

5 Discussion

Surveys for the Green and Golden Bell Frog within the non-certified area revealed that substantial areas of various habitat for the species still exist within this deferred area. However substantial areas of similar habitat also exist elsewhere within the Riverstone precinct and the wider North West Growth Centre.

Much of the habitat that remains is located within the vicinity of First Ponds Creek, adjacent to farm dams and associated with other drainage features on the creek flood plain. Habitat consists of the predominantly cumbungi lined and pooled sections of the creek itself and around the similarly vegetated flood plain features that retain water after heavy rain and following flooding events. These features include ox-bows, overflow depressions and swales that are likely filled during heavy flow events. Some of the floodplain features have been created or modified by human activities. Modified/created features that provide habitat include farm dams, diversion channels, and other bunded areas.

The obvious habitat features forming breeding, shelter and high quality foraging habitat within the study area were mapped during the targeted surveys (Figure 5). However similar habitat features were observed to occur along much of the flood prone areas of other parts of the precinct.

Competing hypotheses exist to explain the apparent shift of GGBF from occupying permanent water bodies as breeding habitat to more ephemeral breeding locations. One hypothesis is that GGBF prefer early successional stages of ponds for breeding when they have just formed or refilled after an extended dry period. Other hypotheses relate to the presence of introduced predatory fish and/or the arrival of frog chytrid carried by vector animals and then the permanent water bodies developing an infective load that persists unless drying or other factors eliminate the pathogen (or fish) eg in the case of frog chytrid, salinity fluctuations. Some evidence is available to support both contentions (Pyke and White, 1999; DECC 2005) but whether it is a one of these factors or a combination there is clearly an active GGBF avoidance of large permanent water bodies for breeding today when compared to historical observations (DECC 2005).

Both types of habitat occur in the study area and these issues should be considered when deciding which areas should be conserved and/or how habitat is managed or constructed in any outcomes of the development decisions for the precinct.

Investigations of how the non-certified area was selected for targeted survey revealed that the selection of the area to be deferred from biocertification was somewhat arbitrary and based on allocating a buffered area to surround the most recent GGBF record at Riverstone. Consequently this has likely skewed the analysis away from other possible/probably habitat areas that may also be utilised by the GGBF from time to time. Nevertheless the selected area does contain significant GGBF habitat and the GGBF was detected in the study area.

Unconfirmed observations of GGBF have also been reported in local schools within the study area for some time and from other residents in the surrounding area. This is not unexpected, given the high densities of GGBF being produced and emanating out from the local residential property in Oxford Street and well within the species regular movement range.

The specimens observed during this study were juveniles but no evidence of functional breeding habitat was found in the study area during the survey period. Most of the likely breeding habitat was either dry leading up to and during the survey period or otherwise heavily infested with Gambusia and Carp that render it less suitable for breeding. No tadpoles were detected in the permanent water bodies. The bunded swale area where the juveniles were detected appears to receive overland and partially channelled flow after rain. After a heavy rain event, or a series of smaller ones, this area would collect and hold water for some time. This functionality became apparent during the surveys when the initially dry swale area became wet when the area received a short episode of heavy rain in the period leading up to the third survey visit. This area, when filled by more substantial inflows, would become an ideal area of ephemeral breeding habitat, free (at least initially) of Gambusia and likely to retain water for a suitable period for breeding. This area should be rated the most important area of habitat in the study area. The conditions that would make this site an ideal ephemeral breeding site did not eventuate during the study period. This was despite the extended survey period being designed to maximise the likelihood of surveys corresponding with favourable conditions for detection ie during or extending across breeding events that make the species most obvious (aggregated and calling).

Nevertheless it is considered likely that the detected specimens of GGBF, in particular juveniles, are a consequence of dispersal from the nearby residential property in Oxford Street rather than on site breeding.

GGBF metamorphlings and juveniles are known to vacate breeding areas because of cannibalism (DEC, 2005). This fact, coupled with the observed high density of juveniles and metamorphlings at nearby Oxford Street and the noted recent instances of cannibalism (L. Jurd pers. comm.), as well as further reports of recent frog sightings from neighbouring residences and the closely located schools is further evidence to support this.

Green and Golden Bell Frogs were once widespread and abundant in the Riverstone area and were regularly detected throughout the First Ponds and Chain of Ponds Creek drainages (R. Wells pers. comm. L. Jurd. pers. comm.). Other historical records for the area are also known to exist but are currently unavailable. These observations are from the late 1960s and early 1970s when the then President of the Australian Herpetological Society Geoff Manning resided in Clarke Street, Riverstone and society meetings were regularly held at his residence (Wells, 2009).

The current colony that persists in Oxford Street Riverstone originated from the Riverstone locality when it was encouraged to establish on the residential allotment during the late 1970s and early 1980s (L. Jurd pers. comm.). This flourishing colony is being considered as the founding source for a possible reintroduction into Scheyville National Park where it was previously known from near Long Neck Lagoon (Ann Goeth pers. comm.; Wellington and Wells 1991).

