



Green and Golden Bell Frog Monitoring, Arncliffe Enhancement Area, 2018-19

Prepared by AMBS Ecology & Heritage Pty Ltd
for CPB Dragados Samsung Joint Venture

Report

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1 Introduction

AMBS Ecology & Heritage Pty Ltd (AMBS) was commissioned by the CPB Contractors Dragados Samsung Joint Venture (CDS) to undertake monitoring of the Green and Golden Bell Frog (*Litoria aurea*) (GGBF) in an area known as the “Enhancement Area” at Arncliffe. The Enhancement Area is located between the south-western boundary of Kogarah Golf Course and the construction compound for the New M5. It incorporates six small ponds that were constructed by CDS, with the permission of the Kogarah Golf Club, and placed between a known GGBF habitat area (the “RTA ponds”) and intact parts of the Golf Course to the south-east (Figure 1).

GGBFs have previously been recorded in the RTA ponds and, on occasion, at a number of other sites in the vicinity, including some of the waterbodies on the Golf Course and some more ephemeral waterbodies south of the M5 (within a broad area between the Cooks River, Muddy Creek, Eve Street and West Botany Street, which is referred to herein as Barton Park). GGBFs are also currently being re-introduced to a site known as the “New M5 Habitat Area”, also located to the south of the M5, as part of a captive breeding program funded by NSW Roads and Maritime Services (RMS).

An underpass beneath the M5, between the Golf Course and Barton Park, is located near the southern end of the Enhancement Area. This underpass was built during the construction of the M5 in the early 2000’s and contains a cycle path and a fenced-off containment pond. Monitoring of the underpass was also undertaken by AMBS as part of the scope of work provided to CDS.

Monitoring of the RTA ponds, Golf Course, Barton Park and the New M5 Habitat Area were undertaken as a separate commission for RMS.

2 Methods

2.1 Tadpole Monitoring (Enhancement Area only)

Monitoring of tadpoles was undertaken in the Enhancement Area monthly, between September 2018 and May 2019 (the seasons during which GGBFs are most likely to breed). Techniques included visual observation and net sweeps. Surveys were undertaken diurnally. Visual observation involved watching each of the small ponds for signs of tadpole activity, prior to undertaking net sweeps. Net sweeps involved use of a long-handled net to sample the water body for tadpoles. Due to the small size of the ponds in the Enhancement Area, three net sweeps per pond were sufficient. Tadpoles observed or captured were identified, stage of development recorded, and counted (or an estimate of numbers made, if a large number of tadpoles were encountered).

2.2 Frog Monitoring (Enhancement Area)

Conditions for frog activity were relatively poor over the last 5 months of the GGBF activity season and particularly in April and May of 2019. Monitoring of frogs in the Enhancement Area was undertaken on four occasions prior to the end of May and a fifth “opportunistic” survey was undertaken in early June 2019. A sixth survey would have been undertaken during the GGBF activity season if conditions were suitable; however, a reconnaissance of the area towards the end of the breeding season found no signs of frog activity. The survey in early June was undertaken after conditions had improved and some frog activity was observed.

Techniques included call detection, call-playback and spotlighting. Surveys were undertaken nocturnally. Each small pond was surveyed for a 7-minute period, which involved 3 minutes of listening for calling frogs, 30 seconds of call-playback, 30 seconds of listening, 30 seconds of call-

playback, 30 seconds of listening and 2 minutes of spotlighting (in that order). Spotlighting of the area between each pond was also undertaken, whilst walking between the ponds. Any frogs heard or seen were identified and counted.

2.3 Frog Monitoring (underpass)

Monitoring of frogs at the M5 underpass involved two ecologists spotlighting in the underpass and around the entrances to the underpass on both sides, for 10 minutes (i.e. 20 person-minutes). Surveys were undertaken nocturnally, generally on one of the same nights as frog monitoring was undertaken in one of the other areas. Any frogs observed or heard calling were identified and counted.

2.4 Water Quality Sampling (Enhancement Area only)

Sampling of a number of water quality parameters was undertaken in each of the Enhancement Area ponds monthly between September 2018 and May 2019, using a hand-held probe. Measurements taken, as a minimum, included pH, salinity, temperature and dissolved oxygen (the four parameters for which survival thresholds for GGBF tadpoles have been assessed by Mahony and Beranak [undated]). Measurements of turbidity and other parameters were also taken.

