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Growling Grass Frog, Natural Spring, and Bird Habitat Surveys for 35 Hams Road, Waurn Ponds

2015

Prepared for Australian Property Partnership

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FIGURES - *none*

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1. EXECUTIVE SUMMARY

Practical Ecology Pty Ltd was commissioned by Australian Property Partnership to undertake a targeted survey for the Growling Grass Frog (GGF) *Litoria raniformis* at 35 Hams Road Waurn Ponds. An assessment was also required to identify habitat suitability for the Wedge-tailed Eagle *Aquila audax* (WTE) and Swift Parrot *Lathamus discolour* (SP) and for the potential presence of a natural spring.

The survey is intended to address community concerns regarding a planned rezoning of the land while also guiding a decision on whether a referral is required for the threatened Growling Grass Frog (GGF) *Litoria raniformis* under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Three waterbodies were surveyed for the presence of the GGF and suitable habitat. No GGF were detected over two nights of surveys. One waterbody (WB1) provided no suitable habitat, while the two remaining and larger waterbodies (WB1 and WB2) provided low to moderate habitat quality for the GGF. Based on the extent and quality of habitat and connectivity to extant populations, the significance of these waterbodies to the GGF is low and a referral is unlikely to be required.

Although prey items (European Rabbits) for Wedge-tail Eagles were abundant across the site, the lack of records for the species in the local area and the scarcity of nearby suitable perch and nest trees limit the significance of the site to the species. There were no suitable blossom feeding trees for Swift Parrot observed within the site or in the surrounding land. On this basis it was determined that the site has no significance for this threatened species.

There was no definitive discovery of a natural spring source on the site, although this does not discount its presence. There would be value in investigating if a natural spring is located at or within waterbodies 1 or 2 as elevated water-levels may have been obscuring a natural spring during the time of survey.

Various management actions and design elements are recommended to conserve and

2. INTRODUCTION

Practical Ecology Pty Ltd was commissioned by Australian Property Partnership to undertake a targeted survey for the Growling Grass Frog (GGF) *Litoria raniformis* at 35 Hams Road Waurn Ponds. An assessment was also required to identify habitat suitability for the Wedge-tailed Eagle *Aquila audax* (WTE) and Swift Parrot *Lathamus discolour* (SP) and for the potential presence of a natural spring at the site.

The survey is in response to community concerns regarding planned amendments to land zoning for the site at 35 Hams Road Waurn Ponds under the Greater Geelong Planning Scheme Amendment C276. The Growling Grass Frog (GGF) *Litoria raniformis* survey was also commissioned to inform a decision on whether a referral under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) will be required. Under the Act an action must be referred to the Australian Government Department of Environment (DOE) if it '*has, will have or is likely to have a significant impact on the southern brown bandicoot*'.

2.1 Study area

The study site consists of two Lots: 35 Hams Road and 151-229 Anglesea Road, Waurn Ponds (Figure 1). The site is approximately 27 ha in area, is currently used for grazing and contains several internal fences, sheds and dams. A mix of native grassland and exotic pasture covers most of the property, with several areas containing weed infestations. The site falls within the Otway Plain bioregion.

2.2 Project Scope

The scope of work includes:

- *Conduct on-site survey capable of detecting the presence of Growling Grass Frogs. In the event that Growling Grass frogs are detected, outline the obligations on what is required in relation to Federal and State legislation. Provide an understanding of options and best practice ways of dealing with Growling Grass Frogs and their habitat on the site in relation to its proposed future use as a housing estate.*

- *Conduct on-site survey and other research if necessary to establish the presence of a natural spring. In the circumstance there is a natural spring, identify the implications on the urban development of the site including options for incorporation of the spring into the tributary buffer that runs through the site acknowledging best practice.*

- *There is suggestion from local residents there may be Wedge Tail Eagles and Swift Parrots frequenting the site. Identify the likelihood and impact of the presence of such species.*

Map 1. Study Site

Map 0. Field map

35 Hams Rd, Waurn Ponds

Legend

- Study site
- Waterway
- Contours (1m)
- Parcels

Details

Mapping by: Colin Broughton & Karen McGregor
Data Source: Aerial photography courtesy of NearMap

Version	1	Date	15/01/2015

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0 50 100 150 m

Scale 1:3,000 (Page size A3)

Disclaimer

Practical Ecology bears no responsibility for the accuracy and completeness of this information and any decisions or actions taken on the basis of the map. While information appears accurate at publication, nature and circumstances are constantly changing.

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3. METHODS

3.1 Growling Grass Frog

Nocturnal surveys for Growling Grass Frog were undertaken on the 20th and 29th January 2015.

The employed survey methods are consistent with recommendations by the Commonwealth Department of the Environment (DOE/DSEWPC) and the Victorian Department of Environment, Land, Water, and Planning (DELWP), formerly known as the Department of Environment and Primary Industries (DEPI) and the Department of Sustainability and Environment (DSE):

- DSEWPC (2009) *Significant impact guidelines for the vulnerable growling grass frog* (Litoria raniformis). Commonwealth of Australia.
- DSE (2010) *Biodiversity Precinct Structure Planning Kit*. Victorian Government Department of Sustainability and Environment Melbourne.

Surveys involved a combination of call playback, dip-netting for metamorphs and tadpoles, along with night time visual encounter surveys (for example as per Heard et al. 2006). Surveys targeted the three waterbodies and associated channels and drainage lines and covered a range of habitat types including: stream structures, wet depressions, farm ponds, dams and irrigation channels. The surveys were accompanied by habitat assessment conducted during daylight hours.

Reference was made to current research for Growling Grass Frog habitat assessments (Clemann et al. 2013: Heard et al 2013).

Best practice biosecurity protocols were used to prevent the spread of Chytrid fungus and other diseases.

