2 Study Area

The study area is contained within the North West Growth Centre located in the northwest sector of the Sydney Cumberland Plain taking in a substantial area of the Blacktown Local Government Area (LGA) along with smaller sections of Baulkham Hills and Hawkesbury LGAs (see Figure 1).

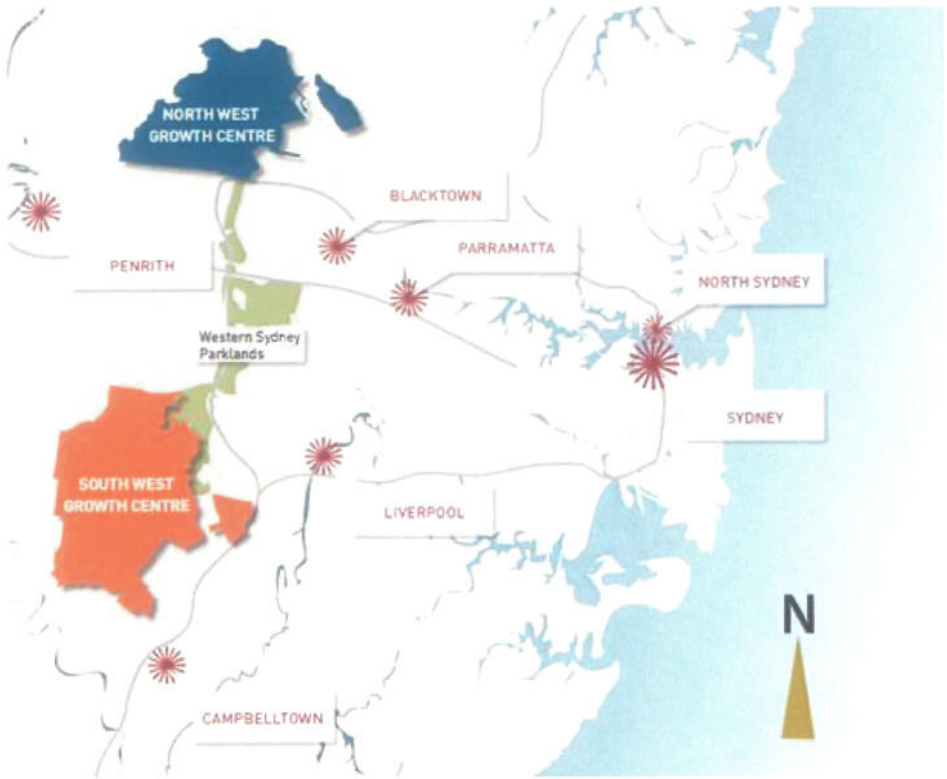

Figure 1 Growth Centres of western Sydney

The North West Growth Centre is divided into a series of precincts that are to undergo planning and staged approval. Figure 2 depicts the precinct boundaries of the North West Growth Centre.

