



Green and Golden Bell Frog Monitoring, Arncliffe, Annual Report for 2023-2024



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Recipient:	Mike Pereira
Authors:	Glenn Muir, Yang Hu, Santiago Cuartas Villa and Chris Jackson
Approved by:	Glenn Muir
Cover Photo:	Green and Golden Bell Frog at Pond A in the M8 Marsh Street Habitat Area. Photo credit: Henry Cook

Contents

1	Introduction.....	4
1.1	Background	4
1.2	Study Area.....	5
1.3	Scope.....	5
1.4	Objectives	5
1.5	Summary of Previous Monitoring Results	7
1.6	Weather Conditions in 2023 - 2024.....	10
2	Methods.....	11
2.1	Captive Breeding and Tadpole Transfer.....	11
2.2	Water Quality Monitoring and Maintenance Checks	11
2.3	Tadpole Monitoring	12
2.4	Frog Monitoring.....	12
3	Results.....	14
3.1	Captive Breeding and Tadpole Transfer.....	14
3.2	Water Quality Monitoring.....	14
3.3	Tadpole Monitoring	15
3.4	Frog Monitoring.....	15
3.5	Maintenance.....	22
4	Discussion.....	23
5	Conclusion.....	24
6	References.....	25
	Appendix A: Water quality data	26
	Appendix B: Tadpole net sweep results	36
	Appendix C: Frog monitoring data for sites outside the M8 Marsh Street habitat area	41

Tables

Table 2.1:	Survival Threshold Range and Higher Survival Range for GGBFs and GGBF tadpoles identified by Mahoney and Beranak.....	12
Table 3.1:	Summary of GGBF tadpole releases in 2023-2024.....	14
Table 3.2:	M8 Marsh Street habitat area GGBF capture results.....	17
Table 3.3:	Frogs observed or heard but not captured (all species), M8 Marsh Street habitat area...18	
Table 3.4:	Observations of GGBFs outside of the M8 Marsh Street habitat area during the 2023-2024 monitoring season.....	20

Figures

Figure 1.1:	Study Area.....	6
Figure 1.2:	Weather data September 2023 to May 2024.....	10
Figure 3.1:	Estimated GGBF population size 2019-2024.....	23

1 Introduction

1.1 Background

AMBS Ecology & Heritage Pty Ltd (AMBS) was commissioned by Transport for NSW (TfNSW) to undertake monitoring of the Green and Golden Bell Frog (*Litoria aurea*) (GGBF) at Arncliffe. This report describes the monitoring and other GGBF management actions undertaken between June 2023 and May 2024. The GGBF monitoring and management is being undertaken in response to conditions of approval and management plans associated with project approvals for the recently constructed M8 motorway (previously referred to as the “New M5” motorway) and the previously constructed M5 East motorway.

Construction of the M5 East commenced in the late 1990’s and the motorway was opened in 2001. The M5 East connects General Holmes Drive in Mascot to the M5 motorway at King Georges Road. There is a tunnel under the Cooks River and a second tunnel west of Marsh Street, Arncliffe. The section between the two tunnels is above-ground and passes between Kogarah Golf Course to the north and the Barton Park Driving Range and Eve Street Wetlands to the south.

Due to impacts on an area known as the “Marsh Street Wetland” (a habitat area for the GGBF), a management plan for the GGBF was prepared (White, 1998). Implementation of this management plan included the construction of two frog ponds on the northern side of the M5 East, adjacent to Kogarah Golf Course. These two ponds are generally referred to as the “RTA Ponds” (Figure 1.1), but have also been referred to as the “M5 East Ponds” (e.g., in DECC [2008]) and are referred to as “Habitat Area 1” in White (1998). In this report these ponds will be referred to as the RTA Ponds.

Construction of the M8 commenced in July 2016. This project was originally called the “New M5” and has since been re-named as the “WestConnex M8”. Much of the documentation associated with the project, including the management plans and the infrastructure approval, still refer to the project as the New M5. In this report the project will be referred to as the M8.

The M8 involved the construction of twin underground tunnels between the M5 East at Kingsgrove to a new interchange at St Peters. A construction compound for the project was established on Kogarah Golf Course. The compound is approximately 7.8 ha in size and is located within 50 m of the RTA Ponds (Figure 1.1).

Conditions of Approval B14 and B15 for the M8 (SSI 6788) included a requirement to prepare a Plan of Management (PoM) for the GGBF (EcoLogical 2018) and a Habitat Creation and Captive Breeding Plan (HCCBP) (EcoLogical 2017). Together these plans outline:

- measures to minimise impacts from construction works on GGBF habitat in the RTA Ponds and Kogarah Golf Course;
- the establishment of a new habitat area for the GGBF south of the M5 East, between Marsh Street and Eve Street (the “M8 Marsh Street habitat area”; Figure 1.1);
- the establishment of six small “stepping-stone” ponds along the southern boundary of Kogarah Golf Course, east of the RTA Ponds (the “Enhancement Area”; Figure 1.1); and
- the establishment of a captive breeding facility at Symbio Wildlife Park.

The M8 project included the installation of permanent infrastructure (ventilation towers and water treatment facilities) located north of the RTA Ponds. With the exception of the area occupied by these permanent facilities, most of the area currently occupied by the compound was intended to be re-instated after construction of the M8 was completed. However, the compound is now being used for the construction of the M6 Stage 1 and re-instatement has been delayed until that project is complete.

1.2 Study Area

The Study Area includes the following locations (Figure 1.1):

- the M8 Marsh Street habitat area (previously known as the “New M5 Marsh Street habitat area”) – an area set aside for the establishment of potential GGBF habitat, including three ponds and surrounding terrestrial habitat, located south of the M5 between Marsh Street and Eve Street;
- the “Creek” area – a drainage line near the M8 Marsh Street habitat area, which runs eastwards from a stormwater outlet below Marsh Street to the Eve Street Wetland Reserve;
- the RTA Ponds – two ponds constructed as replacement habitat for the GGBF when the M5 was built (late 1990’s to early 2000’s), by the then NSW Roads and Traffic Authority (RTA), located near the Marsh Street/M5 intersection and adjacent to the Kogarah Golf Course;
- the Enhancement Area – six small ponds located near a drainage line that runs along the southern boundary of the Kogarah Golf Course, east of the RTA Ponds;
- Kogarah Golf Course – a golf course located between Marsh Street and the Cooks River, which contains a number of water features;
- Riverine Park surrounds* – parts of the area between the M5 and the Spring Street canal, where GGBFs have been recorded or potentially suitable habitat occurs;
- Barton Park* – parts of the area in the northern section of Barton Park;
- Underpass – a passageway below the M5 East, which contains a pedestrian/bicycle path and a fenced-off containment pond.

* N.B. “Riverine Park surrounds” and “Barton Park” are referred to collectively in some previous reports as “Barton Park” and/or “the extended search area in Barton Park”.

1.3 Scope

Monitoring and management of the GGBF at Arncliffe in 2023-2024 included:

- transfer of captive-bred tadpoles from the breeding facility and their release into the ponds in the M8 Marsh Street habitat area and one of the RTA Ponds;
- nocturnal frog surveys in the M8 Marsh Street habitat area;
- support feeding of frogs in the M8 Marsh Street habitat area;
- removal of Striped Marsh Frogs (*Limnodynastes peronii*) from the M8 Marsh Street habitat area and their release into the adjacent creek (under a licence provided by the Office of Environment and Heritage [OEH] under the NSW Department of Climate Change, Energy, the Environment and Water);
- nocturnal frog surveys in the RTA Ponds, Enhancement Area, Kogarah Golf Course, Perimeter, Creek, Underpass, Riverine Park surrounds and Barton Park;
- tadpole surveys and water quality measurements undertaken in the M8 Marsh Street Habitat area, RTA Ponds, Enhancement Area, Kogarah Golf Course, Riverine Park surrounds and Barton Park;
- management of water levels in the M8 Marsh Street habitat area, salting of Pond B and building of refugia.

1.4 Objectives

The objectives of the monitoring program as stated in the PoM are “to assess the ongoing survival of the Arncliffe population at the Kogarah Golf Course and within the RTA Ponds” and in the HCCBP as “to provide information for adaptive management on the effectiveness of the habitat created as part of the project.”



Figure 1.1: Study Area.

1.5 Summary of Previous Monitoring Results

1.5.1 GGBF Monitoring for the M5 East

Monitoring of GGBFs at Arncliffe was undertaken by Dr Arthur White (Biosphere Environmental Consultants Pty Ltd) until 2017-2018. Surveys carried out in 1999-2000 and 2000-2001 showed an increase in the number of GGBFs in the RTA Ponds and a decrease in the Marsh Street Wetland (ELA 2018). Subsequent monitoring was mainly confined to the RTA Ponds and Kogarah Golf Course.

Each year between 2003-2004 and 2012-2013 the RTA Ponds and Kogarah Golf Course supported a population of GGBFs estimated to comprise a maximum of about 60 – 80 adults (except in 2011-2012, when the estimate was between 100 and 120 adults [numbers derived from Figure 2 in ELA 2018]). Breeding was recorded in the RTA Ponds in every year until 2014 (ELA 2017). GGBFs were regularly recorded on Kogarah Golf Course and tadpoles were recorded on a few occasions (the “pond to the east of the Crescent Lake on the Kogarah Golf Course in January / February 2003 and November 2005” [A Hamer, pers. comm. 2017 and A White, pers. comm. 2015 in ELA 2017]).

After 2012-2013 the population appears to have been in decline. In 2013-2014 the number of adult GGBFs captured was too low for a population estimate to be calculated (ELA 2018). In 2014-2015 the maximum population size was estimated to be fewer than 40 adult frogs. In 2015-2016 only a few GGBFs were captured (six in November 2015 and eight in February 2016, the latter being over 5 consecutive nights of survey) (ELA 2017). However, a GGBF breeding event was recorded “in a large, ponded area between the RTA Ponds and the Kogarah Golf Course” in January 2016 (ELA 2017).