3.1.1 Species Surveys

Growling Grass Frog surveys commenced approximately 30 minutes after sunset. Three (3) waterbodies were surveyed using a call playback to elicit a response by any resident adult male frogs. This was followed by quiet listening for several minutes.

The waterbodies were then searched on foot using two 50-watt spotlights to search for frogs on the banks, on floating vegetation, under rocks and logs, and in areas of emergent and fringing vegetation. The surrounding terrestrial habitat within 10 metres of the waterbody was also searched.

Active searching for metamorphs was conducted during nocturnal surveys at sites where suitable aquatic habitat occurred. Searches for tadpoles were undertaken using

a hand-held dip-net. Metamorphs and tadpoles were identified following available current keys (Anstis 2013). Successful recruitment was recorded at a waterbody if metamorphosing tadpoles or recently metamorphosed froglets were observed.

The time spent at each site was determined in reference to EPBC and DELWP guidelines and by the size of the wetland. All other incidental frog and other fauna species were recorded during the surveys. Survey tracks and call playback surveys were mapped using a hand held GPS in the field.

Weather Conditions

Temperature and general weather conditions were noted at the commencement and finish of each survey (Table 1). All waterbodies were surveyed twice in suitable conditions according to DSEWPC (2009) guidelines including warm and still weather conditions (minimum temperature recorded was 16 °C).

Table 1. Weather conditions during Growling Grass Frog surveys.

Date	Time (start)	Wind	Cloud	Temperature	Moon	Rain
20/02/2015	10.00 pm	1-6 km/hr	30-80%	18-20°C	1	nil
29/02/2015	9.45 pm	5-8 km/hr	60-80%	15-16°C	2	nil
Codes						
Moon	n/a; 0: No moon; 1: ¼ moon; 2: ½ moon; 3: ¾ moon; 4 Full Moon; 5: Moon					
Rain	0: Nil 1: Drizzle or light rain; 2: Rain; 3: Heavy Rain					

3.1.2 Habitat Assessments

Field surveys targeted areas that were identified as containing potential habitat for Growling Grass Frog. A Garmin 76 GPS hand held unit was used to accurately record the site locations.

Habitat attributes (Tyler 1989; Cogger 2000; Clemann & Gillespie 2004) assessed included:

- Wetland type and permanency (ephemeral farm dam, permanent/semi-permanent creekline or quarry lagoon);
- The presence of emergent, submergent and floating vegetation (for male calling platforms, sheltering and tadpole protection);
- The presence of fringing vegetation, rocks, and fallen timber (for basking and sheltering) within and adjacent to potential sites;

- Water quality, habitat quality, and the presence of exotic fish;
- Presence of cracking soils and fringing vegetation (for refuge and foraging); and
- Distance of survey sites to the nearest suitable waterbody (NB: this species is highly mobile and can move up to one kilometer within 24 hours (DEWHA 2009; Clemann & Gillespie 2004).

Note that water quality assessments were limited to a visual assessment of turbidity and indicators of eutrophication (nutrient enrichment) such as algal blooms. The latter is usually in response to the addition of phosphates, through detergents, fertilizers, or sewage, to an aquatic system.

3.2 Wedge-tail Eagle (WTE) and Swift Parrot (SP) habitat surveys

The site and adjacent land were assessed for the presence of suitable habitat for the WTE and SP. Wedge-tailed Eagle surveys involved assessing for the presence of suitable habitat for prey species, such as rabbits and other small mammals and reptiles, and also the presence of large trees for nesting.

Swift Parrot habitat surveys involved identifying significant eucalypt feeding trees for the species. Searches were undertaken within the site and adjacent land within 500m of the site boundary. The Swift Parrot is known to feed on Grey Box, White Box, Yellow Box, Ironbark and Yellow Gum. If these trees were detected, their locations were recorded with a handheld GPS unit.

3.3 Natural Spring

A survey for the Natural Spring Site was conducted within the site. Site examination was based on the assumption that a spring may occur either near the top end of the Armstrong Creek tributary, further to the north of the site (given the mapped location of this tributary extending to the west of the Princess Freeway (DEPI 2014)), or from points indicated by standing areas of water or drainage points. The survey was limited to assessing locations where a natural spring could be feeding permanent waterbodies or more permanent habitat for GGF and other flora and fauna.

Note that we are not qualified hydrologists or hydrogeologists so are unable to comment on the origins of a natural spring or provide definitive answers. We are only able to comment on whether there may be a water source that is creating more permanent suitable habitat for the GGF and other species than would normally otherwise occur. The potential impacts of urban development on the spring, and vice versa, would need to be considered by a hydrologist.

3.4 Taxonomy and Permits

Animal taxonomy is consistent with the DELWP's Atlas of Victorian Wildlife (DSE 2011b). Terrestrial fauna surveys for this current study were conducted under Wildlife and Small Institutions Animal Ethics Committee approval issued 10 September 2012 and DELWP

3.5 Mapping

Geographical positioning data collection in the field for the purposes of map display was carried out with a handheld GPS device. This was used to identify survey locations. Determination of waterbody and habitat boundaries was informed by a combination of GPS and ground-truthing with aerial/satellite imagery and marked on fieldmaps created for the project. Survey maps were then digitised and produced using ArcView ArcGIS (version 10.2).

3.6 Limitations

The timing of surveys was undertaken outside the optimal breeding period for GGF. Optimal breeding and calling season for GGF is between September and December and is usually triggered by rain events (DEWHA 2009). Detectability for this species may be somewhat reduced outside this period, particularly in areas where species numbers may be reduced and populations may have retracted over time. Nonetheless, surveys were conducted within the active period for GGF between November and March and designated survey period for 'temperate southern regions' under the EPBC significant impact guidelines (DEWHA 2009). High rainfall and low temeperatures for the area resulted in relatively high water levels being maintained in all the waterbodies in questions and high habitat availability. The waterbodies in question were also small in size and could be subject to a high active search effort.

