Growling Grass Frog Habitat Assessment and Mapping: PSP 25.1 and PSP 25.2, Craigieburn

Project: 13-035

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1 Introduction

Ecology Australia was commissioned by the Growth Areas Authority in May 2013 to undertake habitat assessment and mapping, and to subsequently develop a Concept Plan, for the Growling Grass Frog *Litoria raniformis* within the Craigieburn Employment Area North and English Street Precinct Structure Plan (PSP) areas. This species is listed as Vulnerable under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), is Listed under the *Flora and Fauna Guarantee Act 1988* (FFG Act), and is considered Endangered in Victoria (DSE 2013).

The Growth Areas Authority (GAA) is managing the production of the Craigieburn Employment Area North (PSP 25.1) and English Street (PSP 25.2) Precinct Structure Plans, in consultation with the Department of Environment and Primary Industries (DEPI) and Hume City Council (PSP 25.1) and the City of Whittlesea (PSP 25.2). The purpose of the PSP process is to facilitate the development of the precinct; for PSP 25.1 this will primarily consist of industrial and commercial development, while PSP 25.2 will largely comprise residential development. The precinct structure planning process includes the creation of open space such as retarding basins, wetlands and conservation reserves.

The objective of this project is to gather data and information on existing habitat, including distribution and quality, for the Growling Grass Frog within the study area; this information will be used to inform and develop relevant planning documentation for the Precincts, including PSPs and Conservation Management Plans.

The requirement for a Concept Plan to be developed, as part of the Conservation Management Plan, is included in the Biodiversity Conservation Strategy (DEPI 2013a) and Sub-regional Species Strategy for the Growling Grass Frog (DEPI 2013b). These documents outline the process and requirements for the management and conservation of the Growling Grass Frog in Melbourne's growth areas, and are the guiding policy documents relevant to this project.

This report provides the methodology and results of habitat assessments and mapping for the Growling Grass Frog (GGF) within PSP 25.1 and PSP 25.2.

1.1 Study Area

The areas under investigation are sections of the Merri and Kalkallo Creeks, as well as proximate terrestrial vegetation, in Donnybrook, Victoria. The study area is bounded by Donnybrook Road to the north and the Hume Freeway to the west, with pastoral land to the south and a railway line forming the eastern boundary (Figure 1).

Precincts 25.1 and 25.2 occur within the current Urban Growth Boundary (UGB) in the Hume City Council and City of Whittlesea municipalities respectively. The Precincts are part of the Port Phillip and Westernport Catchment Management Authority, and occur within the Victorian Volcanic Plains bioregion.

Topographically, the study area is relatively flat with some rises, with a number of waterways traversing the Precinct, including Merri Creek and Kalkallo Creek and associated tributaries. Much of the riparian area is steeply dissected, particularly by the Merri Creek.

The majority of land within the study area has a long history of agricultural use, primarily grazing with some cultivation, with the majority of native vegetation removed or substantially modified. Remnant native vegetation within the study area comprises primarily Escarpment Shrubland, Stony Knoll Shrubland, Plains Grassy Woodland, Creekline Grassy Woodland and Riparian Scrub Ecological Vegetation Classes (EVCs) (DEPI 2013a) (Figures 2 and 3). The precinct contains a large number of scattered trees, predominantly River Red Gums *Eucalyptus camaldulensis*, mostly along the creeklines. Woody weeds are well established throughout the majority of the riparian corridor, particularly Gorse *Ulex europaeus*, Hawthorn *Crataegus monogyna*, Willow *Salix* sp., and African Boxthorn *Lycium ferocissimum*.

Plates 1 – 8 illustrate parts of the study area.

1.1.1 Growling Grass Frog distribution

Historically, the Growling Grass Frog has been widely distributed across south-eastern Australia, including Tasmania (Littlejohn 1963; Barker and Grigg 1977; Hero et al. 1991). However, since European settlement, and most notably over the past three decades, the species has declined markedly across much of this former range (Ashworth 1998; Wassens 2008). This is particularly evident in south and central Victoria where populations have experienced widespread declines and local extinctions (Mahoney 1999; DEPI 2013b).

The Growling Grass Frog is well known in areas to the north of Melbourne, including the Merri Creek, Kalkallo Creek, Darebin Creek and Edgars Creek waterways. There are consistent and numerous records for this species throughout most stretches of these creeks and surrounding areas, particularly the Merri Creek and associated tributaries/anabranches (DEPI 2013b).

Land use changes that have occurred over time within the study area and surrounds have reduced habitat continuity for GGF. Fragmentation of the overall Merri Creek population has occurred, and that the species is now comprised of a number of sub-populations (Heard and Scroggie 2009; Heard et al. 2010; Hale et al 2013). This is based upon the current distribution of occupied wetland 'clusters' and the continuity of potential dispersal routes (open space, creek-lines or drainage lines) (Heard et al. 2003, 2004; Ecology Australia 2006). Recent research also suggest that these populations display 'classic meta-population dynamics' where the populations 'blink' in and out of existence, through regular frequent population extinction and recolonisation (Heard et al. 2009, 2010; Hale et al 2013). The sub-populations within the study area and surrounding areas generally occupy spatially discrete 'wetlands' (e.g. pools along streams, non-operational quarries, farm dams etc.), and individual frogs move between these wetlands, and hence between sub-populations (Heard et al. 2010).

Figure 1 shows GGF records within the study area.

1.1.2 Threatening processes

Factors that have contributed to the decline of Growling Grass Frog across its range include habitat loss, the fragmentation and degradation of habitat (such as alteration of the alignment of watercourses, modification of vegetation structure by exotic flora, and changes to hydrological regimes), predation by introduced species (including predation of eggs and tadpoles by introduced fish, such as Eastern Gambusia *Gambusia holbrooki*), infection by the amphibian chytrid fungus *Batrachochytrium dendrobatidis*, salinisation, pollution of waterbodies and waterways by fertilisers, pesticides and toxicants, and impacts from climate change (including direct and indirect/cumulative impacts).

