

# UPGRADING THE PACIFIC HIGHWAY

Woolgoolga to Ballina Planning Alliance

## UPGRADING THE PACIFIC HIGHWAY

### Woolgoolga to Ballina Upgrade

### Supplementary Biodiversity Assessment

**FINAL**

**November 2013**



Transport  
Roads & Maritime  
Services

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## **Appendix E. Supplementary frog survey reports for Section 1 and 2**



# **PACIFIC HIGHWAY UPGRADE:**

**WOOLGOOLGA TO HALFWAY CREEK**

**TARGETED FROG SURVEY**



**JULY 2013**



**PREPARED FOR ARUP-PB JOINT VENTURE BY:**

**LEWIS ECOLOGICAL SURVEYS**

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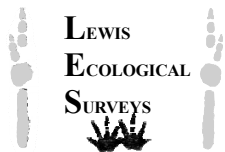
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**Top** – Green-thighed Frog (*Litoria brevipalmata*) a common inhabitant of the project corridor.

**Bottom** – Giant Barred Frog (*Mixophyes iteratus*) from Corindi Creek (ch. 3600).

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## ABBREVIATIONS

Abbreviation	Description
PB-ARUP JV	PB-ARUP Joint Venture
RMS	Roads and Maritime Services
LES	Lewis Ecological Surveys
Ch.	Chainage
MCoA	Minister's Condition of Approval

## 1.0 INTRODUCTION

### 1.1 Background

The proposed upgrade of the Pacific Highway between Woolgoolga and Glenugie is part of the Pacific Highway Upgrade Program. The proposed upgrade extends over approximately 31km from the Sapphire and Woolgoolga Pacific Highway Upgrade (S2W – approximately 32km north of Coffs Harbour) to the Glenugie Upgrade Project (approximately 64km north of Coffs Harbour). Section 1 of the overall project extends from the southern tie-in north of Arrawarra interchange to chainage 16500 within the existing 3.4km Halfway Creek upgrade. Section 2 extends from chainage 16500 within the Halfway Creek upgrade to the southern extent of the new northbound carriageway within the Glenugie upgrade at chainage 31400.

The Arup Parsons Brinckerhoff Joint Venture (APBJV) has been established for the purpose of preparing the detailed design and documentation for the construction of this upgrade. Lewis Ecological Surveys has been engaged by the JV to perform targeted surveys for threatened frog species to inform the design and environmental management during the construction of the Upgrade. The target species have been summarised in Table 1-1.

The following is a report that covers section 1 of the W2G Upgrade.

**Table 1-1.** Summary of target species and their state and commonwealth legislative status.

<b>Species</b>	<b>NSW <i>Threatened Species Conservation Act (1995)</i></b>	<b>Commonwealth <i>Environmental Protection and Biodiversity Conservation Act (1999)</i></b>
Wallum Froglet ( <i>Crinia tinnula</i> )	Vulnerable	-
Green-thighed Frog ( <i>Litoria brevipalmata</i> )	Vulnerable	-
Giant Barred Frog ( <i>Mixophyes iteratus</i> )	Endangered	Endangered
Southern Barred Frog ( <i>Mixophyes balbus</i> )	Endangered	Vulnerable
Wallum Sedge Frog ( <i>Litoria olongburensis</i> )	Vulnerable	Vulnerable
Green and Golden Bell Frog ( <i>Litoria aurea</i> )	Endangered	Vulnerable

## 2.0 SURVEY METHODS

Both desktop and field surveys were undertaken as part of this study.

### 2.1 Desktop Surveys

#### 2.1.1 Database search

Database searches were performed using the Office of Environment and Heritage (OEH) Bionet Wildlife Atlas <http://www.bionet.nsw.gov.au/> with search coordinates covering an area of approximately 600 km<sup>2</sup> using the following coordinates:

North -29.83 West 153.03 East 153.21 South -30.09

### 2.2 Field surveys

All drainage lines and wetland areas that occurred within or close (i.e. 100 m) to the Upgrade corridor were subject to a field inspection during daylight hours to assess their suitability for the target frog fauna. At this time, a number of low lying areas that were likely to become flooded depressions during substantial rainfall events were also identified. This approach identified 21 survey sites that required targeted frog surveys which were subsequently undertaken over 5 nights between the 5<sup>th</sup> December 2012 and the 7<sup>th</sup> February 2013 (Figure 2-1). Surveys undertaken around the 26-28<sup>th</sup> January were in response to rainfall events which delivered in excess of 200 mm in 48 hours and was considered ideal for detecting Green-thighed Frog (Figure 2-2). All the remaining surveys were performed within 7 days of a notable rainfall event (i.e. >10 mm in 24 hours).

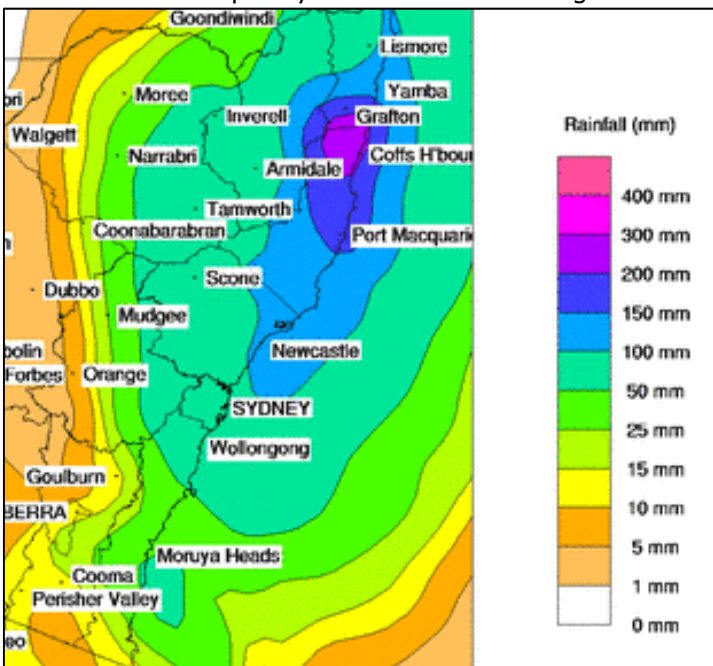


Figure 2-2). Surveys undertaken around the 26-28<sup>th</sup> January were in response to rainfall events which delivered in excess of 200 mm in 48 hours and was considered ideal for detecting Green-thighed Frog (Figure 2-2). All the remaining surveys were performed within 7 days of a notable rainfall event (i.e. >10 mm in 24 hours).

Ephemeral sites were surveyed for 15 minutes to target Green-thighed Frog and occasionally Wallum Froglet whilst dams and streams were surveyed for a standardised 1 hour period. In some instances sites were established in close proximity to one another. Where this occurred it reflected a changed habitat type such as a stream site followed by an adjacent flooded ephemeral depression or a dam.

**Figure 2-2.** Rainfall pattern at the time of the Green-thighed Frog surveys on the 28<sup>th</sup> January 2013.  
**Source** – Bureau of Meteorology

### 2.3 Likelihood of the target species

The likelihood of each target species have been assigned to one of five groups ranging from 'known' to a 'very low'. A description for each of the ratings is provided below.

1. **Very Low:** The site does not support critical habitat attributes associated with the target species. For example, the occurrence of Giant barred Frog at an ephemeral wetland site when this species requires semi permanent to permanent water bodies most often associated with streams.
2. **Low:** The habitat attributes at this site are generally not present or heavily degraded to an extent to which they are unlikely to recover. For example, the suitability of the Arrawarra Creek tributary at ch. 300 for the Giant Barred Frog. At this location, the creek and a lot of its riparian vegetation is heavily degraded following the removal of its understorey and transformation into lawn areas and extensions

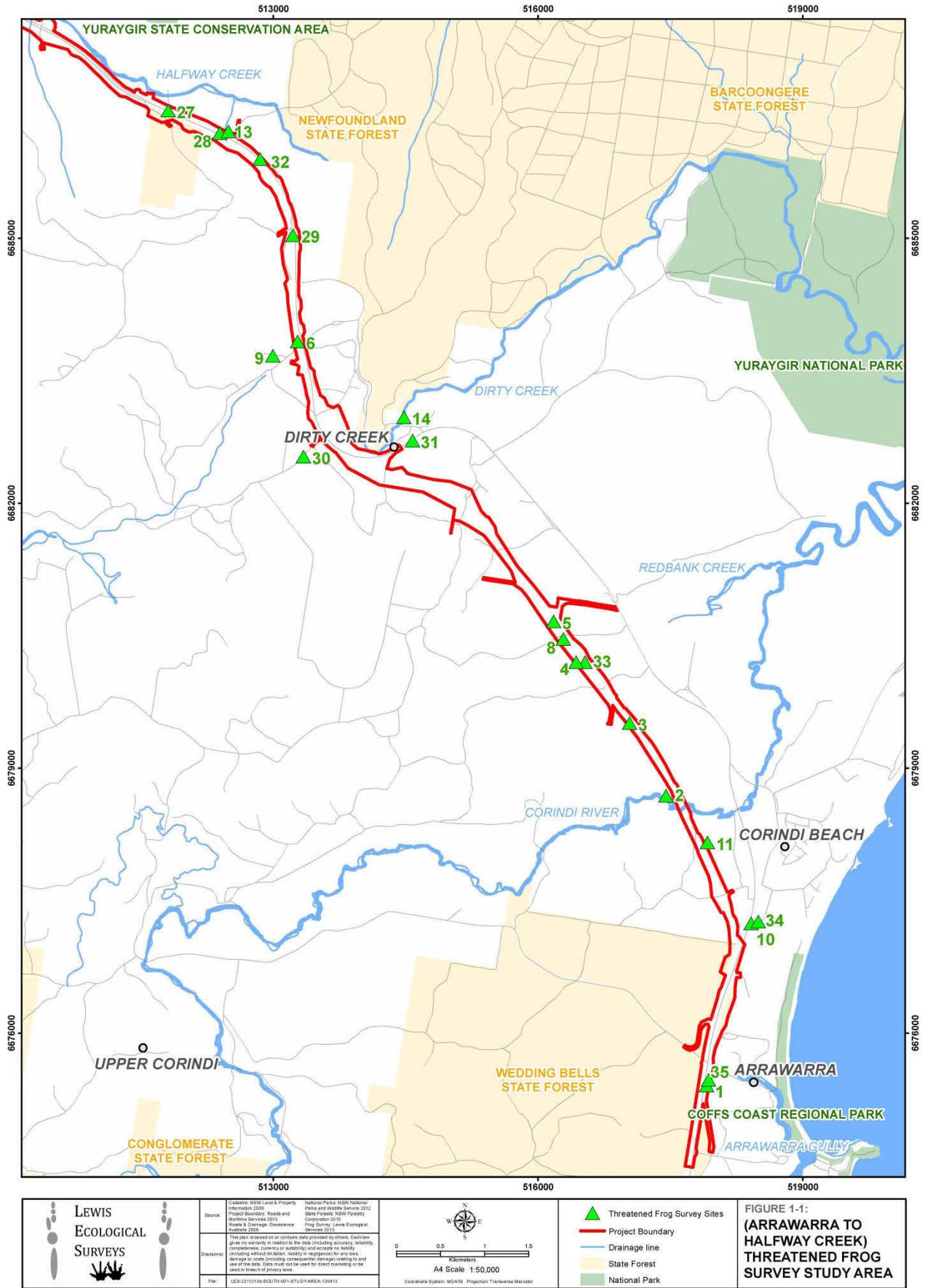
of the creek into dams. Whilst the water itself may be suitable for the larval stage of this frog the riparian habitats offer very few refuge sites and foraging habitat for adults.

3. **Moderate:** The survey site provides suitable habitat for the species but there is usually a factor which has detracted from the site being given a higher ranking. For example, the habitat has been disturbed in some way at Boneys Creek for the Giant Barred Frog due to past clearing of the riparian habitat, periodic grazing of cattle and horses and modification of the water course.
4. **High:** The species is known to utilise habitats similar to those found at the survey site and this is substantiated by nearby records (< 5km) and/or is the expert opinion from the author. There are numerous examples of this for the Green-thighed Frog including the Red Bank Creek area (ch. 5500-6200).
5. **Known:** The species was recorded during the course of the field surveys for this report.