1.5.2 Implementation of the PoM and HCCBP and GGBF monitoring 2016-2017 and 2017-2018

In 2016-2017 surveys of the GGBF were expanded to include a number of areas south of the M5 as well as the RTA Ponds and Kogarah Golf Course (White 2017). Three juveniles were found in the RTA Ponds in September 2016, two were detected on Kogarah Golf Course in October 2016 (one in the “Southern Drain” and one in the Circular Pond), and between one and three GGBFs were observed on four occasions between October 2016 and March 2017 in the expanded survey area (White 2017).

In 2017 the HCCBP was implemented. Eighteen GGBFs found in the RTA Ponds, Kogarah Golf Course or the expanded survey area south of the M5 were transferred to Symbio Wildlife Park in February 2017 (Biosphere 2017a). Construction of the stepping-stone ponds in the Enhancement Area was completed by May-June 2017 (Biosphere 2017b, c) and construction of the M8 Marsh Street Habitat Area was completed over the following year.

In 2017-2018, after the transfer of animals to the captive breeding facility, only two GGBFs were detected; one in the south-eastern corner of Kogarah Golf Course and one in “Barton Park”.

1.5.3 GGBF monitoring 2018-2019

AMBS commenced monitoring of the GGBFs at Arncliffe in September 2018, by which time the construction of the M8 Marsh Street habitat area was complete. Captive breeding of the GGBFs at Symbio Wildlife Park commenced. Approximately 3,500 captive-bred tadpoles were released into the ponds in the M8 Marsh Street habitat area over February and March 2019. Juvenile GGBFs began to be observed almost immediately. Surveys in March and April 2019 recorded well over 100 animals and sometimes more than 200 animals. The average size and weight of the animals increased over time and by April 2019 a small proportion of the animals were large enough to be implanted with a PIT tag. By early June, 16 GGBFs had been tagged.

Two juvenile GGBFs were observed outside the boundary fence during surveys conducted in May 2019.

Outside of the M8 Marsh Street habitat area, monitoring in 2018-2019 included surveys of the RTA Ponds, Enhancement Area, a selection of waterbodies on Kogarah Golf Course and a range of sites south of the M5. No GGBFs were detected in any of these sites. It should be noted that this season marked the commencement of a period of very low rainfall across NSW.

1.5.4 GGBF monitoring 2019-2020

The 2019-2020 season was characterised by extreme weather events, with an extended period of hot, dry conditions followed by heavy rainfall. Conditions between mid-October 2019 and mid-January 2020 were particularly poor, with most of south-eastern Australia in the midst of a drought and a severe bushfire season. There was a short period of heavy rain and thunderstorms in the middle of January 2020 (16-18 January); however, in general the month was characterised by extreme heat, low rainfall, bushfires and poor air quality.

An extreme rainfall event in February 2020 marked the end of this period of extreme heat and dry weather. Approximately 390 mm of rain fell in a 4-day period from 7 to 10 February 2020 (recorded at Observatory Hill by the Bureau of Meteorology). Over those 4 days many parts of Greater Sydney were subject to local flooding and some sites received their highest February rainfall on record. The heavy rain caused a large tree in Eve Street to fall, which landed across the frog fence surrounding the M8 Marsh Street habitat area.

During the drought, the habitat within the M8 Marsh Street habitat area was managed by using water from an on-site tank to top up the ponds and to dampen some of the terrestrial vegetation. A survey in October 2019 was undertaken prior to the release of captive-bred tadpoles in 2019-2020 and counted 110 GGBFs, approximately a third of which were large enough to be tagged. Male GGBFs were heard calling, but no other evidence of breeding was observed and no GGBF tadpoles were recorded in September or October.

Between the end of October 2019 and January 2020, a total of approximately 4,500 captive-bred GGBF tadpoles were released into the M8 Marsh Street habitat area. Juvenile GGBFs were observed in or adjacent to the ponds in November, December and January, shortly after the tadpole releases. At the end of the season a population estimate obtained from mark-recapture data indicated approximately 680 adult GGBFs (the 95% confidence interval being 336-1022 individuals).

No GGBFs were recorded anywhere outside of the M8 Marsh Street habitat area in the latter half of 2019. However, after the rain in January 2020, GGBFs began appearing outside of this area, mainly in nearby locations. Some of these frogs contained microchip codes confirming that they had escaped from the M8 Marsh Street habitat area.

A GGBF breeding event was recorded in the RTA Ponds in January 2020.

After the heavy rain event in February and the tree falling on the perimeter fence, dispersal to other areas was rapid. GGBFs appeared in a number of locations both south and north of the M5 East, including the RTA Ponds, the Enhancement Area, Riverine and Barton Parks and some of the ponds on the Kogarah Golf Course. However, none of the GGBFs that were found north of the M5 East had been tagged in the M8 Marsh Street habitat area; it was therefore unclear whether the animals recorded north of the M5 East had originated from the M8 Marsh Street habitat area, or from the breeding event in the RTA Ponds, or both.

1.5.5 GGBF monitoring 2020-2021

A survey of the M8 Marsh Street habitat area and the RTA Ponds in October 2020 found GGBFs in all ponds in the M8 Marsh Street habitat area, including calling males in Pond B and Pond C, and one GGBF in the Western RTA Pond.

Between the end of October 2020 and January 2021 a total of approximately 4,500 captive-bred GGBF tadpoles were released into the M8 Marsh Street habitat area. In December 2020 approximately 500 captive-bred tadpoles were released into the Western RTA Pond. No GGBF tadpoles were detected in either area prior to the release of captive-bred tadpoles and no GGBF tadpoles were detected in any of the other sites during the season.

At the end of the season a population estimate for the M8 Marsh Street habitat area, obtained from mark-recapture data indicated approximately 470 adult GGBFs (with a 95% confidence interval of 412-527).

GGBFs were also recorded (but in much lower numbers) in many locations outside of the M8 Marsh Street habitat area. These included several locations south of the M5, the RTA Ponds, the Enhancement Area and three of the water features on Kogarah Golf Course.

1.5.6 GGBF Monitoring 2021-2022

The 2021-2022 monitoring season was characterised by low numbers of GGBFs compared to the previous three years and very few tadpoles introduced from the captive breeding program.

GGBFs were recorded in the M8 Marsh Street habitat area early in the season (October), including several calling males, although numbers were relatively low compared to the initial post-winter surveys of previous seasons. No GGBF tadpoles were detected. At the same time, most of the captive breeding attempts undertaken at Symbio Wildlife Park failed. As a result, only about 230 captive-bred GGBF tadpoles were released into the M8 Marsh Street habitat area (compared to several thousand in previous years) and a proportion of these became deformed as they grew. However, evidence of successful on-site breeding was detected in Pond B of the M8 Marsh Street habitat area later in the season. At the same time a small number of juvenile and “sub-adult” GGBFs were recorded in a few locations, indicating that there was at least some natural recruitment to the population later in the season.

At the end of the season a population estimate for the M8 Marsh Street habitat area, obtained from the mark-recapture data, indicated a population of approximately 46 adult GGBFs (with a 95% confidence interval of 27.7 - 64.5).

One of the results from 2021-2022 was the detection of GGBF movement between the north and south of the M5. Although only a single individual has been recorded, it demonstrates that movement between these areas is possible.

The key outcomes of the 2021-2022 season were:

1. A GGBF breeding event was recorded in the M8 Marsh Street habitat area;
2. Movement of one GGBF between the north and south of the M5 was detected;
3. A population of GGBFs was present in the M8 Marsh Street habitat area (with a small number of individuals occupying other sites), but the number of animals present was very low in comparison to previous years when captive-bred tadpoles were introduced.

1.5.7 GGBF Monitoring 2022-2023

The initial results for 2022-2023 indicated that GGBFs had overwintered successfully and were occupying the M8 Marsh Street habitat area in spring 2023. Numbers were low compared to previous years, as would be expected after the results from 2021-2022.

Captive breeding at Symbio Wildlife Park was successful in 2022-2023 and approximately 4,700 tadpoles were released into the M8 Marsh Street habitat area. A further 1850 tadpoles were released into the Western RTA Pond.

As with previous years, the release of tadpoles resulted in a large number of GGBFs occupying the M8 Marsh Street habitat area during the season, with the population estimate for that site being approximately 604 adult GGBFs. GGBFs were also observed around the RTA Ponds, particularly in March 2024, but in much lower numbers than in the M8 Marsh Street habitat area. A few individuals were occasionally observed in some of the other survey sites, most frequently in the Enhancement Area.

1.6 Weather Conditions in 2023 - 2024

After a relatively dry start to the season, from November onwards above average rainfall was recorded at the Sydney Airport weather station (Figure 1.2). Overall, approximately 1005 mm of rain was recorded between September and May, compared to the long-term average of 825 mm. The months of November, December, February, April and May all recorded above average monthly rainfall. The highest level of precipitation recorded in one day was 143 mm on 6 April 2024.

Mean monthly temperatures were above average for almost the entire season, with a mean maximum monthly temperature of 25.4°C compared to the long-term average of 23.9°C, and a mean minimum monthly temperature of 16.8°C compared to the long-term average of 15.5°C, for the months between September and May. There were eight days of extreme heat (over 35°C), compared with three in 2022-2024, two in 2021-2022, five in 2020-2021 and nine in 2019-2020.