While many of these factors are presently impacting populations across the north of Melbourne, it is likely that habitat loss, fragmentation and degradation are the major, if not critical, factors threatening this species in the region (e.g. Heard et al. 2010); the precise contribution of chytrid fungus to the status of the species in the region is not well understood.

1.1.3 Potential impacts of development

A range of potential impacts to GGF can occur as a result of urban development. These include:

- Vegetation removal and/or disturbance of wetlands during construction activities.
- Habitat loss and fragmentation, including barriers to movement through the creation of pathways, road and/or other facilities.
- Changed hydrological regimes and altered water quality due to increased runoff from impermeable surfaces and changes to drainage within the study area.
- Increased sedimentation and pollution of the wetland from uncontrolled run-off and accidental fuel/oil spills from construction machinery on site.
- General habitat degradation due to increased recreational use of the area including trampling by pedestrian traffic, rubbish dumping and increased frequency of disturbances. Pathway and street lighting may also potentially impact foraging behaviour of this species.
- Pest and pathogen invasion. During construction, there is potential for feral animals, weeds and pathogens to be introduced to, or spread further around, the study area, and/or to be taken off-site. These include:
  - Introduction of weeds;
  - Predation by feral animals such as foxes and cats; and
  - Fungal diseases such as Chytridiomycosis (Chytrid infection); this has been implicated in the decline of frog species worldwide, and is listed as a key threatening process under the EPBC Act.
- Death and/or injury to individuals during construction activities.

- Roads and vehicular traffic – direct mortality from vehicles, as well as the potential increase in toxicant/pollution run-off from roads.
- Potential mortality due to domestic cats and dogs.
- Cumulative impacts – the general loss and degradation of habitat in the region, both within and outside of the study area, has the potential to reduce the number of subpopulations and therefore decrease the long-term viability of the frogs. Therefore, impacts associated with development within a precinct must be evaluated with consideration of the presence and viability of frog habitat within the wider region.

2 Methods

2.1 Desktop assessment

The desktop assessment included evaluation of fauna records held within the Department of Environment and Primary Industries (DEPI) Victorian Biodiversity Atlas (DEPI 2013b). Growling Grass Frog records within 5 km of the study area were reviewed.

Existing published literature and unpublished reports relevant to the study area were also reviewed.

2.2 Site assessments

A site inspection was carried out on 6 June 2013, including representatives from GAA and the City of Whittlesea.

Fieldwork was conducted in June and July 2013, and consisted of diurnal site visits to assess and map the distribution and quality of GGF habitat within the study area. The Merri and Kalkallo Creeks, adjacent riparian areas and waterbodies in the landscape were assessed by two zoologists on 21 and 26 June, and 3 July 2013. Conditions during the assessments were generally cool and mostly overcast (excepting 21 June which was mostly sunny), with light to moderate winds.

Habitat assessments focused on the evaluation of the presence and quality of habitat, including the likely relative importance of habitat within the study area. The assessment focused on the creeklines and waterbodies within the proposed Conservation Area where formal assessment points were located (Figures 2 and 3); several waterbodies outside this area were also assessed.

The formal assessment points included evaluation of the following parameters at waterbodies and in-stream pools along the creeks:

- Location of the site (GPS coordinates);
- General site description, including description of waterbody, vegetation structure/dominance, key species, and presence of terrestrial refuge sites (e.g. logs and rocks);
- The surface area of the waterbody;
- Estimation of the hydroperiod of the waterbody (e.g. permanent, semi-permanent, ephemeral, intermittent; *sensu* Heard et al. 2010);
- Mean percentage cover of aquatic vegetation (i.e. emergent, submerged and floating vegetation; as per Heard et al. 2010);
- Basic water chemistry parameters (i.e. DO, EC/Sal, pH, and turbidity);
- Presence/absence of predatory fish, where observed (e.g. Eastern Gambusia *Gambusia holbrooki*);
- Any frog species recorded during the assessment;

- Landscape context and connectivity, including potential barriers to dispersal;
- Potential works to enhance/maintain Growling Grass Frog habitat; and
- Overall relative quality of habitat (*sensu* Ecology Australia 2012, 2013; see below).

Apart from the formal assessment points, rapid assessments were carried out throughout the study area, which involved rapidly evaluating and recording relative habitat quality and key habitat features or opportunities.

Photographs were taken throughout the study area showing landscape and habitat features, some of these are presented in Section 6: Plates.

The habitat attributes above allowed an evaluation to be made of the habitat quality of each waterbody and in-stream pool, as well as the non-pool stretches of waterways. Identification of breeding habitat within the study area was based on known/likely reproductive sites as recorded from field surveys (e.g. Heard et al. 2004, 2009; Ecology Australia 2006, 2013; this survey) and habitat assessment. Three key elements are associated with breeding habitat within the Merri Creek-Donnybrook subpopulation, as follows:

- Off-stream wetlands and relatively large in-stream wetlands, or slow-flowing sections of a stream with a relatively stable water level, and;
- 'Open-vegetated' wetlands, little to no overhanging canopy and a combination of submergent, emergent and floating aquatic vegetation, generally of moderate to high cover; and
- Connectivity to other breeding sites (i.e. connectivity via the creekline, open space or associated tributaries creates a 'cluster' of occupied breeding wetlands within the subpopulation).

Based on the above parameters, areas of potential breeding habitat were categorised as follows:

1. High potential breeding habitat – supporting all of the elements associated with successful breeding (i.e. relatively high permanence, aquatic vegetation cover, refuge/foraging/basking resources, connectivity to other habitat); or supporting most of the elements associated with successful breeding and supporting repeated or recent records of the species;
2. Moderate potential breeding habitat – supporting most of the elements associated with successful breeding; and
3. Linking habitat – supporting some of the elements associated with successful breeding but having no records of the species; or supporting none of the elements associated with successful breeding but providing suitable linking habitat, or potential breeding habitat under favourable conditions.