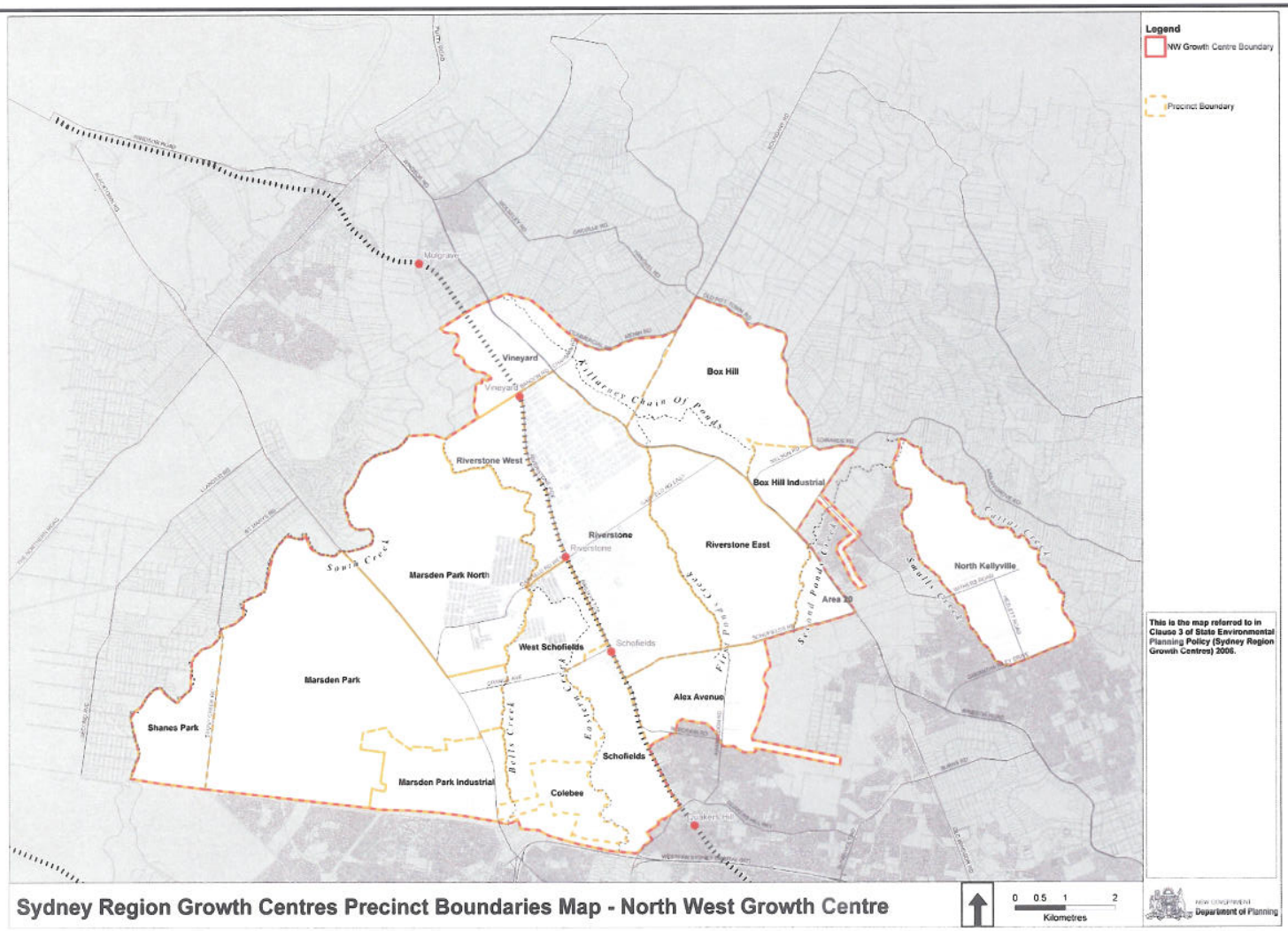

Figure 2 North West Growth Centre precinct layout

The Riverstone precinct has as its boundaries Schofields Road to the south, First Ponds Creek and Windsor Road to the east, the Blacktown to Richmond Rail corridor to the west and the proposed Vineyard precinct to the north (Figure 3). This precinct has an area of approximately 1,149 ha and contains the existing villages of Riverstone and Schofields with their associated residential and industrial zonings. It is proposed that areas of the precinct will be development as residential and other land use releases and include significant road and other infrastructure developments. Parts of the Riverstone precinct are currently zoned for Environmental Conservation and Public Recreation whilst other areas are constrained by flood affectation and required riparian zones.