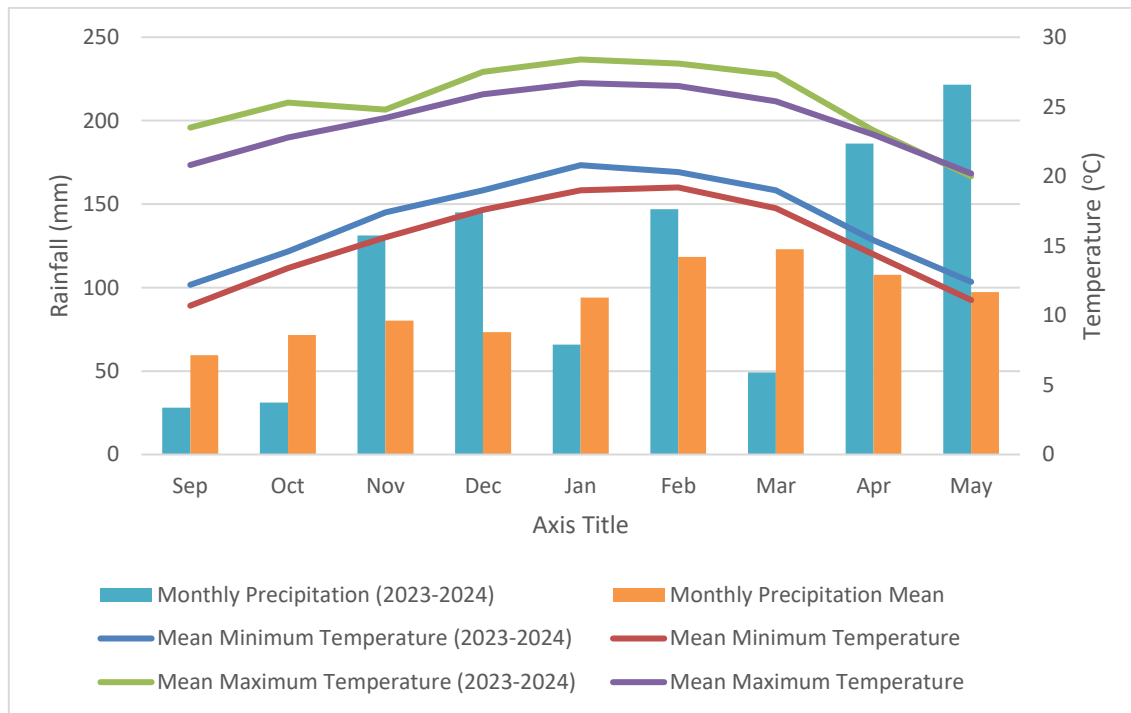


Figure 1.2: Weather data September 2023 to May 2024 (Sydney Airport 066037; Australian Bureau of Meteorology 2024).

2 Methods

2.1 Captive Breeding and Tadpole Transfer

Prior to any tadpole releases, inspections of the recipient sites, including tadpole surveys and sampling of water quality and temperature were undertaken. Searches for Striped Marsh Frogs and their foam egg nests also took place, with any captured Striped Marsh Frogs or collected egg masses removed from the recipient sites.

Husbandry and breeding of the captive GGBFs was undertaken by Symbio Wildlife Park in Helensburgh. Tadpoles resulting from fertilised spawnings were raised until ready for transfer to Arncliffe. Tadpoles were then placed in plastic bags containing water from the rearing tank and air. The bags were sealed at the top to minimise water movement during transportation and transported immediately to the release site in an air-conditioned vehicle.

At the release site, the bags were opened and placed in the target release pond to enable temperature equilibration before release. Water from the release pond was then gradually introduced to the bags. If no negative responses were apparent, the tadpoles were released into the pond. A sample of the tadpoles were released into meshed enclosures placed in each pond, to assist with monitoring post-release development.

After release, tadpoles in the meshed enclosures were checked every 30 minutes for a period of at least 2 hours, then checked again after 24 hours, 72 hours, and then every 2-3 days until released. Each check involved an examination and count of the tadpoles, releasing any that were close to metamorphosis, and support feeding. Water levels and observations of tadpoles in the ponds were made and water was added if necessary. Net sweeps were avoided in order to minimise disturbance. A limited amount of support feeding of tadpoles in the ponds was undertaken.

2.2 Water Quality Monitoring and Maintenance Checks

Water quality and temperature surveys were undertaken approximately once per month between September 2023 and May 2024 (except for any ponds or waterbodies that were dry, too shallow for sampling, or overgrown with vegetation). Sample sites included the M8 Marsh Street habitat area, the RTA Ponds, the Enhancement Area, and a selection of sites in Kogarah Golf Course, the Riverine Park surrounds and the northern end of Barton Park (consistent with monitoring from previous seasons and monitoring previously undertaken by Dr Arthur White). Water was not present in all ponds in all months and some sites in the Riverine Park surrounds and Barton Park were inaccessible.

The water quality surveys were undertaken using a Hanna IC-HI98194 hand-held probe. The key parameters that were measured include:

- temperature (°C);
- salt concentration in either Practical Salinity Units (PSU) or parts per thousand (ppt);
- pH;
- dissolved oxygen (% saturation and milligrams per litre [mg/L]);
- conductivity (uS/cm);
- turbidity (NTU or FNU);
- oxidation reduction potential (mV).

Results of the temperature, salinity, pH and dissolved oxygen were compared with thresholds for GGBF and GGBF tadpole survival identified by Mahony and Beranak (undated), which provided ranges within which frogs and tadpoles survive, as well as a “higher survival range” in which the highest number of tadpoles survive (Table 2.1).

Table 2.1: Survival Threshold Range and Higher Survival Range for GGBFs and GGBF tadpoles identified by Mahoney and Beranak.

Parameter	Higher Survival Range	Survival Threshold Range		
	Tadpoles	Tadpoles	Frogs	Calling Males
Water Temperature (°C)	20 – 37	10.8 - 40.7	3.6 - 40.7	14.1 - 33
Salinity (ppt)	< 4	< 8	< 26.2	< 8
pH	7.0 - 11.8	3.5 - 12.4	2.8 - 13.5	5.0 - 10.4
Dissolved Oxygen (mg/L)	0.14 – 16	0.13 - 17.6	0.13 - 18.2	0.15 - 18.2

Maintenance checks were generally undertaken at the same time as the water quality monitoring and included assessments of:

- water level;
- presence of the introduced fish *Gambusia holbrooki*;
- density of macrophytes (in the constructed ponds);
- weeds (in the constructed pond areas);
- the frog exclusion fence surrounding the M8 Marsh Street habitat area;
- evidence of feral predators;
- any other notes of relevance.

2.3 Tadpole Monitoring

Tadpole surveys were undertaken approximately once per month between September 2023 and May 2024. Sample sites included the M8 Marsh Street habitat area, the RTA Ponds, the Enhancement Area and a selection of sites in Kogarah Golf Course, Riverine Park surrounds and the northern end of Barton Park. Water was not present in all ponds in all months. Some sites in the Riverine Park surrounds and Barton Park were inaccessible, including the Northern Phragmites area and Number 9 Pond for the entire season, and the Eastern Channel and Landing Lights East during parts of the season.

Survey techniques followed those previously undertaken on previous seasons and those of Dr White. Upon reaching each survey site, two ecologists observed the water surface to investigate whether there was tadpole activity. Sweeps of the waterbody were then made with a long-handled net (ten sweeps in most ponds and three sweeps in each of the small ponds in the Enhancement Area). Tadpoles captured in the net sweeps were identified to species when possible and life history stage recorded.

2.4 Frog Monitoring

2.4.1 M8 Marsh Street habitat area

Nine nocturnal frog surveys were undertaken in the M8 Marsh Street habitat area between October 2023 and May 2024. Survey techniques involved a combination of call detection, call playback, spotlighting, and mark-recapture. The majority of the surveys were undertaken between February and May 2024 and focused on mark-recapture to obtain a population estimate.

Call playback was undertaken at each pond prior to undertaking spotlighting as follows: listening for calling frogs – 3 minutes; GGBF call playback – 30 seconds; listening – 30 seconds; GGBF call playback – 30 seconds; listening – 30 seconds. All frogs heard calling were identified and an estimate of the number of calling frogs of each species was made.

Spotlighting involved timed searches of each pond, with duration varying according to the size of the pond. All frogs observed were counted and as many GGBFs as possible were captured. All captured GGBFs large enough to have a tag were scanned and, if previously tagged, the tag number

was recorded. All captured GGBFs were weighed, snout-urostyle length (SUL) was measured, any untagged animals over 40 mm SUL were tagged and then the frogs were released at the site of capture. The tags used were Trovan ID100 FXD-A Midichip Passive Integrated Transponders (PIT tags, also referred to as “microchips”), which were implanted subcutaneously. A Cyanoacrylate compound (Vetbond®) was applied to seal the insertion site, as per Murray *et al.* (2011).

Timed surveys were also undertaken around the inside of the perimeter fence and along a drainage swale located inside the habitat area downslope of the ponds. In these areas the frogs were counted but not captured.

2.4.2 RTA Ponds, Enhancement Area, Kogarah Golf Course, Underpass, Riverine Park surrounds and Barton Park

Twelve frog surveys outside of the M8 Marsh Street habitat were undertaken between November 2023 and May 2024, including repeat surveys of the RTA Ponds, Enhancement Area, Creek, Underpass, and a selection of sites in Kogarah Golf Course, Riverine Park surrounds and the northern end of Barton Park. Water was not present in all ponds in all surveys. Some sites in the Riverine Park surrounds were inaccessible, including the Northern Phragmites area and Number 9 Pond for the entire season, and the Eastern Channel and Landing Lights East for parts of the season.

Survey techniques were the same as described for the M8 Marsh Street habitat area; i.e., call detection, call playback, a timed spotlight survey, with duration of the spotlight survey depending on the size of the pond, and measurement, tagging and release of any GGBFs able to be captured.

2.4.3 Population Estimate

GGBF population estimates were undertaken by The Analytical Edge using mark-recapture data collected from the M8 Marsh Street habitat area. Closed population capture-recapture models were fitted in R (v. 4.4.0, R Core Team 2024) using RMark (v. 3.0.0, Laake 2013), which is an interface with the software package MARK.

3 Results

3.1 Captive Breeding and Tadpole Transfer

Inspections of the captive breeding facility by AMBS found the facility to be well-kept, with hygiene procedures and controls in place. Animals were paired following the recommendations of the Australian Museum (2018) and several spawnings occurred.

Approximately 5050 captive-bred GGBF tadpoles were collected from the captive breeding facility at Symbio Wildlife Park and transported to the M8 Marsh Street habitat area or the RTA Ponds, where they were released on seven different occasions in 2023-2024 (Table 3.1).

Table 3.1: Summary of GGBF tadpole releases in 2023-2024.