These terms are used throughout the remainder of this report including figures and tables used to describe the distribution and likelihood of the target species.

**Table 2-1.** Summary of the surveys and likelihood of each target species using the Upgrade corridor.

Site No	Easting	Northing	Broad Location Details
1	517912	6675407	Arrawarra Tributary @ ch. 300
35	517933	6675472	Darlington Park area slightly further north
10	518417	6677242	Southern entrance to Red Rock and land further to the south east
34	518499	6677263	Same location as above
11	517923	6678158	Large dam south of Corindi Creek
2	517452	6678687	Corindi Creek @ ch.3600
3	517038	6679511	Cassons Creek
33	516535	6680201	Red Bank Creek area
4	516434	6680202	Red Bank Creek south
8	516287	6680464	Borrow Pit on ridge between Redbank Creek tributaries
5	516178	6680661	Red Bank Creek South general area
30	513345	6682526	Range Road around 500 m west of the existing Pacific Highway
31	514578	6682709	Southern Side of Dirty Creek Range
14	514480	6682974	In vicinity of the old Pacific Highway over Dirty Creek
9	512997	6683670	Dundoo Reach upstream
6	513275	6683831	Dundoo Reach downstream
29	513224	6685035	Dirty Creek Range South
32	512852	6685896	Dirty Creek Range North
28	512395	6686189	Boneys Creek area upstream
13	512495	6686209	Pacific Highway over Boneys Creek heading downstream
27	511810	6686446	Southern side of the Halfway Creek Upgrade and north of Boneys Creek



**Figure 2-1.** Distribution of survey sites between Arrawarra and chainage 16500 (Halfway Creek).

## 3.0 RESULTS & DISCUSSION

### 3.1 Giant Barred Frog

Giant Barred Frog was recorded at Corindi Creek and Dirty Creek and is suspected to occur downstream of the proposed carriageway at Boneys Creek<sup>1</sup> (Figure 3-1a-e; Table 3-1). There are relatively high numbers of Giant Barred Frog at Corindi Creek (i.e. 10 adults per 500 m) and this population is likely to extend for a number of kilometres in either direction of the footprint. It is considered an important source population which has the capacity to ensure broader gene flow movements through the Corindi area.

Although access could not be obtained to survey the proposed footprint over Dirty Creek, field surveys downstream of the existing Pacific Highway confirm a breeding population of Giant Barred Frog. Although this creek is comparatively small in size it is suspected to be a spring fed system and provide the necessary permanent water supply for this frog and its tadpoles. At the time of the field survey, three juvenile frogs were recorded within the riparian zone of this stream and are expected to have metamorphosed with the onset of the dry weather in spring 2012<sup>2</sup>.

Although no Giant Barred Frogs were recorded at Boneys Creek this drainage line is suspected to support a population of Giant Barred Frogs further downstream. Within the proposed footprint the area has been assigned a 'moderate' likelihood of occurrence and at 1 km downstream this likelihood has been increased to high. For the purposes of the design and environmental management this location should be considered Giant Barred Frog habitat.

A tributary of Arrawarra Creek (ch. 300) was assessed as containing a low likelihood of supporting Giant Barred Frog (Table 3-2). At the time of the field surveys access could not be obtained<sup>3</sup> for a large artificial dam located around 1 km upstream. This dam site could theoretically provide a source point for Giant Barred Frogs given they are known to utilise a number of other dams constructed along drainage lines within the Sapphire to Woolgoolga project (*see* BEM 2012). Until further surveys upstream of the proposed carriageway have been undertaken this location should be treated as Giant Barred Frog habitat despite the habitat attributes not being particularly suitable within or downstream of the proposed carriageway. A number of other recommendations have been outlined for this species in section 4.

**Table 3-1.** Summary of Giant Barred Frog data.

Site	No. Frogs Recorded	Comments
Tributary of Arrawarra Creek (ch. 300; Site 1)	0	<ul style="list-style-type: none"> <li>• Apparent report of a tadpole from this location being that of a Giant Barred Frog.</li> <li>• Further surveys required to confirm the status of the proposed carriageway and downstream as Giant Barred Frog habitat.</li> <li>• Considered Giant barred Frog habitat until further surveys are performed upstream around the dam.</li> </ul>
Corindi Creek (ch. 3600; Site 2)	10 Adults	<ul style="list-style-type: none"> <li>• 7 males and 3 females recorded.</li> <li>• All frogs located within 20 m of stream.</li> <li>• Footprint contains breeding population of frogs.</li> <li>• Parts of creek currently fenced to stabilise the stream bank.</li> <li>• Nearby dam surveyed but no signs of frogs.</li> </ul>
Dirty Creek (ch. 8500 downstream; Site 14)	5 Adults and juveniles	<ul style="list-style-type: none"> <li>• 2 male frogs calling.</li> <li>• 3 juveniles observed.</li> <li>• All frogs within 15 m of the stream.</li> </ul>
Boneys Creek (ch. 13350; Site 13)	0	<ul style="list-style-type: none"> <li>• Assigned a moderate likelihood of occurrence within 200 m of the proposed footprint. High likelihood of occurring 1 km downstream.</li> </ul>

<sup>1</sup> Tributary of Halfway Creek.

<sup>2</sup> Often declining water levels can increase the rate of Gosner stages in tadpole development.

<sup>3</sup> LFHJV had access blocked off during December 2012.

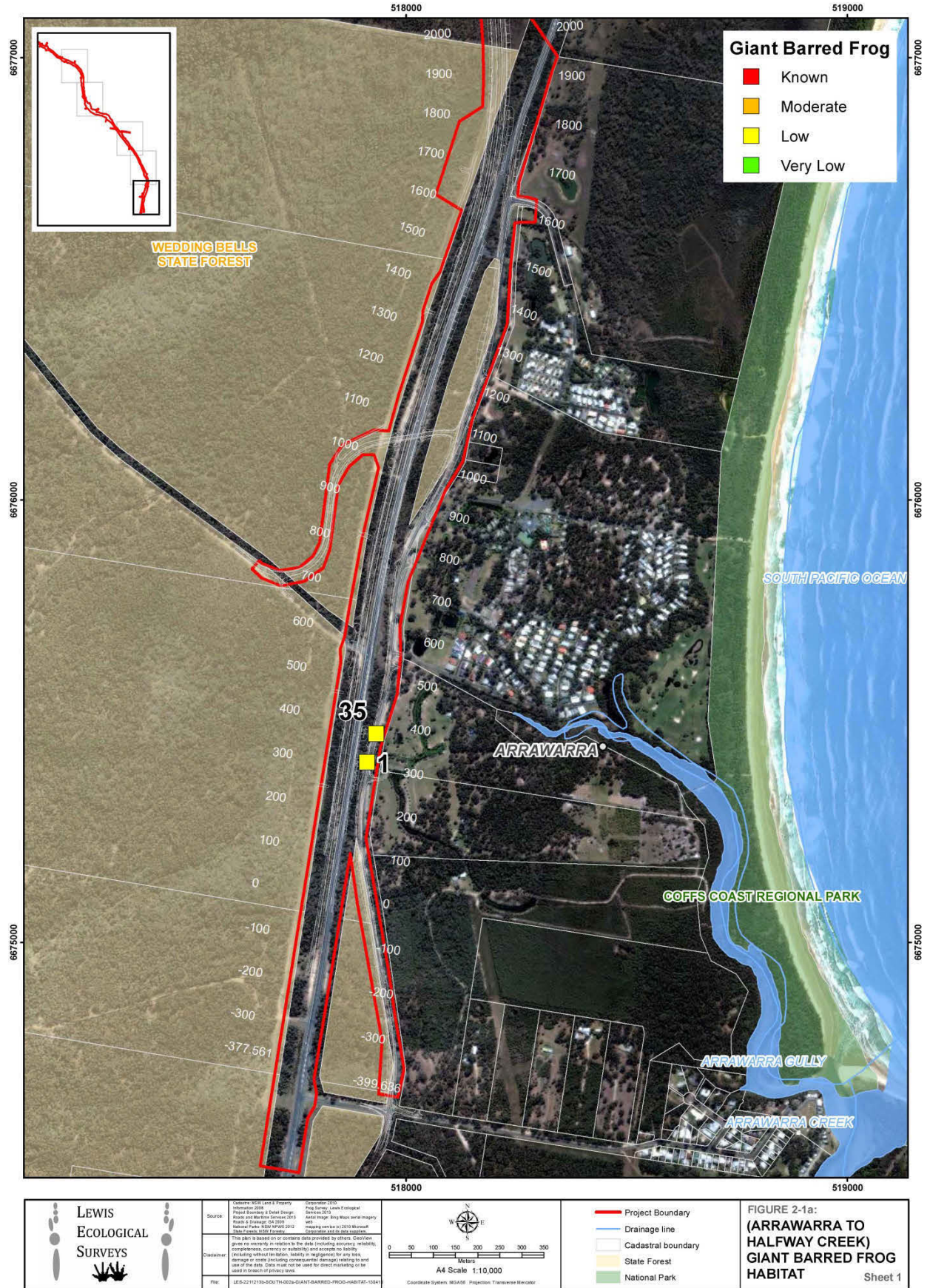


Figure 3-1 a. Survey sites and likelihood of the Giant Barred Frog between ch. 300-2000.



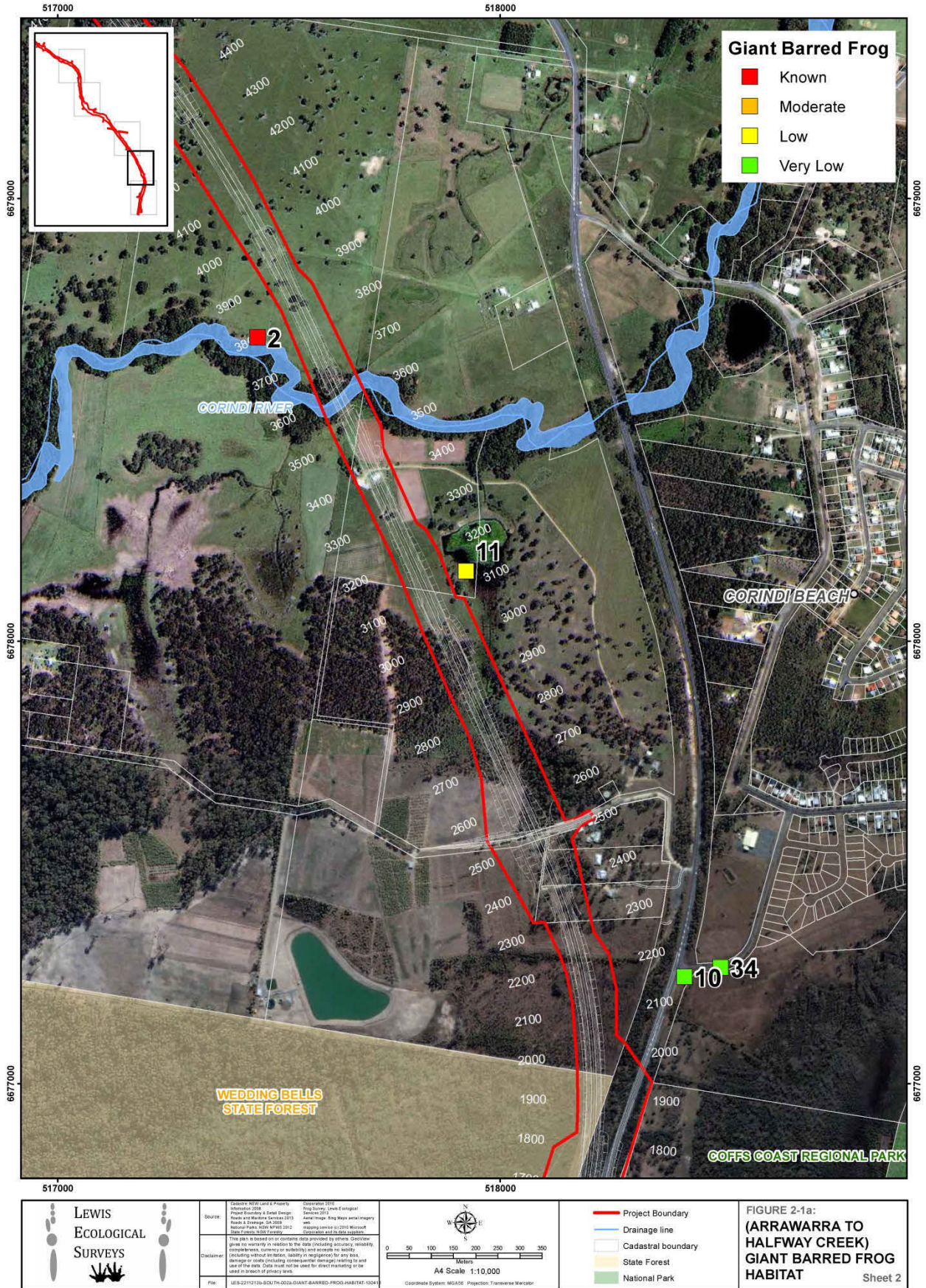


Figure 3-1 b. Survey sites and likelihood of the Giant Barred Frog between ch. 1800-4400.