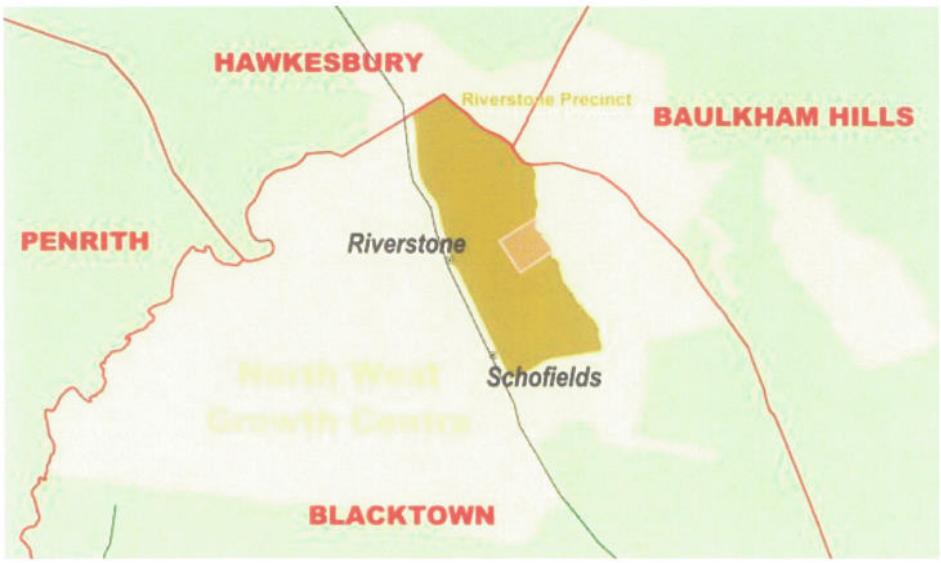

Figure 3 Riverstone Precinct and Study area

The study area within the Riverstone Precinct of the North West Growth Centre is defined as the 'non-certified' area identified within the Biodiversity Conservation Order (BCO – hatched area in Figure 3 above).

The subject land is more or less bound by Riverstone Road to the south east, Garfield Road to the north west, Clarke Street to the north east and McCulloch Street to the south west (see Figure 4).

Figure 4 Non-certified study area within the Riverstone Precinct

3 Method

3.1 DATA AUDIT

A search of the NSW Wildlife Atlas and other threatened species data sets was undertaken to provide a basis for previous records and more recent sightings of the Green and Golden Bell Frog (GGBF) for the Riverstone and wider North West Growth Centre. Interviews were also undertaken with other herpetologists that had historical experience with the GGBF in the Riverstone area.

Previous reports relevant to the area were read and reviewed as was information contained within the threatened species profiles, EIA guidelines and the draft recovery plan for the species.

3.2 AERIAL PHOTO INTERPRETATION

Orthorectified aerial photographs were provided by the Growth Centres Commission for analysis in combination with other spatial data sets. A desktop GIS analysis of the area was undertaken including an assessment of distributional records and other habitat attributes throughout the precinct.

3.3 FIELD SURVEY

A survey methodology for the GGBF was developed and designed to comply with the bio-certification requirements of the Growth Centres Conservation Plan and was framed against Appendix 2 of the DECC GGBF draft Recovery Plan (and GGBF Environmental Impact Assessment (EIA) Guidelines, (NPWS, 2001). The methodology was designed to maximise the opportunity of detecting the GGBF within a single survey season. The method includes three repeated but temporally separated survey efforts and the amended methodology was approved/endorsed by DECC on 2nd December 2008.

On Friday 12th December 2008 a reconnaissance visit was undertaken with Growth Centre Commission (GCC) project Manager Paul Robilliard, GCC Officer Tom Copping and, from the ELA survey team, Ross Wellington and Daniel Magdi. This preliminary visit was to identify the study area and property boundaries, familiarize team members with the general locality and to identify individual properties for which access and permission had been organised.

Three temporally separated, targeted surveys were then undertaken in accordance with the approved methodology.

Survey timing was as follows:

- Diurnal and nocturnal survey on Tuesday 16th December 2008 with a nocturnal survey on Wednesday 17th December 2008
- Diurnal and nocturnal survey on Friday 16th January 2009 with a nocturnal survey on Thursday 22nd January 2009
- Diurnal and nocturnal survey on Friday 20th February with a nocturnal survey on Saturday 21st February 2009

The prescribed methodology was specifically varied in consultation with the DECC so that there was a period of more than three weeks between survey efforts.

Survey techniques included diurnal searching of emergent rushes and sedges and other aquatic vegetation surrounding water bodies, such as pooled sections of First Ponds Creek, farm dams, depressions, pits, diversion channels and bunded areas that had been created by drainage works or flood mitigation works which retain rain and runoff water from time to time.

During the diurnal searches for basking individuals amongst emergent rushes and sedges, the GGBF's call was also imitated in an effort to elicit a response from any unobserved individuals that may have been present.

Water bodies were dip netted for tadpoles and all ground cover searched, which was able to be turned;. including logs, rocks, building material, concrete slabs and other refuse. This was carefully lifted and searched for refuging amphibians and then replaced.

Nocturnal surveys included call playback using a pre-recorded call of the GGBF on CD played back through a PA loud hailer. Call playback was undertaken at 6 sites on each evening and these sites are depicted in Figure 9.

The auditory survey consisted of an initial listening period at each site followed by 15 minutes of repeated replays of calls of the GGBF followed by 10 minutes of listening. Habitat in the vicinity of each call playback site was then thoroughly surveyed using headlamp and spotlight.