4. RESULTS

For targeted Growling Grass Frog Surveys, a total of three waterbodies were surveyed and habitat assessments undertaken under suitable warm and calm conditions (Table 1). The extent of the existing drainage lines were mapped and incidental fauna records were also noted (APPENDIX 1, Map 2; APPENDIX 2, Table 5).

The site and adjacent land within 500m of the site boundary were inspected visually for the presence of significant habitat features and resources for the Wedge-tail Eagle and Swift Parrot.

The site was also surveyed on foot for a potential natural spring that may occur on the site.

4.1 Growling Grass Frog Survey

There were no Growling Grass Frogs detected by call or sight both within the study site or across the three waterbodies sampled.

Four other frog species and one eel species were recorded during the survey. Frog species detected included Common Froglet *Crinia signifera*, Banjo Frog *Limnodynastes dumerilii*, and Spotted Marsh Frog *Limnodynastes tasmaniensis* (Table 2). The Common Froglet and Spotted Marsh Frog were heard at all sites on at least one occasion, whereas the Banjo Frog was only recorded in Waterbodies 2 and 3.

The Spotted Marsh Frog were also visually observed calling (Plate 8) and foraging in Waterbody 2. Metamorphs and tadpoles of Spotted Marsh Frog were also observed in Waterbodies 2 and 3 and those of Common Froglet in waterbodies 1 and 2. Frog spawn (eggs) was observed (Plate 9) at all three waterbodies but was not particularly abundant. Other species observed included the Short-finned eel *Anguilla australis* and House Mouse *Mus musculus* in Waterbody 3 along with incidental nocturnal observations of Pacific Black Duck *Anas superciliosa*.

Table 2. Survey Results.

Date	Water body	Call playback	Spotlight	Dip-netting
20/01/2015	1	*Crinia signifera* x 20+ (calling) *L. tasmaniensis* x 2+ (calling)	Nil	*Crinia signifera* x 1 tadpole
	2	*Crinia signifera* x 100+ (calling) *L. tasmaniensis* x 20+ (calling)	*L. tasmaniensis* x 2	*L. tasmaniensis* x 2 tadpole

Date	Water body	Call playback	Spotlight	Dip-netting
		L. dumerilii x 2 (calling)		
	3	*Crinia signifera* x 5+ (calling) *L. tasmaniensis* x 20+ (calling) *L. dumerilii* x 5 (calling)	*L. dumerilii* x 1	Nil
29/01/2015	1	*Crinia signifera* x 10+ (calling)		
	2	*Crinia signifera* x 10+ (calling) *L. tasmaniensis* x 20+ (calling)		*L. tasmaniensis* x 1 tadpole
	3	*L. tasmaniensis* x 10+ (calling)	*Anguilla australis* x1 *Mus musculus* x 1	*L. tasmaniensis* x 4 tadpole

4.2 Growling Grass Frog Habitat Assessment

Three waterbodies were assessed against criteria for Growling Grass Frog habitat including the mapping and % cover estimates of different vegetation types (Map 3-Map 5). None of the existing drainage lines supported habitat for feeding or breeding, although they could function as movement corridors if the species were present.

A general description of each waterbody is provided below in Table 3.

Table 3. Waterbody description.

Waterbody	Type	Description
1	Depression	Small depression of shallow water measuring approximately 15 x 10 m and located at the western end of an observable watercourse. Mostly open water with some emergent vegetation and narrow band of fringing vegetation composed largely of grasses. Water quality poor with high sedimentation and bank pugging. Likely to be ephemeral. No fringing logs, dense tall grass, or rocks and disturbance from domestic stock.
2	Dam	Large dam located at western end of existing watercourse channel. The natural watercourse has been dammed allowing an open water body to develop. Water quality appeared to be moderate with no evidence of high nutrient inputs but moderate sedimentation. Narrow band of fringing and emergent (i.e. *Isolepis*) vegetation around main waterbody with higher cover in the western inlet section. Sparse but present submerged (Water-milfoil *Myriophyllum spp.*) and floating vegetation (Swamp Lily

Waterbody	Type	Description
		Ottelia ovafolia, Potamogeton *Potamogeton tricarinatus*). Little fringing vegetation and associated sheltering sites such as rocks, logs or dense grasses. Surrounded by low grazed pasture grass. Edge disturbance and pugging by domestic stock.
3	Pond	Pond at low point in study site at which water pools from a channel running north-south. Water comes from the north and exits the pool to the south-east. Very low water quality due to very high nutrient inputs as indicated by large algal blooms. Patchy fringing vegetation of rushes and sedges mixed with swards of exotic grasses. Abundant floating vegetation in the form of algal blooms and also some Ferny Azolla *Azolia pinnata* and Swamp Lily *Ottelia ovafolia*.

Although all three waterbodies were determined to have fairly similar habitat quality scores for Growling Grass Frog ranging from 1-3, there was considerable differences between each (Table 4).

Waterbody 1 would provide little utility for the species based on its small size, shallow bathymetry, potentially frequent ephemeral state, and absence of suitable fringing habitat and floating vegetation (Plate 1). The remaining waterbodies all supported still and permanent water preferred by the species (Plate 2 and Plate 5.)

Based on the percentage cover of different vegetation habitat components and scoring categories from Heard *et al.* (2010), Waterbody 3 would have the highest quality for the Growling Grass Frog, bordering on category 3 (Plate 6). This is principally due to the higher cover of submerged and floating vegetation (Plate 7) compared to Waterbody 2 (Plate 4). Deeper open water sections preferred by the species were only present in Waterbody 2 (Plate 3).

