-none
29/12/09	Start 10:00pm	15.6	12.4	81	S	11	0	Bright	None
30/12/09	End 1:05am	16.8	14.4	86	SSE	13	0	Not visible	Overcast
30/12/09	Start 10:10pm	27.1	15.8	50	NE	11	0	Bright	None
31/12/09	End 2:00am	20.4	13.4	64	ENE	9	0	Bright	None
6/1/10	Start 10:30pm	15.2	9.6	69	S	13	0	Not risen	Light
7/1/10	End 1:30am	12.4	8.7	78	WNW	6	0	Bright	None
7/1/10	Start 10:30pm	14.6	10.2	75	S	11	0	Not risen	None
8/1/10	End 2:10am	12.5	9.9	84	WNW	11	0	Medium-bright	None

Sources: Weatherzone ([www.weatherzone.com.au](http://www.weatherzone.com.au)); Field observations

## APPENDIX 5

### Table A5: Indigenous Planting List for Cowies Creek

Adapted from 'Constructed Wetland Systems: Design Guidelines for Developers' (Melbourne Water 2005 - available online). Please note that this is a preliminary list of suitable plants. Other locally indigenous plants could also be used. Section 5 Recommendations should be referred to when considering any revegetation works. Further guidelines can be found in Melbourne Water 2005.

SCIENTIFIC NAME	COMMON NAME
<b>WITHIN DAM/WATER</b>	
<i>Eleocharis sphacelata</i>	Tall Spike-sedge
<i>Glyceria australis</i>	Australian Sweet-grass
<i>Marsilea drummondii</i>	Common Nardoo
<i>Myriophyllum caput-medusea</i>	Coarse Water-milfoil
<i>Potamogeton tricarinatus</i>	Floating Pondweed
<i>Potamogeton ochreatus</i>	Blunt Pondweed
<i>Schoenoplectus tabernaemontani</i>	River Club-sedge
<i>Triglochin procerum</i>	Common Water-ribbons
<i>Vallisneria americana</i>	Ribbon-weed
<b>AT EDGE OF WATER</b>	
<i>Amphibromus nervosus</i>	Common Swamp Wallaby-grass
<i>Bolboschoenus caldwellii</i>	Salt Club-sedge
<i>Craspedia paludicola</i>	Swamp Billy-buttons
<i>Crassula helmsii</i>	Swamp Crassula
<i>Eleocharis acuta</i>	Common Spike-sedge
<i>Eleocharis pusilla</i>	Small Spike-sedge
<i>Eryngium vesiculosum</i>	Prickfoot
<i>Glyceria australis</i>	Australian Sweet-grass
<i>Lobelia pratensis</i>	Poison Lobelia
<i>Lycopus australis</i>	Gypsywort
<i>Neopaxia australasica</i>	White Purslane
<i>Myriophyllum crispatum</i>	Upright Water-milfoil
<i>Myriophyllum simulans</i>	Amphibious Water-milfoil
<i>Persicaria praetermissa</i>	Spotted Knotweed
<i>Persicaria decipiens</i>	Slender Knotweed
<i>Ranunculus inundatus</i>	River Buttercup
<i>Stellaria angustifolia</i>	Swamp Starwort
<b>ON EMBANKMENT</b>	
<i>Acaena novae-zelandiae</i>	Bidgee-widgee
<i>Agrostis avenacea</i>	Common Blown-grass
<i>Agrostis punicia</i>	Gilgai Blown-grass
<i>Calystegia sepium</i>	Large Bindweed
<i>Carex appressa</i>	Tall Sedge
<i>Carex fascicularis</i>	Tassel Sedge
<i>Epilobium billardierianum</i>	Smooth Willow-herb
<i>Juncus amabilis</i>	Hollow Rush

SCIENTIFIC NAME	COMMON NAME
<i>Juncus flavidus</i>	Yellow Rush
<i>Juncus holoschoenus</i>	Joint-leaf Rush
<i>Juncus procerus</i>	Tall Rush
<i>Lomandra longifolia</i>	Spiny-headed Mat-rush
<i>Microlaena stipoides</i> var. <i>stipoides</i>	Weeping Grass
<i>Poa ensiformis</i>	Sword Tussock-grass
<i>Poa labillardierei</i>	Common Tussock-grass