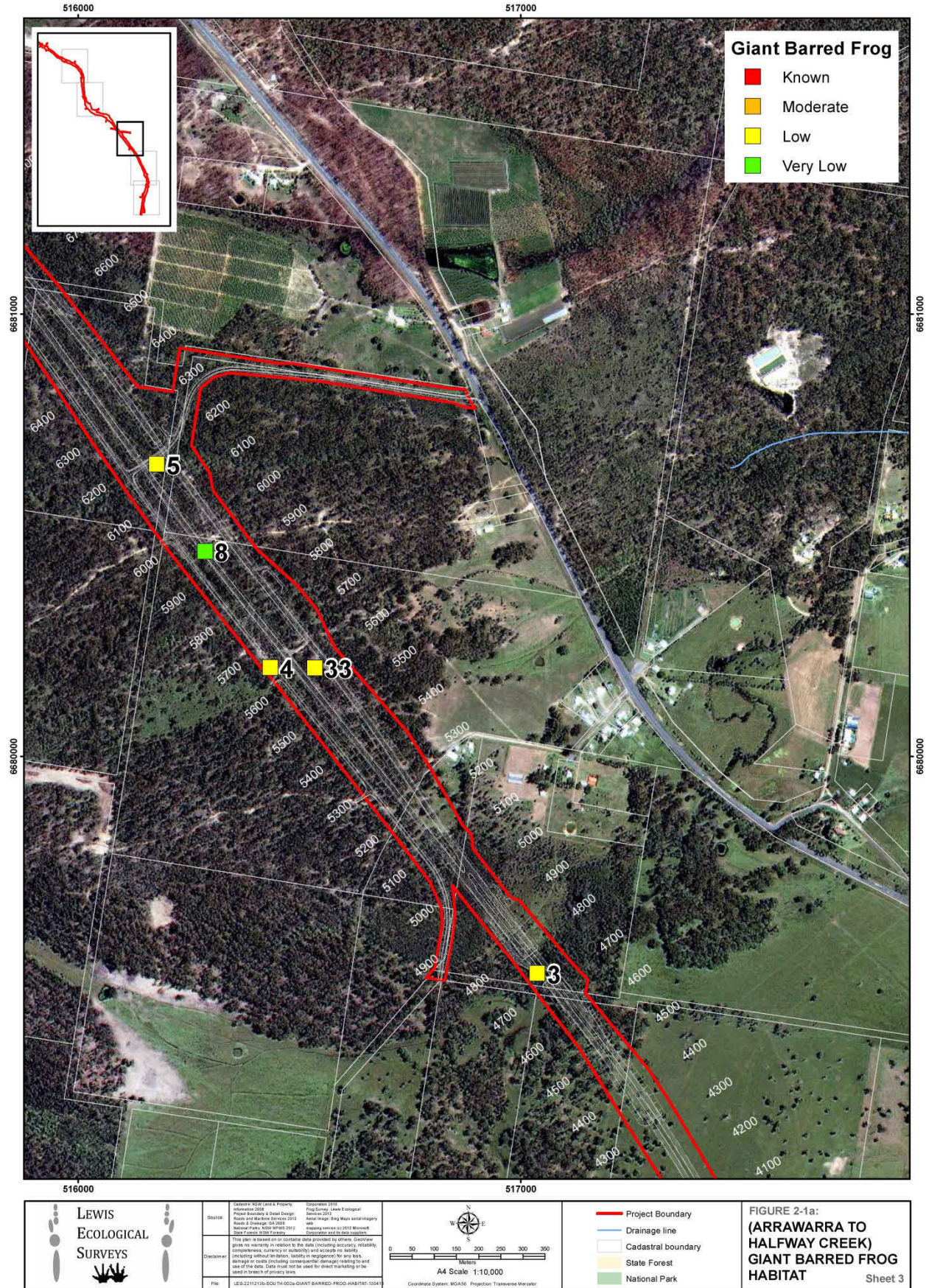


Figure 3-1 c. Survey sites and likelihood of the Giant Barred Frog between ch. 4400-6600.

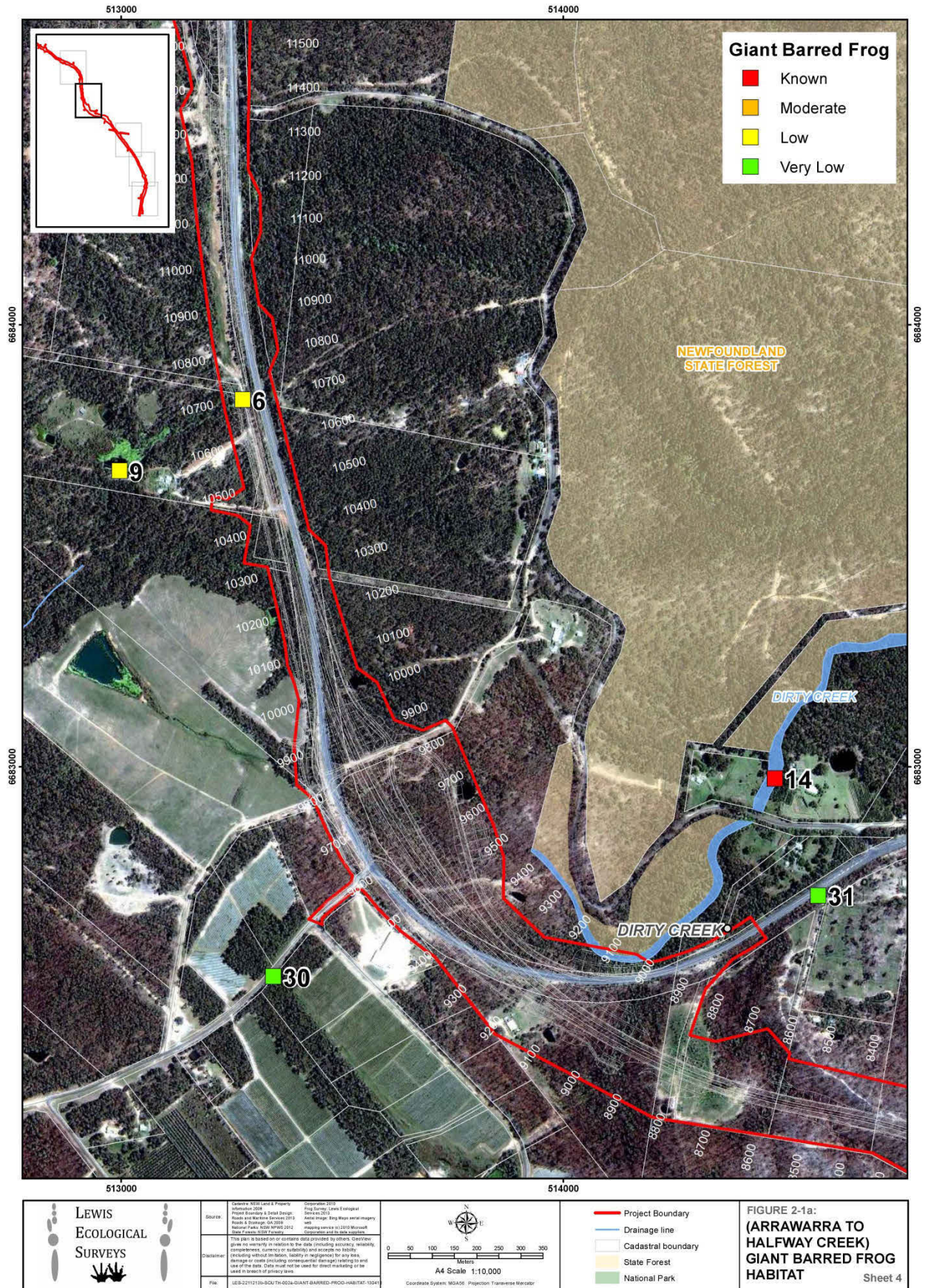


Figure 3-1 d. Survey sites and likelihood of the Giant Barred Frog between ch. 8300-11500.

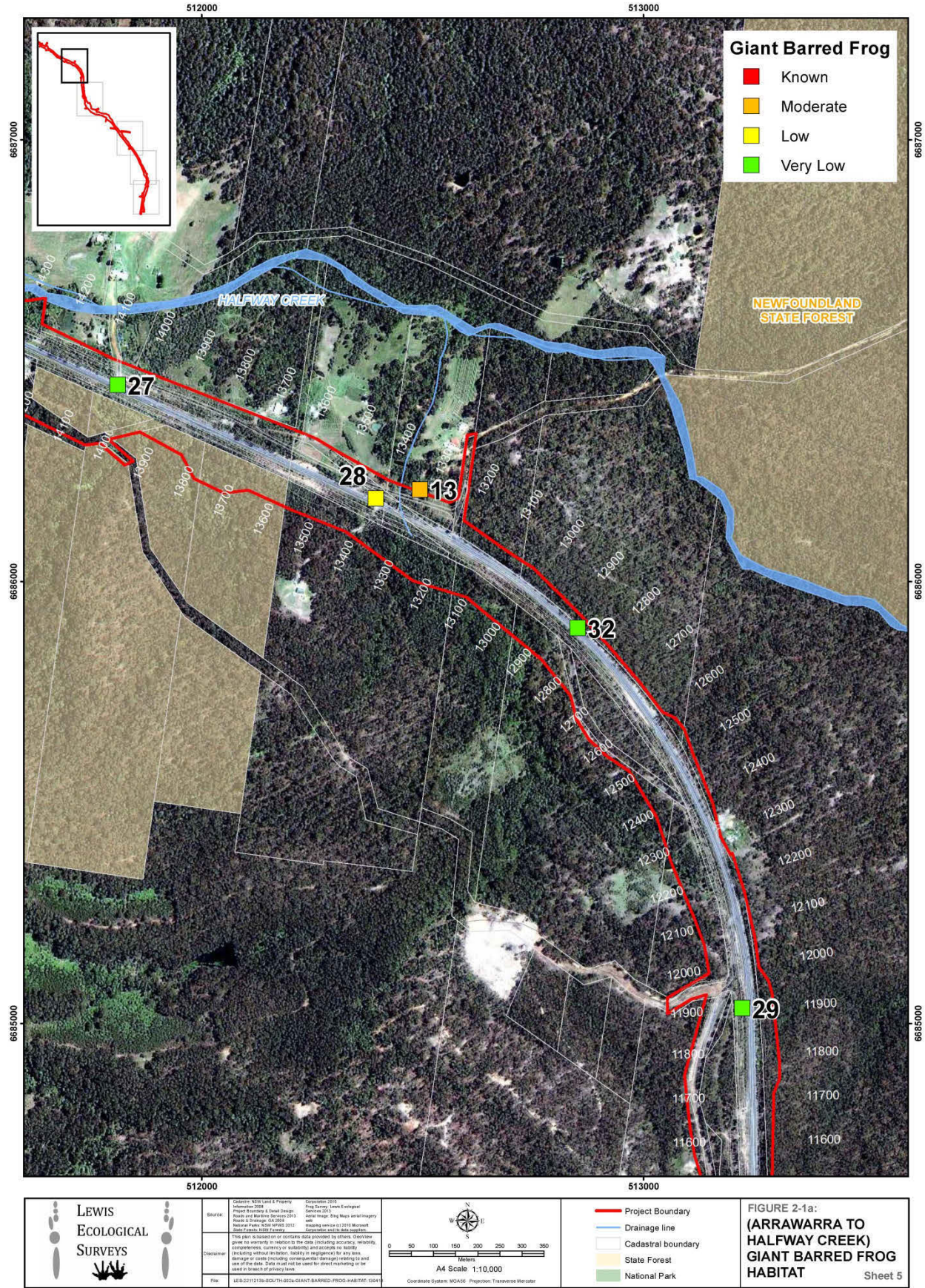


Figure 3-1 e. Survey sites and likelihood of the Giant Barred Frog between ch. 11500-14200.

