Oxley Highway to Kempsey

2023/2024 Annual Ecological Monitoring Report

Transport for NSW | October 2024

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Contents

Purpose 4
Statutory and planning framework 9

Appendix A Green-thighed Frog Monitoring Report

Purpose

This report provides an update on the ecological monitoring associated with the Oxley Highway to Kempsey Pacific Highway upgrade.

This report covers the period from **22 July 2023 to 21 July 2024** and has been prepared in accordance with the Oxley Highway to Kempsey Ecological Monitoring Program (Version 3 and 4 2019 and Version 5 2022), for submission to the Department of Planning and Environment and Environment Protection Authority (EPA).

This report includes monitoring outcomes for the following monitoring undertaken in the 2023/2024 reporting period:

- Green-thighed Frog

In some instances, monitoring of a particular species or mitigation measure requires several monitoring events throughout the year. In these instances, it is considered more informative to wait until all monitoring events have been conducted for that year, before reporting on the results. This allows for between seasons and further statistical analysis to be conducted than if individual monitoring events are reported on.

Table 1 identifies the species / mitigation measures monitored for the OH2K project in accordance with the Ecological Monitoring Program (Version 3 and 4 2019 and Version 5 2022), and also highlights the specific species / mitigation monitoring included in this 2023/2024 report (**Appendix A**).

Table 1 Ecological monitoring requirements and reporting outcomes

Species / mitigation monitored	Timing	Done/ yet to be done	Reporting
Koala	Spring/Summer	Year 3 monitoring (2017) completed. Year 4 monitoring (2018) completed. Year 5 monitoring undertaken in spring 2019 and summer 2019/20. Year 6 monitoring undertaken spring 2020 and summer 2020/21. Year 8 monitoring undertaken in spring 2022 and summer 2022/2023.	No further monitoring / reporting required.
Spotted-tail Quoll	Autumn/winter	Year 4 monitoring (2018) completed. Year 6 monitoring undertaken in autumn/winter 2020. Year 8 monitoring scheduled for autumn/winter 2022.	No further monitoring / reporting required.
Giant Barred Frog	Spring, Summer and Autumn	Year 3 monitoring (2017/18) completed. Year 4 monitoring (2018/19) completed. Year 5 monitoring undertaken in spring 2019, summer 2019/20 and autumn 2020. Year 6 monitoring undertaken spring 2020, summer 2020/21and autumn 2021. Year 7 monitoring scheduled for spring 2021, summer 2021/22 and autumn 2022. Year 8 monitoring undertaken in spring 2022, summer 2022/2023 and autumn 2023.	No further monitoring / reporting required.

Green-thighed Frog	Summer (although ultimately rainfall dependent) on four occasions during operational phase (year 4-7)	Year 4 (2017/2018) monitoring completed. Year 5 2018/19 monitoring not undertaken due to lack of rain as per EMP. Recent approved updates to the EMP permits flexibility for future monitoring to permit alternative rainfall events deemed suitable by the project ecologist. Year 6 2019/20 undertaken summer 2019/2020 Year 7 2020/21 undertaken in summer 2022 in accordance with required trigger rainfall events. **Year 8 2021/22 scheduled dependent if suitable rainfall event occurs (to account for missed Year 5). The required trigger rainfall events did not occur during the required seasonal period for monitoring. This final monitoring will be undertaken during spring/summer 2023 and summer (January-February) 2024 pending required trigger rainfall events.** **Monitoring was undertaken in April 2024 following the required rainfall trigger event.**	**Year 8 monitoring included in this report. Appendix A.** This is the final monitoring event and report as required by the Ecological Monitoring Program.
Yellow-bellied Glider	August-December year 4, 6 and 8.	Year 4 monitoring (2018) completed. Year 6 monitoring Undertaken in August-December 2020. Year 8 monitoring undertaken in August-December 2022.	No further monitoring / reporting required.
Brush-tailed phascogale	Winter and summer year 4, 6 and 8.	Year 4 monitoring (2018) completed. Year 6 monitoring undertaken winter 2020 and summer 2020. Year 8 monitoring scheduled for winter 2022 and summer 2022/2023.	No further monitoring / reporting required.

Squirrel Glider	April-August year 4, 6 and 8.	Year 4 monitoring (2018) completed. Year 6 monitoring undertaken April-August 2020. Year 8 monitoring undertaken in April-August 2022.	No further monitoring / reporting required.
Fauna Fence and Road Kill Report	Weekly during October (spring), January (summer) and April (autumn) in Year 4, 5, 6 and 8	Construction / post opening – July 2017 – June 2018 completed. Year 4 monitoring (2018/19) completed. Year 5 monitoring October 2019, January 2020 and April 2020 completed Year 6 monitoring undertaken Roadkill - October 2020, January 2021, and April 2021. Fauna Fence - Autumn 2020 and spring/summer 2020/2021 Year 6 monitoring undertaken Roadkill – Autumn (April) 2022, Spring (October) 2022, and Summer (January) 2023. Fauna Fence - Autumn 2022 and Spring/Summer 2022/2023.	No further monitoring / reporting required.
Fauna underpass Monitoring Report	Autumn and spring/summer year 4, 6 and 8	Year 4 monitoring (2018/19) completed. Year 6 monitoring undertaken late autumn 2020, late spring /early summer 2020. Year 8 monitoring undertaken in late autumn 2022, late spring /early summer 2022.	No further monitoring / reporting required.
Aerial Crossings	Autumn and spring/summer year 4, 6 and 8.	Year 4 monitoring (2018) completed. Year 6 monitoring undertaken autumn and spring/summer 2020. Year 8 monitoring undertaken in autumn and spring/summer 2022.	No further monitoring / reporting required.
Widened Median	June-September year 4, 6 and 8.	Year 4 monitoring (2018) completed. Year 6 monitoring Undertaken June-September 2020 Year 8 monitoring undertaken	No further monitoring / reporting required.

		in June-September 2022	
Nest Box	Summer and winter year 4, 6 and 8.	Year 4 summer 2018 and winter 2018 complete Year 6 monitoring undertaken summer 2020 and winter 2020 Year 8 monitoring undertaken in 2022 and winter 2022.	No further monitoring / reporting required.
Bat box	Summer and winter year 4, 6 and 8.	Year 4 summer 2018 and winter 2018 complete Year 4 outcomes recommended discontinuing monitoring due to lack of uptake. Additional roost structure analyses determined uptake of new underpass structures by target species. Ongoing monitoring/reporting not required.	No further monitoring / Reporting.
Revegetation and landscaping	Monthly through construction and 1 year after operation	Year 4 monitoring (2018/19) completed. Year 5 monitoring (2019/20) completed	No further monitoring / Reporting.

Statutory and planning framework

Approval for the Oxley Highway to Kempsey Pacific Highway upgrade was granted by the then Department of Planning & Infrastructure on 8 February 2012. Transport for NSW has constructed and opened the project in stages. The three main stages of the project are:

- Stage 1 - The Sancrox Traffic Arrangement works located about two kilometres north of the Oxley Highway / Pacific Highway intersection. This section of the project opened to traffic on 30 November 2015
- Stage 2 - Kundabung to Kempsey Stage consisting of about 14 kilometres of dual carriageway, commencing north of Barry's Creek near Kundabung (chainage 24,000) and connecting to the Kempsey Bypass at Stumpy Creek (Chainage 37,800). This stage of the project opened to traffic on 31 October 2017.
- Stage 3 - Oxley Highway to Kundabung Stage consisting of about 24 kilometres of dual carriageway, commencing just north of the Oxley Highway / Pacific Highway intersection (chainage 700) and connecting with the Kundabung to Kempsey stage just north of Barry's Creek (chainage 24,000). This stage of the project opened to traffic in two parts initially on 17 November 2017 and finally in its entirety on 29 March 2018.