Date	Site	Number of tadpoles
3 Nov 2023	M8 Marsh Street Habitat Area Pond C	720
14 Dec 2023	M8 Marsh Street Habitat Area Pond C	2600
21 Dec 2023	M8 Marsh Street Habitat Area Pond C	40
16 Jan 2024	RTA Pond West	690
22 Feb 2024	RTA Pond West	690
22 Feb 2024	M8 Marsh Street Habitat Area Pond C	10
21 Mar 2024	RTA Pond West	300
Total		5050

3.2 Water Quality Monitoring

Water quality data are presented in Appendix A.

In the M8 Marsh Street habitat area, water levels were managed such that one pond was allowed to dry out (Pond A) during a dry period, while levels were topped up in other ponds prior to the release of tadpoles and maintained at least half full throughout the monitoring period. Water temperature fluctuated in response to the prevailing climatic conditions but was within the general survival threshold for tadpoles throughout the entire monitoring period. Results of salinity and pH measurements at the M8 Marsh Street habitat area were within the general survival threshold for the entire monitoring period.

Water levels in both RTA Ponds were generally adequate to good throughout the season, although some variation was observed, particularly after dry periods, with the lowest water levels observed during December 2023. Results of temperature, salinity and pH measurements at the RTA Ponds were within the general survival threshold for the entire monitoring period. Water levels in the Enhancement Area ponds varied throughout the monitoring period, with Ponds 2, 3, and 4 being dry, or almost dry, for most of the season.

Many of the sites in the Riverine Park surrounds and Barton Park were dry or too shallow to sample for most of the season; the main exception being the Southern Phragmites / Bend Swamp areas, which were completely flooded during a rainfall event in April. Water quality in the Riverine Park surrounds, Barton Park and Kogarah Golf Course ponds varied, but was mostly within the general survival thresholds, except for salinity in the Mangrove Pond (which has a connection to the Cooks River and is usually very saline).

Measurements of dissolved O₂ varied considerably in several sites, particularly during the first months of the season, which appeared to be a result of equipment malfunction.

3.3 Tadpole Monitoring

Tadpole monitoring data are presented in Appendix B.

No GGBF tadpoles were detected in any of the sites prior to the release of the captive-bred tadpoles. GGBF tadpoles were recorded in the M8 Marsh Street habitat area and the Western RTA Pond subsequent to the releases.

Striped Marsh Frog tadpoles were frequently detected during the monitoring and recorded in a number of sites including the M8 Marsh Street habitat area, the RTA Ponds, the Enhancement Area Ponds and some of the Riverine Park surrounds and Barton Park sites. An enormous number (at least tens of thousands) of Striped Marsh Frog tadpoles were observed in the Southern Phragmites and Bend Swamp areas after flooding in April, along with several water birds that were feeding on them.

Other species of tadpole observed were Peron's Tree Frog tadpoles (mainly in the M8 Marsh Street habitat area), Eastern Dwarf Tree Frog tadpoles (these were abundant in the Western RTA Pond), and Common Eastern Froglet tadpoles (Western RTA Pond).

No tadpoles of any species were detected in the Kogarah Golf Course ponds. The introduced Plague Minnow *Gambusia holbrooki* was regularly detected in the Kogarah Golf Course ponds, often in high numbers.

3.4 Frog Monitoring

3.4.1 M8 Marsh Street habitat area

Three hundred and eighty-one (381) captures of GGBFs were made over nine survey events at the M8 Marsh Street habitat area between October 2023 and May 2024 (Table 3.2). All were captured around the ponds, except for two (2), which were captured along the internal perimeter or in the swale. Of the total, one hundred and seventy-one (171) were "juveniles" (<40 mm in SUL length). The remaining two hundred and ten (210) frogs were "adults" (>40 mm in SUL length), of which one hundred and fifty-nine (159) were implanted with PIT tags (microchips), sixty-nine (69) were recaptures, and one individual was captured but not tagged. These as whole, represent one hundred and forty-eight (148) distinct adult frogs. Some individuals were recaptured more than once.

The majority of the GGBF observations or captures took place in the latter half of the season, after the release of the captive-bred tadpoles. GGBFs were present in the surveys earlier in the season but relatively small numbers were recorded, with only 15 and 18 captures in October and December 2023 respectively (Table 3.2), with a relatively high proportion of these being juveniles. By comparison, the average number of captures for surveys undertaken between March and May 2024 was 46. After the release of tadpoles, large numbers of juveniles were observed, with the proportion of adult frogs gradually rising to over 80% during the last two surveys in May 2024.

Another two hundred and ten (210) GGBFs were observed but not captured (Table 3.3).

Six (6) of the GGBFs that were captured were recaptures from the previous season. All of these were originally tagged in April 2023 at the same or an adjacent pond in the M8 Marsh Street habitat area. Overall, the proportion of recaptures was low (5%) in January, before rising to between 33% and 51% in April and May.

Sex ratios this season were slightly male-biased, with males constituting 51.3% of all captured GGBFs whose sex was identified, which is lower than the ratios recorded for all previous seasons: 61.1% (2022-2023), 62.9% (2021-2022), 66% (2020-2021) and 61% (2019-2020).

Analysis of the mark-recapture data indicated that the best fitting model was the “time dependent effect” (QAICc = -43.29), which suggests that the probability of capture changes with time, and is equal to the probability of recapture. The resulting population estimate for adult GGBFs (>40 mm in length) was 288 (with a 95% confidence interval of 174-401) individual GGBFs across the M8 Marsh Street habitat area in the 2023-2024 season.

Other frog species detected within the compound include the Striped Marsh Frog and Peron’s Tree Frog, though the density of the latter is much lower than the other species (Table 3.3). Eastern Dwarf Tree Frog, which had been present in the compound in previous years, was not seen in this survey season. One hundred and ninety-seven (197) Striped Marsh Frog egg masses and sixty-five (65) individuals were relocated from the M8 Marsh Street Habitat to surrounding habitats outside of the compound.

Table 3.2: M8 Marsh Street habitat area GGBF capture results.

Date	Pond	Juvenile / Subadult / Not tagged	Recapture	Number microchipped	Total
24 Oct 2023	Pond A	2	1	1	4
	Pond B	2	0	3	5
	Pond C	3	1	2	6
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	7	2	6	15
19 Dec 2023	Pond A	0	0	0	0
	Pond B	1	1	1	3
	Pond C	10	1	2	13
	Swale	0	0	1	1
	Perimeter	0	1	0	1
	Subtotal	11	3	4	18
31 Jan 2024	Pond A	3	0	1	4
	Pond B	5	0	7	12
	Pond C	44	1	11	56
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	52	1	19	72
12 Mar 2024	Pond A	15	1	3	19
	Pond B	9	2	9	20
	Pond C	10	4	11	25
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	34	7	23	64
27 Mar 2024	Pond A	4	0	8	12
	Pond B	7	3	7	17
	Pond C	11	0	6	17
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	22	3	21	46
10 Apr 2024	Pond A	3	0	5	8
	Pond B	4	2	3	9
	Pond C	4	5	6	15
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	11	7	14	32
24 Apr 2024	Pond A	10	2	9	21
	Pond B	5	4	2	11
	Pond C	4	4	4	12
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	19	10	15	44
8 May 2024	Pond A	1	2	3	6
	Pond B	3	8	5	16
	Pond C	3	11	12	26
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	7	21	20	48
22 May 2024	Pond A	0	2	3	5
	Pond B	6	8	7	21
	Pond C	2	5	9	16
	Swale	0	0	0	0
	Perimeter	0	0	0	0
	Subtotal	8	15	19	42
Grand Total		172	69	140	381

Table 3.3: Frogs observed or heard but not captured (all species), M8 Marsh Street habitat area.

Date	Pond	<i>Litoria aurea</i>	<i>Limnodynastes peronii</i>	<i>Litoria peronii</i>
24 Oct 2023	Pond A	1	1	0
	Pond B	1	10	0
	Pond C	4	49	8
	Swale	0	0	0
	Perimeter	0	0	0
	Subtotal	6	60	8
Opportunistic Sep – Nov 2023	Pond A	1	0	0
	Pond B	0	0	0
	Pond C	26	0	1
	Swale	0	0	0
	Perimeter	0	0	0
	Subtotal	27	0	1
19 Dec 2023	Pond A	0	0	0
	Pond B	0	0	0
	Pond C	0	0	0
	Swale	0	0	0
	Perimeter	0	0	0
	Subtotal	0	0	0
31 Jan 2024	Pond A	3	0	0
	Pond B	5	3	0
	Pond C	54	6	1
	Swale	0	0	0
	Perimeter	10	0	0
	Subtotal	72	9	1
Opportunistic Dec 2023 – Feb 2024	Pond A	0	0	0
	Pond B	0	0	0
	Pond C	19	0	0
	Swale	0	0	0
	Perimeter	0	0	0
	Subtotal	19	0	0
12 Mar 2024	Pond A	4	1	0
	Pond B	3	5	0
	Pond C	0	0	0
	Swale	0	0	0
	Perimeter	0	0	0
	Subtotal	7	6	0
27 Mar 2024	Pond A	2	2	0
	Pond B	2	22	0
	Pond C	12	7	1
	Swale	3	0	0
	Perimeter	4	0	0
	Subtotal	23	31	1
10 Apr 2024	Pond A	3	8	0
	Pond B	9	7	0
	Pond C	3	15	0
	Swale	0	0	0
	Perimeter	0	0	0
	Total	15	30	0
24 Apr 2024	Pond A	9	0	0
	Pond B	4	7	0
	Pond C	8	1	0
	Swale	0	0	0
	Perimeter	3	0	0
	Subtotal	24	8	0
8 May 2024	Pond A	0	0	0
	Pond B	2	0	0

Date	Pond	<i>Litoria aurea</i>	<i>Limnodynastes peronii</i>	<i>Litoria peronii</i>
	Pond C	4	0	0
	Swale	0	0	0
	Perimeter	5	0	0
	Subtotal	11	0	0
22 May 2024	Pond A	0	0	0
	Pond B	3	0	0
	Pond C	2	0	0
	Swale	0	0	0
	Perimeter	1	0	0
	Subtotal	6	0	0
Grand Total		210	144	11

3.4.2 Underpass, RTA Ponds, Enhancement Area, Kogarah Golf Course, Riverine Park surrounds and Barton Park, Creek and Perimeter

Frog monitoring data from outside of the M8 Marsh Street habitat area are described below and summarised in Appendix C.