### 3.2 Green-thighed Frog

Green-thighed Frog was recorded at three locations north from Dirty Creek Range (ch. 11900) to just south of the Halfway Creek (ch. 14050) deviation (Figure 3-2a-e; Table 3-3). At each location, between 2-8 males were heard calling from flooded ephemeral areas within 50 m of the existing Pacific Highway on the 27<sup>th</sup>-28<sup>th</sup> January. The ephemeral areas surrounding both Redbank Creek and Boneys Creek have also been assigned a 'high' likelihood of supporting populations of Green-thighed Frog whilst areas around Range Road and the southern side of Dirty Creek Range have been assigned a 'moderate' likelihood of supporting Green-thighed Frog (Table 3-1). A number of mitigation options should be adopted to reduce impacts on this species, namely strategic frog fencing and creating some breeding ponds where large areas of suitable breeding habitat would be removed by the Upgrade (*see* Section 4).

**Table 3-2.** Summary of Green-thighed Frog data.

Site	No. Frogs Recorded	Comments
Redbank Creek (ch. 5550-6700; Sites 4, 33, 5,8)	High	<ul style="list-style-type: none"> <li>• Unconfirmed record made by Sandpiper Ecological Surveys during other ecological works for the JV.</li> <li>• A tadpole resembling this species was recorded during December 2012.</li> <li>• Low lying ephemeral areas assigned a 'high' likelihood of supporting populations of Green-thighed Frog.</li> </ul>
Dirty Creek Range South	Moderate	<ul style="list-style-type: none"> <li>• Suitable ephemeral areas and large tracts of dry forest with nearby records less than 5 km away.</li> </ul>
Range Road (30)	Moderate	<ul style="list-style-type: none"> <li>• Suitable ephemeral areas and large tracts of dry forest with nearby records less than 5 km away</li> </ul>
Dirty Creek Range South (ch. 11500; Site 29)	5-8	<ul style="list-style-type: none"> <li>• Between 5-8 males calling from w western side of the road as the edge of fill section for the highway.</li> </ul>
Dirty Creek Range North (ch. 12500; Site 32)	2-5	<ul style="list-style-type: none"> <li>• Between 2-5 male frogs calling on the western side of the road.</li> </ul>
Boneys Creek (ch. 13400; Site 28)	High	<ul style="list-style-type: none"> <li>• Frogs not recorded but are considered highly likely to occur in this area.</li> </ul>
Halfway Creek South (ch. 14500; Site 27)	≥2	<ul style="list-style-type: none"> <li>• At least two frogs calling.</li> </ul>

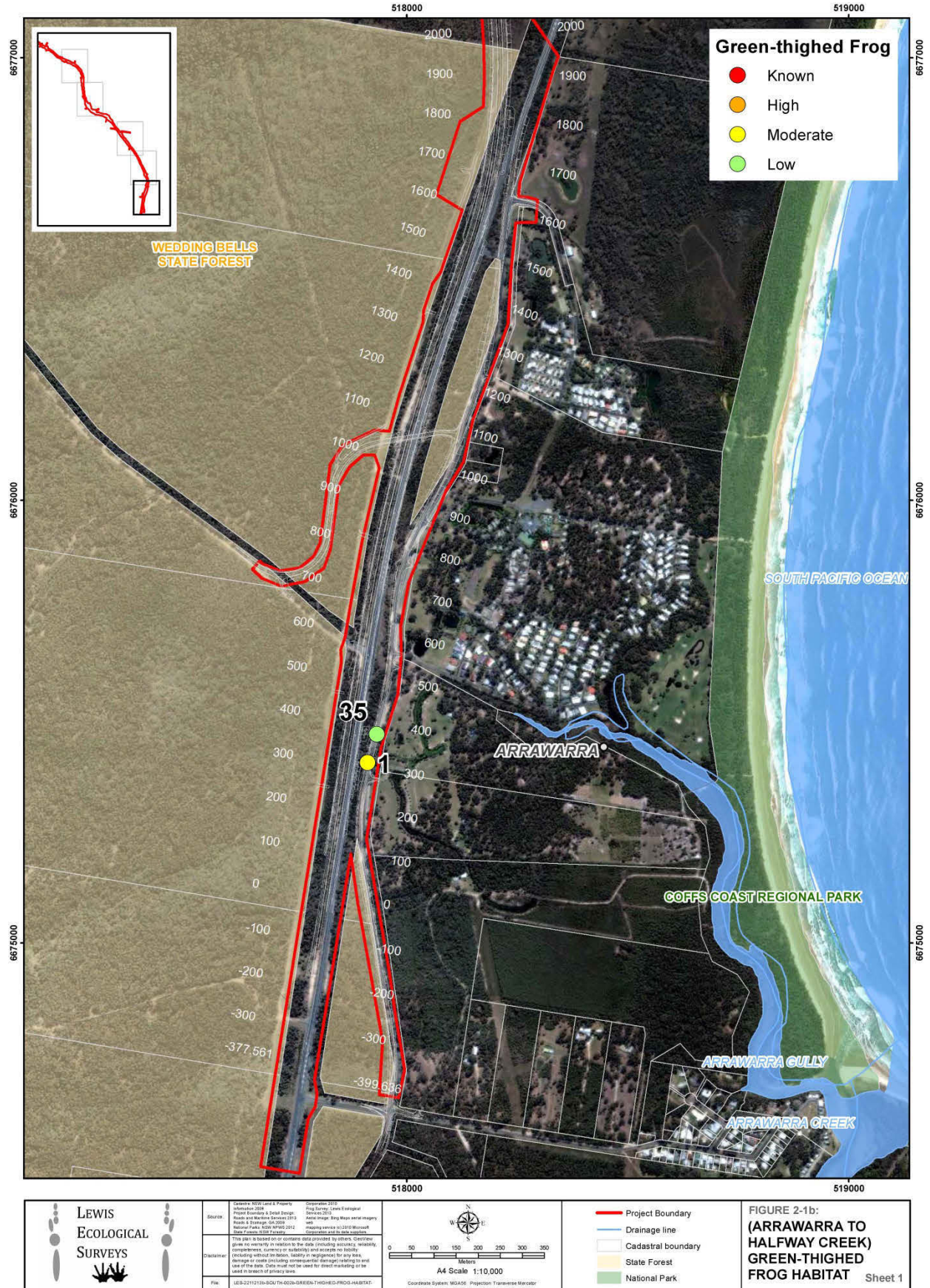


Figure 3-2 a. Survey sites and likelihood of the Green-thighed Frog between ch. 300-2000.

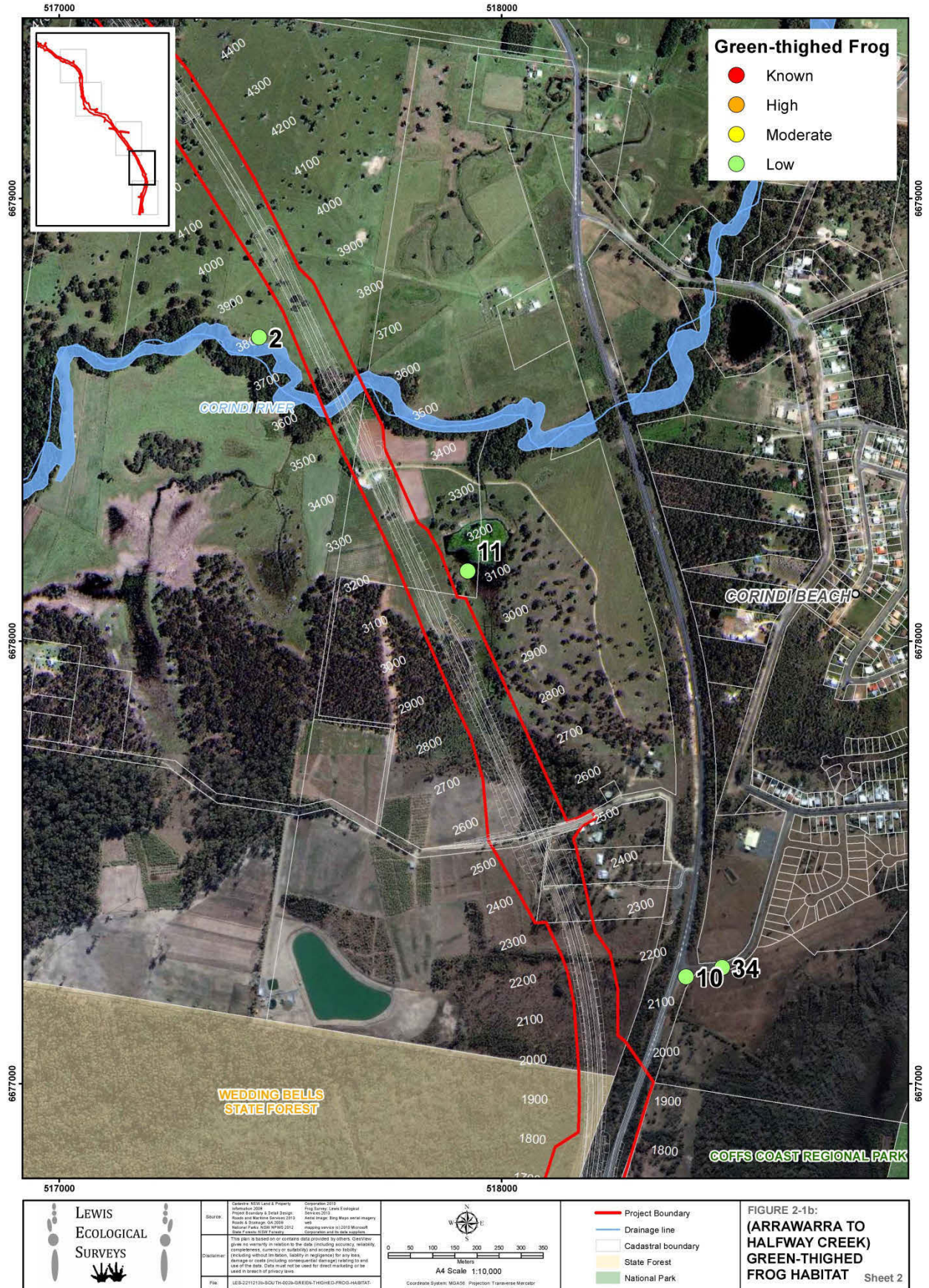


Figure 3-2 b. Survey sites and likelihood of the Green-thighed Frog between ch. 1800-4400.