However, research is unsure on what effect the very poor water quality in Waterbody 3 may have on the quality of habitat for the GGF. Bankside disturbance and the absence of sheltering elements such fringing rocks, logs, or dense grass lower the utility of all these waterbodies for the GGF. None of the waterbodies supported large areas of suitable habitat. The low cropped pasture grasses across the site may also impede movement of animals from surrounding points and waterbodies in the landscape.

In regard to general fauna habitat quality, Waterbody 2 provides slightly greater current utility and quality. Water quality was visually assessed as moderate, there are open water sections, a gradient in water levels, and submerged and floating aquatic

vegetation. An abundance of aquatic insects were sampled from the waterbody and frog populations were large (based on calls). Interestingly, no exotic or native fish were sampled which suggests that periodic drying may occur (likely based on inspection of aerial photography) and that the waterbody is not connected to other catchments. Absence of exotic fish (particularly Mosquito Fish *Gambusia holbrooki*) improves the habitat suitability of all of the waterbodies.

However, waterbodies and wetland quality can vary greatly overtime in rapid response to external inputs (water, nutrients and disturbance pressures such as domestic stock). Comparisons to waterbody photographs taken in 2012 and early 2014 shows that vegetation and water quality has varied dramatically over time. Water quality has declined between 2012 and early 2014 (with drying conditions) and then improved in the current assessment. Water quality has declined significantly in waterbody 3 since 2012.

Table 4. Waterbody conditions and habitat assessment.

	Waterbody		
Physical Components	**1**	**2**	**3**
Waterbody type	Depression	Dam	Pond
Water depth	40 cm	+80 cm	+60cm
Permanence	Ephemeral	Permanent	Semi-Ephemeral
Water Flow	Still	Still	Still
Water Temp °C	20°C	19.8°C	19.1°C
Water Quality	Poor	Moderate	Very Poor
Habitat Components	**1**	**2**	**3**
Fringing Vegetation %	10	10	20
Emergent Vegetation %	20	20	20
Submerged Vegetation %	0	20	60
Floating Vegetation %	0	20	20
Open Water %	40	60	10
Dominant Plants	Grasses	Grasses, sedges, and rushes	Grasses, sedges, and rushes
Fringing Rocks	0	0	0
Fringing Logs	0	0	0
Frog eggs present	Yes	Yes	Yes
Mosquito Fish	No	No	No
Exotic fish	No	No	No
Native fish	No	No	No
Overall Quality	1	1-2	2-3

Codes	
Overall Quality	0=*no habitat present*; **1**=*30% Fringing;* ***2***=*30% Emergent + 30% submergent + AV aquatic cover=20%;* **3**=*30% Emergent + 50% submergent + 10% Floating + AV aquatic cover=30%*; **4**=*30% Emergent + 60% submergent + 30% Floating + AV aquatic cover=40%* (adapted from Heard *et al.* 2010). Note that the nearest match is applied. AV=total aquatic vegetation cover

Plate 1. Waterbody 1

Plate 2. Waterbody 2 (facing eastward)

Plate 3. Waterbody 2 (eastern end facing south)

Plate 4. Waterbody 2 (floating, submerged, and emergent vegetation)

Plate 5. Waterbody 3 (facing north-east)

Plate 6. Waterbody 3 (facing east)

Plate 7. Waterbody 3 (vegetation)

Plate 8. Spotted Marsh Frog vocalising in Waterbody 2

Plate 9. Frog spawn/eggs in Waterbody 2

4.3 Wedge-tail Eagle Habitat

Based on night-time and day-time surveys there is an abundance of prey within the site for the Wedge-tail Eagle. Large numbers of European Rabbits *Oryctolagus cuniculus* were detected during nocturnal surveys of the site and there was considerable evidence of high abundance through observations of warrens and pellets across the site during daylight surveys. Warrens were concentrated along the existing drainage line running east between Waterbody 1 and Waterbody 3. It was obvious that rabbits have been present on the site for a considerable period of time. Warren construction, rabbit diggings, and overgrazing has caused considerable environmental damage to the waterway. The embankment located south of Hams Rd and to the west of the site bordering the old quarry site was also noted to support large numbers of rabbits.

No Wedge-tail Eagles were observed during the course of the habitat surveys. There are no nesting or perch trees observed to be present on the site. A search of surrounding land revealed a similar lack of such trees, with strips of vegetation largely composed of young and small eucalypts and low shrubs with only a few larger eucalypts.

A small clump of moderate sized eucalypt and Cypress trees are present directly south of the site, on the southern boundary of the train line easement between Ghazeepore and Anglesea Roads. The bordering Anglesea Road to the west supports low and small sized tree and shrub not suitable for Wedge-tail Eagles for nesting, roosting, or feeding (Plate 10). The bordering Ghazeepore and Hams Roads also largely support small trees (mostly eucalypts) and low shrubs (Plate 11).

Plate 10. Vegetation along Anglesea Road to the south-west of the site.

Plate 11. Facing south along Ghazeepore Road.

A single moderate sized Sugar Gum *Eucalyptus cladocalyx* potentially suitable for feeding and resting is located near the south-east corner of the site on Ghazeepore Road (Plate 11). Another couple of larger trees are located approximately a further 400m along Ghazeepore Road from the study site.

4.4 Swift Parrot Habitat

No suitable feeding eucalypt species (Grey Box, White Box, Yellow Box, Ironbark, or Yellow Gum) were observed within the site or adjacent areas. Tree species were almost exclusively non-indigenous eucalypts and larger trees naturalised Sugar Gums. Other eucalypts include Allocasaurina, Corymbias, and Bloodwoods. Other eucalypts may provide suboptimal feeding and resting opportunities but these would not be considered significant for the species.

4.5 Natural Spring

No obvious natural spring source was located during the site assessment. All three of the existing waterbodies occur at low points in the site and surrounding landscape and are likely to receive from surface runoff or from existing drainage.