To determine/validate GGBF activity and detectability, prior to commencement of each survey, the property of Mr Lance Jurd at 46 Oxford Street Riverstone was visited. This property contains a semi captive colony of the GGBF and the yard is set aside almost entirely to provide various habitat elements for the GGBF. Mr Jurd was interviewed at the start of each survey period regarding any frog activity or calling he had observed. Mr Jurd's garden was also directly inspected for evidence of GGBF activity on each visit.

As an additional survey technique a focused community survey was also undertaken. Each of the schools at Riverstone were approached and provided with Green and Golden Bell Frog identification brochures and stickers produced by the DECC.

The Principal and or other relevant teaching staff were advised of the potential presence of the GGBF in the area and the purpose of the survey. The principal and teachers were asked to advise students of the possible presence of the GGBF and to strategically locate identification brochures around the school or in class rooms. Students were requested to notify the DECC Enviro Line or other contact number provided if any suspected observations of the species were made. A number of GGBF stickers were also distributed to students.

Schools visited:

- Riverstone High School – corner Riverstone Road and McCulloch Street
- St Johns Primary School – corner of Garfield and McCulloch Streets
- Norwest Christian College – corner of Regent and McCulloch Streets
- Riverstone Public School – Regent Street
- Casuarina School – Garfield Street

4 Results

4.1 DATA AUDIT AND ASSESSMENT

An assessment of the wildlife atlas revealed that 16 records of the Green and Golden Bell Frog have been registered in the Wildlife Atlas and associated licensed data sets within a radius of 10 kilometres of the study site. Of these records only two are relatively recent and only one is recent and within the study area (Table 2). These records constitute most of what is considered to make up the Western Sydney GGBF Key Population in the GGBF Threatened Species Recovery Plan (DEC 2005), (see Table 2).

Table 2 Previous records of the Green and Golden Bell Frog in an approximate 10km radius of study area

Observation Date	Observer	Location	Easting	Northing
1998	Arthur White and Leah Morgan	St Marys, Driving Range	294140	6263672
1994	Arthur White	Mt Druitt, power easement near Kurrajong Street	296236	6261736
1974	Arthur White	Pitt Town	301414	6280591
1994	Arthur White	Reserve land north of the railway line and east of Rope's Creek. T8	296200	6261800
1998	Arthur White	St Marys Leagues Club Site dam NE of driving range	294236	6263720
1998	Arthur White	St Marys ephemeral ponds east of driving range near Ropes Creek	294476	6263736
2001	Arthur White	St Marys Leagues Club Site	295650	6263600
1973	P Wettin	Long Neck Lagoon	304268	6282502
1969	Richard Wells	Eastern Creek now Nurragugy Reserve	301508	6261728
1968	Richard Wells	Elizabeth Macarthur Creek, ponds along	308568	6267964
1960	Richard Wells	Long Neck Lagoon	304056	6283200
1960	Richard Wells	Long Neck Lagoon	304232	6281896
1969	Richard Wells	Riverstone, Clarke Road	303536	6272024
2000	Richard Wells	Riverstone	303020	6271236
1969	Richard Wells	Riverstone High School	303004	6271272
1966	Richard Wells	Ropes Creek, ADI site	293676	6264852

During the formulation of the Growth Centres Conservation Plan, the most recent GGBF record at Riverstone was identified as occurring behind the Riverstone High School. Personnel in the Planning and Aboriginal Heritage Section of NSW DECC Metro Branch were required to provide advice to the Minister for Environment and Climate Change regarding the Growth Centre Conservation Plan and the application for biocertification of the Growth Centres SEPP. It is understood that the most recent observation of GGBF within the study area, coupled with the recognition of the significance of the record with respect to the western Sydney GGBF Key Population still persisting in the locality, triggered the requirement for further assessment (R. Mezzatesta, T. Hager and L. Peterson, pers. comm.; NSW DEC, 2005). It is further understood that it was on this basis that a buffer was placed around the most recent GGBF record and this defined the (non-certified) study area of the Riverstone Precinct.

4.2 PREVIOUS SURVEY REPORTS

A GGBF report was previously commissioned by the Growth Centres Commission to satisfy the BCO. Consulting company GHD Pty Ltd (GHD 2008) endeavoured to address the same issues and is briefly reviewed below.