The Oxley Highway to Kempsey Pacific Highway upgrade approval included the requirement to develop an ecological monitoring program:

The Proponent shall develop an Ecological Monitoring Program to monitor the effectiveness of the biodiversity mitigation measures implemented as part of the project. The program shall be developed by a suitably qualified and experienced ecologist in consultation with the OEH and DPI (Fishing and Aquaculture) and shall include but not necessarily be limited to:

a) an adaptive monitoring program to assess the effectiveness of the mitigation measures identified in conditions B1, B4, B7 and B31(b) and allow amendment to the measures if necessary. The monitoring program shall nominate performance parameters and criteria against which effectiveness will be measured and include operational road kill surveys to assess the effectiveness of fauna crossings and exclusion fencing implemented as part of the project;

b) mechanisms for developing additional monitoring protocols to assess the effectiveness of any additional mitigation measures implemented to address additional impacts in the case of design amendments or unexpected threatened species finds during construction (where these additional impacts are generally consistent with the biodiversity impacts identified for the project in the documents listed under condition A1);

c) monitoring shall be undertaken during construction (for construction-related impacts) and from opening of the project to traffic (for operation/ ongoing impacts) until such time as the effectiveness of mitigation measures can be demonstrated to have been achieved over a minimum of three successive monitoring periods (i.e 6 years) after opening of the project to traffic, unless otherwise agreed by the Director General. The monitoring period may be reduced with the agreement of the Director General in consultation with the OEH and DPI (Fishing and Aquaculture), depending on the outcomes of the monitoring;

d) provision for the assessment of the data to identify changes to habitat usage and whether this can be directly attributed to the project;

e) details of contingency measures that would be implemented in the event of changes to habitat usage patterns directly attributable to the construction or operation of the project; and

f) provision for annual reporting of monitoring results to the Director General and the OEH and DPI (Fishing and Aquaculture), or as otherwise agreed by those agencies.

The Program shall be submitted to the Director General for approval no later than 6 weeks prior to the commencement of construction that would result in the disturbance of native vegetation (unless otherwise agreed by the Director General).

The initial Oxley Highway to Kempsey Ecological Monitoring Program was approved by the Department of

Planning & Environment on 25 January 2014. This was updated in 2016 (Version 2) and approved by the Department on 6 December 2016.

The EMP was further updated (Version 3 and 4) in 2019 and approved by the Department on 20 August 2019.

The species and mitigation monitoring reports included in the appendices to this annual report have been assessed against the 2019 Version 3 and 4 EMP.

A fifth revision of the Ecological Monitoring Program was submitted to the Minister on 6 May 2022 and approved by the Minister on 30/05/2022. The amendments to the Ecological Monitoring Program where for updates to the Spotted-tail Quoll monitoring methodology.

Appendix A – Green-thighed Frog

Green-thighed Frog Monitoring 2023/2024

Breeding Ponds

Oxley Highway to Kempsey, Pacific Highway Upgrade

Prepared for Transport for NSW

June 2024

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Cover photograph: Green-thighed Frog located at Site 3W in 2022 (left) and Site 3W (Pond 4) during Stage 2 2022 monitoring (right).

Executive summary

Context

This report documents the 2023/2024 monitoring period, the fifth and final monitoring event for the Green-thighed Frog breeding ponds, as required for the Oxley Highway to Kempsey (OH2K) Pacific Highway upgrade project (the Project). Transport for NSW (TfNSW) is required to manage and monitor the effectiveness of biodiversity mitigation measures implemented as part of the Project, including installation of 25 breeding ponds for the Green-thighed Frog (at five sites). Monitoring of ponds is to be performed in accordance with the methodology presented in the Ecological Monitoring Program (EMP) (TfNSW 2022).

Aims

The aim of the Green-thighed Frog breeding ponds monitoring is to determine if Green-thighed Frogs are using the purpose-built breeding habitat. Final recommendations are also provided.

Methods

Surveys were undertaken in accordance with the EMP in two stages. Stage 1 surveys focussed on adult frog detection after a sufficient rainfall trigger; Stage 2 surveys focussed on tadpole detection (indicating successful breeding). Stage 1 surveys involved a 30-minute nocturnal active search at the Collombatti reference site and at each of the constructed pond sites, as well as a peripheral habitat search. Stage 2 surveys involved a 20-minute active search of the ponds and adjacent vegetation and dip-netting of ponds. During Stage 2 surveys, pond depth was recorded, presence of fish and predatory larvae noted, and a photograph was taken from a designated reference point.

Key results

The key results are as follows:

- Stage 1 surveys were undertaken on 5 April 2024 after rainfall that was deemed suitable by the Project Ecologist: 24 hour rainfall between 56-78 millimetres; cumulative rainfall over 72 hours between 67-88 millimetres.
- Stage 2 surveys were undertaken on the 15 May 2024, 40 days after Stage 1 surveys.
- No Green-thighed Frogs were identified during Stage 1 surveys.
- Stage 1 pond depth at Sites 1, 3W and 4W varied between 5-70 centimetres and Site 4E contained water at only one pond.
- Green-thighed Frog tadpoles were not identified at any site.
- Ponds at Site 1 (E&W) and Site 3W held water at Stage 2 surveys, Site 4W contained water at one pond only while all ponds at Site 4E were dry.
- All ponds holding water contained predatory invertebrates.

Conclusions

None of the three performance indicators of success has been met for the 2023/2024 monitoring period, with no Green-thighed Frogs recorded at constructed breeding ponds, adjacent habitat or Collombatti reference site. Green-thighed Frogs continue to be absent from Sites 1 (E&W) and 4 (E&W) and Site 4 (E&W) ponds are not retaining water for a sufficient amount of time to enable tadpoles to reach metamorphosis.

Management implications

Green-thighed Frogs have not been recorded at the constructed breeding pond Sites 1 and 4 during monitoring periods where they were recorded at either the Collombatti reference site (2016/2017 and

2019/2020) or Site 3W (2016/2017, 2017/2018, 2019/2020, 2021/2022). Additional incidental surveys undertaken in 2020/2021 recorded the species at a number of locations in proximity to the Project area. Due to these outcomes, further surveys of these ponds or adjacent habitat are not required as the species is known to persist in the Project area.

Table of Contents

Executive summary ..... **iii**

1. Introduction **1**

1.1 Context 1

1.2 Performance Measures 2

1.3 Monitoring Timing 3

1.4 Reporting 3

1.5 Limitations 3

2. Survey Methods **4**

2.1 Monitoring Sites 4

2.2 Survey Method 4

2.3 Analysis 5

3. Results **10**

3.1 Frog Fence Monitoring 10

3.2 Stage 1 – Determining Presence and Breeding Activity 10

3.3 Stage 2 - Determining the Success of the Breeding Event 11

3.4 Cumulative Results 14

3.5 Consideration of Adjacent Habitat and Pond Location 15

3.6 Incidental records 2020/2021 15

4. Discussion **18**

5. Recommendations **20**

5.1 Contingency Measures 20

5.2 Recommendations 20

References **22**

Annex 1. 2023/2024 monitoring results **23**

Annex 2. Photo monitoring **26**

List of Figures

Figure 1: Green-thighed Frog breeding pond location 6

Figure 2: Green-thighed Frog breeding ponds – Site 1 7

Figure 3: Green-thighed Frog breeding ponds – Site 3 8

Figure 4: Green-thighed Frog breeding ponds – Site 4 9

Figure 5: Incidental records 17

List of Tables

Table 1: Performance indicators 2

Table 2: Survey sites 4

Table 3: Rainfall and temperatures for 5 April 2024 10

Table 4: Monitoring results summary 13

Table 5: Cumulative monitoring results 14

Table 6: Adjacent habitat and constructed pond location review 16

Table 7: Performance indicators of success 18

Table 8: Signs of the mitigation being unsuccessful 18

Table 9: Contingency measures 20

1. Introduction

1.1 Context

The Oxley Highway to Kempsey (OH2K) section of the Pacific Highway Upgrade Project (the Project) was approved in 2012, subject to various Ministers Conditions of Approval (MCoA) and a Statement of Commitments (SoC). A subsequent approval with additional conditions of consent (CoA) was granted in 2014 by the then Commonwealth Department of Climate Change, Energy, the Environment and Water (Commonwealth DCCEEW) for Matters of National Environmental Significance (MNES) listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1995* (EPBC Act). The Ecological Monitoring Program (TfNSW 2022) (hereafter referred to as the EMP) combines these approval conditions and defines the mitigation and offsetting requirements for threatened species and ecological communities impacted by the Project. The Green-thighed Frog (*Litoria brevipalmata*) was identified as requiring mitigation and monitoring through the course of the Projects' construction and post-construction period.