Waterbody 3 (Plate 5) is fed from the land to the north, draining directly south to form a tributary of Armstrong Creek, so there is no reason to believe a natural spring would be required to explain water inflow at this location. Also, considerable reduction in the extent of water was observed in comparing photographs taken in early 2014 and those from the current assessment one year later. The poor water quality was also highly indicative of nutrient-rich surface runoff from the urban catchment to the north.

Waterbodies 1 (Plate 1) and 2 (Plate 2) have no obvious source apart from being a low point in the surrounding landscape and being fed by surface runoff.

Earthworks have likely occurred at some point in the past to construct a dam wall around the eastern edges of Waterbody 2 and there is no obvious drainage line between this waterbody and Waterbody 3. There is an obvious drainage channel that arises suddenly to the east of Waterbody 1 and would likely direct water to Waterbody 2. Although infilling of the drainage line could have occurred west of Waterbody 1 the sudden occurrence of a deep drainage line suggests that a natural spring at Waterbody 1 could be present. However, inspection of satellite aerial imagery suggest this area experiences drying events.

Water quality at both Waterbodies 1 and 2 was also somewhat higher than would be expected if sourced from runoff from the surrounding landscape. However, a comparison of photos taken in 2012, 2014 and 2015 (current assessment) and those from satellite photos (Google Earth) show that water levels do vary over time across all waterbodies. However, a natural spring may ensure permanency.

5. DISCUSSION

The results of surveys and implications for legislative requirements and site management are discussed below. Best practice for future development of the site in relation to management of Growling Grass Frog habitat and other fauna is also discussed.

5.1.1 Growling Grass Frog

No Growling Grass Frogs (GGF) were detected over two nights of surveys using call playback, night time visual searches, and dip-netting for metamorphs and tadpoles. Considering this result it is unlikely the site supports a viable population of GGF.

The Growling Grass Frog generally requires permanent or largely-permanent still water bodies for reproduction, but has also been recorded breeding in ephemeral water bodies (Tyler 1997, Robertson et al. 2002). Water bodies inhabited by the species include slow-flowing streams with dense in-stream vegetation, disused quarry holes, swamps, ponds, farm dams, and areas which receive artificial flood-irrigation (Robertson *et al.* 2002). Growling Grass Frogs often inhabit water bodies with a diverse assemblage of aquatic vegetation and current research suggests that water bodies with extensive cover of aquatic vegetation (e.g. fringing, emergent and submergent), reasonable water quality and an absence of predatory fish are preferred by this species for breeding (Organ 2005).

Three waterbodies were surveyed for the presence of the GGF and suitable habitat. Based on these requirements and the results of habitat assessments, waterbody 1 represents low quality habitat and waterbodies 2 and 3 constitute habitat of low-moderate quality for the species. Comparisons to photos collected in previous years of Waterbodies 2 and 3 (2012 and 2014), illustrate the ephemeral nature of the waterbodies and wetland systems, particularly waterbody 3.

There are only two records of the species within 5km of the study site and both were made in 1982 on the grounds of Deakin University's Waurn Ponds campus. Several waterbodies are located to the west but all are associated with mining activities, are unvegetated and likely unsuitable for the GGF. There are scattered small un-vegetated dams in the surrounding landscape and 4 wetland/vegetated waterbodies within the grounds of Deakin University, 2km to the north of the site. Connectivity to these waterbodies is poor and overland dispersal of these distances unlikely. Recent surveys of lower reaches of Armstrong Creek and adjacent dams between Ghazepore Road and Surfcoast Highway detected no GGFs and lack of suitable habitat features (Aberton and McKinnon 2011).

Consequently, although habitat quality could improve, the general poor connectivity to known extant GGF populations or habitat and limited records (2) within the surrounding landscape, suggest that dispersal and recolonisation of the site would be unlikely. The site is not part of a known aquatic corridor nor contributes to the availability of waterbodies for an important population.

Based on these determinations, a referral is unlikely to be required for the threatened Growling Grass Frog (GGF) *Litoria raniformis* under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). As a precaution, pre-clearance checks (see Section 5.5.1) should be undertaken prior to any works occurring.

It is also important to note that the site supports large populations of several other frog species and provides habitat for native waterbirds and the Short-finned Eel along with an abundance of indigenous insect species. The site and associated waterbodies are of local significance to fauna.

5.2 Wedge-tail Eagle Habitat

Although prey items (i.e. rabbits) are abundant within the site and are the main prey item for Wedge-tailed Eagles (Brooker and Ridpath 1980), large numbers were also observed at locations nearby and they are likely to be a fairly abundant food resource in the surrounding landscape.

Once a prey item is captured by a WTE, they generally take rabbit-sized animals to a suitable perch-tree in which they can de-fur and consume the food and roost afterwards. In southern temperate regions, preferred perch and nest trees are larger sized eucalypts that can support their weight, have moderate canopy cover, and are rarely roadside trees (Marchant and Higgens 2007). The species is a shy nester and will desert nests if exposed to moderate levels of disturbance (Mooney and Holdsworth 1991). The absence of such larger trees in locations of low disturbance in the surrounding land for WTE to use for feeding (perching) or nesting, likely reduces the significance of the site to the WTE.

No records for Wedge-tail Eagle have been lodged within 5km of the study site although they are likely to be present within the general area. Based on the scarcity of perch or nest trees, few records, and likely sufficient food resources elsewhere in the surrounding landscape, the site is likely to have a low significance for the species.

5.3 Swift Parrot Habitat

There were no feeding blossom trees observed within the site or neighboring land for the Swift Parrot. Other eucalypt trees along bordering roadsides and property boundaries may provide resting opportunities for migrating birds. On this basis, the site was deemed to have no significance for the species.