The survey report documents field work that covered the lands constituting the non-certified area and followed a methodology that may have resulted in the detection of the GGBF if present. However the methodology did not follow the GGBF EIA guideline as closely as it could have. The survey timing was during a time towards the end of the species activity period in mid March of 2008. Survey effort was only made up of two visitations and these separated by a single week. The GHD report asserts that the survey effort and timing is in accordance with the survey guidelines for the GGBF. However the DECC Environmental Impact Assessment (EIA) Guideline for the GGBF (NPWS 2003) actually states *"It is likely that several visits to a site will be required to detect the species (ideally each survey separated by 2-4 weeks)"*. Similarly the GGBF EIA guidelines identify that a nearby reference point should be selected to determine GGBF activity as well as be undertaken during or immediately following suitable weather patterns. The GHD report further indicates that it relied on a verbal report from surveyors undertaking monitoring of the Sydney Olympic Park (SOP) GGBF population during February and weather information taken from the Bureau of Meteorology (BoM) site at Observatory Hill, nearer the coast.

Whilst none of these factors on their own mean that the surveys undertaken by GHD were lacking in rigor or were carried out during unsuitable conditions; together they may mean that the chances of finding the GGBF at Riverstone were reduced. The SOP site is some 26 km away and the Observatory Hill BoM site 38km away, from the Riverstone precinct study area where conditions and species activity may have been different. The intent of the DECC EIA guidelines is to maximise the likelihood of finding the GGBF because it is a species that can be difficult to detect when in low numbers and diffusely distributed. Notwithstanding the above, the EIA guidelines still do not guarantee detection. The GHD report contains some somewhat perfunctory general information about the GGBF that appears to be virtually verbatim from the species Recovery Plan (DEC 2005; GHD, 2008). The discussion and recommendations section deserves some merit as it provides useful suggestions that would assist the ongoing survival of the GGBF in the Riverstone precinct in the face of major development pressures on habitat and habitat quality that are likely to occur as a result of the wider NW Growth Centre land releases.

A survey and report was also commissioned by the NSW DECC to undertake surveys of historical GGBF sites in western Sydney where the species had been recorded (Jurd, 2008). This included sites identified in the NSW Wildlife Atlas comprising most of the western Sydney GGBF Key Population, as well as sites known to Lance Jurd but not previously entered into the Wildlife Atlas. Mr Jurd is a long time local resident of Riverstone, a frog enthusiast and maintains his residential allotment for the benefit of the GGBF (see Figure 7),

The DECC sponsored surveys failed to detect the GGBF at any of these former sites but documented the generally degraded or altered habitat condition at these sites. Most had factors that reduced the GGBF habitat quality including lack of fringing vegetation, presence of predatory fish (Gambusia, Carp and Eels), shading by emergent vegetation and lack of overwintering shelter or basking sites.

4.3 COMMUNITY SURVEY

The results of a community survey produced three unconfirmed observations of the GGBF in the study area and additional historic locality information from elsewhere in the precinct and NW Growth Centre. Another possible record from Cranbourne Street (off Clarke Street) was also reported but was considered likely to be a misidentification.

This information is presented in Table 3 below.

Table 3 Results of Community Survey

Date	Observer	Location	Easting	Northing
2008	Principal St Johns Primary School	Nunnery, released near school boundary	302572	6271712
2008	Principal St Johns Primary School	Playground, released near school boundary	302569	6271632
2007	Principal Riverstone HS	Girls toilets Riverstone HS; released at the back of the school.	302974	6271130
2009	Resident*	Cranbourne Street, off Clarke Street	303802	6271121
1974	Lance Jurd	Riverstone Meat works	301360	6271574
1975	Lance Jurd	2nd Ponds Creek	306495	6268569
1975	Lance Jurd	2nd Ponds Creek	305855	6268361
1975	Lance Jurd	2nd Ponds Creek	306414	6268034
2008	Lance Jurd	Residential record Wellington Street	301717	6272635
1976	Lance Jurd	Chain of Ponds Creek	301262	6275410
1976	Lance Jurd	Chain of Ponds Creek	301514	6275291
1977	Lance Jurd	Bush Rd near Long Swamp Maraylya	308716	6280885

*** likely misidentification**

4.4 SITE DESCRIPTION

4.4.1 Site characteristics

The study area is approximately 76 ha in area and is bound by the streets indicated in Section 2 and depicted in Figure 4 above. The site was searched for various habitat components and areas, that had obvious breeding, foraging, and shelter attributes, were plotted using a GPS and mapped in a GIS see Figure 5 below.