For the purposes of mapping, these categories of breeding habitat quality were assigned for waterways (c. 10 m either side) and waterbodies within the study area (Figures 2 and 3). Areas

outside of this are considered to represent terrestrial habitat, which are generally used more for foraging, dispersal and potentially overwintering, than breeding. This distinction is necessarily somewhat arbitrary, due primarily to the fact that these activities often overlap spatially, and hence in some areas the realistic transition between breeding and terrestrial habitat may extend further, or less, than indicated.

The assessment included evaluation of potential locations for the creation of dedicated Growling Grass Frog ponds; these locations will be developed and discussed as part of the creation of the Concept Plan for the study area.

Limitations

Access was not granted for several properties in PSP 25.1, and hence not all waterways and habitat within the Conservation Area were able to be assessed (see Figures 1 and 2).

Due to equipment failure, water quality data at four in-stream sites was not able to be collected (see Appendix 1); this is not considered to be a significant limitation as water quality within streams generally reflects broad scale conditions (i.e. macro vs micro scale). An approximation of water quality at these sites can be inferred from up and/or downstream sites, and it is highly unlikely that water quality would differ sufficiently to materially affect the assessment of habitat quality for GGF.

Targeted surveys for GGF were not undertaken as part of this project.

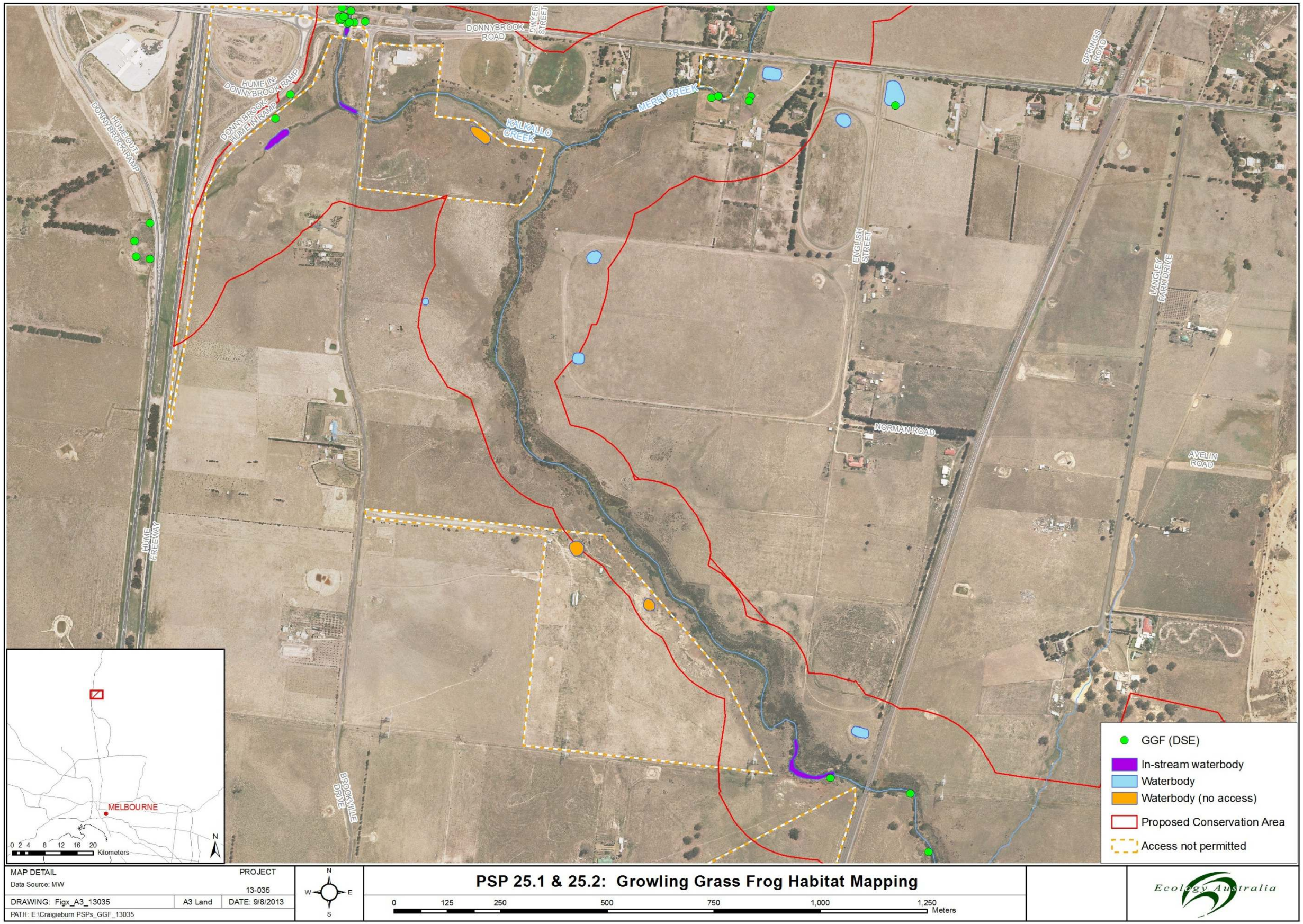

Figure 1 Craigieburn North Employment Area (PSP 25.1) and English Street (PSP 25.2), showing site access constraints, waterbodies and Growling Grass Frog (GGF) records

3 Results

3.1 Habitat assessment

Habitat for the Growling Grass Frog within PSP 25.1 and 25.2 is generally modified and degraded. The waterways have a history of agricultural impacts and use, particularly grazing, and are dominated by exotic vegetation, especially woody weeds and exotic pasture grasses.

Existing vegetation is dominated by introduced woody weeds such as Gorse *Ulex europaeus*, Hawthorn *Crataegus monogyna*, African Boxthorn *Lycium ferocissimum*, and Blackberry *Rubus fruticosus* sp.agg., and exotic pasture grasses, particularly Phalaris (Toowoomba Canary Grass) *Phalaris aquatica*. The introduced Artichoke Thistle *Cynara cardunculus* is also pervasive throughout the study area.