A total of sixty-eight (68) GGBF captures were made outside of the M8 Marsh Street habitat area, including twenty-one (21) juveniles and forty-seven (47) adults, of which nine (9) were recaptures. Another seventeen (17) GGBFs were observed, but were not captured.

The population trend outside of the M8 Marsh Street habitat area was similar to the pattern observed within, in that few GGBFs were seen prior to the captive-bred tadpole releases (15 records from October 2023 through to February 2024, compared to 61 from March to May 2024) (Table 3.4). Most of these GGBFs were found either in the Creek area, which is nearest to the compound, or in the western RTA Pond after tadpoles were released there (Table 3.4, Figure 3.1). GGBFs were occasionally recorded in the Circular Pond or Long Pond on Kogarah Golf Course and two GGBFs were also recorded late in the season in the Skinny Pond, which is some distance from the other sites. Few GGBFs were detected in the Riverine Park and surrounds or Barton Park.

Some recaptures from the previous season were found, including two GGBFs in the Creek area and one GGBF in the Eastern RTA Pond, all of which were recaptured in the area they were originally tagged. The same GGBF in the Eastern RTA Pond was subsequently recaptured at Pond 5 in the Enhancement Area. Three GGBFs that were first tagged in the Creek area during the current season were later recaptured in Pond C of The M8 Marsh Street habitat area.

Striped Marsh Frogs were frequently detected across multiple sites, including the Creek area, both RTA Ponds, and most ponds in the Enhancement Area, Kogarah Golf Course, and the Riverine Park and surrounds and Barton Park. Peron's Tree Frogs were detected in both RTA Ponds, Long Pond on the Kogarah Golf Course, as well as in the Underpass (the first time frogs had been detected there since 2021-2022). Eastern Dwarf Tree Frogs (*Litoria fallax*) were observed at both RTA ponds, often in high numbers. Common Eastern Froglets (*Crinia signifera*) were detected at both RTA Ponds, as well as in Pond 6 of the Enhancement Area.

Table 3.4: Observations of GGBFs outside of the M8 Marsh Street habitat area during the 2023-2024 monitoring season (numbers in parenthesis indicate frogs observed but not captured and measured).

Site	Nov-23	Dec-23	Feb-24	Mar-24	Apr-24	May-24	Total
Creek	1	1	3	6	10 (4)	8	29 (4)
Underpass							
RTA Pond West		1 (1)		5 (3)	6 (6)	3 (1)	15 (11)
RTA Pond East	1	1	1	1	2	2	8
Enhancement Area	2					5	7
Circular Pond	(1)			3		1	4 (1)
Long Pond			1 (1)				1 (1)
Eastern Pond							
Skinny Pond						2	2
Northern Pond							
Mangrove Pond							
Eastern Channel							
Southern Phragmites		1					1
Bend Swamp					1		1
Southern Jungle							
Driving Range Wetland							
Landing Lights East							
Landing Lights West							
Total Observations	4 (1)	4 (1)	5 (1)	15 (3)	19 (10)	21 (1)	68 (17)



Figure 3.2: GGBF observations during the 2023-2024 monitoring season.

3.5 Maintenance

3.5.1 M8 Marsh Street habitat area

During the winter of 2023 Pond A was allowed to dry out and the macrophyte cover was cut back. On the afternoon and early evening of 30 August the pond was refilled at the same time as a thunderstorm passed through the area, bringing rain to Arncliffe after a relatively dry month. Water levels in Ponds B and C had dropped a little over winter but both ponds were still relatively full.

After 30 August water levels in all three ponds progressively dropped over the next 2-3 months. By 19 October the water level in Pond A was relatively low and Ponds B and C about half-full. Pond C was refilled on 19 October in preparation for upcoming tadpole releases. Pond A was dry again on 30 January 2024 and was completely refilled on that date.

3.5.2 RTA Ponds

Both RTA Ponds were holding water for the duration of the monitoring season and the introduced Plague Minnow *Gambusia holbrooki* was not observed.

3.5.3 Enhancement Area

All ponds within the Enhancement Area were overgrown with weeds and grasses. Several ponds were dry for parts or all of the survey period. The introduced fish species *Gambusia holbrooki* was not recorded in the Enhancement Area ponds. Cats and foxes were observed on the golf course (including the Enhancement Area) during the monitoring period.

4 Discussion

Both adult and juvenile GGBFs were present at the beginning of the 2023-2024 season, with a small number of recaptures from the previous year recorded both inside and outside the M8 Marsh Street habitat area. The number of GGBFs observed was not large but was an improvement on the numbers observed at the start of last year.

As the season progressed, tadpoles from the captive breeding program were released into the M8 Marsh Street habitat area and the Western RTA Pond. After these tadpole releases, the number of GGBFs encountered increased, especially in the M8 Marsh Street habitat area, the adjacent Creek area, and in the RTA Ponds. Towards the end of the season the proportion of adults/juveniles increased, as did the recapture rates.

The overall population estimate for adult GGBFs calculated for the M8 Marsh Street habitat area in the 2023-2024 season was approximately 288, which is a significant improvement on the year in which no tadpoles from the captive breeding program were released (2021-2022), but somewhat lower than in other years (Figure 4.1). No definitive evidence of GGBF recruitment was noted this season outside of the tadpoles released from the captive breeding program.

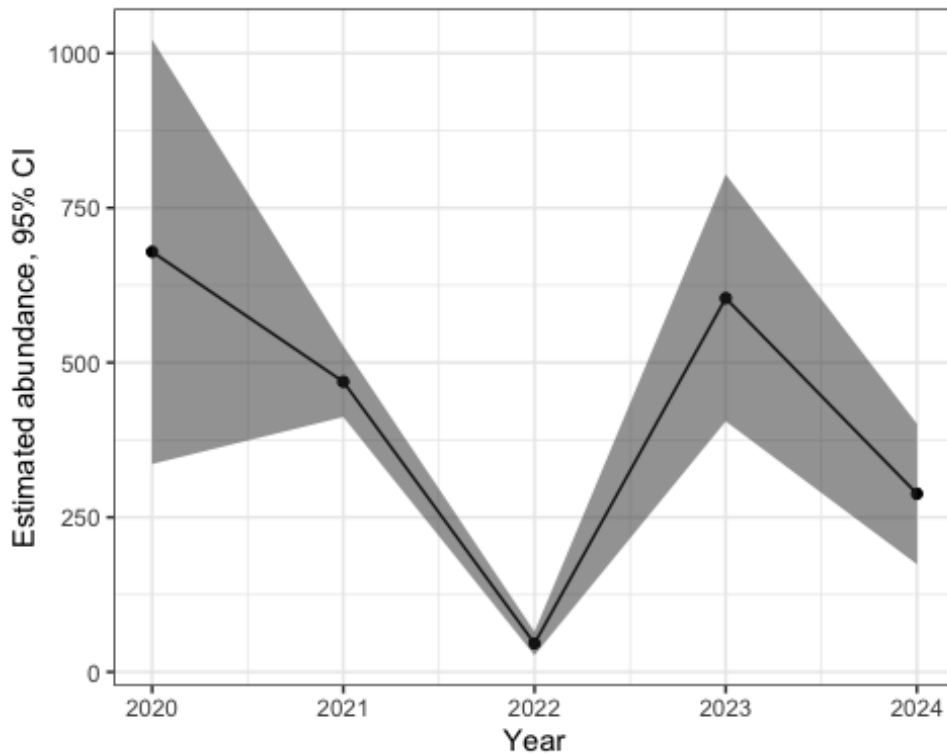


Figure 3.1. Estimated GGBF population size 2019-2024.

5 Conclusion

As stated in Section 1.4, the objectives of the monitoring program are stated in the PoM as “to assess the ongoing survival of the Arncliffe population at the Kogarah Golf Course and within the RTA Ponds” and in the HCCBP as “to provide information for adaptive management on the effectiveness of the habitat created as part of the project” (i.e., the M8 Marsh Street habitat area).

The Arncliffe population at the Kogarah Golf Course and within the RTA Ponds is currently very dependent on the captive breeding program. There have been no confirmed breeding events in the RTA Ponds since January 2020. However, the presence of a small number of GGBFs at the start of the season and a recapture of a tagged frog from the previous year is encouraging.

The M8 Marsh Street habitat area has been effective at creating an environment suitable for the growth of captive-bred tadpoles, their metamorphosis into frogs, and the continued growth of the metamorphosed animals into adult frogs. A proportion of the GGBFs from the previous season overwintered successfully. However, recruitment outside of the captive breeding program has been limited.