5.4 Natural Spring

There was no definitive discovery of a natural spring source on the site, although this does not discount its presence. There would be value in investigating if a natural spring is located at/within waterbodies 1 or 2.

5.5 Management of GGF and Fauna Habitat

GGF habitat within the site can be conserved and enhanced through a number of management actions. These activities would also benefit other waterway-dependent fauna. These actions include:

- Fencing to exclude stock access and associated damage to wetland vegetation, banks, and buffer zones
- Storm water runoff treatment (particularly for waterbody 3) which could include:
    - Installing a sediment trap and constructed wetland according to Melbourne Water guidelines (Melbourne Water 2005, 2010) to treat water form urban areas to the north (Hams Road) prior to entering waterbody 3
    - Convert the existing eroded gully into a constructed wetland treating storm water runoff from the proposed housing estate prior to entering waterbodies.
- Maintain GGF habitat connectivity and dispersal opportunities by:
    - Reinstating the natural watercourse connection between waterbodies 2 and 3
    - Enhance the natural watercourse the Armstrong Creek tributary running from waterbody 3 to the site boundary at the intersection with the railway line

    - Ensure there are no barriers to dispersal

- Reduce the potential for the spread of Chytrid Fungus (a lethal pathogen of frogs, Berger *et al.* 1999) by implementing hygiene biosecurity protocols as described in New South Wales Parks and Wildlife Service (NPWS 2008) and DEH standards (DEH 2006) in the construction and post-construction phases.
- Do not apply herbicides or pesticides in or around wetland (i.e. buffer zones)
- Removal of weeds (Gorse, Kikuyu, Couch etc.) by methods safe to frogs and gradually replace with indigenous plants in buffer zones and wetlands
- Ensure there is a buffer zone (>20m width) around waterbodies/wetlands and limit disturbance and access along banks (e.g. pedestrians and domestic dogs) within this zone as GGF bask and call either from floating vegetation or from bank edges. Delineate boundary of buffer zone with bollard fencing
- Maintain the existing combination of open water, submerged/floating, emergent, and fringing vegetation in waterbodies and encourage more floating vegetation in waterbody 2
- Revegetate banks and buffer zones with indigenous vegetation of local provenance and reflecting appropriate EVCs
- Place fringing rock piles and logs around wetlands – adjacent to banks and in buffer zones – to provide additional sheltering and overwintering opportunities for GGFs
- Implement bank stabilisation measures along the existing drainage line
- Wetlands should be kept free of predator fish (Plague Minnow and non-native fish) – periodic drying will effectively manage this threat
- Water levels managed so that at least one waterbody at any one time has a water level of 0.5-2.0 m in depth
- Control rabbits (likely to occur as part of any development).
- Apply best practice sedimentation control (e.g. sediment fencing) and environmental best practice during and post-constructions including the use of sedimentation traps and barriers to limit sedimentation into waterbodies and Armstrong Creek catchment

- Maintain and facilitate the natural drying and wetting cycles of the wetlands/waterbodies – this facilitates more stable sediment fixation of contaminants (such as phosphorus and metals) in the substratum

To mitigate impacts on other fauna:

- Prior to any works within or draining of existing waterbodies, salvage of frogs should occur
- Implement controls for cats and foxes

5.5.1 Pre-clearance surveys and fauna salvage

- Pre-clearance surveys will be undertaken by suitably qualified zoologists prior to any works being undertaken. Surveys will commence 24 hours prior to works during the GGF active period between September and March and 48 hours prior to works commencing between April and August. Pre-clearance surveys will ascertain the presence and any location of GGF that may disperse into the site at a future time or be present not not detected by the current survey. These checks will guide salvage and supervision requirements pre- and during construction/clearance. They will involve day/night active searches and male call playback, active searches of all habitat proposed for removal or modification/disturbance (e.g. draining of waterbodies) and potential overwintering sites (rocks etc)
- Salvage of all other frogs will be required for any works within or adjacxent ot exiusting waterbodies that could have an impact such as bank works or draining or modifications of water inputs. All works will be supervised by a suitablky qulaified zoologist.