Remnant vegetation largely comprises scattered River Red Gum *Eucalyptus camaldulensis*, primarily along the waterways, with native sedges, rushes and grasses (e.g. Phragmites *Phragmites australis,* Common Spike Rush *Eleocharis acuta*, *Juncus* spp. and *Poa* spp.) and aquatic species (e.g. Water Ribbons *Triglochin procerum s.l.*) occurring within the riparian zone.

Despite the modification of native vegetation in the study area, the riparian zone and various waterbodies within the study area provide potentially suitable habitat for GGF, which is generally influenced more by hydrological parameters and vegetation structure rather than vegetation composition or landuse *per se*. Water quality was relatively uniform throughout the wetlands, with results for all sites generally within the range of water quality results from known populations, including successful breeding sites (Ecology Australia 2011; unpublished data). However, there is a paucity of data on the potential effects of water quality parameters on this species, including the effect of salinity or other parameters on chytrid fungus.

Terrestrial habitat within the proposed Conservation Area (i.e. land not proximate or adjacent to waterways and waterbodies) is relatively uniform and consists largely of open pasture with some areas fenced to exclude stock; portions of the southern two-thirds of the study area are relatively steeply incised by Merri Creek. Knowledge of the precise use of these habitats by the species is not readily available; however, terrestrial habitat is important for foraging and dispersal movements of GGF, with recent modelling suggesting that reducing the width of this habitat around major creeklines can pose a substantial risk to the long-term viability of a population (Heard and McCarthy 2012). Grassy, low vegetation (including escarpments) surrounding the waterways is likely to be regularly used in areas where frogs occur; the regularity of use is likely to generally decline with distance from the water's edge.

No predatory fish were observed during the assessment, however, it is highly likely that they are present in some waterbodies and/or sections of the waterways. Only one frog species was recorded during the current assessment; the Common Eastern Froglet *Crinia signifera*.

3.1.1 Merri Creek

Based on recent research, the Merri Creek GGF population is considered to display 'classic metapopulation dynamics' where the populations 'blink' in and out of existence given frequent population extinction and recolonisation (Heard et al. 2010). The populations within Merri Creek occupy spatially discrete wetlands (e.g. pools along streams, farm dams etc.), and individual frogs move between these wetlands and hence populations (Heard et al. 2010; Hale et al. 2013).

The Merri Creek waterway and associated riparian habitat within the study area is considered to represent 'core permanent habitat' for the Growling Grass Frog. Core permanent habitat is defined as being critical for the long-term persistence of a population; it is generally a permanent waterbody or waterway, however, water levels may fluctuate. Core permanent habitat provides continuity of habitat in the long-term and provides breeding habitat (in most years). Other habitat attributes are also associated with core habitat such as terrestrial foraging and over-wintering habitat. There are numerous records of Growling Grass Frog (current and historic) for the Merri Creek.

The Merri Creek is also categorised as a 'habitat link within and between' sub-population(s), providing continuity of habitat between breeding sites and habitat for dispersal and movement. Merri Creek provides connectivity of habitat between other wetland 'clusters' to the north and south of the precinct. This is important for dispersal, genetic interchange and habitat diversity (Hale et al 2013). Movement along habitat links may vary from year to year depending on the conditions of the habitat link.

Terrestrial habitats associated with Merri Creek (i.e. open space adjacent to waterways, waterbodies) are essential for the Growling Grass Frog, including long-term viability. Terrestrial habitats support dispersal, foraging and shelter/over-wintering habitat and can include a combination of open grassy/mud banks, dense fringing vegetation, rock rubble/boulders, soil cracks/crevices, leaf litter and logs, and open vegetation dominated by native and/or exotic grasses (i.e. grasslands adjacent to waterways).

The northern and southern sections of Merri Creek are considered to provide high potential breeding habitat; this is in contrast to the intervening section, which is considered to generally provide moderate potential breeding habitat (see Figures 2 and 3, Table 1). The northern and southern sections in general support a greater number and amount of in-stream wetlands, less steeply-incised banks, more favourable aquatic vegetation cover (less dominated by emergent vegetation, with generally higher floating vegetation cover), and more open water areas with less over-shading from woody species.

The entire stretch of Merri creek within the study area is extensively invaded by weeds, particularly woody weed species. It is considered highly likely this woody weed cover is increasingly impacting the suitability of riparian and terrestrial habitat for GGF.

The habitat parameters recorded along Merri Creek are presented in Appendix 1.

3.1.2 Kalkallo Creek

The majority of Kalkallo Creek comprises a wide alluvial terrace with a semi-permanent hydroperiod. The waterway is dominated by emergent vegetation, particularly Phragmites, with very few areas of open water east of Brookville Drive. Fringing vegetation comprises primarily exotic pasture grasses, especially Phalaris. To the west of Brookville Drive, Kalkallo Creek is primarily open with some emergent and extensive fringing vegetation, primarily rushes *Juncus* sp.; this vegetation change is likely driven by livestock grazing, with trampling of the waterway and margins evident. These sections of the Kalkallo Creek are considered to provide moderate potential breeding habitat.

A small portion of Kalkallo Creek in the northwest of the study area, of approximately 50 m, is considered to support high potential breeding habitat for GGF (see Table 1). This section is wide and mostly open, with a moderate cover of aquatic vegetation; the fence to the south restricts grazing, with a concomitant reduction in erosion and trampling impacts.

The tributary of Kalkallo Creek within the west of the study area is a relatively minor waterway that is ephemeral; it was mostly dry during the current assessment. This waterway may provide potential breeding habitat for GGF during higher flow periods, although during drier years it is not considered likely to support breeding habitat for this species. This tributary supports a moderately sized dam with low to moderate aquatic vegetation cover; this dam is likely to maintain a semi-permanent hydroperiod, and is considered to support high potential breeding habitat for the species.

Part of the Kalkallo Creek was not able to be assessed, as access was not granted; based on visual observation from outside of this property, this section of the Kalkallo Creek was considered to support moderate potential breeding habitat.