6 Conclusion and Recommendations

Good quality Green and Golden Bell Frog habitat continues to exist in the study area, however similar habitat also exists over an extensive area of the Riverstone precinct outside the 'non-certified' area as well as within other precincts of the North West Growth Centre and beyond.

Observations of the GGBF within the vicinity of the Riverstone High School appear to have triggered a conservative consideration by the DECC when the Growth Centres SEPP Biocertification application was being considered. The area depicted as non-certified in the BCO maps was arrived at by a decision to protect and buffer likely habitat surrounding a specimen record.

The Wells Wildlife Atlas record for 2000 (Table 2), appears to have been the basis for the BCO Condition 18, and ultimately this report, and was apparently triggered by a communication made at a Hawkesbury Herpetological Society meeting at Richmond where a record of the GGBF was reported as having been recently found in the playground at the back of Riverstone HS (R. Wells pers. comm.).

A residual population of the GGBF still persists in the Riverstone precinct but is possibly only sustained by the persistence of a 'hotspot' population element in a private residence nearby. This is most likely emulating what happens at other 'more natural' locations and fits the 'metapopulation' model of expansion during favourable conditions and contraction to important hot spot areas that operate as refugia during less favourable episodes (DEC 2005).

The private residence at 48 Oxford Street Riverstone maintains a large population of the GGBF in a semi captive situation but where GGBF are able to escape from and return to the residential property. This residential population is large and demonstrates regular breeding events and recruitment (L. Jurd pers. comm.). The population was originally founded on specimens collected at another site in Riverstone during the 1970s (vicinity of the Riverstone meat works L. Jurd pers. comm.). This resident should be encouraged to maintain the colony and supported in other initiatives that may arise out of the recovery program for the species in western Sydney.

Observations of possible sightings at two of the local schools could not be confirmed but were potential sightings. A number of identification posters were distributed to all the schools in the area to assist with possible identification and reporting. This illustrates the importance and potential for further community education awareness and engagement initiatives that would likely assist the species survive locally. A wider circulation of these brochures and promotion to encourage community engagement would likely result in wider reporting of GGBF observations in the area.

Detection of a possible GGBF juvenile and a subsequent observation of two confirmed juvenile specimens in the same area of the study site shows that the areas mapped as GGBF habitat were well founded.

Conditions during the study period were such that no suitable breeding habitat was detected during the three visitations to the subject land. Areas that contained permanent water such as farm dams and suitable fringing habitat would be ideal foraging habitat but appear less suitable than ephemeral locations as breeding habitat.

This is likely due to a combination of factors that include introduced predatory fish and persistence of frog chytrid disease pathogens.

There is also permanent water along First Ponds Creek in pooled sections along this reach of the creek where it traverses the study area. Some of these pooled sections have habitat value but were also observed to have a high level of infestation of *Gambusia* and Carp along with a significant population of eels. Whilst none of these renders the habitat unusable by the GGBF, the likelihood is that breeding efforts in these sites would be severely curtailed by predatory threats on eggs and larvae as well as possible chytrid infection that appears to prevail in permanent water bodies.

The area with greatest potential for being good ephemeral breeding habitat is the large 'L' shaped patch of Cumbungi that covers a drainage depression bounded by earthworks (Sites 2 and 3). This vegetation patch is located on the north west side of the end of Regent Street (south).

The presence of juveniles in what appears to be the best quality habitat area, and where pests/threats are absent, could be explained by dispersal from the known breeding habitat area at Oxford Street or from another breeding site outside the study area and not detected. The former is considered more likely given observed predation pressures to disperse from that site.

This colony should be utilised to assist the founding or supplementing of other component/satellite elements of the western Sydney GGBF key population (eg those reintroductions previously proposed for Long Neck Lagoon/Scheyville NP and Penrith Lakes, Ann Goeth pers. comm.; Sandy Booth pers. comm.), and perhaps elsewhere in the North West Growth Centre.

This project has confirmed the presence of the GGBF in the study area and mapped the important GGBF habitat elements present. Management of some, or all, of this habitat would be relatively easy to achieve and is recommended although other more strategic approaches may be a preferred outcome. Creation of alternative habitat in the study area may be another option to accommodate intended development for the area. Such an option would however be likely to require habitat performance criteria on created habitat prior to removal of existing habitat to be consistent with other conditions imposed by DECC at other GGBF sites with likely development impacts (eg Woonona, Edgewood Village Building Co site; Kurnell, Australands site; Arncliffe M5 RTA site; and Greenacre, Hannas site). However as is concluded here that the GGBF appear to be merely occupying habitat in the study area after dispersal rather than completing the reproductive stages of their life cycle in situ, the DECC may decide to adopt a less onerous performance criterion than at some of these other sites?

Ideally any retained and/or created habitat would include habitat enrichment, supplementation and remediation actions as well as the maintenance of connectivity as indicated in *Best Practice Guidelines Green and Golden Bell Frog Habitat* (DECC, 2008). These Guidelines provide specific advice regarding habitat components required by the species and how these may be provided or enhanced to satisfy its various life cycle stages.