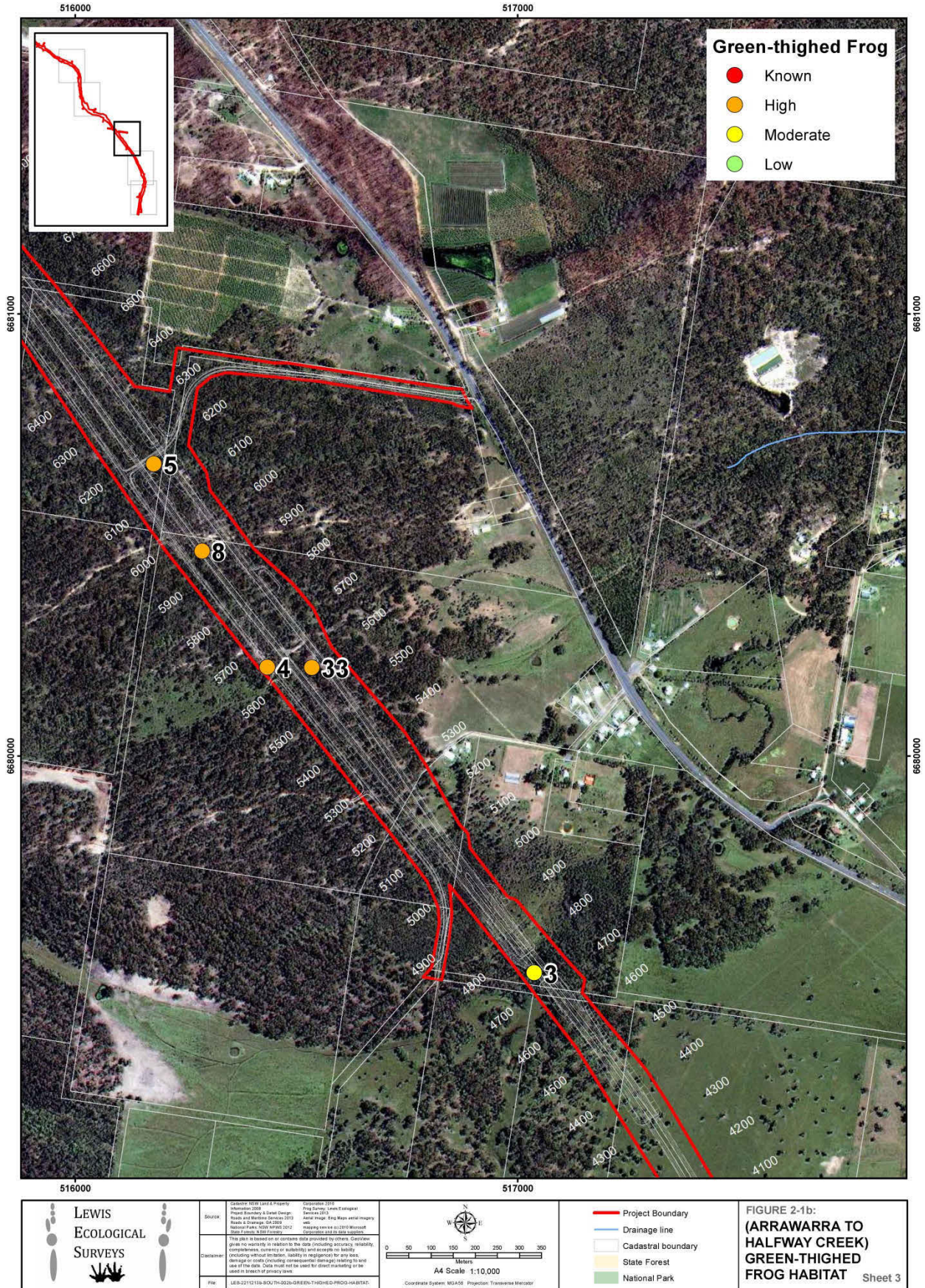


Figure 3-2 c. Survey sites and likelihood of the Green-thighed Frog between ch. 4100-6600.



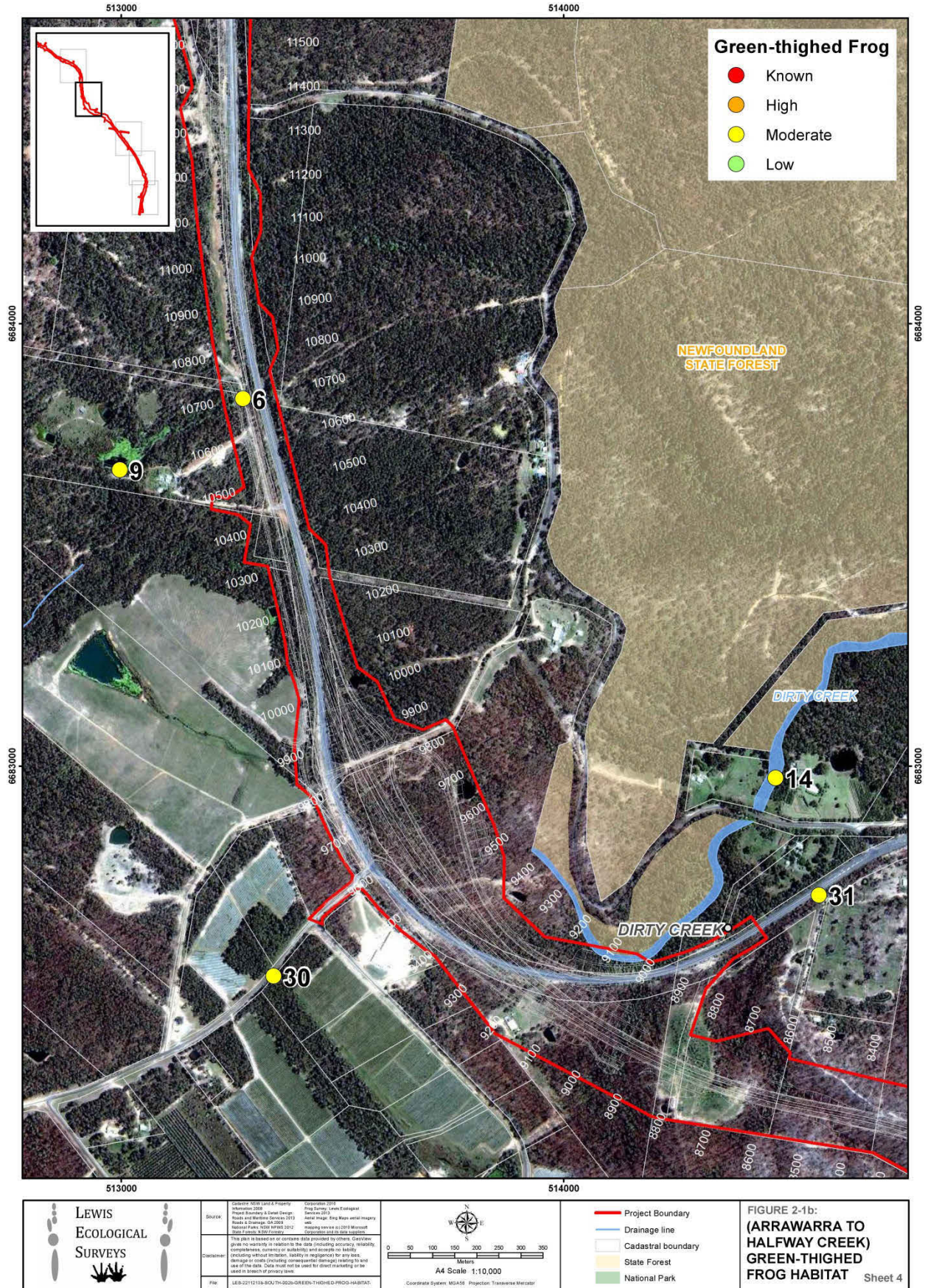


Figure 3-2 d. Survey sites and likelihood of the Green-thighed Frog between ch. 8300-11500.

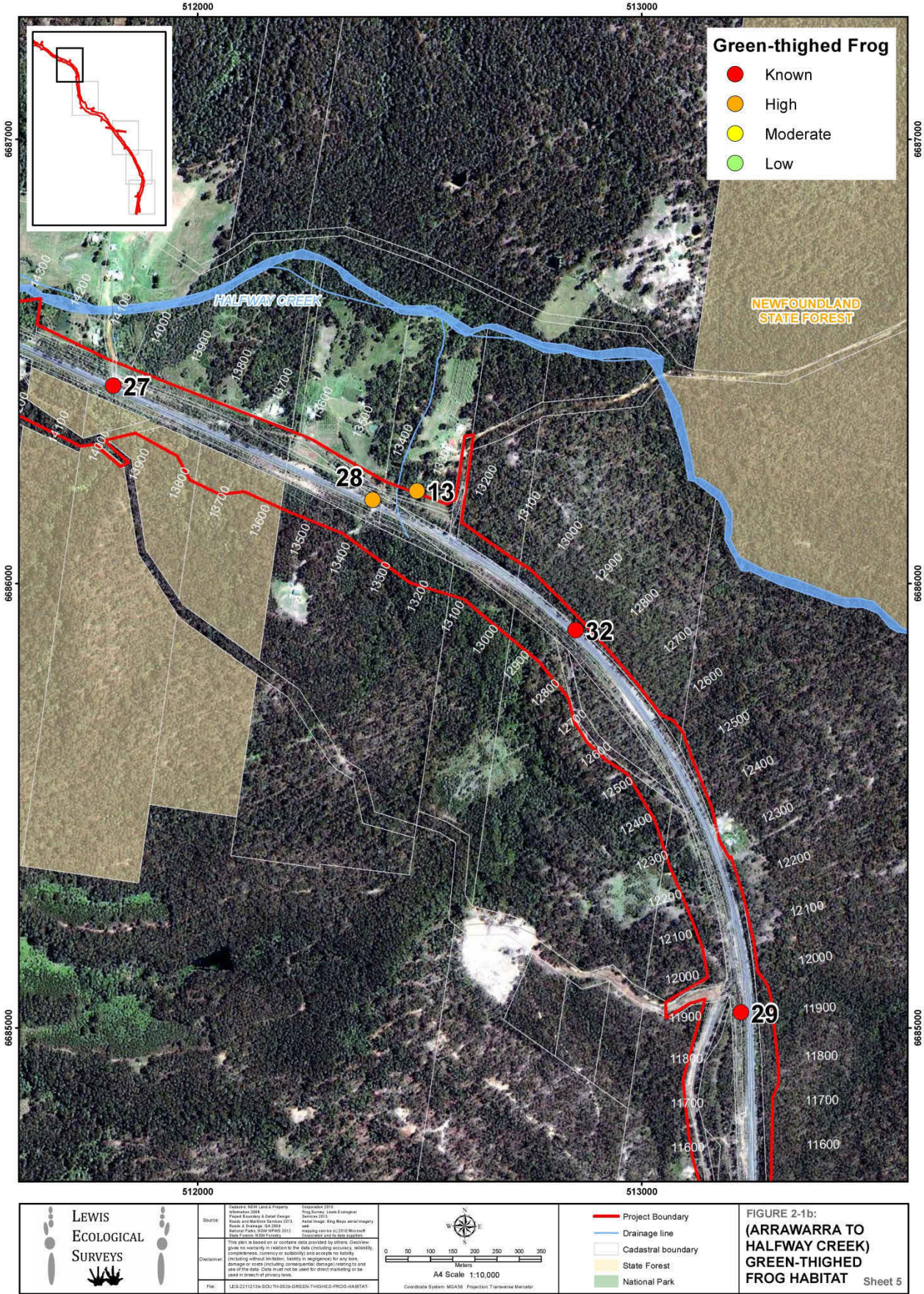


Figure 3-2 e. Survey sites and likelihood of the Green-thighed Frog between ch. 11500-14200.

### 3.3 Wallum Froglet

The Wallum Froglet was not recorded during the survey. Habitat on the eastern side of ch.1500 to ch.2100 appears suitable and it is possible for this species to occur (Table 3-2). This is also supported by a record of a calling Wallum Froglet from further to the east in 2007 (OEH 2013; Figure 3-3a). In this context, Site 10 and 34 (Tasman Street) has been assigned a moderate likelihood of supporting Wallum Froglet and measures centred around habitat protection will need to be incorporated in the environmental management systems for the construction of the Upgrade (*see* Section 4.0). It should also be noted that parts of this area are occasional mown so the overall suitability and distribution of habitat may change over time.

Elsewhere in the study area there is another calling record at ch. 2900 from February 2007 (OEH 2013; Figure 3-3). This area is close to a large farm dam with some residual swamp sclerophyll forest further to the south. A number of Eastern Sign-bearing Froglet (*Crinia parinsignifera*) were recorded during surveys performed for this study in December 2012.

Both of the records obtained from the OEH database were identified on the basis of call identification. Differentiating the calls between the Wallum Froglet and the Eastern Sign-bearing Froglet is almost impossible and is best supported with visual confirmation in areas north from Coffs Harbour. Most of the other records in the study area occur closer to the coast and more synonymous with low pH waters of coastal swamps and forests (i.e. Red Rock, Yuraygir National Park). In this context, the surveyed habitats around chainage 2900 (i.e. Site 11) have been assigned a low likelihood of supporting this species.