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Appendix A: Water quality data

22 September 2023

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	22/9/2023	A	Full	14.8	6.9	133.1	0.9	0.09	219	110	0.1	2.9	15.9	No
	22/9/2023	B	Full	28.2	6.6	131.7	0.3	0.03	5370	2681	2.92	8.4	15.8	No
	22/9/2023	C	Full	-0.6	7.1	115.2	0.6	0.06	466	233	0.23	8.6	16.1	No
RTA Ponds	22/9/2023	Western	75% full	40	6.3	287.3	0.3	0.02	192	34	0.03	21.2	14.4	No
	22/9/2023	Eastern	75% full	44.7	6.2	161.6	0.3	0.02	199	95	0.09	19.1	14.3	No
Enhancement Area	22/9/2023	1	Dry											
	22/9/2023	2	Dry											
	22/9/2023	3	Dry											
	22/9/2023	4	Dry											
	22/9/2023	5	Dry											
	22/9/2023	6	Dry											
Kogarah Golf Course	22/9/2023	Circular	25% full	-19.1	8	-122.6	0.1	0.01	12470	6245	7.21	11.6	15.8	No
	22/9/2023	Long	50% full	-46.9	7.9	-81.3	0.1	0.01	4246	2149	2.3	17.7	17.4	No
	22/9/2023	Mangrove Pond	25% full	-63.3	8.2	-60.5	1.5	0.12	44636	2237	28.95	31	15.8	No
	22/9/2023	Eastern	50% full	-161.7	8.9	-64.4	0.1	0.01	10590	5301	6.04	24.3	16.6	Yes
Riverine Park and surrounds and Barton Park	22/9/2023	Southern Phragmites	Dry											
	22/9/2023	Bend Swamp	Dry											
	22/9/2023	Southern Jungle	Dry											
	22/9/2023	Landing Lights West	Dry											
	22/9/2023	Driving Range Wetland	Dry											
	22/9/2023	Landing Lights East	No access											

18 October 2023

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	18/10/2023	A	50% full	8.8	7	96.4	4.6	0.43	253	126	0.12	66.5	17.7	No
	18/10/2023	B	75% full	7.7	7	133.1	5.4	0.51	6100	3054	3.35	6.7	16.3	No
	18/10/2023	C	75% full	-1.7	7.1	130.6	2.6	0.25	516	190	0.25	71.9	16.6	No
RTA Ponds	18/10/2023	Western	75% full	15.8	7	188	1.8	0.18	175	88	0.08	17.6	15.9	No
	18/10/2023	Eastern	75% full	49.7	6.6	117.9	1.9	0.19	192	96	0.09	13.2	15.2	No
Enhancement Area	18/10/2023	1	Dry											
	18/10/2023	2	Dry											
	18/10/2023	3	Dry											
	18/10/2023	4	Dry											
	18/10/2023	5	Dry											
	18/10/2023	6	Dry											
Kogarah Golf Course	18/10/2023	Circular	Almost dry											
	18/10/2023	Long	50% full	-58.5	8.2	-29.9	0.3	0.03	5446	2710	295	138	16.5	No
	18/10/2023	Mangrove Pond	75% full	-47.2	8	-47.5	2	0.15	51440	25750	34.7	15.1	17.5	No
	18/10/2023	Eastern	25% full	-68.4	8.3	-123.5	0	0	8433	4212	4.72	11.6	16.7	Yes
Riverine Park and surrounds and Barton Park	18/10/2023	Southern Phragmites	Dry											
	18/10/2023	Bend Swamp	Dry											
	18/10/2023	Southern Jungle	Dry											
	18/10/2023	Landing Lights West	Dry											
	18/10/2023	Driving Range Wetland	Dry											
	18/10/2023	Landing Lights East	No access											

1 December 2023

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	1/12/2023	A	50% full	27.7	6.68	75.5	4.5	0.4	245	122	0.12	14.1	21.92	No
	1/12/2023	B	50% full	54.8	6.09	67.4	3	0.25	7423	3723	4.12	5	21.7	No
	1/12/2023	C	75% full	21.8	6.68	-24	1.7	0.15	360	180	0.17	2.7	21.49	No
RTA Ponds	1/12/2023	Western	50% full	15.2	6.79	-14.3	0.6	0.05	196	98	0.09	14	20.33	No
	1/12/2023	Eastern	25% full	59.5	6.02	32	0.5	0.05	184	92	0.09	18.7	19.29	No
Enhancement Area	1/12/2023	1	Dry											
	1/12/2023	2	Dry											
	1/12/2023	3	Dry											
	1/12/2023	4	Dry											
	1/12/2023	5	75% full	35.9	6.43	5.7	0.2	0.02	260	130	0.12	2.2	20.84	No
	1/12/2023	6	Dry											
Kogarah Golf Course	1/12/2023	Circular	25% full	-37.6	7.73	-102.2	0.2	0.01	12.77	6392	7.36	137	21.49	No
	1/12/2023	Long	25% full	-23.3	7.49	-60.7	0.5	0.04	4715	2358	2.52	41.5	23.3	Yes
	1/12/2023	Mangrove Pond	25% full	-37.9	7.75	-40.9	6.5	0.46	49.79	24.88	32.61	5.7	23.37	Yes
	1/12/2023	Eastern	25% full	-122.1	9.29	-79.8	0.1	0.01	9719	4859	5.48	658	21.32	Yes
Riverine Park and surrounds and Barton Park	1/12/2023	Southern Phragmites	Dry											
	1/12/2023	Bend Swamp	Dry											
	1/12/2023	Southern Jungle	Dry											
	1/12/2023	Landing Lights West	Dry											
	1/12/2023	Driving Range Wetland	Dry											
	1/12/2023	Landing Lights East	50% full	-19.8	7.43	-46.7	5.1	0.44	3705	1852	1.96	132	21.6	Yes

22 December 2023

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	22/12/2023	A	25% full	11.6	7	70.6	5.3	0.47	292	0.0	0.14	28.1	20.4	No
	22/12/2023	B	25% full	38.6	6.4	60.3	2.8	0.24	7657	3834	4.26	8	20.2	No
	22/12/2023	C	Full	10.5	6.9	45.6	3.3	0.29	361	180	0.17	3.42	21.2	No
RTA Ponds	22/12/2023	Western	25% full	36.5	6.4	9.6	1.6	0.16	213	106	0.1	10.3	18.9	No
	22/12/2023	Eastern	25% full	57.6	6	72.8	2.1	1.9	166	83	0.08	23.1	18.5	Yes
Enhancement Area	22/12/2023	1	Too shallow											
	22/12/2023	2	Dry											
	22/12/2023	3	Dry											
	22/12/2023	4	Dry											
	22/12/2023	5	50% full	27.8	6.5	-10.6	0.01	0.05	245	122	0.12	14.7	18.8	No
	22/12/2023	6	75% full	11.8	6.9	64.1	0.9	0.5	9848	4931	5.57	1.3	19.7	No
Kogarah Golf Course	22/12/2023	Circular	Not sampled											
	22/12/2023	Long	50% full	-68.3	8.3	-152.6	2.2	1.4	4704	2347	2.51	0.9	19.7	Yes
	22/12/2023	Mangrove Pond	75% full	-33.6	7.7	-15.6	6	0.45	49.8	24.6	32.26	14.7	20.3	Yes
	22/12/2023	Eastern	Not sampled											
Riverine Park and surrounds and Barton Park	22/12/2023	Eastern Channel	Dry											
	22/12/2023	Southern Phragmites	Dry											
	22/12/2023	Bend Swamp	Dry											
	22/12/2023	Southern Jungle	Dry											
	22/12/2023	Landing Lights West	Dry											
	22/12/2023	Driving Range Wetland	Dry											
	22/12/2023	Landing Lights East	25% full	-13.3	7.3	-222.5	1.8	0.14	3623	1813	1.92	404	19.6	Yes

30 January 2024

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	30/1/2024	A	Dry											
	30/1/2024	B	25% full	38.7	6.3	49.9	7.6	0.6	8846	8553	0.85	4.9	23.5	No
	30/1/2024	C	Full	4.8	7	74.2	6.5	0.52	431	216	0.21	3.2	24.9	No
RTA Ponds	30/1/2024	Western	50% full	-2.8	7.1	106.8	2.6	0.22	144	82	0.08	12	23.2	No
	30/1/2024	Eastern	50% full	18.8	6.7	-48.5	2.2	0.19	207	103	0.1	14.4	23.6	No
Enhancement Area	30/1/2024	1	50% full	13.2	6.8	235.6	2	0.17	417	296	0.2	1.2	22.9	No
	30/1/2024	2	Dry											
	30/1/2024	3	Dry											
	30/1/2024	4	Dry											
	30/1/2024	5	Dry											
	30/1/2024	6	Dry											
Kogarah Golf Course	30/1/2024	Circular	Too shallow											
	30/1/2024	Long	50% full	-30.6	7.6	-107.9	2.1	0.17	5427	2737	2.95	11.8	24.5	Yes
	30/1/2024	Mangrove Pond	75% full	-31.9	7.6	-82.6	1.7	0.12	48170	24130	31.5	21.6	24.6	Yes
	30/1/2024	Eastern	50% full	-133.6	9.5	-92.4	3.5	0.27	12500	6267	7.19	46.2	24.6	Yes
Riverine Park and surrounds and Barton Park	30/1/2024	Eastern Channel	Not sampled											
	30/1/2024	Southern Phragmites	Dry											
	30/1/2024	Bend Swamp	Dry											
	30/1/2024	Southern Jungle	Dry											
	30/1/2024	Landing Lights West	Dry											
	30/1/2024	Driving Range Wetland	Dry											
	30/1/2024	Landing Lights East	No access											

28 February 2024

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	28/2/2024	A	Full	11.6	6.9	169.3	5.2	0.46	216	108	0.1	3.2	22.4	No
	28/2/2024	B	75% full	25.8	6.8	126.4	7.7	0.65	3159	1564	1.63	7.3	22.4	No
	28/2/2024	C	Full	17.7	7.2	52.9	7.6	0.65	414	207	0.2	3.6	22.7	No
RTA Ponds	28/2/2024	Western	75% full	12.2	6.9	47.2	2	0.18	171	86	0.7	2.2	21.7	No
	28/2/2024	Eastern	Full	40.4	6.6	58.7	1.5	0.13	139	70	0.07	4	21	No
Enhancement Area	28/2/2024	1	25% full	10.8	6.9	71.8	3.4	0.3	225	11.4	0.11	7.1	21.4	No
	28/2/2024	2	Almost dry											
	28/2/2024	3	Almost dry											
	28/2/2024	4	Almost dry											
	28/2/2024	5	25% full	37.4	6.4	36.3	1.8	0.15	163	0.2	0.08	11.1	21	No
	28/2/2024	6	25% full	12.2	6.9	110.3	0.4	0.03	1669	0.32	0.03	28.4	21.1	No
Kogarah Golf Course	28/2/2024	Circular	Full	-43.3	7.9	-30.1	12.2	1.05	5002	256.3	2.72	37.6	22.6	Yes
	28/2/2024	Long	Full	-48.7	8	41.7	9.6	0.83	2930	1483	1.55	36.3	23.1	Yes
	28/2/2024	Mangrove Pond	Full	-13.5	7.3	-205.4	2.1	0.15	34450	17220	21.6	21.1	22.3	Yes
	28/2/2024	Eastern	Not sampled											
Riverine Park and surrounds and Barton Park	28/2/2024	Eastern Channel	Not sampled											
	28/2/2024	Southern Phragmites	25% full	16.6	6.8	-77.7	1.4	0.12	431	216	0.21	25	19.8	No
	28/2/2024	Bend Swamp	Dry											
	28/2/2024	Southern Jungle	Dry											
	28/2/2024	Landing Lights West	Dry											
	28/2/2024	Driving Range Wetland	Dry											
	28/2/2024	Landing Lights East	No access											