1.1.1 Legal status

The Green-thighed Frog is listed as vulnerable under the New South Wales *Biodiversity Conservation Act 2016* (BC Act). Monitoring of this species is required under the Project's approval.

1.1.2 Monitoring framework

Green-thighed Frog monitoring is to be performed in accordance with the EMP and the Green-thighed Frog Management Strategy (Lewis 2013), with the EMP taking precedence where inconsistencies occur. Construction involved direct and indirect impacts on known Green-thighed Frog habitat areas, which prevented post-construction monitoring. Therefore, monitoring relates to their presence/potential presence within purpose-built constructed breeding ponds, as per the EMP.

The EMP states: "*Monitoring will be undertaken on five occasions commencing in Years 3-7 (construction and operation phase). Each monitoring event should be at least 10-12 months apart but ultimately dependant on rainfall events.",* and that *" The first round of monitoring (Year 3) is to commence once the vegetation on the edges of the constructed ponds is considered sufficient (>20% groundcover), to be determined by a suitably qualified Ecologist*."

The Green-thighed Frog Management Strategy requires a two-component approach to Green-thighed Frog monitoring:

- monitoring of breeding ponds, and
- monitoring the integrity of the frog fences.

The final monitoring of frog fences was completed in 2022/2023 as part of the fauna fence monitoring (Niche 2023).

The 2023/2024 monitoring represents the fifth and final monitoring event. To date, these monitoring events have been reported as follows:

- *2016/2017*: Niche (2017).
- *2017/2018*: Niche (2018).
- *2018/2019*: insufficient rainfall to trigger surveys.
- *2019/2020*: Niche (2020).
- *2020/2021*: surveys not completed due to timeframes involved in changes in methodology to address unsuccessful mitigation.

- *2021/2022*: Niche (2022).
- *2023/2024*: current report.

The EMP states that monitoring is to occur on five occasions. This report presents the results for the fifth and final monitoring event of the Green-thighed Frog Breeding Ponds monitoring program.

1.1.3 Baseline data

Green-thighed Frogs were identified from seven locations during baseline surveys (Lewis 2013, Figure 1), however no tadpoles, metamorphs or juvenile Green-thighed Frogs were recorded at identified breeding sites 57 days after rain events enabled identification of adult frogs. As construction of the Project directly or indirectly impacted seven known habitat areas, frog breeding ponds were proposed at these locations. The Green-thighed Frog Management Strategy (Lewis 2013) states: "*Frog breeding ponds will be constructed at four locations, two within the Oxley Highway to Kundabung Upgrade section and two within the Kundabung to Kempsey section.*"

The EMP provides a summary of the location of the proposed breeding ponds:

- "*Ch.9050-9350. Five ponds to be constructed on each side of the carriageway.*
- *Ch.11550. Five ponds to be constructed on each side of the carriageway (Project Ecologist to investigate the suitability of ponds in consultation with RMS and the EPA and be guided by the results of pre-clearing surveys).*
- *Ch.30660. Five ponds to be constructed on the western side of the carriageway.*
- *Ch.33650. Five ponds to be constructed on each side of the carriageway*."

It was determined in consultation with the NSW Environment Protection Authority (EPA) that the construction of 10 ponds at Ch. 11550 was not warranted due to several surveys finding no record of Green-thighed Frogs in the area around Ch. 11550. In addition, it was determined that breeding habitat remained available locally outside the Project boundary. As such, monitoring has been undertaken of ponds constructed at the remaining three areas (baseline sites 20, 11 and 16).

1.1.4 Purpose of this report

This report complies with the monitoring requirements described within the approved EMP and the Green-thighed Frog Management Strategy (Lewis 2013) and details the findings from the fifth monitoring period. It represents the final monitoring event. The aims of this report are to summarise the methods and results of the 2023/2024 monitoring, determine if performance measures are being met, and to comment on the need for contingency measures, as per the EMP.

1.2 Performance Measures

The Green-thighed Frog Management Strategy and the EMP specify a number of performance indicators against which the success of the ponds will be measured. These are listed in Table 1 along with their inclusion in the relevant document.

Table 1: Performance indicators

Performance indicator	GThF MS	EMP
Performance indicators of success		
Continued presence of Green-thighed Frog at two/three or more of the three/four breeding pond sites.	✓	✓
Green-thighed Frogs calling from the edge of the constructed ponds.	✓	✓
The presence of tadpoles, juveniles or metamorphs at the frog breeding ponds during Stage 2 surveys.	✓	✓
Signs of the mitigation being unsuccessful		

Performance indicator	GThF MS	EMP
Absence of Green-thighed Frogs from one or more of the four sites (GThF MS) Absence of Green-thighed Frogs from the area (EMP)	✓	✓
Ponds not holding water for a sufficient time to enable tadpoles to reach metamorphosis.	✓	✓
Ponds holding water for too long and representing unsuitable habitat (i.e. permanent versus ephemeral).	✓	✓
Exotic fish fauna recorded in breeding ponds.	✓	

GThF MS = Green-thighed Frog Management Strategy (Lewis 2013); EMP = Ecological Monitoring Program (TfNSW 2022).

1.3 Monitoring Timing

The EMP specifies that:

"*Monitoring will be undertaken on five occasions commencing in Years 3-7 (construction and operation phase). Each monitoring event should be at least 10-12 months apart but ultimately dependant on rainfall events. On each occasion the site would be surveyed for 30 minutes during Stage 1 and for 20 minutes during stage 2 (see section 4.9.3). Four of the five monitoring events are to occur during the operational phase of the Project (Years 4-7). The first round of monitoring (Year 3) is to commence once the vegetation on the edges of the constructed ponds is considered sufficient (>20% groundcover), to be determined by a suitably qualified Ecologist. The timing would be staggered accordingly for either stage of the Upgrade.*"

1.4 Reporting

Annual reporting of monitoring results is required to include:

- Detailed description of monitoring methodology employed
- Results of the monitoring period
- Discussion of results, including how the results compare against performance measures, if any modifications to timing or frequency of monitoring periods or monitoring methodology are required and any other recommendations
- If contingency measures should be implemented.

All reports prepared under the EMP will be submitted to the NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW) and the NSW EPA.

1.5 Limitations

The following limitations to the monitoring procedure were encountered:

- A definitive statement as to the fulfilment of performance indicators relating to ponds drying too soon or holding water for too long cannot be made for some or all of the ponds, due to surveys requiring Stage 2 surveys to be undertaken 30-40 days after Stage 1 and the minimum water retention period of 30 days and maximum water retention period of 60 days. As such, data concerning the presence of water in the ponds prior to or after Stage 2 surveys cannot be captured without additional surveys, which were beyond the identified scope of the monitoring program.
- Significant rainfall events between Stage 1 and Stage 2 surveys influenced the water depth of constructed ponds at Stage 2 surveys.

2. Survey Methods

2.1 Monitoring Sites

The monitoring site locations are shown in Figures 1 to 4. These sites correspond to the proposed pond locations as required by the EMP and are described in Table 2. The Collombatti site was used as the reference site.

Table 2: Survey sites

Site name (map ID)	Proposed frog pond sites (EMP)
Collombatti Reference (Ref)	As required by Stage 1 surveys: "*Upon the study area receiving the required rainfall, a reference site would be visited to determine the extent of Green-thighed Frog activity*"
1E	Ch.9050-9350. Five ponds to be constructed on each side of the carriageway (10 in total)
1W	
3W	Ch.30660. Five ponds to be constructed on the western side of the carriageway
4E	Ch.33650. Five ponds to be constructed on each side of the carriageway (10 in total)
4W	

2.2 Survey Method

The survey method described within the EMP (extracted from the Green-thighed Frog Management Strategy) was employed for all surveys and is provided below.