### 3.4 Green and Golden Bell frog

The Green and Golden Bell Frog was not recorded during the field survey (Table 3-2). This species is not known from the study area although two populations do exist in Yuraygir National Park with the first at Blue Lake around 9 km to the east of where the alignment traverses Dirty Creek Range and the second at Diggers Camp around 25 km to the east of Glenugie (Lewis and Goldingay 1999).

Surveys identified three sites which have been assigned as having a 'low' likelihood of supporting a population of bell frogs. They include:

- the ponds to the east of the Arrawarra Creek (ch. 300) which form part of landscaping in Darlington Holiday Park;
- a large stock dam (ch. 3100-3200) to the south of Corindi Creek; and
- a large stock dam (ch. 10600) at Dundoo Reach.

Habitat at these sites is consistent with the broad habitat requirements of this species with emergent aquatic vegetation, slow or still water body and they are within 10 km of a known bell frog population. There are, however, no obvious habitat links in which a meta population structure could be linked with these known populations. Given their low overall likelihood no specific bell frog mitigation is warranted.

### 3.5 Wallum Sedge Frog

The Wallum Sedge Frog was not recorded during the field survey (Table 3-2). This species is not known from the study area although it is known from a number of locations closer to the coast where it reaches its southern distributional limit around Woolgoolga (Lewis and Goldingay 2005; Meyer et al. 2005; OEH 2013).

Field surveys conducted throughout the study area identified this species as having a 'very low' likelihood of occurrence. This is due to its specialised habitat requirements which are not present within or in close proximity to the study area. For example, Wallum Sedge Frogs are restricted to coastal fore dune swamps and lagoon systems that are frequently inundated with low pH waters (Barker *et al.* 1995; Cogger 1995; Robinson 1995; Ehmann 1997; Hines *et al.* 1999; Lewis and Goldingay 2005; Meyer et al. 2006). They are more sensitive to habitat disturbance than the Wallum Froglet and require more permanent naturally fluctuating wallum wetlands. Given their low overall likelihood no specific sedge frog mitigation measures are warranted.

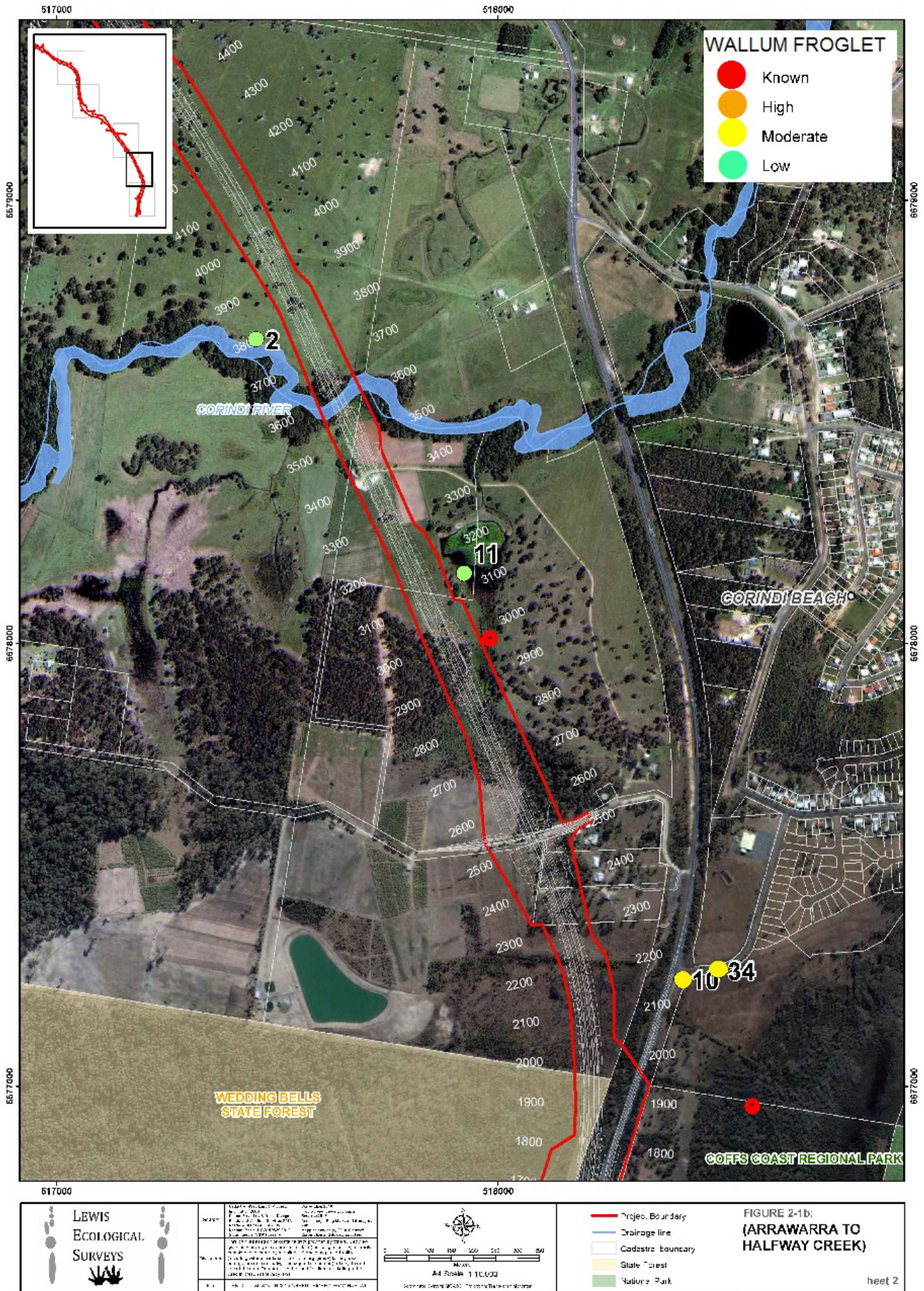


Figure 3-3 a. Survey sites and likelihood of the Wallum Froglet between ch. 1750-3600.

### 3.6 Southern Barred Frog

The Southern Barred Frog was not recorded during the field survey (Table 3-2). This species is not known from the study area although it is known from a number of locations further to the west in the Dorrigo and Nymboida areas (OEH 2013). These populations are around 30-40 km further to the west.

Field surveys conducted throughout the study area identified this species as having a 'very low' likelihood of occurrence. This is due to its association with more montane areas above 500 m elevation on the NSW north coast. No specific mitigation measures are warranted for this species.

### 3.7 Discussion of Key Findings

The area between the Arrawarra Interchange and ch. 16500 supports populations of the endangered Giant Barred Frog and the vulnerable Green-thighed Frog. There is also some evidence to suggest the southern part of the project corridor (i.e. ch. 1500-2100) provides habitat for the vulnerable Wallum Froglet. For the remaining three species considered in this survey the project corridor either provides no habitat and as such the Southern Barred Frog and Wallum Sedge Frog have been assigned a 'very low' likelihood of occurrence. In the case of the Green and Golden Bell Frog some still water bodies supporting emergent aquatic vegetation are present around Arrawarra, Corindi and Dundoo Reach but the absence of suitable habitat linking these areas with known coastal locations at Yuraygir National Park suggests there is a low likelihood of their occurrence.

Although surveys performed as part of this study were cursory in their nature (1-2 visits) the results are considered adequate for the purposes of providing useful information to progress the design and environmental management requirements for this section of the Upgrade. In this context, it is considered necessary to adopt some species specific management strategies to reduce impacts on threatened frogs as the Upgrade is constructed between ch. 1500-2100 (Tasman Street), over Corindi Creek, Redbank Creek, Dirty Creek, Boneys Creek and at ch. 11900, ch.12850 and ch. 14050 where known populations of Green-thighed Frog occur. These management strategies relating to design and environmental management during construction have been presented in Section 4.0

**Table 3-3.** Summary of the surveys and likelihood of each target species using the Upgrade corridor.

Site No	Easting	Northing	Broad Location Details	Giant Barred Frog	Green-thighed Frog	Southern Barred Frog	Wallum Sedge Frog	Green and Golden Bell Frog	Wallum Froglet
1	517912	6675407	Arrawarra Tributary @ ch. 300	Low	<b>Moderate</b>	Very Low	Very low	Low	Very low
35	517933	6675472	Darlington Park area slightly further north	Low	Low	Very Low	Very low	Very Low	Very low
10	518417	6677242	Southern entrance to Red Rock and land further to the south east	Very Low	Low	Very Low	Very low	Very Low	<b>Moderate</b>
34	518499	6677263	Same location as above	Very Low	low	Very Low	Very low	Very Low	<b>Moderate</b>
11	517923	6678158	Large dam south of Corindi Creek	Low	Low	Very Low	Very low	Low	Low
2	517452	6678687	Corindi Creek @ ch.3600	<b>Known</b>	Low	Very Low	Very low	Very Low	Very low
3	517038	6679511	Cassons Creek	Low	<b>Moderate</b>	Very Low	Very low	Very Low	Very low
33	516535	6680201	Red Bank Creek area	Low	<b>High</b>	Very Low	Very low	Very Low	Very low
4	516434	6680202	Red Bank Creek south	Low	<b>High</b>	Very Low	Very low	Very Low	Very low
8	516287	6680464	Borrow Pit on ridge between Redbank Creek tributaries	Very low	<b>High</b>	Very Low	Very low	Very Low	Very low
5	516178	6680661	Red Bank Creek South general area	Low	<b>High</b>	Very Low	Very low	Very Low	Very low
30	513345	6682526	Range Road around 500 m west of the existing Pacific Highway	Very Low	<b>Moderate</b>	Very Low	Very low	Very Low	Very low
31	514578	6682709	Southern Side of Dirty Creek Range	Very Low	<b>Moderate</b>	Very Low	Very low	Very Low	Very low
14	514480	6682974	In vicinity of the old Pacific Highway over Dirty Creek	<b>Known</b>	<b>Moderate</b>	Very Low	Very low	Very Low	Very low
9	512997	6683670	Dundoo Reach upstream	Low	<b>Moderate</b>	Very Low	Very low	Low	Very low
6	513275	6683831	Dundoo Reach downstream	Low	<b>Moderate</b>	Very Low	Very low	Very Low	Very low
29	513224	6685035	Dirty Creek Range South	Very Low	<b>Known</b>	Very Low	Very low	Very Low	Very low
32	512852	6685896	Dirty Creek Range North	Very Low	<b>Known</b>	Very Low	Very low	Very Low	Very low
28	512395	6686189	Boneys Creek area upstream	Low	<b>High</b>	Very Low	Very low	Very Low	Very low
13	512495	6686209	Pacific Highway over Boneys Creek heading downstream	<b>Moderate</b>	<b>High</b>	Very Low	Very low	Very Low	Very low
27	511810	6686446	Southern side of the Halfway Creek Upgrade and north of Boneys Creek	Very Low	<b>Known</b>	Very Low	Very low	Very Low	Very low

## 4.0 RECOMMENDED ACTIONS

Five broad management actions have been recommended as a means to avoid, minimise and mitigate impacts to threatened frog fauna for the Upgrade during both the design and construction phases of the project. These could be captured in the later development of a threatened frog management strategy that considers at least Giant Barred Frog, Green-thighed Frog and Wallum Froglet with the objective to guide construction and environmental management of threatened frog populations during the construction of the Upgrade.

As part of these early works design package the recommended actions include:

- 1. Frog fencing in areas of Giant Barred Frog and Green-thighed Frog habitat considered in the context of:**
  - a. Temporary frog fencing; and**
  - b. Permanent frog fencing.**
- 2. Creation of frog breeding ponds for Green-thighed Frog.**
- 3. Identification and protection of known habitat and areas considered to have a 'moderate' or 'high' likelihood of supporting threatened frog fauna;**
- 4. Frog survey and collection to be implemented in four stages of:**
  - a. Early works when establishing site controls (i.e. clearing limits for clearing and grubbing);**
  - b. Pre-clearing survey within 5 days of commencing the clearing and grubbing program;**
  - c. Supervision during the clearing and grubbing program; and**
  - d. De-watering procedures within areas identified as Giant Barred Frog habitat (i.e. creek diversions) and as deemed necessary by the project Ecologist for identified Green-thighed Frog breeding locations<sup>4</sup>.**
- 5. An unexpected finds procedure to address instances where threatened frogs are detected during routine pre-clearing surveys or at other times during the project.**

### 4.1 Development of Frog Fencing

The development of frog fencing can be divided into two categories of temporary frog fencing leading up to and during the construction of the Upgrade followed by the installation of permanent frog fencing. Both are discussed below.