However the identification of extensive areas of other habitat outside the study area in the precinct and wider Growth Centre coupled with the knowledge of other GGBF satellite populations suggest that a strategic approach to conserving and linking these would be preferable to undertaking extensive habitat creation and remediation provisions restricted to one site within the Precinct to satisfy the BCO.

Consequently it is recommended that the GCC discuss this issue with the DECC to perhaps broaden the scope of habitat creation and maintenance works and perhaps synchronise some of these with other initiatives and actions that are likely to arise or be required under waterfront land management strategies under the WM Act and as part of WSUD principles forming part of drainage and flood

mitigation requirements. It is understood that Creek and riparian zones are to be kept as part of the precinct plan, and rehabilitated as Category 2 streams – this will contribute some habitat values and connectivity to other areas and further opportunities may arise to integrate DECC 2008 Guidelines with these other requirements under other legislation.

Other wet and periodically dry (ephemeral) habitats could also be recreated in association with drainage works and possibly provide higher quality habitat that is more appropriately located?

Nevertheless, in order to satisfy the requirements of the BCO the following matters will still need to be addressed and negotiated as to the detail of extent of such things as:

- how the demarcation of the identified habitat is to be achieved because various habitat areas interconnect with others and some habitat is likely better quality than other habitat but the full extent of its utilisation by the species is still not understood;
- what level of management/maintenance/monitoring might be required and for what duration;
- whether there will be a requirement for provision of other habitat elements within the study area and whether performance criteria will or won't be imposed;
- whether any areas of habitat outside the study area will require conservation and management and how many and to what extent is reasonable.

These are all somewhat open ended matters and available for interpretation as to the detail and scope, both missing from the BCO, in how certification is to be met once the specific surveys and mapping of GGBF habitat have been completed.

The GGBF Recovery Plan and PAS identifies the Riverstone population is an element of the western Sydney GGBF Key Population that requires strategic management across much of the Blacktown and surrounding LGAs eg Penrith.

A GGBF Key Population Management Plan for the western Sydney Key Population would satisfy the DECCs recovery planning requirements for MPs in the Sydney region and would, if implemented, likely achieve a more coordinated and strategic GGBF conservation outcome in western Sydney that includes the North West Growth Centre and Riverstone precinct.

The preparation of such Management Plans in other areas has generally been a very productive exercise that fosters collaboration across land owner/managers and spreads responsibility for the conservation of the GGBF more widely. However the responsible agency for undertaking preparation of such a management plan is the DECC and so is beyond being considered as a responsibility for the GCC. Previously the Hawkesbury Nepean Catchment Management Authority (HNCMA) has funded other such GGBF Key Population Management Plans using Commonwealth allocated CMA investment funds.

From a purely GGBF conservation outcome driven perspective, it is therefore recommended that the GCC enters into discussions with the DECC in relation to its meeting the requirements of BCO Condition 18 and in gaining Biocertification of the outstanding non-certified section of the Riverstone Precinct. Other opportunities or options for the DECC to consider regarding the BCO requirements and perhaps with potential for them to vary from the original specific intent should be discussed with the view to achieve a more strategic conservation outcome. The scope of such an approach would need to be agreed to by both the DECC and the GCC.

It is here further recommended for consideration that the existing high quality habitat areas within the study area, identified herein, be set aside from any proposed development footprint ('L' shaped area mapped and depicted in Figures 5 and 9 and the ill-defined overland flow path connecting the habitat area downstream) and that habitat enhancement initiatives be employed to improve the extent of the various habitat components present in this habitat element in this locality in accord with DECC 2008.

That other sites be identified for establishment as additional habitat 'nodes', via a rapid assessment process, and the areas so identified be similarly set aside and enhanced. The number and precise location of such nodes should be a matter for discussion and agreement between the GCC and the DECC and informed by the rapid assessment. It may be possible for a component of funding for such matters to come from the Growth Centres Conservation Fund to be established as part of BCO Conditions 20 and 21 (Appendix A).

That DECC, the GCC and perhaps the HNCMA enter into discussions with respect to catalysing the development of a GGBF Key Population Management Plan in accordance with the GGBF Recovery Plan. It may also be possible to integrate this with other initiatives including DECCs proposed reintroduction of GGBF at Scheyville/Long Neck Lagoon and/or through industry partners like Penrith Lakes Development Corporation who have previously expressed an interest in undertaking similar GGBF habitat creation and GGBF reintroductions at their site which also forms another component of the western Sydney GGBF Key Population.

That the process of preparing such a GGBF Key Population Management Plan be through a facilitated, consultative process that engages with key stakeholders and the community. GCC participation in such a strategic approach and adopting a wider scope and identify other opportunities for the conservation of the western Sydney GGBF population would not only be preferable to the securing of a small area of habitat in one locality, but would also be seen as a highly visible and meaningful effort by the GCC to conserve an important population of a high profile threatened species.

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