"*Monitoring of the constructed breeding ponds would ideally be undertaken on a rainfall event basis when 24-hour rainfall totals exceed 75 millilitres or a cumulative total of 150 millilitres over a 72-hour period. Such rainfall events would be monitored via the Bureau of Meteorology (BOM) website, specifically the Port Macquarie (Station No. 060183) and/or Kempsey (Station No. 059017) weather stations. Where sufficient rainfall is unlikely to occur during the monitoring period, the Project Ecologist will determine whether smaller rainfall events are suitable to conduct a monitoring event. The suitability of the rainfall trigger chosen would be subject to the reference site visit outlined in Stage 1 below. Surveys would be performed using a two-stage process outlined below.*

A) Stage 1 – Determining Presence and Breeding Activity

Upon the study area receiving the required rainfall, a reference site would be visited to determine the extent of Green-thighed Frog activity. The survey would comprise a 30 minute nocturnal active search at each of the four breeding pond areas (sites) using a hand held spotlight. Peripheral habitats (i.e. <50 m) would also be surveyed at this time. Upon the completion of Stage 1 surveys the next stage would be implemented.

b) Stage 2 – Determining the Success of the Breeding Event

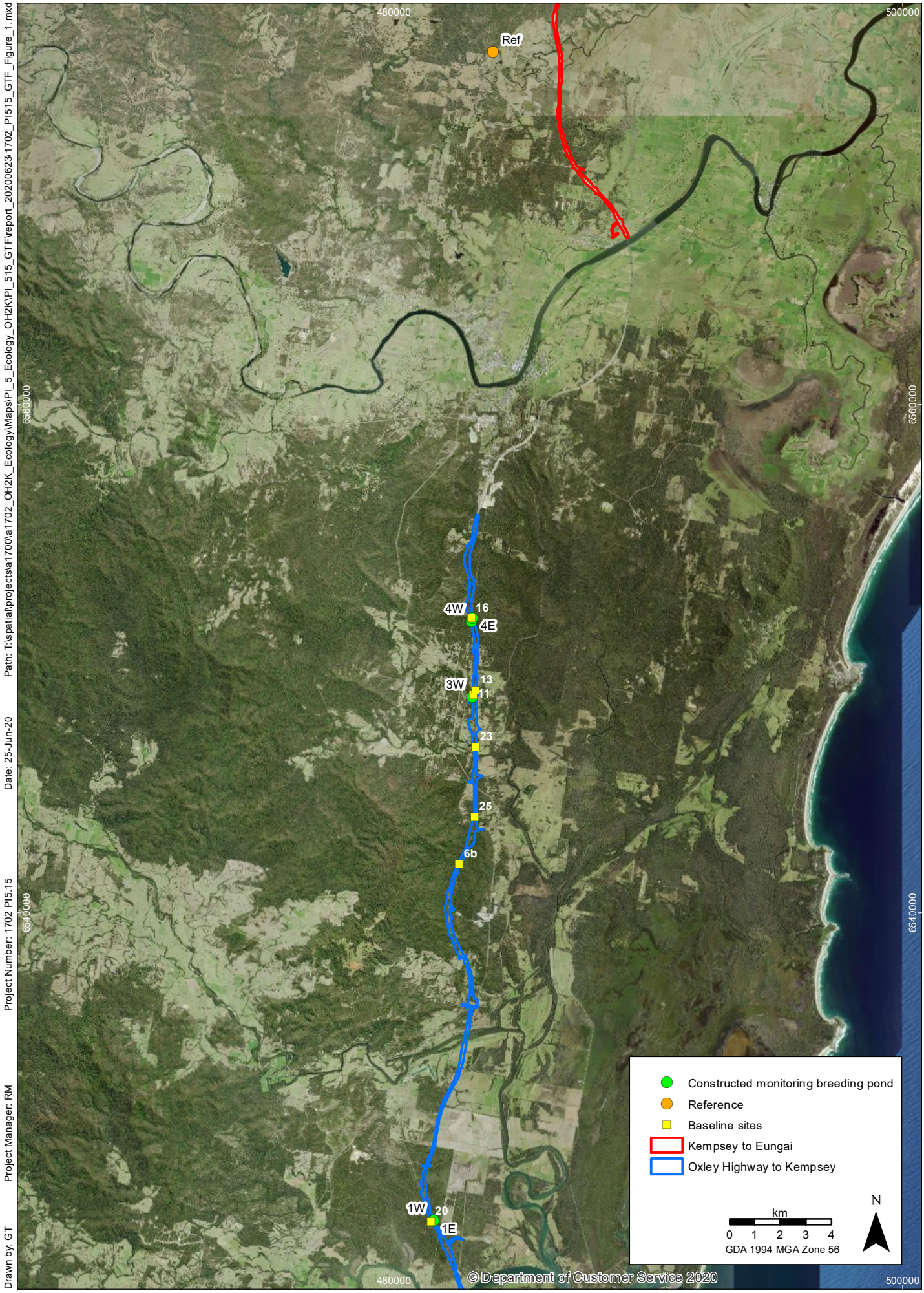
All sites would be subject to follow-up surveys between 30-40 days after Stage 1 to assess the outcome of the breeding event. This follow up survey will comprise:

- *A 20 minute active search for metamorphs and juvenile frogs around the pond edge and vegetation immediately adjacent to the pond (i.e. <10 m).*
- *Dip-netting of the constructed pond and subsequent tadpole identification. Specific attention will be given toward identifying the presence of fish (both native and exotic) along with predatory invertebrates such as dytiscid larvae.*

- *The depth of the ponds would be measured from the permanently installed water staff.*
- *Photo taken from a designated photo point (to be established during the first Stage 2 survey).”*

2.3 Analysis

Monitoring results are to be analysed in accordance with the performance indicators specified within the EMP. In the case of the Green-thighed Frog, performance measures are based on presence/absence results and pond habitat quality and do not require statistical comparison between survey events.



Green-thighed Frog constructed breeding pond locations

Pacific Highway Upgrade - Oxley highway to Kempsey

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FIGURE 1

Imagery: (c) LPI 2014-10-06

Green-thighed Frog constructed breeding ponds - Site 1

Pacific Highway Upgrade - Oxley highway to Kempsey

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FIGURE 2

Imagery: (c) NearMap 2017-12-13

Green-thighed Frog constructed breeding ponds - Site 3

Pacific Highway Upgrade - Oxley highway to Kempsey

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FIGURE 3

Green-thighed Frog constructed breeding ponds - Site 4

Pacific Highway Upgrade - Oxley highway to Kempsey

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FIGURE 4

3. Results

Field data from Stage 1 and Stage 2 monitoring for all sites are provided in Annex 1. Photo monitoring results are provided in Annex 2.

3.1 Frog Fence Monitoring

The final frog fence monitoring was completed in 2022/2023 as part of the fauna fence monitoring program. Results were provided within the fauna fence monitoring report (Niche 2023).

3.2 Stage 1 – Determining Presence and Breeding Activity

3.2.1 Conditions

Suitable rainfall within the 2023/2024 monitoring period, as specified within the EMP, did not occur until April 2024, two years after the previous trigger and monitoring event (February 2022). Stage 1 surveys were undertaken on 5 April 2024 when rainfall was deemed suitable by the Project Ecologist. Rainfall and temperatures for relevant weather stations are provided in Table 3.

Table 3: Rainfall and temperatures for 5 April 2024

BOM weather station	24hr rainfall (mm)	72hr rainfall (mm)	Min temperature˚C	Max. temperature˚C
Port Macquarie Airport AWS #60139	78.2	87.6	17.8	23.1
Kempsey Airport AWS #59007	56.4	66.8	17.8	21.7

3.2.2 Nocturnal active searches

No Green-thighed Frogs were identified at the ponds or the Collombatti Reference Site during Stage 1 surveys. No Green-thighed Frogs were calling at the time of surveys.

A number of frog species were heard calling at the Collombatti reference site, Site 1, Site 3W and Site 4W. Other species identified include the Striped Marsh Frog (*Limnodynastes peronii*), Common Eastern Froglet (*Crinia signifera*), Whirring Tree Frog (*Litoria revelata*), Graceful Tree Frog (*Litoria gracilenta*) and Dusky Toadlet (*Uperoleia fusca*).

These results are summarised in Table 4.

3.2.3 Pond depth during Stage 1

Water depth of the ponds varied during Stage 1 surveys, and can be summarised as follows:

- Collombatti reference site: 40-60 cm
- Site 1W: between 5-10 cm
- Site 1E: between 40-50 cm
- Site 3W: between 50-70 cm
- Site 4W: between 5-40 cm
- Site 4E: between 0 – 5 cm.

Table 4 presents Stage 1 water depths.