#### 4.1.1. Temporary Frog Fencing (Early Works – Establishing Site Controls)

- a) Temporary frog fencing should be installed for up to 200 m either side of the stream or breeding site (minimum 500 mm for Green-thighed Frog and Wallum Froglet and 900 mm for Giant Barred Frog high above ground and buried to a depth of 50-100 mm)<sup>5</sup>. Where the terrestrial habitat bordering the stream is cleared land (i.e. northern side of Corindi Creek) this could be reduced to 100 m. In each instance, a return wing (5 m in length) should be installed to reduce frogs breaching the fence.

<sup>4</sup> Often these would be expected to be dry leading up to a clearing event.

<sup>5</sup> It is acknowledged that installation of the fence itself will represent ground/vegetation disturbance and as such it should be subject to a pre clearing active search survey and the works supervised by the Project Ecologist.

- c) Fencing should be installed and inspected/signed off by the Project Ecologist involved with the Upgrade. This procedure should form part of the pre clearing/ground disturbance checklist/permit.
- d) Fencing should be installed at least 5 days prior to the scheduled clearing date so that active searches for frogs can be performed within the clearing footprint (see below).
- e) The works area for the temporary fencing should be inspected/searched by the Project Ecologist immediately prior to installing the temporary fencing. The search should use active techniques such as raking the leaf litter, call broadcast (this species will readily call during the day) and inspections around tussocks (i.e. *Lomandra* clumps in particular) and logs. A nocturnal survey may be required the night before depending on the season and prevailing weather conditions.

#### 4.1.2 Permanent Frog Fencing

- a) Frog fencing should be installed in areas where the presence of threatened frogs have been confirmed **and** there is a 'high' risk of frogs accessing the carriageway (Figure 3-1a-e; Figure 3-2a-e; Figure 3-3). A high risk has been defined as earth embankments/batters with a batter profile of less than 2:1 and within 200 m of the stream.
- b) The fence should provide the required protection for between 100-200 m either side of the stream.
- c) A fence return of 5 m should be installed if the frog fencing does not extend for at least 50 m into unsuitable habitat (i.e. cleared land or non-riparian habitat) at the above mentioned sites.

Design wise, the frog fencing should be incorporated into the fauna fencing design or alternatively the boundary fence. From a design perspective, two types of frog fencing have been proposed to address the differing sizes of the threatened frog's encountered (Figure 4-1a-c). Any amendments to these designs should ensure the gauze size is no greater than 30-40 mm at sites with Giant Barred Frogs and <20 mm at sites with Green-thighed frog to ensure they remain effective. This should still prevent frogs from moving through the fence whilst still allowing for overland water flows/drainage. The fence would need to stand at least 900 mm in height with the residual 150 mm use as an on ground return (i.e. product 1050 mm in width/height).

The success of this design during any subsequent ecological monitoring should be based on the absence of Giant Barred Frog or Green-thighed Frog fence breaches<sup>6</sup>. As part of the monitoring procedures for measuring the effectiveness of the frog fencing, some monitoring of fence breaches should be undertaken by a suitable qualified zoologist at certain times of the year (i.e. when population monitoring occurs) and involve surveys for frogs on both sides of the fence.

<sup>6</sup> This will also be detailed in the EMS required for the project.



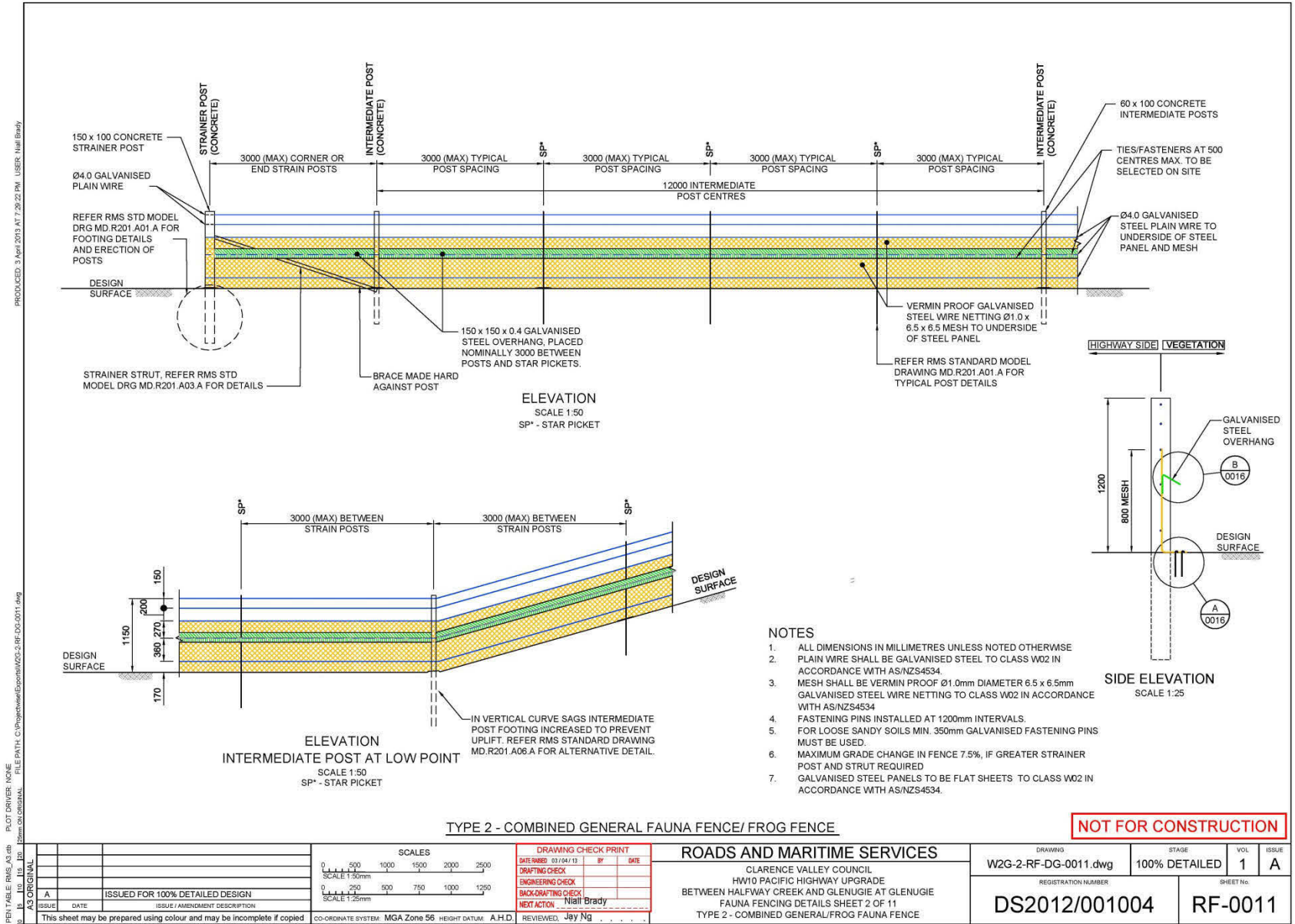


Figure 4-1a. – Type 2 General fauna/frog fence design.

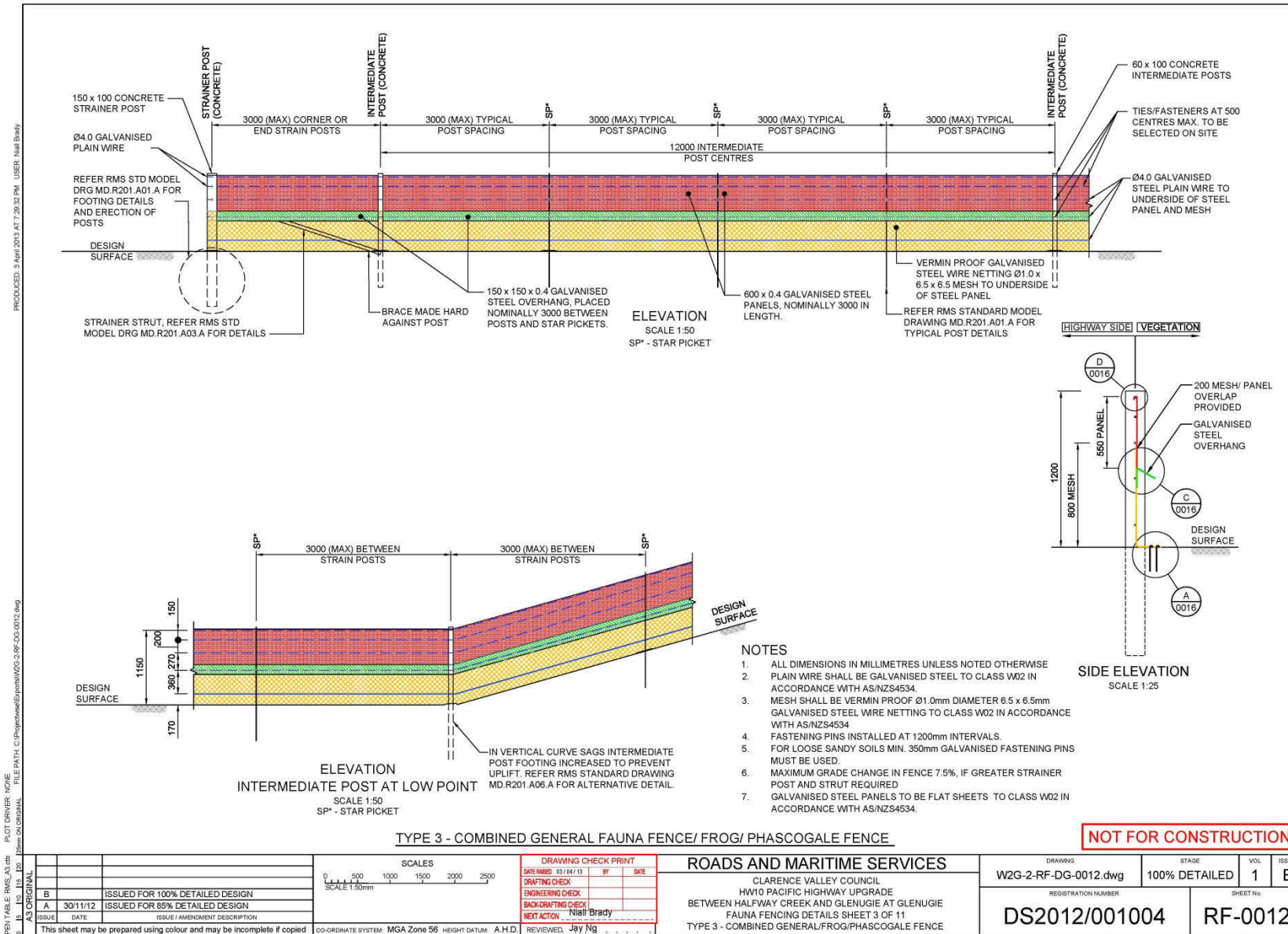


Figure 4-1b. – Type 3 General fauna/frog fence design.