Potential may exist for the creation of in-stream waterbodies along Kalkallo Creek.

The habitat parameters recorded along Kalkallo Creek and its tributary are presented in Appendix 1.

3.1.3 Off-stream waterbodies

Other potential breeding habitat occurs within off-line waterbodies and depressions within the study area. There are a number of known records of the Growling Grass Frog in dams/wetlands within the immediate surrounds, which supports the potential importance of these waterbodies in the long-term viability of GGF in the area. Many of these dams are likely to be free of predatory fish, through periodic drying out, which may increase the likelihood of successful recruitment if breeding conditions are favourable (e.g. available water over the spring/summer period, moderate to high aquatic vegetation cover and available open space/connectivity to Merri Creek or other suitable habitat). These waterbodies may also provide habitat for non-breeding activities such as foraging and dispersal (e.g. 'stepping stones').

The dam southeast of the Merri Creek where it crosses Donnybrook Road (#7) is considered to support high potential breeding habitat for GGF. There are a number of records for the species

from this location, which has a relatively high hydroperiod, moderate cover of aquatic vegetation, and no overshading (see Table 1). This wetland is connected via a drainage channel to two moderate size dams to the east, outside the proposed Conservation Area; these dams are considered to support moderate potential breeding habitat.

There are three dams located on the periphery of the proposed Conservation Area near the center of the study area (# 17, 18 and 19); these dams generally support low levels of aquatic vegetation, have a low to moderate amount of rock and refuge resources, and have no overshading of the waterbody. Given their location and the likelihood of periodically drying out, the dams may also be free of predatory fish. These dams are considered to support moderate potential breeding habitat, although connectivity to the riparian corridor is relatively low.

A relatively large dam occurs in the south east of the proposed Conservation Area (#13). This dam currently has very little aquatic vegetation, some refuge and foraging resources and no overshading of the waterbody; it is considered to support moderate potential breeding habitat.

In the event that stock were to be excluded from these farm dams, it is likely that aquatic vegetation would regenerate naturally to some degree; this would likely result in an increase in habitat suitability for GGF.

The habitat parameters recorded for the various waterbodies are presented in Appendix 1.

Table 1 Description of general habitat features within PSP 25.1 and PSP 25.2, by habitat type

Habitat Type	Location (see Figures 2 to 3)	Field assessment points	General habitat attributes
Known/high potential breeding habitat (shown as green in Figures 2 and 3)	Merri Creek, from Donnybrook Road to approximately 400 m downstream of Kalkallo Creek confluence	1, 2, 8, 10, 16	Slow to moderate flowing sections of stream; some small open sections along the creek; generally comprised a moderate to high cover of aquatic vegetation, primarily emergent with some areas dominated by Phragmites. Overshading is extensive in some areas, primarily by exotic woody weeds (e.g. Hawthorn, Gorse, willows etc.) and opportunistic native shrubs (e.g. Woolly Teatree, Tree Violet); previous GGF records
	Dam southeast of where Merri Creek crosses Donnybrook Road	7	Open wetland with moderate aquatic vegetation cover; terrestrial vegetation dominated by exotic pasture grasses; previous GGF records
	Kalkallo Creek, stretch from Donnybrook Road to c. 50 m downstream	3	Open wetland with moderate to high aquatic vegetation cover; fringing grasses, rushes and sedges; substantial refuge including rocks for basking and foraging; previous GGF records
	In-stream dam of c. 80 m length (likely constructed), on tributary of Kalkallo Creek in west of study area	6	Still to slow-flowing section of tributary; moderate size open pool with apparently stable water level; moderate cover of emergent vegetation; previous GGF records in proximity
	Merri Creek, stretch of c. 400 m in southeast of study area	15	Slow-flowing, open sections of stream; moderate to high aquatic vegetation cover; limited overshading, largely by eucalypts, exotic woody weeds (e.g. Hawthorn and Gorse); previous GGF records
Moderate potential breeding habitat (shown as pink in Figures 2 and 3)	Remainder of Merri Creek	11, 12, 14	Slow to moderate flowing sections of stream; often steeply incised; generally a moderate to high cover of aquatic vegetation, primarily emergent, often dominated by Phragmites. Extensive overshading in some areas, primarily by exotic woody weeds (e.g. Hawthorn, Gorse, willows etc.) and opportunistic native shrubs (e.g. Woolly Teatree, Tree Violet)

Habitat Type	Location (see Figures 2 to 3)	Field assessment points	General habitat attributes
	Remainder of Kalkallo Creek	4	Wide alluvial terrace, dominated by emergent vegetation (esp. Phragmites), little open water; moderate rock cover on banks
	Remaining (assessed) dams and off-stream pools	9, 13, 17, 18, 19	Semi-permanent to ephemeral waterbodies, low cover of aquatic vegetation; little to moderate rock cover and other refuge; little or no overshading of water surface
	Drainage ditch running from assessment point 7 to English Street	N/A	Ephemeral drainage line running east to west; low to moderate aquatic vegetation cover little rock or other refuge; provides connectivity between several waterbodies and Merri Creek
Linking habitat (shown as orange in Figures 2 and 3)	Drainage ditch running from English street to the east.	N/A	Moderate to fast flowing narrow sections of stream, often with dense over hanging vegetation, banks often eroded, incised or steep rock. Water level is stable, aquatic vegetation varies, but generally low diversity/cover.
	Associated tributary of Kalkallo Creek	5	Ephemeral waterway; very high cover of emergent vegetation, little to no floating or submergent vegetation; fringing vegetation dominated by rushes and exotic pasture grasses