2.5 Maintenance Check

A check of the ponds for maintenance or other issues was undertaken at the same time as the water quality sampling. Observations generally included water levels, presence or absence of the pest fish *Gambusia holbrooki*, and any other features of note e.g. mowing, any evidence of cats or foxes.

3 Results

3.1 Tadpole Monitoring

No GGBF tadpoles were detected in the Enhancement Area ponds during any of the surveys.

Tadpoles of one frog species were detected during the monitoring. Striped Marsh Frog (*Limnodynastes peronii*) tadpoles were detected at different times in the Enhancement Area Ponds 1, 2, 3, 4 and 5 (i.e. every pond except Pond 6).

In addition, tadpoles of the Striped Marsh Frog and also a second frog species, the Common Eastern Froglet (*Crinia signifera*), were detected in a number of ponds in the Enhancement Area during the June spotlight survey.

Data from the tadpole surveys are provided in Appendix 1.

3.2 Frog Monitoring (Enhancement Area)

No GGBFs were detected in the Enhancement Area during any of the frog surveys.

Two frog species were detected during the monitoring; the Striped Marsh Frog and the Peron's Tree Frog (*Litoria peronii*). Striped Marsh Frogs were detected at all of the Enhancement Area ponds at different times and were also often opportunistically detected in a nearby drain, which runs along the boundary of the Golf Course to the Cooks River. The Peron's Tree Frog was detected only at Pond 6, which is the closest pond to the RTA ponds, where it has been regularly recorded.

Data from the frog surveys are provided in Appendix 2.

3.3 Frog Monitoring (underpass)

No GGBFs were detected in or near the underpass during any of the frog surveys.

A small number of individuals of two frog species were detected on occasion in or near the underpass during the frog surveys; the Striped Marsh Frog and the Peron's Tree Frog.

Data from the frog surveys are provided in Appendix 2.

3.4 Water Quality Sampling (Enhancement Area)

Salinity levels in the Enhancement Area ponds were generally within the higher survival thresholds for GGBFs as defined by Mahoney and Beranak (undated), with only a few exceptions. Pond 6 recorded an unusually high reading in December 2018. This reading was never repeated so it may have been a probe malfunction. The pH measurements were within the general tadpole survival thresholds at all sites measured during the monitoring. Dissolved oxygen levels were within the higher survival threshold range for GGBF tadpoles and adults at all sites during all surveys.

Water temperature fluctuated in response to the prevailing climatic conditions and spent periods below the GGBF survival threshold, especially early in the breeding season and at the very end of the season. Given the ponds are small, temperature fluctuations in response to ambient background temperatures are likely to be frequent.

Water quality data are provided in Appendix 3.

3.5 Maintenance Check (Enhancement Area)

Pond 6, Pond 4 and Pond 1 were all dry at various times during the monitoring period. Pond 6 was completely dry on six out of the nine surveys and water levels were low on other surveys.

Vegetation within the ponds varied, depending on the pond and the time of year. Pond 6 was overgrown by (mainly terrestrial) grasses and weeds for most of the monitoring period. Weeds were generally scarce at the other Enhancement Area ponds. The water weed *Azolla* sp. was recorded regularly at two ponds but had cleared by the end of the season. Crofton Weed (*Ageratina adenophora*) had begun establishing at Ponds 4 and 5 during the monitoring period but was periodically removed by AMBS ecologists.

Vegetation around the ponds was kept short due to regular mowing by the Golf Club. At all ponds except Pond 6 the vegetation was mown right to the pond edge.

4 Discussion

Monitoring of the Enhancement Area over the 2018-2019 GGBF activity season found that, overall, most of the ponds except Pond 6 were suitable for use by frogs, and potentially suitable for use by GGBFs, but that no GGBFs were recorded. Water quality was generally good and within the thresholds defined by Mahony and Beranak (undated), with the exception of water temperature at the beginning and end of the season, which is not considered to be an issue. The ponds were utilised over the season by other frog species, including for breeding by the Striped Marsh Frog and the Common Eastern Froglet.

The key issues that we recommend are addressed are:

1. Pond 6 is clearly defective and does not retain water for a sufficient length of time;
2. Mowing of all of the vegetation around the ponds is reducing the suitability of the terrestrial habitat around the ponds.

Monitoring of the underpass over the 2018-2019 GGBF activity season detected a small number of frogs of other species (the Striped Marsh Frog and Peron's Tree Frog) utilising either the underpass or the area around it.

5 References

CDS (2017). GGBF Habitat Enhancement Area, Maintenance and Management Principles, dated 1 September 2017.