The site slopes generally in a south west to the north east direction towards First Ponds Creek. A heavily modified lateral creek traverses the centre of the study area in the same direction. First Ponds Creek is also heavily modified with ponded areas, diversions to dams and other bunding and earth

works associated with it. Most of the study site is cleared of much of the natural vegetation and has been used for various small scale agricultural activities including nursery, market gardens, dog kennels, stock grazing, agistment as well as dwelling houses. The upper most section of the study area is occupied by Riverstone High School and the Norwest Christian College, both fronting McCulloch Street.

Figure 5 Habitat areas of the GGBF mapped within the study area.

4.4.2 Vegetation Assessment

Vegetation across the site is primarily cleared grassland of predominantly introduced grasses and weed species but some areas still retain patches of native grasses. Some sections of First Ponds Creek maintain small stands of *Casuarina glauca* as a simple riparian zone while a few upslope areas have small patches of remnant *Eucalyptus tereticornis* indicative of a former cover of Cumberland Plain Woodland.

Freshwater wetland species predominated around the low lying depressions of the floodplain and bordering constructed dams and bunded areas. Species included *Typha ssp*, *Eleocharus sphaecelata*, *Juncus usitatus*, *Carex adpressa*, *Cyperus ssp* and *Triglochin procerum*.

These species are indicators of periodic or more permanent inundation and provide elements of the required foraging, shelter and basking habitat as well as complementing the ephemeral and permanent water bodies that provide breeding habitat for the species in the study area.

4.4.3 Drainage Assessment

The main drainage line traversing the study area is a section of First Ponds Creek. The creek meanders more or less in a NNW direction parallel to Chain of Ponds Creek and Eastern Creek towards its confluence with South Creek and then the Hawkesbury River.

Parts of the study area, sections of the precinct and the broader Growth Centre adjacent to the creeks are identified as flood prone. These areas are likely to have restricted development potential. Similarly riparian zones along the creeks will likely be retained and rehabilitated as part of the overall precinct conservation strategy and to conform with aspects of the WM Act.

These areas are all likely to contain elements of suitable GGBF habitat. They also provide a connectivity network throughout the Growth Centre as well as opportunities for GGBF habitat creation and enhancement initiatives. Much of the identified habitat areas within the study area are contained within the 1% AEP level indicated land or adjacent to it.

Figure 6 depicts the drainage of the study area and its surrounds and also indicates the 1% AEP flood liable land and riparian buffers.