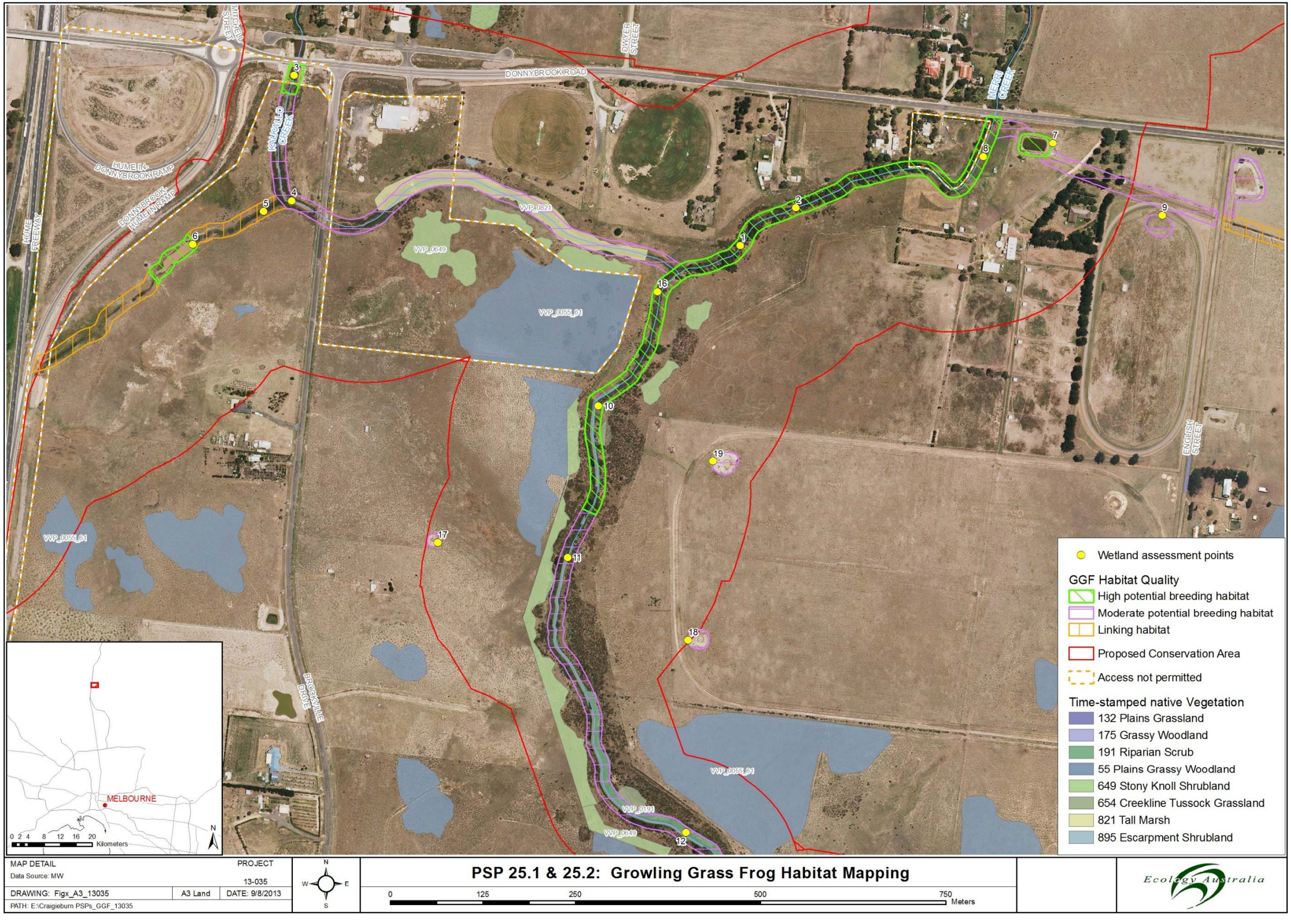

Figure 2 Growling Grass Frog habitat, assessment points and native vegetation within Craigieburn North Employment Area (PSP 25.1) and English Street (PSP 25.2)