3.2.4 Vegetation structure and other observations

As discussed in Niche (2018), it is possible that invasive grass species present at many ponds is too dense and possibly unsuitable for Green-thighed Frogs, a species that requires leaf litter for foraging (OEH 2018) and a more open low ground vegetation (Hero 2004), such as ferns and mat rushes. Each site is discussed below and site photos provided in Annex 2 show the level of vegetation and exposure of ponds at each site.

Site 1

Site 1 (E&W) ponds are surrounded by dense exotic perennial grasses (*Andropogon* sp. and *Seteria* sp.) with sedges or rushes within and around ponds. Site 1W Ponds are positioned within an exposed sunny location without canopy cover. Whilst ponds at Site 1E are partially shaded by adjacent vegetation and regenerating vegetation. The presence of bulrushes at ponds 1 and 3 Site 1E and pond 5 Site 1W may indicate that these ponds are acting as semi-permanent water bodies and holding water for too long. Adjacent habitat at Site 1E represents potential habitat suitable for Green-thighed Frogs consisting of *Lomandra* spp. and Paperbark species.

Site 3W

Ponds at Site 3W are surrounded by dense exotic grasses and scattered regenerating shrubs and trees present at pond edges. The density of exotic grass has continued to increase substantially over the monitoring program and ponds have become difficult to detect. Canopy is predominately absent with some cover provided by adjacent native midstorey and canopy. The adjacent habitat to the west consists of a larger ephemeral pond within a swamp forest providing good habitat for Green-thighed Frogs. The canopy is predominately *Melaleuca* spp. and the ground cover includes the presence of *Lomandra* spp.. Pond 4 was observed to be overflowing into the adjacent habitat during Stage 1 surveys.

Site 4

Site 4E ponds are situated on a ridgetop within a narrow strip of open forest that is bounded by the Pacific Highway and a wide easement. The forest vegetation immediately surrounding ponds provides some cover with a native midstorey and predominately grassy ground layer. Site 4W ponds are partially exposed with limited canopy cover, however vegetation growth has increased at the site and cover is provided by a native midstorey. Site 4E and 4W ponds are notably shallower than other sites and are not capable of holding water for 40 days, if at all.

3.3 Stage 2 - Determining the Success of the Breeding Event

Stage 2 surveys were undertaken on 15 May 2024, 40 days after Stage 1 surveys.

3.3.1 Active searches and dip-netting

A number of tadpoles were caught at the Collombatti reference site, Site 1E, Site 3W and Site 4W. All of the five ponds at Site 4 E were dry during Stage 2 surveys.

Tadpoles were identified as either Striped Marsh Frog or *Crinia* spp. Unidentified specimens were not Green-thighed Frog tadpoles.

3.3.2 Predatory fish and invertebrates

Various predatory invertebrates were detected at Collombatti reference site, Sites 1 (E&W), 3W and 4W for all ponds holding water. Predatory fish were not detected during Stage 2.

3.3.3 Pond depth during Stage 2

Table 4 provides the Stage 1 and Stage 2 water levels, including the hydroperiod requirements according to Lewis (2013). According to Lewis (2013), ponds should have a maximum depth of 400 mm and hold water for between 30-40 days at sunny exposed sites or 50-60 days at shaded locations. The constructed ponds can be classed as both sunny exposed sites and shaded sites (see Table 4). Water should therefore be retained up to 40 days in exposed ponds or 60 days in shaded ponds. Stage 2 surveys were undertaken 40 days after Stage 1.

Water levels during Stage 2 surveys can be summarised as follows:

- Site 1W - all five constructed ponds held water (10-23 cm deep)
- Site 1E - all five constructed ponds held water (5-23 cm deep)
- Site 3W - all five constructed ponds held water (31-48 cm deep)
- Site 4W - all five constructed ponds held water (0-15 cm deep)
- Site 4E - all five constructed ponds were dry.

Minimum water retention period – 30 days

Four of the five ponds at Site 4E were dry during Stage 1 surveys following heavy rain with pond one holding 5 cm only, therefore the assumption can be made that Site 4E ponds do not hold water for the minimum required 30 or 50 days (depending on sun exposure; Lewis (2013) and see Table 7). Four of five ponds at Site 4W did not hold water during Stage 2, therefore four ponds were considered to not hold water for the minimum required period. All Site 1 (E&W) and Site 3W ponds were considered to successfully retain water for the minimum required period (i.e. more than 30 days).

Maximum water retention period – 40-60 days

Stage 1 surveys and Lewis (2013) states a suitable hydroperiod of up to 40 days for exposed sites or up to 60 days for shaded sites. Given the Stage 2 surveys were undertaken 40 days following Stage 1 ponds holding water have been determined as successful in meeting the suggested hydroperiod. However, as water retention is dependent not only on pond permeability but on weather conditions and local rainfall, it is difficult to draw conclusions regarding the likelihood of ponds to dry within the recommended hydroperiod. Assessment of water levels after Stage 2 and beyond 60 days (maximum hydroperiod prescribed by Lewis (2013)) was not possible due to survey limitations. Research has shown that an extended hydroperiod is unlikely to impact the breeding of this species, as long as the pond is ephemeral (Lemckert *et al.* 2006, and Lemckert *pers. comm.*). Therefore, water retention within ponds somewhat beyond the preferred hydroperiod is not considered as important to the survival of this species as the retention of water for periods long enough to allow for metamorphosis to occur.

Table 4: Monitoring results summary

Site	Hydroperiod (Lewis 2013)	Site condition	GTF	Other frog species	Pond	Stage 1 depth (cm)	Stage 2 depth (cm)	Minimum water retention period	Maximum water retention period
1W	Ponds to support water for up to 30-40 days	Sunny exposed ponds. Established vegetation surrounding ponds.		Common Eastern Froglet	1	10	10	Successful	Not available due to survey limitations
					2	5	23	Successful	Not available due to survey limitations
					3	5	18	Successful	Not available due to survey limitations
					4	10	10	Successful	Not available due to survey limitations
					5	10	16	Successful	Not available due to survey limitations
1E		Sunny ponds with vegetation immediately adjacent to east. Established vegetation immediately surrounding ponds.		Common Eastern Froglet, Striped Marsh Frog	1	50	9	Successful	Not available due to survey limitations
					2	50	23	Successful	Not available due to survey limitations
					3	40	16	Successful	Not available due to survey limitations
					4	40	5	Successful	Not available due to survey limitations
					5	40	10	Successful	Not available due to survey limitations
3W	Ponds to support water for up to 30-60 days depending on whether the location is shaded or unshaded.	Sunny ponds with vegetation immediately adjacent to the west		Striped Marsh Frog, Common Eastern Froglet, Dusky Toadlet, Whirring Tree Frog	1	50-70	45	Successful	Not available due to survey limitations
					2	50-70	46	Successful	Not available due to survey limitations
					3	50-70	24	Successful	Not available due to survey limitations
					4	50-70	48	Successful	Not available due to survey limitations
					5	50-70	31	Successful	Not available due to survey limitations
4W	Ponds to support water for 30 days*	Partially shaded ponds with native midstorey, grassy groundcover and limited canopy cover.		Common Eastern Froglet, Dusky Toadlet	1	20	15	Successful	Not available due to survey limitations
					2	30	0	Unsuccessful	Did not retain water
					3	5	0	Unsuccessful	Did not retain water
					4	40	0	Unsuccessful	Did not retain water
					5	40	0	Unsuccessful	Did not retain water
4E	Ponds to support water for 30 days*	Shaded ponds amongst surrounding open woodland, grassy groundcover.			1	5	0	Unsuccessful	Did not retain water
					2	0	0	Unsuccessful	Did not retain water
					3	0	0	Unsuccessful	Did not retain water
					4	0	0	Unsuccessful	Did not retain water
					5	0	0	Unsuccessful	Did not retain water

* Ponds at sunny exposed sites should hold surface water for between 30-40 days, and between 50-60 days at shaded locations (Lewis 2013). Discussions with TfNSW concluded that Site 4 (E&W) ponds should be classified as shaded or only partly shaded. Metamorphosis may occur within 28 days (Lewis 2013) and field records show metamorphosis occurring at an exposed site within 40 days (Lemckert *et al.* 2006). As such, it is considered that ponds at Site 4 (E&W) should support water for 30-60 days to allow for a range of sunny and shaded locations, to provide enough time for metamorphosis to occur (in accordance with Table 3-1, Lewis 2013).