Mahony, M. and Beranak C (undated). *Water Quality parameters measured to assess suitability for Green and Golden Bell Frog occupancy*. Unpublished report provided to NSW Roads and Maritime Services.



Figure 5-1: Enhancement Area ponds. Image by Lynton Surveys, courtesy of CDS (2017).

Appendix 1: Tadpole Survey Data

Pond	Date	<i>Litoria aurea</i>		<i>Litoria peronii</i>		<i>Limnodynastes peronii</i>		<i>Crinia signifera</i>		Other	
		Total	Stage(s)	Total	Stage(s)	Total	Stage(s)	Total	Stage(s)	Total	Stage(s)
6	21/09/2018	-	-	-	-	-	-	-	-	-	-
5	21/09/2018	-	-	-	-	-	-	-	-	-	-
4	21/09/2018	-	-	-	-	-	-	-	-	-	-
3	21/09/2018	-	-	-	-	-	-	-	-	-	-
2	21/09/2018	-	-	-	-	-	-	-	-	-	-
1	21/09/2018	-	-	-	-	-	-	-	-	-	-
6	31/10/2018	-	-	-	-	-	-	-	-	-	-
5	31/10/2018	-	-	-	-	-	-	-	-	-	-
4	31/10/2018	-	-	-	-	3	A, B	-	-	-	-
3	31/10/2018	-	-	-	-	-	-	-	-	-	-
2	31/10/2018	-	-	-	-	-	-	-	-	-	-
1	31/10/2018	-	-	-	-	-	-	-	-	-	-
6	14/11/2018	-	-	-	-	-	-	-	-	-	-
5	14/11/2018	-	-	-	-	-	-	-	-	-	-
4	14/11/2018	-	-	-	-	-	-	-	-	-	-
3	14/11/2018	-	-	-	-	-	-	-	-	-	-
2	14/11/2018	-	-	-	-	-	-	-	-	-	-
1	14/11/2018	-	-	-	-	-	-	-	-	-	-
6	13/12/2018	-	-	-	-	-	-	-	-	-	-
5	13/12/2018	-	-	-	-	-	-	-	-	-	-
4	13/12/2018	-	-	-	-	-	-	-	-	-	-
3	13/12/2018	-	-	-	-	-	-	-	-	-	-
2	13/12/2018	-	-	-	-	11	B	-	-	-	-
1	13/12/2018	-	-	-	-	13	B	-	-	-	-
6	17/01/2019	-	-	-	-	-	-	-	-	-	-
5	17/01/2019	-	-	-	-	-	-	-	-	-	-
4	17/01/2019	-	-	-	-	-	-	-	-	-	-
3	17/01/2019	-	-	-	-	-	-	-	-	-	-
2	17/01/2019	-	-	-	-	3	B	-	-	-	-
1	17/01/2019	-	-	-	-	15, 3	B,3	-	-	-	-
6	15/02/2019	-	-	-	-	-	-	-	-	-	-
5	15/02/2019	-	-	-	-	30,10,2	B, C, D	-	-	-	-
4	15/02/2019	-	-	-	-	-	-	-	-	-	-
3	15/02/2019	-	-	-	-	-	-	-	-	-	-
2	15/02/2019	-	-	-	-	6,2,1	B, C, D	-	-	-	-
1	15/02/2019	-	-	-	-	-	-	-	-	-	-
6	23/03/2019	-	-	-	-	-	-	-	-	-	-
5	23/03/2019	-	-	-	-	8,11,2	B, C, D	-	-	-	-
4	23/03/2019	-	-	-	-	-	-	-	-	-	-
3	23/03/2019	-	-	-	-	-	-	-	-	-	-
2	23/03/2019	-	-	-	-	-	-	-	-	-	-
1	23/03/2019	-	-	-	-	3	D	-	-	-	-

Pond	Date	<i>Litoria aurea</i>		<i>Litoria peronii</i>		<i>Limnodynastes peronii</i>		<i>Crinia signifera</i>		Other	
		Total	Stage(s)	Total	Stage(s)	Total	Stage(s)	Total	Stage(s)	Total	Stage(s)
1	18/04/2019	-	-	-	-	-	-	-	-	-	-
2	18/04/2019	-	-	-	-	18,1	B, C	-	-	-	-
3	18/04/2019	-	-	-	-	17,2	B, C	-	-	-	-
4	18/04/2019	-	-	-	-	-	-	-	-	-	-
5	18/04/2019	-	-	-	-	-	-	-	-	-	-
6	18/04/2019	-	-	-	-	-	-	-	-	-	-
1	8/05/2019	-	-	-	-	-	-	-	-	-	-
2	8/05/2019	-	-	-	-	2,1	A, B	-	-	-	-
3	8/05/2019	-	-	-	-	50+, 3	A, B	-	-	-	-
4	8/05/2019	-	-	-	-	-	-	-	-	-	-
5	8/05/2019	-	-	-	-	4,4	A, B	-	-	-	-
6	8/05/2019	-	-	-	-	-	-	-	-	-	-