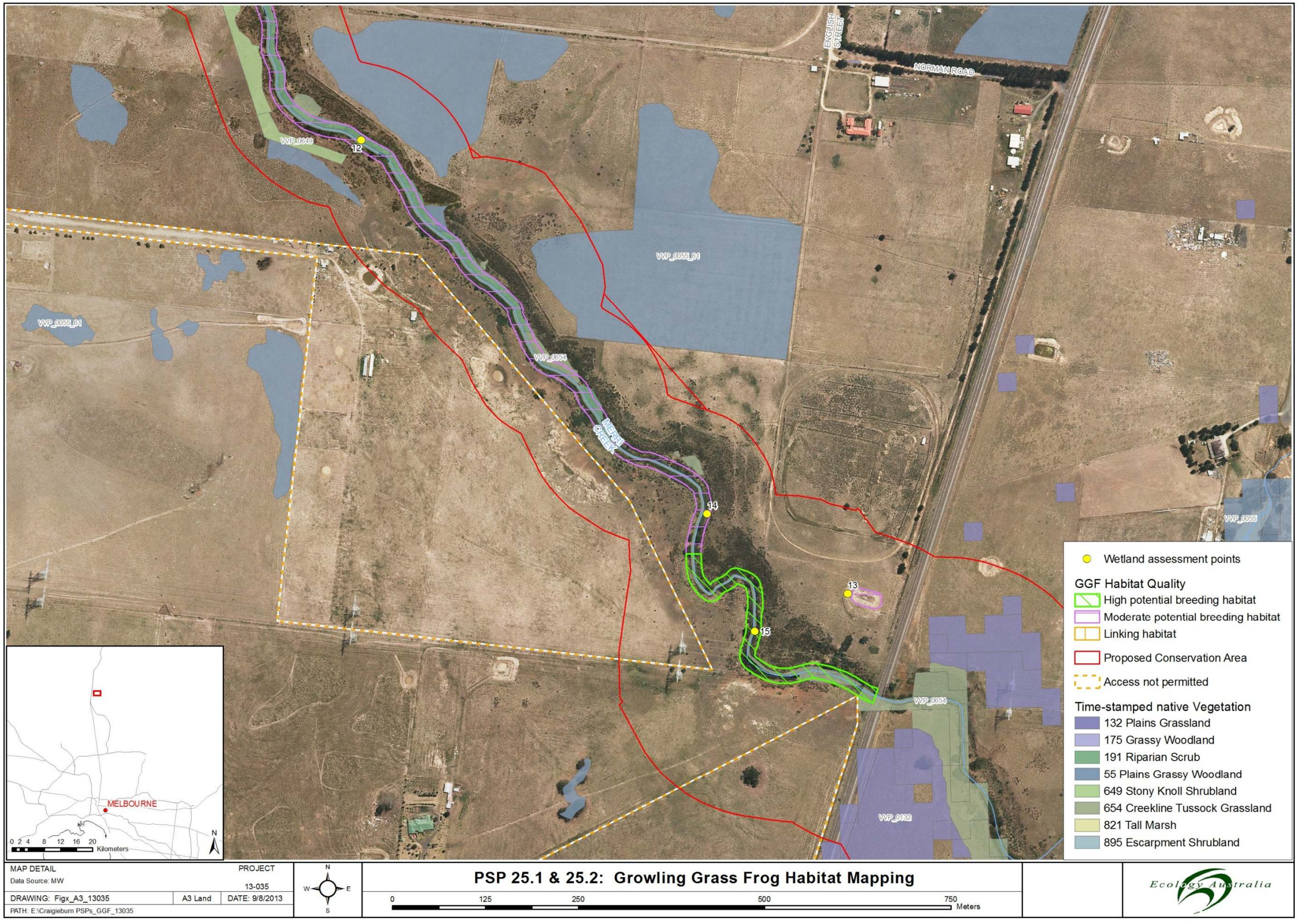

Figure 3 Growling Grass Frog habitat, assessment points and native vegetation within Craigieburn North Employment Area (PSP 25.1) and English Street (PSP 25.2)

4 Conclusion

The findings of this Growling Grass Frog habitat assessment will inform the development of the Concept Plan for PSPs 25.1 and 25.2. The Concept Plan will provide recommendations and identify potential locations for the creation of dedicated Growling Grass Frog breeding wetlands, including the identification of potential 'nodes', where several wetlands may be located in proximity.

We make the following general comments and recommendations relevant to the study area:

- The entirety of the Merri and Kalkallo Creeks within the study area supports at least moderate potential breeding habitat for GGF; much of the Merri Creek supports high potential breeding habitat.
- Existing waterbodies within the proposed Conservation Area, which all provide at least moderate potential breeding habitat, should be protected and enhanced, wherever possible, as part of the precinct planning process.
- The high cover of woody weeds, on Merri Creek particularly, is likely to currently be significantly impacting on the quality of GGF habitat; woody weed control is required within riparian areas and adjacent habitat to ameliorate these impacts in the short to medium term (i.e. prior to Precinct-level conservation works commencing). Many of the woody weed species extant within the study area are listed as Regionally Controlled under the *Catchment and Land Protection Act 1994* (e.g. Gorse, Hawthorn, Blackberry and African Boxthorn); this legislation obligates landowners to take all reasonable steps to prevent the growth and spread of these species on their land.

5 References

Ashworth, JM (1998) An appraisal of the Conservation of *Litoria raniformis* (Kefferstein) in Tasmania. University of Tasmania March 1998. Unpublished Masters Thesis.

Barker J and Grigg GC (1977) A Field Guide to Australian Frogs. Rigby, Sydney.

DSE (2013) Advisory List of Threatened Vertebrate Fauna in Victoria - 2013. (Department of Sustainability and Environment: East Melbourne)

DEPI (2013a) Biodiversity Interactive Map Version 3.2. Available at: http://mapshare2.dse.vic.gov.au/MapShare2EXT/imf.jsp?site=bim (Department of Environment and Primary Industries: East Melbourne). Accessed June 2013.

DEPI (2013b) Victorian Biodiversity Atlas. (Department of Environment and Primary Industries: East Melbourne)

Ecology Australia (2006) Sub-regional Conservation Strategy for the Growling Grass Frog – Epping/Somerton, Victoria. Unpublished report prepared for the Department of Primary Industries. (Authors C. Renowden., L.E. Conole, G.W. Heard., and P. Robertson).

Ecology Australia (2011) Growling Grass Frog Monitoring 2010/11 – Western Treatment Plant. Unpublished report prepared for Melbourne Water.

Ecology Australia (2013) Lockerbie Precinct: Conservation Management Plan (Draft). Unpublished report prepared for Stockland Pty. Ltd.

Hale JM, Heard GW, Smith KL, Parris KM, Austin JJ, Kearney M, Melville J (2013) Structure and fragmentation of growling grass frog metapopulations. *Cons. Gen.* **14**: 313-322.

Heard GW, Robertson P and Scroggie MP (2004) The ecology and conservation status of the Growling Grass Frog (Litoria raniformis) within the Merri Creek Corridor. Report prepared for the Department of Sustainability and Environment. (Wildlife Profiles P/L and the Arthur Rylah Institute for Environmental Research (ARIER)).

Heard GW and Scroggie MP (2009) Assessing the impacts of urbanisation on Growling Grass Frog Metapopulations. Report produced for the Department of Sustainability and Environment. (Wildlife Ecology and ARIER).

Heard GW and McCarthy M (2012) Metapopulation viability of the Growling Grass Frog in Melbourne's urban growth areas. Unpublished report prepared for Biodiversity and Ecosystems Services Division, Department of Sustainability and Environment: Victoria)

Heard GW, Scroggie MP and Clemann N (2010) Guidelines for managing the endangered Growling Grass Frog in urbanising landscape. Report produced for the Department of Sustainability and Environment. (Wildlife Ecology and ARIER).

Hero J, Littlejohn M and Marantelli G (1991) 'Frogwatch Field Guide to Victorian Frogs'. (Department of Conservation and Environment: Victoria).

Littlejohn MJ (1963) Frogs of the Melbourne area. Victorian Naturalist. 79:296–304.