3.4 Cumulative Results

Summary results of monitoring events to date are provided in Table 5, with records of Green-thighed Frogs shaded in darker grey. To date, Green-thighed Frogs have not been detected at Site 1 (E&W) or Site 4 (E&W), while Site 3W has shown success in four out of five monitoring periods. Unsuccessful detection of Green-thighed Frogs for the 2023/2024 monitoring event at both Site 3W and Collombatti Reference Site may be attributed to the timing of survey, despite good weather conditions and high levels of frog activity observed at these sites for other frog species. The 2023/2024 surveys were undertaken on the 5 April 2024, which may be considered late in the breeding season for the species (spring to autumn). Site 4 ponds are considered to have shown insufficient water retention in three monitoring periods. Water retention post-survey is difficult to determine due to the survey design, but is considered less important than detection of insufficient water retention, and is not included in the cumulative results.

Table 5: Cumulative monitoring results

Site (pond)	2016/2017			2017/2018			2019/2020			2021/2022			2023/2024		
	# GTF	#GTF TP	Pond WR	# GTF	#GTF TP	Pond WR	# GTF	#GTF TP	Pond WR	# GTF	#GTF TP	Pond WR	# GTF	#GTF TP	Pond WR
Ref	**1**	0	Y	0	0	Y	**2, 3C**	0	Y	0	0	Y	0	0	Y
1W(1)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1W(2)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1W(3)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1W(4)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1W(5)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1E(1)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1E(2)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1E(3)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1E(4)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
1E(5)	0	0	Y	0	0	Y	0	0	Y	0	0	Y	0	0	Y
3W(1)	0	0	Y	**C**	0	Y	0	0	Y	0	0	Y	0	0	Y
3W(2)	0	0	Y	**1, C**	**1**	Y	0	0	Y	0	0	Y	0	0	Y
3W(3)	0	0	Y	**C**	0	Y	0	0	Y	**1 (adjacent)**	0	Y	0	0	Y
3W(4)	**1**	0	Y	**1, C**	**3**	Y	**1 (adjacent)**	0	Y	0	0	Y	0	0	Y
3W(5)	**1**	0	Y	**C**	0	TS	0	0	Y	0	0	Y	0	0	Y
4W(1)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	Y
4W(2)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	TS
4W(3)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	TS
4W(4)	0	0	TS	0	0	TS	0	0	TS	0	0	Y	0	0	TS
4W(5)	0	0	TS	0	0	TS	0	0	TS	0	0	Y	0	0	TS
4E(1)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	TS
4E(2)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	TS
4E(3)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	TS
4E(4)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	TS
4E(5)	0	0	TS	0	0	TS	0	0	TS	0	0	TS	0	0	TS

C = heard calling in vicinity of pond; #GTF TP = number of Green-thighed Frog tadpoles; Pond WR = minimum water retention period met; Y = Yes; TS = water not retained for the minimum period.

3.5 Consideration of Adjacent Habitat and Pond Location

Given the lack of records of Green-thighed Frogs at the constructed breeding ponds to date, habitat immediately adjacent to the constructed ponds was inspected for its suitability as Green-thighed Frog breeding habitat and a brief review of the location of the constructed ponds with regard to the baseline records was undertaken previously (Niche 2020). Table 6 provides details of monitoring sites and baseline survey information. It should be noted that the two areas where Green-thighed Frogs have not been detected (Sites 1 and 4) were heavily impacted by habitat removal during construction. The species persists at Site 3 where direct impacts did not occur.

To date, Green-thighed Frogs have been observed at the constructed ponds only at Site 3W and tadpoles have been found within the constructed ponds. This would indicate that where a population of Green-thighed Frogs persists, the ponds may provide breeding habitat, where the pond conditions are suitable. The remaining sites therefore may either not be in proximity to a population and/or may not provide suitable breeding conditions. It is considered likely that Site 1W and Site 4(E&W) ponds are not located in an area (or are separated from by a road) that would support a population of Green-thighed Frogs and are therefore unlikely to be used for breeding. Site 1E lies adjacent to potential habitat, however Green-thighed Frogs have not been detected at or adjacent to Site 1E to date during the monitoring.

3.6 Incidental records 2020/2021

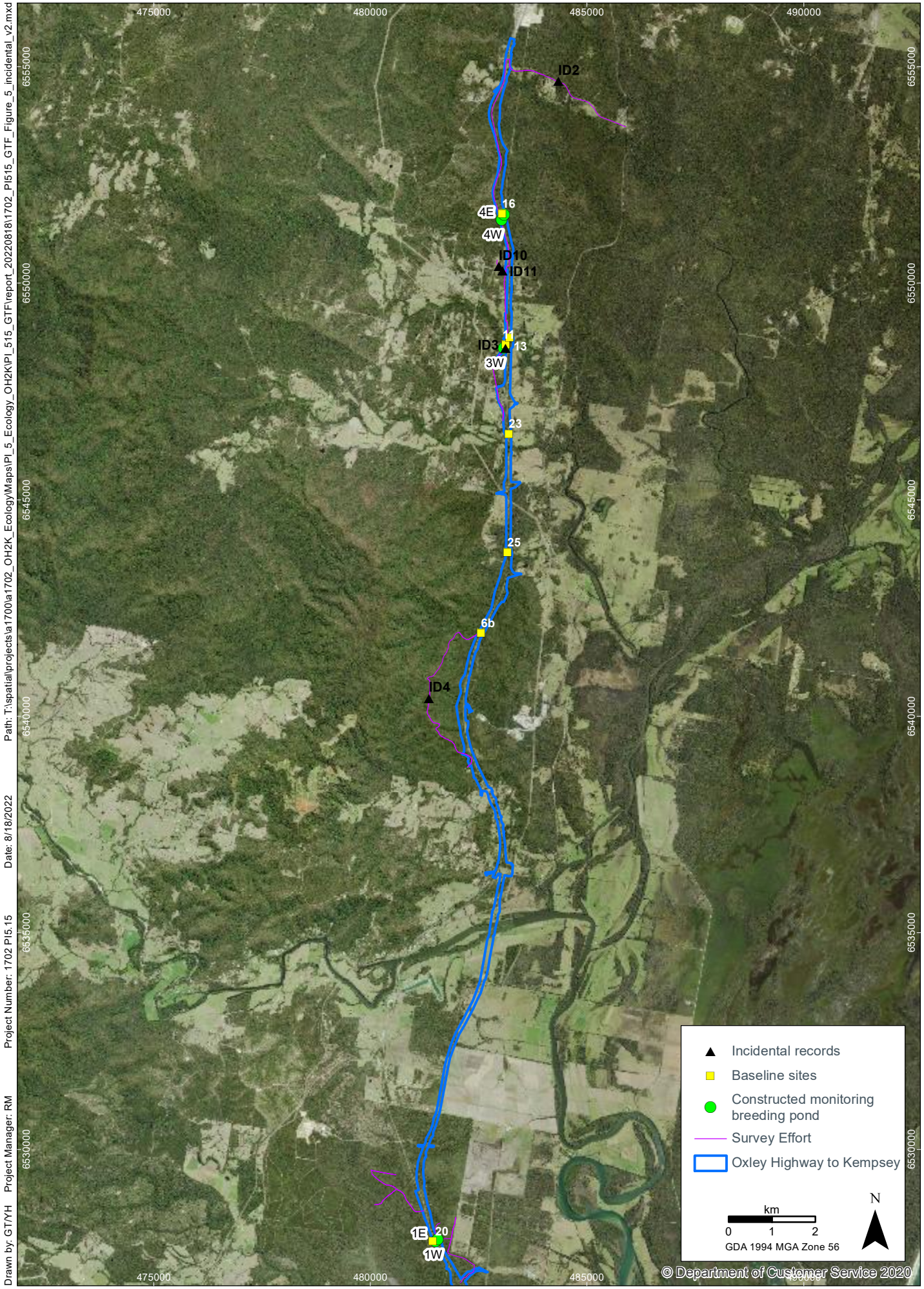
After substantial rainfall in December 2020, TfNSW completed incidental surveys of accessible tracks and trails in proximity to the Project area. Green-thighed Frogs were identified calling from a number of locations, shown in Figure 5. These records are summarised as follows:

- ID2: calling from wheel ruts along Kemps Road (1000 m from Project)
- ID3: 5-10 calling from the edge of the Site 3W pond in exposed areas and from within the Setaria
- ID4: <5 calling from one small forestry dam high on a ridge top (650 m from Project)
- ID10: calling from flooded area in paddock away from the road (150 m from Project)
- ID11: individual crossing road (49 m from Project).