Appendix 2: Frog Survey Data

Location	Pond	Date	Species (captured/observed/heard)	Number
Eastern Frog Corridor	N/A	3/12/2018	<i>Limnodynastes peronii</i> (Ob)	2
Enhancement Area	6	4/12/2018	<i>Litoria peronii</i> (Ob)	1
	5	4/12/2018		
	4	4/12/2018		
	3	4/12/2018		
	2	4/12/2018		
	1	4/12/2018	<i>Limnodynastes peronii</i> (Ca)	
Eastern Frog Corridor	N/A	13/02/2019	<i>Litoria peronii</i> (Ob)	1
Enhancement Area	6	14/02/2019		
	5	14/02/2019		
	4	14/02/2019		
	3	14/02/2019		
	2	14/02/2019		
	1	14/02/2019	<i>Limnodynastes peronii</i> (2 Ob, 2 He)	4
Enhancement Area	6	12/03/2019		
	5	12/03/2019		
	4	12/03/2019	<i>Limnodynastes peronii</i>	2
	3	12/03/2019	<i>Limnodynastes peronii</i>	1
	2	12/03/2019	<i>Limnodynastes peronii</i>	1
	1	12/03/2019	<i>Limnodynastes peronii</i>	1
Eastern Frog Corridor	N/A	2/04/2019		
Enhancement Area	6	2/04/2019	<i>Limnodynastes peronii</i>	2
	5	2/04/2019	<i>Limnodynastes peronii</i>	2
	4	2/04/2019	<i>Limnodynastes peronii</i>	5
	3	2/04/2019	<i>Limnodynastes peronii</i>	2
	2	2/04/2019		
	1	2/04/2019	<i>Limnodynastes peronii</i>	2
Eastern Frog Corridor	N/A	12/06/2019	<i>Limnodynastes peronii</i>	2
Enhancement Area	6	12/06/2019		
	5	12/06/2019	<i>Limnodynastes peronii</i> (Tadpoles)	100+
	4	12/06/2019	<i>Limnodynastes peronii</i> (Tadpoles)	50+
			<i>Crinia signifera</i> (Tadpoles)	20+
	3	12/06/2019	<i>Limnodynastes peronii</i> (Tadpoles)	20+
	2	12/06/2019	<i>Limnodynastes peronii</i> (Tadpoles)	100+
			<i>Crinia signifera</i> (Tadpoles)	10
	1	12/06/2019	<i>Limnodynastes peronii</i> (Tadpoles)	20+