Mahoney M (1999) Review of the declines and disappearances within the bell frog species group (Litoria aurea species group) in Australia. In: Declines and Disappearances of Australian Frogs. The University of Newcastle, Newcastle, NSW.

Wassens S (2008) Review of the past distribution and decline of the southern bell frog *Litoria raniformis* in New SouthWales. *Australian Zoologist* **34**: 446–52.

6 Plates

Plate 1 Dam near the Merri Creek/ Donnybrook Rd crossing (Point #7)

Plate 2 Merri Creek in the north of the study area, showing floating Water-ribbons and fringing vegetation, dominated by Phalaris

Plate 3 Small dam in northeast of study area (Point #9)

Plate 4 Waterbody east of English Street in the northeast of the study area

Plate 5 The alluvial terrace of Kalkallo Creek, dominated by Phragmites

Plate 6 Merri Creek, showing overshading by exotic woody weeds (c. point #2)

Plate 7 Dam in southeast of study area (Point #13)

Plate 8 Merri Creek in southeast of the study area, showing in-stream pool consisting of high potential breeding habitat (c. point #15).

Appendix 1 Description and ecological parameters of waterbodies and waterways assessed within the study area.

Site ID	Site Description	Surface Area (m2)	Hydro-period	Habitat Quality	Aquatic Vegetation Cover	EC (us/cm)	Salinity (ppt)	DO (mg/L)	pH	Turbidity (NTU)	Recommended Enhancement Works	Notes
1	Merri Creek - relatively high canopy cover, mostly eucalypt but also woody weeds e.g. gorse, hawthorn		Semi-permanent	High potential breeding habitat	23	n/a	n/a	n/a	n/a	n/a	Weed control	
2	Merri Creek - overgrown and shaded; primarily woody weeds e.g. hawthorn, willows, gorse		Semi-permanent	High potential breeding habitat	3	n/a	n/a	n/a	n/a	n/a	Weed control, revegetation	
3	Kalkallo Creek, Donnybrook Road - c. 10m wide, open water, substantial aquatic vegetation	159	Ephemeral	High potential breeding habitat	23	n/a	n/a	n/a	n/a	n/a	Provision of refuge	*C.signifera* calling
4	Kalkallo Creek - c. 10m wide, open in-stream wetland. 100% fringing vegetation, with some emergent on edges	366	Ephemeral	Moderate potential breeding habitat	5	n/a	n/a	n/a	n/a	n/a	Weed control, provision of refuge	
5	Tributary - ephemeral, relatively small catchment, likely occasional high flow events e.g. from freeway		Ephemeral	Linking habitat	35	Dry	Dry	Dry	Dry	Dry	Weed control	Potential to build in-stream GGF ponds
6	Constructed (likely) wetland on tributary, mostly open, high fringing and moderate emergent vegetation	961	Permanent	Moderate potential breeding habitat	5	271	0.13	9.21	8.0	104	Weed control, provision of refuge, revegetation	
7	Mostly open wetland (dam); exotic grass dominated, moderate aquatic vegetation, no overshading	1166	Permanent	High potential breeding habitat	8	262	0.13	5.80	8.6	122	Weed control, provision of refuge, revegetation	
8	Merri Creek - Typha dominated, moderate open water, scattered eucalypt overstorey, mildly incised		Semi-permanent	High potential breeding habitat	25	662	0.32	8.78	8.2	n/a	Weed control (incl. Willows), provision of refuge	
9	Small farm dam, mostly open, low aquatic vegetation cover, moderate trampling from horses	857	Semi-permanent	Moderate potential breeding habitat	5	322	0.16	9.14	8.5	200	Weed control, provision of refuge, revegetation, stock exclusion	
10	Merri Creek - mildly incised, dense Woolly Teatree, high emergent cover		Semi-permanent	High potential breeding habitat	18	682	0.34	10.05	8.3	97	Weed control	
11	Merri Creek - partly open, mostly shaded by Woolly Teatree, Tree Violet and hawthorn		Semi-permanent	Moderate potential breeding habitat	5	773	0.38	10.15	9.0	80	Weed control, provision of refuge, revegetation	
12	Merri Creek - mostly closed, eucalypt dominated canopy, Woolly teatree and Phragmites dominated understorey		Semi-permanent	Moderate potential breeding habitat	20	877	0.43	11.40	8.2	82	Weed control	
13	Moderate size open dam, very little aquatic vegetation	829	Permanent	Moderate potential breeding habitat	0	285	0.14	10.50	9.1	398	Weed control, provision of refuge, revegetation, stock exclusion	*C.signifera* calling
14	Merri Creek - mostly shaded, Woolly Teatree and Phragmites dominated, very high gorse fringing cover		Semi-permanent	Moderate potential breeding habitat	15	1123	0.56	10.84	n/a	71	Weed control (particularly Gorse)	
15	Merri Creek - wide instream waterbody, continuing downstream, relatively open, generally gently sloped banks	1516	Semi-permanent	High potential breeding habitat	12	1126	0.53	11.11	n/a	73	Weed control	
16	Merri Creek near confluence - narrow creekline, mostly shaded by Phragmites, Woolly Teatree and Tree Violet, relatively wide alluvial terraces		Semi-permanent	High potential breeding habitat	20	792	0.39	n/a	8.8	45	Weed control, provision of refuge	
17	Small farm dam, moderate aquatic vegetation and rocks, no overshading	202	Semi-permanent	Moderate potential breeding habitat	7	159	0.07	7.60	8.3	322	Revegetation	*C.signifera* calling
18	Farm dam, low aquatic vegetation cover, moderate rock cover and refuge	644	Semi-permanent	Moderate potential breeding habitat	3	475	0.23	9.61	7.4	n/a	Revegetation, stock exclusion	*C.signifera* calling
19	Farm dam, very little aquatic vegetation, few rocks or other refuge	820	Semi-permanent	Moderate potential breeding habitat	0	370	0.22	9.92	8.0	n/a	Provision of refuge, revegetation, stock exclusion	