These records demonstrate ongoing presence at a number of locations in proximity to the Pacific Highway.

Table 6: Adjacent habitat and constructed pond location review

Site (map ID)	Proposed frog pond sites (EMP)	Baseline site	Baseline location details	Baseline notes (Lewis 2013)	Location comment	Adjacent habitat comment
1 (E&W)	Five ponds each side of the carriageway	20	Blackmans Point Road	> 3 males calling on western side of highway. Another 2-3 males calling 300 m north on the eastern side of highway.	Ponds constructed as per Lewis (2013). East and west ponds are located at the chainage point where the species was identified of the western side of carriageway. The species was detected 300 m further north on the eastern side. The western ponds are isolated in a strip of vegetation between the Pacific Highway and Telegraph Road. Extensive works occurred in this location in association with the Blackmans Point Road Interchange.	1W: ponds are located within a linear strip of disturbed grassy habitat sitting between Telegraph Point Road and the Pacific Highway, which is unlikely to represent suitable breeding habitat. The western side of Telegraph Point Road is predominantly woodland, which may support areas of suitable breeding habitat. 1E: ponds are located in a low lying densely vegetated wet area, which may represent suitable breeding habitat. The adjacent vegetation is a densely vegetated swamp forest, and may support suitable breeding habitat.
3W	Five ponds on the western side of the carriageway	11	South west side of Pipers Creek	No tadpoles, metamorphs or juvenile frogs recorded. Some small pools of water to 30 mm with tadpoles of other species seeking refuge in leaf litter. Males chorusing in regrowth Acacia vegetation around 30-40 m west of existing highway.	Ponds constructed as per Lewis (2013). Ponds directly adjoin adjacent suitable habitat to the west. This area was not directly impacted by the Project.	Ponds are located immediately adjacent to a swamp sclerophyll forest, which represents suitable breeding habitat. Green-thighed Frogs have been consistently recorded in this area.
4 (E&W)	Five ponds on each side of the carriageway	16	South east of Bloodwood Rest Area on top of cut within existing powerline easement	No tadpoles, metamorphs or juvenile frogs recorded. Main pools occur on the access track running east across the powerline easement.	Ponds constructed as per Lewis (2013). Eastern ponds are located within isolated vegetation between the Pacific Highway and an access track constructed to access the power easement. The section of the easement where the species was identified was directly impacted by the Project and is no longer present.	4W: ponds are located on a north-south slope within a linear strip of woodland habitat sitting between Ravenswood Road and the Pacific Highway, which is unlikely to represent suitable breeding habitat. The western side of Ravenswood Road drops off into a gully with some sclerophyll vegetation, which may represent suitable breeding habitat. 4E: ponds are located on a hill crest within a linear strip of vegetation between the Pacific Highway and an access track, which is unlikely to represent suitable breeding habitat.



Incidental records

Pacific Highway Upgrade - Oxley highway to Kempsey

niche Environment and Heritage

FIGURE 5

Imagery: (c) LPI 2014-10-06

4. Discussion

A discussion of the 2023/2024 monitoring results in relation to the performance measures detailed in the EMP and the Green-thighed Frog management Strategy (Lewis 2013) is provided in Table 7 and Table 8.

Table 7: Performance indicators of success

Performance indicators of success	Discussion
Continued presence of Green-thighed Frog at two or more of the three breeding pond sites.	**This performance measure has not been met.** No Green-thighed Frogs were identified at breeding pond sites. Noting that the species was not recorded at the reference site or Site 3W, where Green-thighed Frogs are known to occur, for the 2023/2024 monitoring event.
Green-thighed Frogs calling from the edge of the constructed ponds.	**This performance measure has not been met.** No Green-thighed Frog were observed. As above, the species was not recorded at the reference site or Site 3W, where the species has been consistently recorded in proximity each monitoring period.
The presence of tadpoles, juveniles or metamorphs at the frog breeding ponds during Stage 2 surveys.	**This performance measure has not been met.** No Green-thighed Frog tadpoles were caught during the 2023/2024 surveys.

Table 8: Signs of the mitigation being unsuccessful

Performance indicators of unsuccessful mitigation	Discussion
Absence of Green-thighed Frogs from one or more of the three sites (GThF MS). Absence of Green-thighed Frogs from the area (EMP).	**This performance indicator of unsuccessful mitigation has been met.** Green-thighed Frogs were not recorded during the 2023/2024 monitoring event. Unsuccessful detection of Green-thighed Frogs for the 2023/2024 monitoring event at both Site 3W and Collombatti Reference Site may be attributed to the timing of survey despite good weather conditions and high levels of frog activity observed at these sites for other frog species. The 2023/2024 surveys were undertaken on the 5 April 2024 which may be considered late in the breeding season for the species (spring to autumn).
Ponds not holding water for a sufficient time to enable tadpoles to reach metamorphosis.	**This performance indicator of unsuccessful mitigation has been met for 8 of the 25 constructed ponds.** According to Lewis (2013), ponds should have a maximum depth of 400 mm and hold water for between 30-40 days at sunny exposed sites or 50-60 days at shaded locations. Water should therefore be retained for at least 30 days and up to 60 days in these ponds. Stage 2 surveys were undertaken 40 days after Stage 1. All ponds at Site 1 and Site 3 contained water during Stage 1 and Stage 2 surveys, i.e. they held water long enough for breeding cycles to occur as per Lewis (2013). This performance indicator of unsuccessful mitigation has therefore not been met for these sites. During Stage 1 surveys 4E ponds were found to be dry except for one pond holding 5 cm of water. All ponds at Site 4W were holding during Stage 1 surveys, however only one pond was holding water during Stage 2 surveys. It is therefore considered that nine of the 10 ponds at site 4 did not hold water for the minimum required 30 or 50 days (depending on sun exposure; Lewis (2013)). **This performance indicator of unsuccessful mitigation has therefore been met for these 9 ponds.**
Ponds holding water for too long and representing unsuitable habitat (i.e. permanent versus ephemeral).	**This performance indicator of unsuccessful mitigation cannot be assessed due to survey limitations.** Given that Stage 2 surveys were undertaken 40 days after Stage 1 surveys and Lewis (2013) states a suitable hydroperiod of up to 40 days for exposed sites or up to 60 days for shaded sites, it is not possible to state if ponds have held water beyond the suggested hydroperiod. However, water retention within ponds somewhat beyond the preferred hydroperiod is not considered as important to the survival of this species as the retention of water for long enough to allow for metamorphosis to occur.

Performance indicators of unsuccessful mitigation	Discussion
Exotic fish fauna recorded in breeding ponds (GThF MS).	**This performance indicator of unsuccessful mitigation has not been met.** Exotic fish were not recorded in constructed ponds for the 2023/2024 monitoring period. Other predatory invertebrates were recorded in a number of ponds.

GThF MS = Green-thighed Frog Management Strategy (Lewis 2013); EMP = Ecological Monitoring Program (TfNSW 2022).

5. Recommendations

5.1 Contingency Measures

The EMP lists potential problems and contingency measures for various components of the monitoring program. Those considered relevant to the Green-thighed Frog monitoring program are listed and discussed in Table 9.

Table 9: Contingency measures

Potential problem	Contingency measure proposed in EMP	Discussion of proposed measure
Ponds not used by Green-thighed frog.	Survey adjacent areas to confirm frogs remain in area. Review/modify ponds to improve potential site suitability problems.	Green-thighed Frogs have not been recorded at Site 1 (E&W) or Site 4 (E&W) during any surveys. **This contingency measure is considered relevant.**
Ponds not holding water long enough to enable breeding to succeed.	Review/modify ponds either by placing a semi permeable layer or further excavation.	A number of ponds were dry at Stage 1 surveys, as per Table 8. **This contingency measure is considered relevant.**
Ponds holding water for too long encouraging competition from non-target frog fauna.	Improve drainage.	Site 1 E&W has at least three ponds with bulrushes, which may indicate they are holding water for too long. **This contingency measure is considered relevant.**
Exotic fish species recorded in breeding ponds.	Modify pond to ensure it dries out.	Exotic fish were not observed in 2023/2024 surveys. **This contingency measure is not considered relevant.**

5.2 Recommendations

Green-thighed Frogs have not been recorded at the constructed breeding pond Sites 1 and 4 during monitoring periods where they were recorded at either the Collombatti reference site (2016/2017 and 2019/2020) or Site 3W (2016/2017, 2017/2018, 2019/2020, 2021/2022). The species was recorded at number of locations in proximity to the Project area during additional incidental surveys undertaken in 2020/2021, as detailed in section 3.6.