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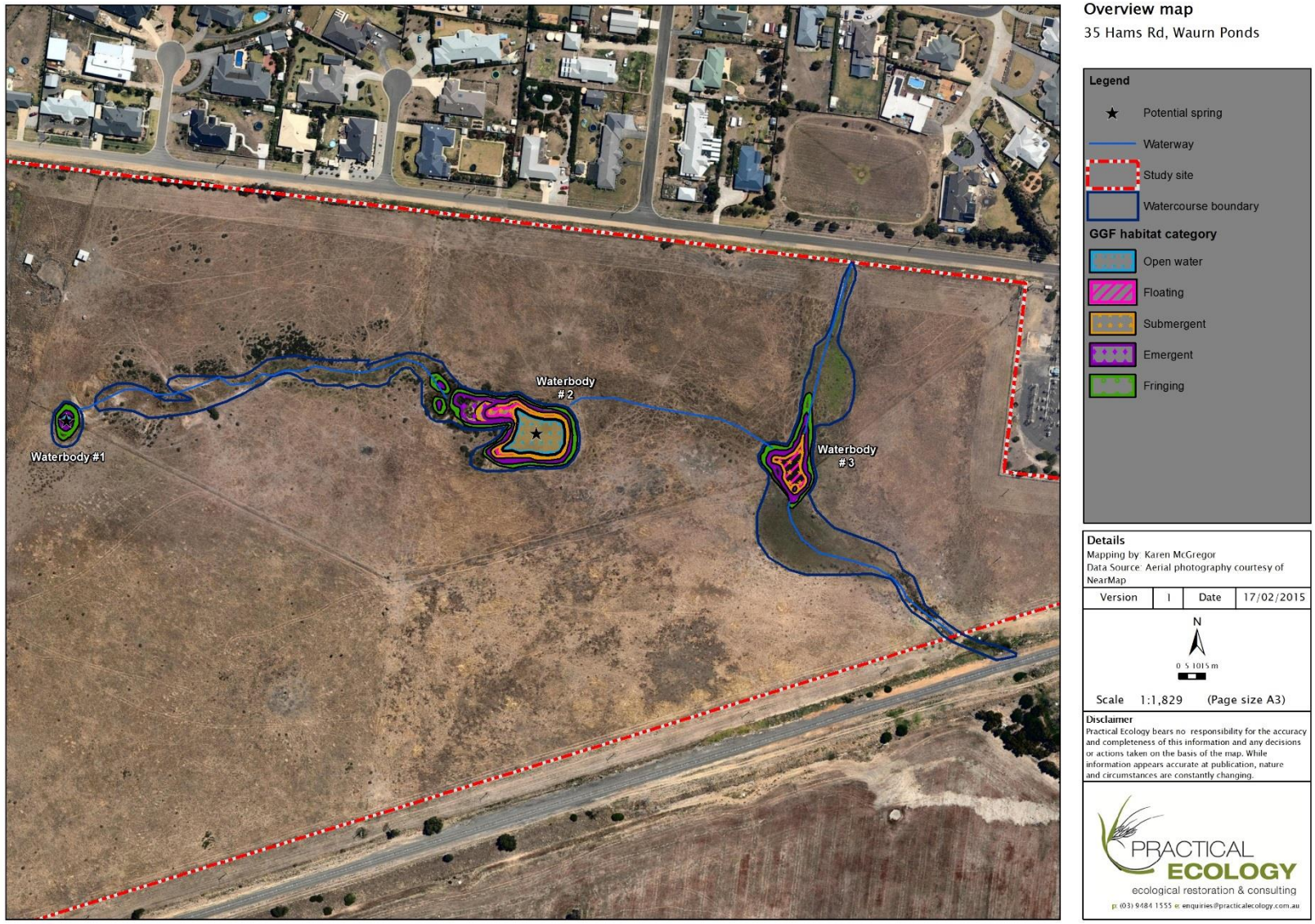
APPENDIX 1. Maps

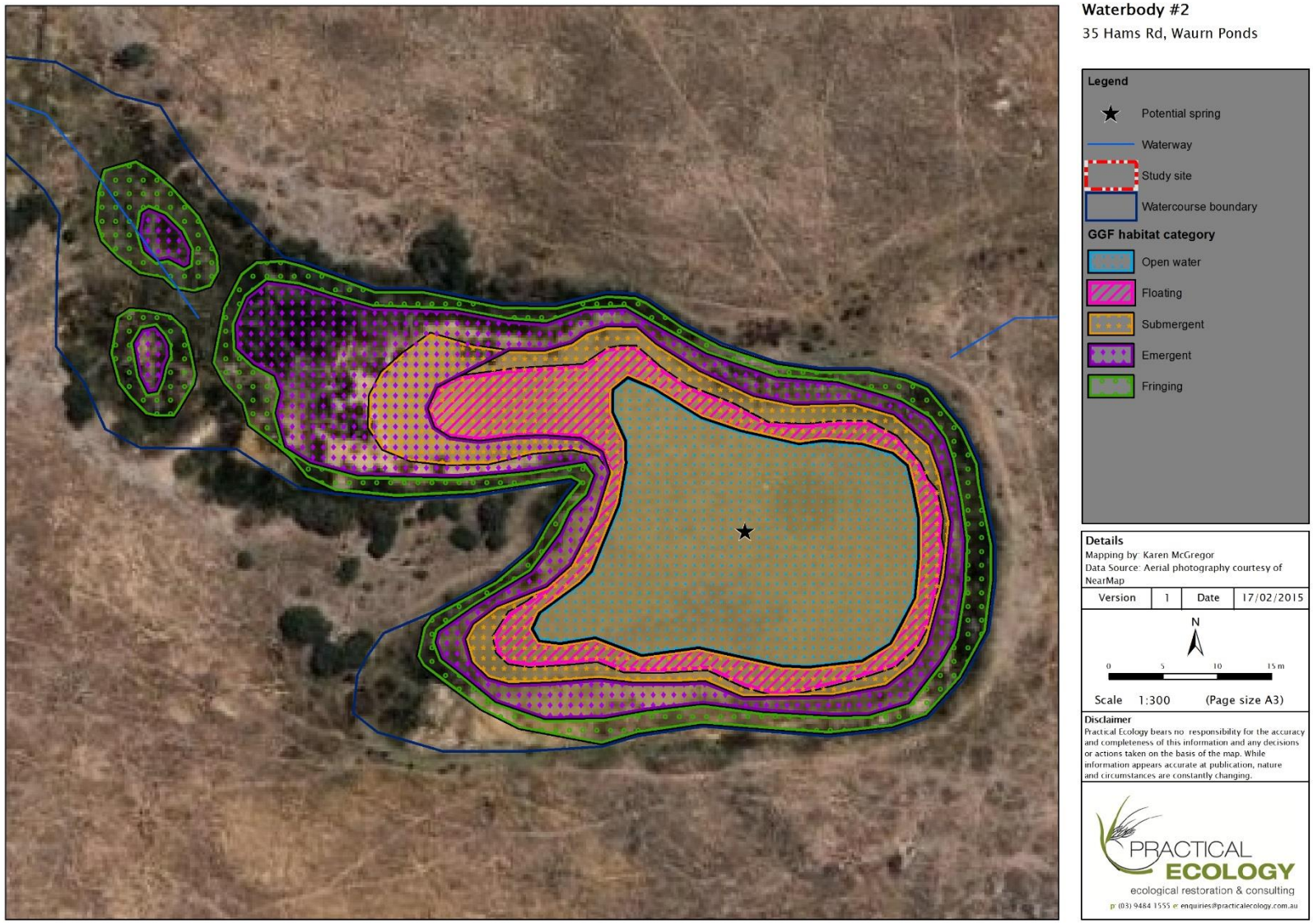
See Maps over page .