22 March 2024

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	22/03/2024	A	Full	14.6	7	142.1	14	1.33	265	133	0.13	12.2	17.7	No
	22/03/2024	B	Full	23.2	6.9	138.4	11.2	1.04	4348	217	2.33	3	17.8	No
	22/03/2024	C	Full	-11.6	7.2	110.7	11.3	1.04	405	203	0.19	4.3	19.9	No
RTA Ponds	22/03/2024	Western	75% full	24.9	6.6	70.3	6.7	0.63	180	90	0.09	11.6	17.6	No
	22/03/2024	Eastern	Full	44.1	6.3	94.5	5.3	0.49	169	85	0.08	7.4	17.4	No
Enhancement Area	22/03/2024	1	50% full	9.4	6.9	39.2	3.9	0.37	220	111	0.11	15	16.9	No
	22/03/2024	2	Very shallow	15.6	6.7	67.8	2.4	0.23	241	121	0.12	16.2	16.9	No
	22/03/2024	3	Dry											
	22/03/2024	4	Dry											
	22/03/2024	5	Very shallow	41.7	6.3	15.6	1.6	0.15	185	93	0.09	17.7	17.5	No
	22/03/2024	6	Very shallow	30.3	6.6	46.2	1.8	0.16	1330	342	0.64	10.2	17.5	No
Kogarah Golf Course	22/03/2024	Circular	75% full	-55.5	8.1	29.7	10.3	0.96	5041	2529	2.9	241	18.4	Yes
	22/03/2024	Long	75% full	-40.6	7.8	44	4	0.35	3260	1630	1.71	5.9	19.7	Yes
	22/03/2024	Mangrove Pond	50% full	-19.5	7.4	-168.6	4	0.34	37410	18722	23.82	275	17.9	Yes
	22/03/2024	Eastern	Not sampled											
Riverine Park and surrounds and Barton Park	22/03/2024	Eastern Channel	Not sampled											
	22/03/2024	Southern Phragmites	Dry											
	22/03/2024	Bend Swamp	Dry											
	22/03/2024	Southern Jungle	Dry											
	22/03/2024	Landing Lights West	Dry											
	22/03/2024	Driving Range Wetland	Dry											
	22/03/2024	Landing Lights East	No access											

17 April 2024

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	17/04/2024	A	Full	33.6	6.5	112.9	11	1.05	159	79	0.07	3.3	17.5	No
	17/04/2024	B	Full	29.2	6.5	131.2	13.3	1.26	1550	778	0.79	1.9	17.5	No
	17/04/2024	C	Full	15.6	7.2	125.1	12.9	1.2	364	182	0.17	1.3	18.1	No
RTA Ponds	17/04/2024	Western	Full	40.6	6.4	90.3	5.4	0.49	144	32	0.07	8.4	17.4	No
	17/04/2024	Eastern	Full	44.7	6.2	58.4	7.4	0.69	151	76	0.07	11.1	16.8	No
Enhancement Area	17/04/2024	1	Full	5.3	7	65.3	4.3	0.41	223	112	0.11	1.9	16.9	No
	17/04/2024	2	Dry											
	17/04/2024	3	50% full	15.5	6.8	43.8	2.5	0.21	213	107	0.1	19.4	16.2	No
	17/04/2024	4	Dry											
	17/04/2024	5	Full	23.6	6.7	4.9	3.1	0.3	252	125	0.12	2.1	16.9	No
	17/04/2024	6	75% full	13.2	6.9	-83.5	3.6	0.34	1719	852	0.86	19.8	17	No
Kogarah Golf Course	17/04/2024	Circular	Full	-39.9	7.8	40.6	18.6	1.73	5227	2610	2.82	23.8	19.1	Yes
	17/04/2024	Long	Full	-30.7	7.6	33.4	9.5	0.85	1794	896	0.91	5.4	20	Yes
	17/04/2024	Mangrove Pond	Full	-56.6	7.4	-145.9	6.7	0.56	24300	12560	15.5	14.8	19.4	Yes
	17/04/2024	Eastern	Full	-49.7	7.9	66.5	13.3	1.2	2347	1174	1.21	11.4	20	Yes
Riverine Park and surrounds and Barton Park	17/04/2024	Eastern Channel	Not sampled											
	17/04/2024	Southern Phragmites	Full	21.1	6.6	-80.3	6.4	0.62	256	128	0.12	11.8	16.3	No
	17/04/2024	Bend Swamp	Full	42.4	6.3	-64.2	2	0.18	159	80	0.08	7.3	16.7	No
	17/04/2024	Southern Jungle	Too shallow											
	17/04/2024	Landing Lights West	Dry											
	17/04/2024	Driving Range Wetland	Dry											
	17/04/2024	Landing Lights East	No access											

16 May 2024

Location	Date	Pond	General Condition	mVpH	pH	ORP [mV]	% Sat (DO%)	Diss. O2 [mg/l]	Conduct [uS/cm]	TDS ppm	Salinity (PSU)	Turbidity [FNU]	Temp [C°]	Gambusia
Eve Street	16/05/2024	A	Full	28.2	6.6	88.2	22.8	2.26	142	71	0.07	54.5	14.8	No
	16/05/2024	B	Full	40.3	6.3	110.4	15.2	1.51	1819	909	0.93	10.2	15.4	No
	16/05/2024	C	Full	7.4	6.9	57.2	8.4	0.85	331	166	0.16	4.4	15.7	No
RTA Ponds	16/05/2024	Western	Full	34.5	6.4	37.6	11.8	1.18	94	47	0.05	7.1	15.3	No
	16/05/2024	Eastern	Full	44.6	6.3	31.5	4.4	0.44	118	60	0.06	157	14.6	No
Enhancement Area	16/05/2024	1	Full	11.5	6.9	76.4	16.7	1.68	203	102	0.1	36.6	14.3	No
	16/05/2024	2	25% full	16.2	6.8	73.2	20.1	2.02	57	28	0.03	18.6	13.8	No
	16/05/2024	3	Dry											
	16/05/2024	4	Too shallow											
	16/05/2024	5	Full	23.5	6.6	-14.3	7.5	0.7	171	86	0.08	88.4	14.7	No
	16/05/2024	6	Full	23.4	6.7	-158.5	17.4	1.45	4987	25	2.79	9.9	16.6	No
Kogarah Golf Course	16/05/2024	Circular	Full	3.6	7	-13.7	17.8	1.65	5706	2873	3.13	1000	18.2	Yes
	16/05/2024	Long	Full	-16.8	7.4	-29.1	26.5	2.53	2564	1286	1.34	80.2	17.1	Yes
	16/05/2024	Mangrove Pond	Full	-8.9	7.2	-140.6	11.8	0.7	6645	3316	3.66	97.3	16.4	No
	16/05/2024	Eastern	Full	-41.3	7.8	41.8	46.9	4.65	2295	1154	1.2	12	16.4	Yes
	16/05/2024	Skinny	75% full	-17.8	7.4	-12.6	13.3	1.04	13.56	6808	7.91	86.5	19.2	No
	16/05/2024	Northern (South Pool)	75% full	31.9	6.5	10.4	15	1.45	2304	1082	1.12	58.3	16.8	No
	16/05/2024	Northern (North Pool)	Full	22.8	6.7	31.2	10.5	1.02	298	152	0.15	13.8	16.6	No
Riverine Park and surrounds and Barton Park	16/05/2024	Eastern Channel	Not sampled											
	16/05/2024	Southern Phragmites	Full (flooded)	-7.8	7.2	47.6	44.3	0.38	450	225	0.22	7.5	16.2	No
	16/05/2024	Bend Swamp	Full (flooded)	-7.8	7.2	47.6	44.3	0.38	450	225	0.22	7.5	16.2	No
	16/05/2024	Southern Jungle	25% full	8.8	7.1	-48.5	14.4	0.95	917	461	0.46	33.5	14.8	No
	16/05/2024	Landing Lights West	Dry											

	16/05/2024	Driving Wetland	Range	Dry										
	16/05/2024	Landing Lights East		No access										

Appendix B: Tadpole net sweep results

22 September 2023

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	No	-	-	-	-	-
	B	No	-	-	-	-	-
	C	No	-	-	-	-	-
RTA Ponds	Western	Yes	Limnodynastes peronii	-	9	-	-
	Eastern	Yes	Limnodynastes peronii	1	-	-	-
Enhancement Area	1	Dry	-	-	-	-	-
	2	Dry	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	Dry	-	-	-	-	-
	6	Dry	-	-	-	-	-
Kogarah Golf Course	Circular	No	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Southern Phragmites	Dry	-	-	-	-	-
	Bend Swamp	Dry	-	-	-	-	-
	Southern Jungle	Dry	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	N/s	-	-	-	-	-

18 October 2023

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Yes	Litoria peronii	-	1	-	-
	B	Yes	Limnodynastes peronii	-	-	1	-
	C	No	-	-	-	-	-
RTA Ponds	Western	Yes	Litoria fallax	-	1	-	-
			Crinia signifera	-	1	-	-
	Eastern	Yes	Limnodynastes peronii	-	1	-	-
Enhancement Area	1	Dry	-	-	-	-	-
	2	Dry	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	Dry	-	-	-	-	-
	6	Dry	-	-	-	-	-
Kogarah Golf Course	Circular	Dry	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Southern Phragmites	Dry	-	-	-	-	-
	Bend Swamp	Dry	-	-	-	-	-
	Southern Jungle	Dry	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-

	Landing Lights East	N/s	-	-	-	-	-
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1 December 2023