Compensatory habitat for the Green-thighed Frog has been provided for within the offset strategy for the Project. Offset areas were assessed and considered to provide suitable habitat for this species. As such, the intent of the constructed frog ponds was not to provide compensation for lost habitat but to provide artificial habitat to act as an experimental mitigation for this species (Parsons Brinckerhoff 2006): "*A suggested mitigation measure to account for the loss of potential breeding habitat is the creation of artificial breeding ponds adjacent to the new road. Such breeding ponds have not been constructed or trialled previously, Although such ponds have been suggested on other sections of the Pacific Highway where the species occurs, they have not as yet been constructed or trialled. As such the creation of frog breeding ponds should be considered experimental*." (Parsons Brinckerhoff 2007).

Given the experimental nature of the ponds, it was not the intent that the ponds act as an indicator of successful mitigation for this species. Adaptive management and monitoring was highlighted as necessary to determine their effectiveness. All efforts to improve the ponds did not result in records of individuals at sites where Green-thighed Frogs were absent. The outcome of this monitoring should therefore reflect the ineffectiveness of this mitigation measure, as opposed to Project impacts to this species.

It is therefore recommended that further monitoring is not undertaken as:

- The species is known to persist in proximity to and within the Project area
- The species has been shown to use the ponds at Site 3W where there is an existing population
- The breeding ponds were not intended to compensate for loss of habitat, but as an experimental mitigation measure, that has proven to be unsuccessful.

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Annex 1. 2023/2024 monitoring results

Stage 1 field data

Site	Pond	Date	Time	Water depth (cm)	GTF observed from pond	GTF calling from pond	GTF observed 10-100 m from pond	GTF calling 10-100 m from pond	Comments/other species	Air temp (°C)	Humidity	Wind	Cloud cover %
Collombatti Ref site		5/4/2024	8:30PM		0	0	0	0	*Litoria revelata, Litoria gracilenta, Limnodynastes peronii*	17.8	98	0	100
1 W	1	5/4/2024	11:05PM		0	0	0	0	*Crinia signifera*	17.8	98	0	100
	2				0	0	0	0					
	3				0	0	0	0					
	4				0	0	0	0					
	5				0	0	0	0					
1 E	1	5/4/2024	11:05PM		0	0	0	0	*Crinia signifera, Limnodynastes peronii*	17.8	98	0	100
	2				0	0	0	0					
	3				0	0	0	0					
	4				0	0	0	0					
	5				0	0	0	0					
3 W	1	5/4/2024	8:00PM		0	0	0	0	High level of activity for other species. *Litoria revelata, Crinia signifera, Limnodynastes peronii, Uperoleia fusca.*	17.8	98	0	100
	2				0	0	0	0					
	3				0	0	0	0					
	4				0	0	0	0					
	5				0	0	0	0					
4 W	1	5/4/2024	9:50PM		0	0	0	0	*Crinia signifera, Uperoleia fusca*	17.8	98	0	100
	2				0	0	0	0					
	3				0	0	0	0					
	4				0	0	0	0					

Site	Pond	Date	Time	Water depth (cm)	GTF observed from pond	GTF calling from pond	GTF observed 10-100 m from pond	GTF calling 10-100 m from pond	Comments/other species	Air temp (°C)	Humidity	Wind	Cloud cover %
	5				0	0	0	0					
4 E	1	5/4/2024	10:30PM		0	0	0	0		17.8	98	0	100
	2				0	0	0	0					
	3				0	0	0	0					
	4				0	0	0	0					
	5				0	0	0	0					

Stage 2 field data

Site	Pond	Depth (cm)	No. GTF (juv)	No. of tadpoles	Tadpoles identified	Presence of Fish	Predatory Invertebrates	Comments
Ref	Collombatti	38	0	5	*Crinia signifera, Limnodynastes peronii*	N	Y	Paperbark swamp shaded.
1W	1	10	0	0		N	Y	Rushes in pond. Exposed no midstorey/canopy.
	2	23	0	0		N	Y	Rushes in pond. Exposed no midstorey/canopy.
	3	18	0	0		N	Y	Exposed no midstorey/canopy. Pond shallow bank eroded.
	4	10	0	0		N	Y	Exposed and grassy.
	5	16	0	0		N	Y	Bulrush and overgrown with Seteria.
1E	1	9	0	2	*Crinia sp.,* Unidentified not GTF	N	Y	Adjacent vegetation provides some shade for Ponds.
	2	23	0	0		Y	Y	
	3	16	0	2		N	Y	
	4	5	0	0		N	Y	
	5	10	0	1		N	Y	
3W	1	45	0	0	*Crinia signifera, Limnodynastes peronii*	N	Y	Adjacent vegetation provides some shade for Ponds. Ponds are overgrown with grass but still holding good level of water.
	2	46	0	3		N	Y	
	3	24	0	0		N	Y	
	4	48	0	4		N	Y	
	5	31	0	0		N	Y	
4W	1	15	0	6	Possible *Crinia sp.*	N	Y	Partly shaded by vegetation growth. Being used by some species however, ponds dry out quickly with four holding no water.
	2	0	0	0		NA	NA	
	3	0	0	0		NA	NA	
	4	0	0	0		NA	NA	
	5	0	0	0		NA	NA	
4E	1	0	0	0		NA	NA	Do not hold water and location does not represent appropriate habitat.
	2	0	0	0		NA	NA	
	3	0	0	0		NA	NA	
	4	0	0	0		NA	NA	
	5	0	0	0		NA	NA	Paperbark swamp shaded.

Annex 2. Photo monitoring

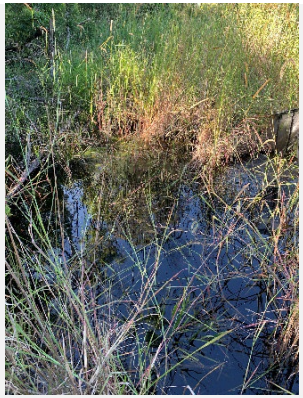
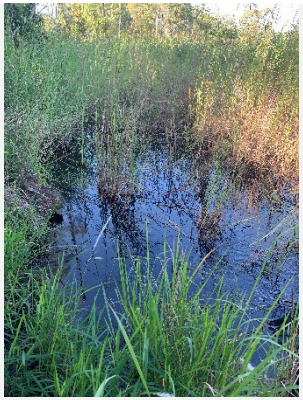
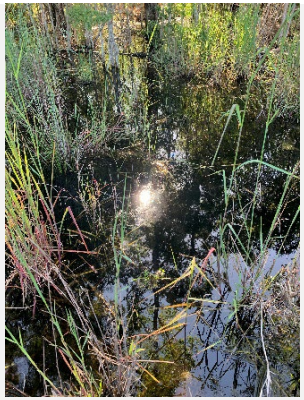
Individual pond photos

Site	Pond 1	Pond 2	Pond 3	Pond 4	Pond 5
1W 2017					
1W 2018					
1W 2020					

1W 2022					
1W 2024					

1E 2017					
1E 2018					
1E 2020					

1E 2022					
1E 2024					

3W 2017					
3W 2018					
3W 2020					

3W 2022					
3W 2024					

4E 2017		*	*	*	*
4E 2018					
4E 2020					

4E 2022					
4E 2024					

4W 2017				*	*
4W 2018					
4W 2020					

4W 2022					
4W 2024					

NA = not applicable, * group pond photos provided in Table 14.

Site photos

Site ID	Summer 2017	2018	2020	2022	2024
Collombatti Reference					
Site 1W					

Site 1E					
Site 3W					

Site 4W					
Site 4E					

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