Appendix 3: Water Quality Data

Date	Pond	General Condition	Turbidity [NTU]	Diss. [mg/l]	O2	% Sat	ORP [mV]	pH	Salinity	Conduct [uS/cm]	Conduct [ms/cm]	Temp [C°]
21/09/2018	6	Dry	-	-	-	-	-	-	-	-	-	-
21/09/2018	5		88.6	2.2	21.0	-131	7.3	0.35	532	0.6	11.6	
21/09/2018	4		53.6	2.2	20.2	-207	7.4	0.41	628	0.7	10.2	
21/09/2018	3		18.8	2.2	21.1	-225	7.4	0.30	470	0.5	12.5	
21/09/2018	2		12.1	2.0	19.8	-200	7.7	0.28	443	0.5	8.1	
21/09/2018	1	Near dry	-	-	-	-	-	-	-	-	-	-
31/10/2018	6											
31/10/2018	5		4.6	4	42.2	-146	7	0.1	246	0.3	18.2	
31/10/2018	4		3.7	3.8	39.9	-155	7.1	0.1	209	0.3	17.9	
31/10/2018	3		5.2	3.6	37.5	-160	7.1	0.1	304	0.4	17.6	
31/10/2018	2		4.6	3.5	37.2	-181	7.2	0.1	277	0.3	17.9	
31/10/2018	1		6.4	3.5	37.2	-175	7.3	0.2	241	0.3	17.5	
14/11/2018	6	Dry										
14/11/2018	5		11.8	1.2	12.6	-22	5.8	0.21	410	0.5	20.9	
14/11/2018	4		22.4	1.3	13.8	-33	6.6	0.19	279	0.3	19.2	
14/11/2018	3		11.7	1.3	13.6	-44	6.5	0.25	388	0.4	19.1	
14/11/2018	2		8.6	1.4	14.7	-30	6.3	0.19	306	0.4	19.5	
14/11/2018	1		5.5	1.3	13.7	-47	6.6	0.16	255	0.3	19.3	
13/12/2018	6	5%	1.9	1.7	17.6	-228	6.7	16.6	8000	27.5	20.9	
13/12/2018	5	30%	1	1.6	16.8	-213	6.7	0.25	389	0.5	23.6	
13/12/2018	4	Full	0.4	1.7	17.5	-188	6.6	0.14	226	0.3	25.4	
13/12/2018	3	30%	0.3	1.9	17.8	-101	6.8	0.24	373	0.4	25.1	
13/12/2018	2	40%	66.4	1.3	15.1	-191	6.9	0.22	326	0.4	20.9	
13/12/2018	1	70%	19.6	1.5	16.5	-204	7.1	0.17	254	0.3	23.1	
17/01/2019	6	Dry	-	-	-	-	-	-	-	-	-	-
17/01/2019	5	100%	3.2	1.6	17.6	-238	5.9	0.2	303	0.4	25.2	
17/01/2019	4	100%	11.5	1.2	14.8	-191	6	0.15	239	0.3	26.5	
17/01/2019	3	75%	1.4	1.8	20.1	-129	6	0.23	370	0.5	27	
17/01/2019	2	75%	17.6	1.6	16.8	-127	6.1	0.19	305	0.4	23.2	

Date	Pond	General Condition	Turbidity [NTU]	Diss. O2 [mg/l]	% Sat	ORP [mV]	pH	Salinity	Conduct [uS/cm]	Conduct [ms/cm]	Temp [C°]
17/01/2019	1	50%	9.3	1.4	16.3	-230	6.1	0.22	336	0.4	25
16/02/2019	6	DRY	-	-	-	-	-	-	-	-	-
16/02/2019	5		1.3	1.3	13.6	-32	6.8	0.16	239	0.3	19.3
16/02/2019	4	DRY	-	-	-	-	-	-	-	-	-
16/02/2019	3		6.5	1.2	12.5	-30	7.1	0.23	384	0.5	19
16/02/2019	2		17.6	1.4	13.7	-11	6.8	0.23	385	0.5	18.8
16/02/2019	1		543	1.2	12.6	-133	7	0.16	253	0.3	19.6
22/03/2019	6	10% full	17.7	1.3	12.6	-255	7.8	0.71	1203	1.4	20.9
22/03/2019	5	60% full	15.5	1.9	20.5	-192	7.8	0.13	213	0.3	21.6
22/03/2019	4	full	4.5	1.1	12	-275	7.6	0.18	245	0.4	21.3
22/03/2019	3	80% full	2.2	2	21.1	-206	7.8	0.16	225	0.3	21.6
22/03/2019	2	80% full	7.8	1.7	17.9	-201	7.8	0.2	293	0.4	21.4
22/03/2019	1	80% full	10.4	1.8	19	-199	7.9	0.14	190	0.3	20.1
18/04/2019	1	Dry									
18/04/2019	2	1/2	24.6	2.1	21.2	119.2	6.7	0.1	211	177	16.4
18/04/2019	3	1/2	125	1.3	14.3	23.7	6.6	0.1	279	243	18.2
18/04/2019	4	1/2	37.3	3.1	32.8	83.5	7.1	0.1	193	170	18.7
18/04/2019	5	Full	100	3	30.5	45.9	7.2	0.1	215	178	16
18/04/2019	6	Low	15.1	5.59	55.6	-46.1	6.5	0.66	1351	1120	16.2
8/05/2019	1	Dry									
8/05/2019	2	1/2	37.3	3.02	26.9	112.2	7.6	0.01	32	22	9.9
8/05/2019	3	1/2	14.3	3.88	17.3	23.7	7.6	0.1		14.8	11.5
8/05/2019	4	1/2	30.3	4.3	37.5	36.1	8.1	0.73	453	327	10.4
8/05/2019	5	Full	9.2	4	36.8	57.7	8.1	0.21	453	317	10.8
8/05/2019	6	Dry									