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Yes	<i>Limnodynastes peronii</i>	-	1	1	-
	B	Yes	<i>Litoria peronii</i>	-	3	-	-
			<i>Limnodynastes peronii</i>	-	4	-	-
C	No	-	-	-	-	-	
RTA Ponds	Western	Yes	<i>Litoria fallax</i>	-	1	-	-
	Eastern	No	-	-	-	-	-
Enhancement Area	1	Dry	-	-	-	-	-
	2	Dry	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	Dry	<i>Limnodynastes peronii</i>	-	5	-	-
	6	Dry	-	-	-	-	-
Kogarah Golf Course	Circular	No	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Southern Phragmites	Dry	-	-	-	-	-
	Bend Swamp	Dry	-	-	-	-	-
	Southern Jungle	Dry	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	No	-	-	-	-	-

22 December 2023

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Yes	<i>Litoria peronii</i>	-	2	-	-
			<i>Limnodynastes peronii</i>	-	6	7	-
	B	No	-	-	-	-	-
C	Yes	<i>Litoria aurea</i>	-	1	-	-	
		<i>Litoria peronii</i>	-	17	-	-	
RTA Ponds	Western	Yes	<i>Litoria peronii</i>	-	1	-	-
	Eastern	No	-	-	-	-	-
Enhancement Area	1	Yes	<i>Limnodynastes peronii</i>	-	20	-	-
	2	Dry	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	No	-	-	-	-	-
	6	No	-	-	-	-	-
Kogarah Golf Course	Circular	N/s	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	N/s	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Eastern Channel	Dry	-	-	-	-	-
	Southern Phragmites	Dry	-	-	-	-	-
	Bend Swamp	Dry	-	-	-	-	-
	Southern Jungle	Dry	-	-	-	-	-

	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	N/s	-	-	-	-	-

30 January 2024

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Dry	-	-	-	-	-
	B	Yes	<i>Limnodynastes peronii</i>	-	-	1	-
	C	Yes	<i>Litoria aurea</i>	-	-	-	1
RTA Ponds	Western	Yes	<i>Litoria aurea</i>	-	-	3	-
			<i>Litoria fallax</i>	-	4	-	-
			<i>Limnodynastes peronii</i>	-	-	1	-
			<i>Litoria sp.</i>	-	20	-	-
	Eastern	Yes	<i>Limnodynastes peronii</i>	-	-	1	-
Enhancement Area	1	Yes	<i>Limnodynastes peronii</i>	-	80	-	-
	2	Dry	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	Dry	-	-	-	-	-
	6	Dry	-	-	-	-	-
Kogarah Golf Course	Circular	Dry	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Eastern Channel	N/s	-	-	-	-	-
	Southern Phragmites	Dry	-	-	-	-	-
	Bend Swamp	Dry	-	-	-	-	-
	Southern Jungle	Dry	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	N/s	-	-	-	-	-

28 February 2024

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Yes	<i>Limnodynastes peronii</i>	-	-	3	-
	B	Yes	<i>Limnodynastes peronii</i>	-	2	2	-
	C	Yes	<i>Litoria peronii</i>	-	2	-	-
RTA Ponds	Western	Yes	<i>Litoria fallax</i>	26	-	-	-
	Eastern	No	-	-	-	-	-
Enhancement Area	1	Yes	<i>Limnodynastes peronii</i>	-	40	-	-
	2	Dry	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	Yes	<i>Limnodynastes peronii</i>	-	25	-	-
	6	Yes	<i>Limnodynastes peronii</i>	-	-	4	-
Kogarah Golf Course	Circular	No	-	-	-	-	-

	Long	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Eastern Channel	N/s	-	-	-	-	-
	Southern Phragmites	Dry	-	-	-	-	-
	Bend Swamp	Dry	-	-	-	-	-
	Southern Jungle	Dry	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	N/s	-	-	-	-	-

22 March 2024

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Yes	<i>Limnodynastes peronii</i>	-	10	3	-
	B	Yes	<i>Limnodynastes peronii</i>	-	2	1	-
	C	No	-	-	-	-	-
RTA Ponds	Western	Yes	<i>Litoria aurea</i>	-	1	-	-
			<i>Litoria fallax</i>	-	7	1	1
	Eastern	No	-	-	-	-	-
Enhancement Area	1	Yes	<i>Limnodynastes peronii</i>	-	50	-	-
	2	No	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	No	-	-	-	-	-
	6	No	-	-	-	-	-
Kogarah Golf Course	Circular	No	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	N/s	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Eastern Channel	N/s	-	-	-	-	-
	Southern Phragmites	Dry	-	-	-	-	-
	Bend Swamp	Dry	-	-	-	-	-
	Southern Jungle	Dry	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	N/s	-	-	-	-	-

17 April 2024

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Yes	<i>Limnodynastes peronii</i>	-	3	-	-
	B	Yes	<i>Limnodynastes peronii</i>	-	2	-	-
	C	No	-	-	-	-	-
RTA Ponds	Western	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
Enhancement Area	1	Yes	<i>Limnodynastes peronii</i>	50	-	-	-
	2	Dry	-	-	-	-	-
	3	No	-	-	-	-	-
	4	Dry	-	-	-	-	-

	5	Yes	<i>Limnodynastes peronii</i>	50	10	-	-
	6	Yes	<i>Limnodynastes peronii</i>	50	-	-	-
Kogarah Golf Course	Circular	No	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Eastern Channel	N/s	-	-	-	-	-
	Southern Phragmites	Yes	<i>Limnodynastes peronii</i>	500	-	-	-
	Bend Swamp	Yes	<i>Limnodynastes peronii</i>	200	-	-	-
	Southern Jungle	Dry	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	N/s	-	-	-	-	-

16 May 2024

Area	Pond	Tadpoles Present	Species	Number and Stage			
				A	B	C	D
M8 Marsh Street habitat area	A	Yes	<i>Limnodynastes peronii</i>	-	1	2	-
	B	Yes	<i>Limnodynastes peronii</i>	-	2	4	-
	C	No	-	-	-	-	-
RTA Ponds	Western	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
Enhancement Area	1	Yes	<i>Limnodynastes peronii</i>	-	40	-	-
	2	No	-	-	-	-	-
	3	Dry	-	-	-	-	-
	4	Dry	-	-	-	-	-
	5	Yes	<i>Limnodynastes peronii</i>	-	60	-	-
	6	Yes	<i>Limnodynastes peronii</i>	-	11	-	-
Kogarah Golf Course	Circular	No	-	-	-	-	-
	Long	No	-	-	-	-	-
	Eastern	No	-	-	-	-	-
	Mangrove	No	-	-	-	-	-
	Skinny	No	-	-	-	-	-
	Northern	No	-	-	-	-	-
Riverine Park and surrounds and Barton Park	Eastern Channel	N/s	-	-	-	-	-
	Southern Phragmites	Yes	<i>Limnodynastes peronii</i>	-	300	-	-
	Bend Swamp	Yes	<i>Limnodynastes peronii</i>	-	200	-	-
	Southern Jungle	No	-	-	-	-	-
	Landing Lights West	Dry	-	-	-	-	-
	Driving Range Wetland	Dry	-	-	-	-	-
	Landing Lights East	N/s	-	-	-	-	-

Appendix C: Frog monitoring data for sites outside the M8 Marsh Street habitat area

September – November 2023

Area	Pond	<i>Litoria aurea</i>	<i>Limnodynastes peronii</i>	<i>Litoria peronii</i>	<i>Litoria fallax</i>	<i>Crinia signifera</i>
Eastern Frog Corridor and Underpass	Creek (west)					
	Creek (east)	1				
	Underpass					
RTA Ponds	Western			16+	19+	
	Eastern	1	10			10+
Enhancement Area	1					
	2					
	3					
	4					
	5	2				
	6		8			
	Creek					
Kogarah Golf Course	Circular	1				
	Long			2		
	Eastern					
	Skinny					
	Northern					
	Mangrove					
Riverine Park and surrounds and Barton Park	Eastern Channel					
	Southern Phragmites		2			
	Bend Swamp		6			
	Southern Jungle					
	Driving Range Wetland					
	Landing Lights West					
Total		5	26	18	19	10

December 2023 – February 2024

Area	Pond	<i>Litoria aurea</i>	<i>Limnodynastes peronii</i>	<i>Litoria peronii</i>	<i>Litoria fallax</i>	<i>Crinia signifera</i>
Eastern Frog Corridor and Underpass	Creek (west)	1				
	Creek (east)	2	2			
	Underpass			5		
RTA Ponds	Western	2		38	48+	2
	Eastern	2	4	2	5	
Enhancement Area	1					
	2		2			
	3					
	4		2			
	5					
	6		4			
	Creek		6			
Kogarah Golf Course	Circular		6			
	Long	2	7			
	Eastern					
	Skinny		3			
	Northern					
	Mangrove					
Riverine Park and surrounds and Barton Park	Eastern Channel					
	Southern Phragmites	1	1			
	Bend Swamp		1			
	Southern Jungle					
	Driving Range Wetland					

Area	Pond	<i>Litoria aurea</i>	<i>Limnodynastes peronii</i>	<i>Litoria peronii</i>	<i>Litoria fallax</i>	<i>Crinia signifera</i>
	Landing Lights West					
Total		10	38	45	53	2

March – May 2024

Area	Pond	<i>Litoria aurea</i>	<i>Limnodynastes peronii</i>	<i>Litoria peronii</i>	<i>Litoria fallax</i>	<i>Crinia signifera</i>
Eastern Frog Corridor and Underpass	Creek (west)	17	7			
	Creek (east)	11	7			
	Underpass					
RTA Ponds	Western	21	1		51	18
	Eastern	5	1		24	1
Enhancement Area	1	1				
	2		2			
	3		1			
	4					
	5	1	2			
	6		3			2
	Creek					
Kogarah Golf Course	Circular	4				
	Long					
	Eastern		3			
	Skinny					
	Northern		2			
	Mangrove					
Riverine Park and surrounds and Barton Park	Eastern Channel		8			
	Southern Phragmites		10			
	Bend Swamp	1	12			
	Southern Jungle					
	Driving Range Wetland					
	Landing Lights West		3			
	Landing Lights East					
Total		61	62	0	75	21