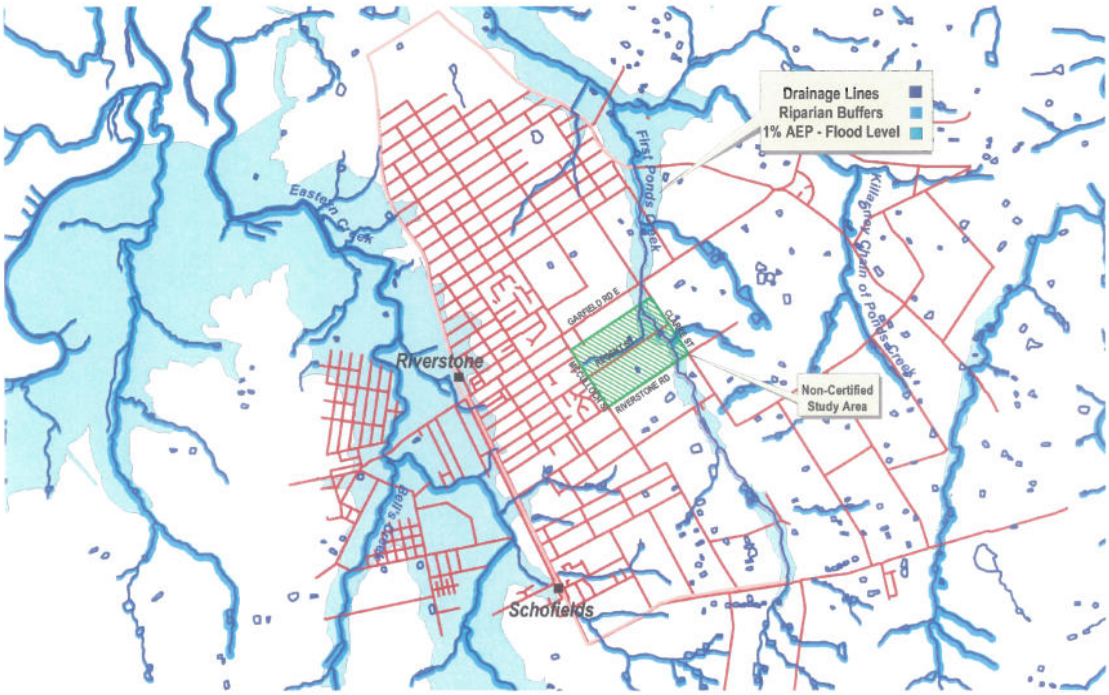

Figure 6 Flood liable and riparian buffer zones in the locality

Figure 7 No. 48 Oxford Street Riverstone

4.4.4 Reference Site

The private residence of Mr Lance Jurd is located at 48 Oxford Street Riverstone. It is approximately 700 metres in a straight line distance from the study area, at its closest point, and approximately 1200 metres in a straight line distance from the main areas of habitat surveyed within the study area. It was considered that the semi-wild population of the GGBF at this residence would be likely to provide an indication of cues that were the same or similar to that which were being experienced by other wild specimens of the target species elsewhere at Riverstone. No other closer reference populations are known.

Mr Jurd's 48 Oxford Street residence is situated in an average residential area; however the front and back yard have approximately 10 water filled ponds of various sizes and styles randomly positioned throughout. The garden area is overgrown with long Kikuya grass that surrounds the ponds. An aviary area also contains a pond and has a funnel trap set up in the roof to attract and collect insects as supplementary food for the large GGBF population that is located there. The ponds were observed to contain many thousands of tadpoles at various stages of development including many at or near metamorphosis. Adult, juvenile and metamorphling frogs were also observed to be present surrounding and in the ponds as well as throughout the elongated vegetation covering the garden area.

Figure 8 Recently metamorphosed GGBF juveniles and breeding pond at Oxford Street Riverstone

4.5 FROG SURVEY RESULTS

Climatic parameters were considered to be identical between the reference site and the study area and surveys were undertaken during or immediately following ideal conditions when diurnal temperatures and humidity were high and, where possible, when thunderstorms were threatening. Rain fell during the first survey period, in the same week but prior to the second survey period and immediately following the third survey period of this study.

Climatic data recorded for the meteorological site at Richmond (approximately 10 km from the study area in western Sydney) are provided in Table 4 below.

Table 4 Prevailing Climatic Data

Date	Temp^0 C	Rainfall mm	Relative Humidity %	Details
16th December 2008	28.8		76	34 mm of rain fell on previous 2 days
17th December 2008	29.7		70	heavy cloud cover during evening survey
16th January 2009	34.9	4	72	heavy cloud cover during evening survey
22nd January 2009	32.8	1.8	65	
20th February 2009	32.4	5	45	
21st February 2009	26.8	2	87	Heavy cloud cover during evening survey

Table 5 below shows the composite survey results of frogs detected by all methods. Sites are as indicated in Figure 9 below.

Two juvenile GGBFs were detected amongst Kikuyu on the margins of the Cumbungi covered ephemeral breeding area near Site 3 during the third survey period and another probable but unconfirmed sighting near Site 2 during the first survey period.

Table 5 Frog Survey Results

Common Name	Scientific Name	Status	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Brown Toadlet	*Crinia signifera* #	P	X		X	X	X	X
	Uperoleia laevigata #	P						
Brown-striped Marsh Frog	*Limnodynastes peronii* #	P	X	X		X	X	X
Spotted Marsh Frog	*Limnodynastes tasmaniensis* #	P				X	X	X
Green and Golden Bell Frog	*Litoria aurea*	E		X?	X			
Dwarf Green Tree Frog	*Litoria fallax* #	P	X			X	X	X
Brown Tree Frog	*Litoria peronii* #	P				X	X	X
Whistling Grass Frog	*Litoria verreauxii*	P				X	X	X

Some species were also observed opportunistically at other non survey sites and are indicated by #; ? = probable but unconfirmed sighting; P = protected; E = Endangered

Figure 9 Frog Survey Sites