Map 2. Site overview, waterway boundary, and potential natural spring sources

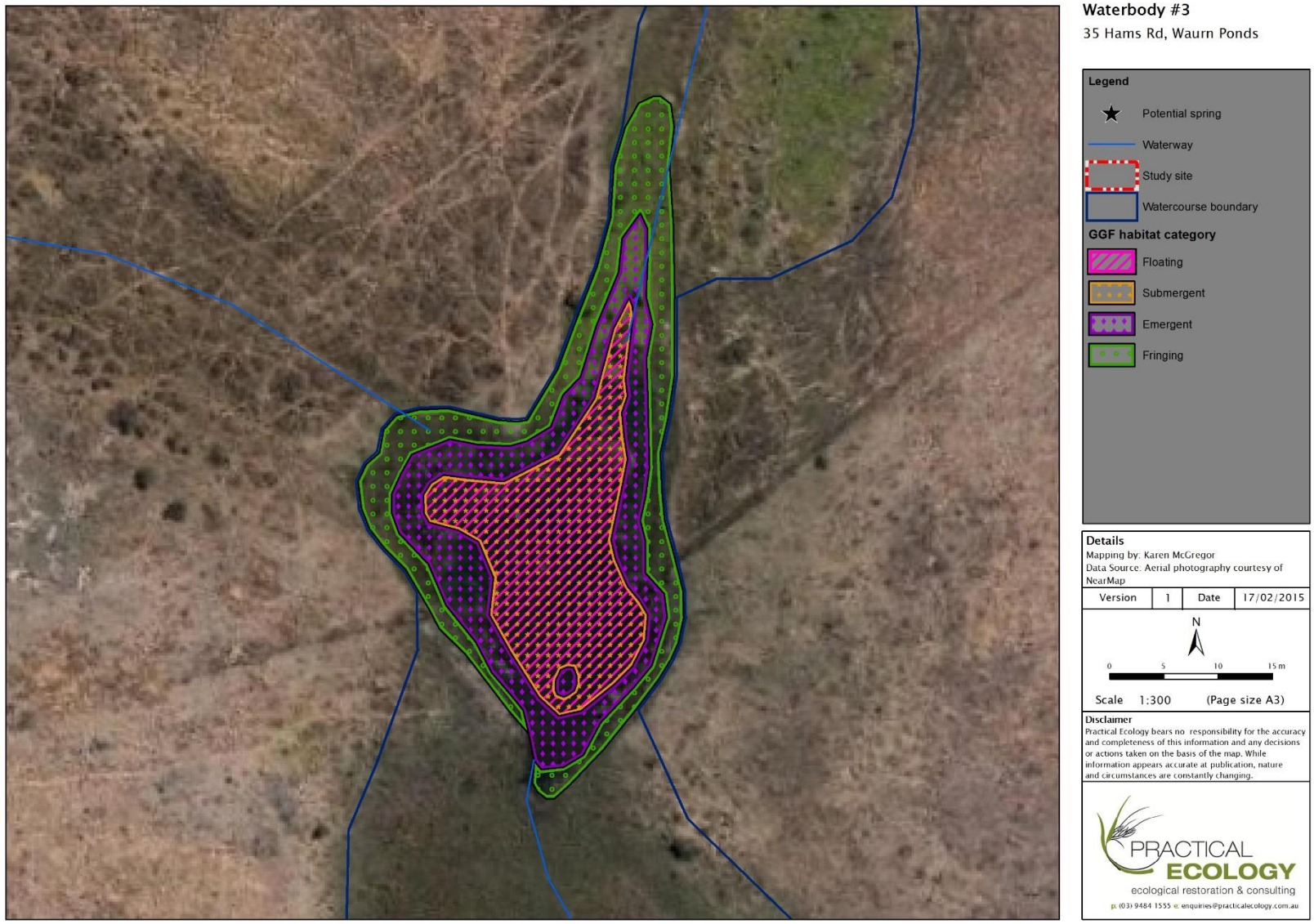


Map 3. Growling Grass Frog Habitat Assessment: Waterbody 1

Map 4. Growling Grass Frog Habitat Assessment: Waterbody 2



Map 5. Growling Grass Frog Habitat Assessment: Waterbody 3



APPENDIX 2. Incidental Fauna Records

Table 5. Incidental fauna records.

Common Name	Type of Observation	Location
Australian Magpie	Visual	Pasture
*Common Myna	Visual	Pasture
*Common Starling	Visual	Pasture
*European Goldfinch	Visual	WB 2 and 3
*European Rabbit	Visual	Pasture
Australasian Grebe	Visual	WB 3
Banjo Frog	Calling	WB 3
Common Froglet	Calling	WB 1 and 2
Crested Pigeon	Visual	Pasture
Damselfly (Odonata) nymph	Visual	WB 2 and 3
Dragonfly (Odonata) nymph	Visual	WB 2 and 3
Little Corella	Visual	Flyover
Little Raven	Visual	Flyover
Magpie-lark	Visual	Pasture
New Holland Honeyeater	Visual/Call	Adjacent land
Pacific Black Duck	Visual	WB 2 and 3
Rainbow Lorikeet	Visual	Flyover
Red-rumped Parrot	Visual/Call	Pasture
Red Wattle Bird	Visual	Adjacent land
Short-finned Eel	Visual	WB 3
Spotted Marsh Frog	Calling	1 and 3
Superb Fairy-wren	Visual	Pasture
Welcome Swallow	Visual	Pasture
White-faced Heron	Visual	WB 3
Yellow-tailed Black Cockatoo	Visual	Flyover
WB=Waterbody		