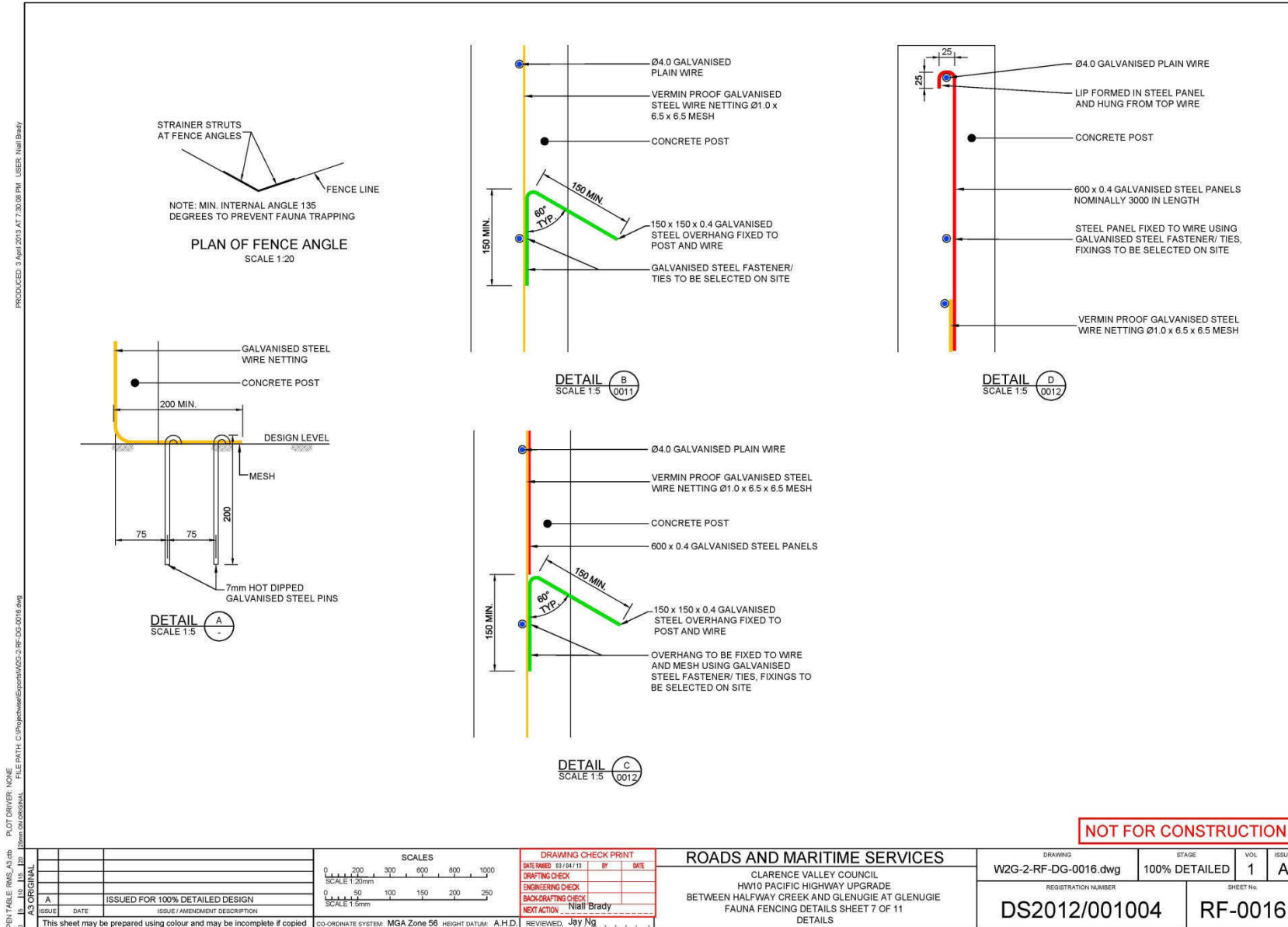


Figure 4-1c. – Cross section profile of Type 2 and Type 3 general fauna/frog fence design.

## 4.2 Green-thighed Frog Breeding Ponds

The construction of Green-thighed Frog breeding ponds should be undertaken at locations where there is potential for the loss of breeding sites within the Upgrade corridor and the changed hydrological patterns have the potential to affect the suitability of residual areas adjacent to the corridor. After considering this, two locations have been identified:

- Redbank Creek area somewhere between ch. 5500 to ch. 6700; and
- Dirty Range at a suitable location preferably adjacent to a fill section between ch. 11500 to ch. 12900.

At the remaining locations where Green-thighed Frog was recorded or is expected to occur (i.e. moderate or high likelihood) the construction of breeding ponds is not warranted. This is due to the newly constructed carriageway inevitably creating new areas of breeding habitat as a result of changed drainage patterns and the positioning of fill and embankments that will create the required ephemeral pools of water. For example, Green-thighed Frogs have recently used an area on the Kempsey Bypass Project which was formerly a seasonally inundated grazing paddock adjacent to swamp forest (Lewis in prep).

The key element with designing a breeding site for Green-thighed Frog is to ensure the water body periodically dries out. This provides two important advantages for this species, firstly, it reduces competitive interactions with pond dwelling frogs (i.e. Tyler's Tree Frog, *Litoria tyleri*) which are common in the study area, and secondly, it reduces predatory interactions associated with the exotic Mosquito Fish (*Gambusia holbrooki*). Based on site specific data and surveys of breeding sites on the mid north coast including monitoring of constructed Green-thighed Frog ponds at Kempsey, a temporary water body should hold surface water for between 40-50 days at sunny exposed sites and for between 60-70 days at more shaded locations following a suitable summer rainfall event of 100-150 mm in 24-36 hours.

With the above in mind, the shallow excavated ponds should have the following attributes:

- Each pond should cover an area of around 12 m<sup>2</sup>;
- Maximum deep of 400 mm;
- Batters no steeper than 1:4;
- Construct 3-5 with each one staggered out from a drainage line thus ensuring they will be flooded at differing rainfall events; and
- Vegetated via assisted planting techniques with low naturally occurring ground covers obtained from the site (i.e. *Carax sp.*, *Fimbristylis sp.*).

Another key message in the design of the breeding ponds is to not over design the pond and replicate features from other known breeding locations on the mid north coast and thus provide the best opportunity for a successful breeding event. Essentially, a simple shallow excavation that will hold water for the required period is all that is needed as this species has been regularly encountered breeding in inundated motor vehicle wheel ruts, disused logging dumps, roadside culverts and eroded gully lines (B. Lewis unpublished data). Where possible, a number of options should be proposed and can include *in situ* habitat if it is deemed suitable. The design and construction of breeding ponds should be supervised by the Project Ecologist and this should occur within 12 months of the clearing and grubbing operations.



a. September 2011



b. September 2011



c. March 2012

**Plate 4-1.** Green-thighed Frog ponds at Fill 6 Kempsey Bypass project (September 2011-March 2012).

### 4.3 Identification of Known and Potential Threatened Frog Habitat

Environmental management during the construction of the Upgrade should as a minimum consider the following sites outlined in Table 4-1. The areas should be protected from construction related works other than what is considered essential. The locating of access tracks, utilities redistribution, car parking facilities and other ancillary works including topsoil stock piles, lay down areas, wash down bays, site shedding and compound sites should not be located in these areas. This approach is likely to be consistent with the MCoA issued as part of the approval to construct the Project. The protection of the identified areas should include the demarcation of clearing limits and signage identifying these areas as 'threatened species habitat' and/or 'no go' zones.

**Table 4-1.** Summary of target species and their state and commonwealth legislative status.

Species	Known Locations	Suspected/Potential
Wallum Froglet ( <i>Crinia tinnula</i> )	Nil	• Tasman Street South (ch. 1500-2100)
Green-thighed Frog ( <i>Litoria brevipalmata</i> )	<ul style="list-style-type: none"> <li>• Dirty Creek Range South (29)</li> <li>• Dirty Creek Range North (32)</li> <li>• Halfway Creek South (27)</li> </ul>	<ul style="list-style-type: none"> <li>• Redbank Creek (4, 33, 5,8)</li> <li>• Dirty Creek Range South</li> <li>• Range Road (30)</li> <li>• Boneys Creek (28)</li> </ul>
Giant Barred Frog ( <i>Mixophyes iteratus</i> )	<ul style="list-style-type: none"> <li>• Corindi Creek (ch. 3600)</li> <li>• Dirty Creek (ch. 8500) – downstream</li> </ul>	<ul style="list-style-type: none"> <li>• Tributary Arrawarra Creek (ch. 300)</li> <li>• Boneys Creek (ch. 13350)</li> </ul>
Southern Barred Frog ( <i>Mixophyes balbus</i> )	Nil	Nil
Wallum Sedge Frog ( <i>Litoria olongburensis</i> )	Nil	Nil
Green and Golden Bell Frog ( <i>Litoria aurea</i> )	Nil	Nil

### 4.4 Additional Construction Related Recommendation - Pre-clearing Surveys

Additional construction related management including the use of pre-clearing surveys should be undertaken as an additional safeguard to reduce direct mortality to individual frogs during the clearing and grubbing phase of the project. At all of the sites identified in Table 4-1 and any others (i.e. unexpected finds) the following pre-clearing survey procedure is recommended.

#### 4.4.1 Pre-clearing Survey for Frogs

- a) Within 5 days of scheduled clearing/ground disturbance operations, the Project Ecologist or environmental manager of the Upgrade should ensure that temporary frog fencing has been installed (*see* 4.2.1) so that a qualified and suitably experienced ecologist can perform pre-clearing surveys over a minimum of two non-consecutive nights (i.e. before clearing commences).
- b) Surveys should last 1 person hour per hectare of habitat to be disturbed/removed and involve the use of call broadcast, spotlighting and active searches of litter, debris and logs.
- c) All threatened frogs<sup>7</sup> captured should be relocated to the nearest side of the clearing limit with information collected on sex, breeding condition and snout-vent length. Alternative relocation sites should also be considered provided they occur within the same drainage line. As a general rule, frogs should not be relocated further than 200-300 m from the capture site which should theoretically remain within an individual's home range<sup>8</sup>.
- d) Consideration should be given to marking these frogs (i.e. >40 mm will be PIT<sup>9</sup> tagged) to document the performance measure of this as a suitable relocation strategy. Smaller frogs may need to be marked using another method in accordance with the animal care and ethics licence of the Project Ecologist. Toe-clipping is one possible method, however, not all animal care and ethics committees support this approach.
- e) A frog hygiene protocol would need to be adopted at sites with threatened frogs. This protocol will be in accordance with Department of Environment and Climate Change DECC (now EPA) **Hygiene protocol** for the control of disease in **frogs** Information Circular Number 6 (DECC 2008).

#### 4.4.2 Clearing Supervision

- a) At all sites with threatened frogs, the clearing and grubbing activities should be supervised by the Project Ecologist until such a time they are confident no individual frogs remain within the work site.
- b) Captured frogs should be treated as per 4.5.1 c) and 4.5.1 d).
- c) The need to perform additional night time surveys should be considered and ultimately at the discretion of the Project Ecologist. For example, only part of the site may have been cleared or more suitable weather conditions present an increased opportunity to detect frogs.

#### 4.4.3 Dewatering Procedures

- a) The dewatering process should be conducted in accordance with an Environmental Work Method Statement (EWMS) and the DECC (2008) hygiene protocol for the control of disease in frogs. All waterbodies identified as threatened frog habitat should be subject to this dewatering process.

<sup>7</sup> Non threatened frogs will be relocated in accordance with fauna handling procedure to be developed for the Upgrade.

<sup>8</sup> Based on current knowledge of mark recapture data and radio tracking (B. Lewis unpublished data).

<sup>9</sup> Passive Integrated Transponder (i.e. microchip as used to mark and identify domestic animals).

- b) Where the water body is to be pumped dry, the intake pipe should be positioned in the deepest section. This would avoid further disturbance of the aquatic habitat prior to capture and relocation of aquatic fauna.
- c) Screening of the pump intake (5mm mesh size) should be installed to prevent tadpole entrainment.
- d) Dip netting should be undertaken to remove as many aquatic fauna as practical once the water body is shallow enough to be effectively waded through by field personnel.
- e) All tadpoles should be identified and sorted by species and/or genus and placed into separate holding containers. The size of these containers should ultimately be left to the discretion of the Project Ecologist.
- f) All tadpoles should be released into adjacent habitats that support the same microhabitat attributes. Tadpoles should be acclimatised to the recipient sites water temperature by immersing bags or aquaria in the release pools to allow a gradual equilibrium of water temperature prior to release.
- g) In instances where there are numerous tadpoles from a wide range of species, preferential treatment should be given to the tadpoles of threatened frogs. The release of predatory species (i.e. eels) should not occur in areas where the tadpoles of threatened frogs are being released. This will reduce the risk of additional predation and/or competition.

#### **4.5 Unexpected Finds Process**

An unexpected finds process should be developed as part of the environmental management during the construction of the Upgrade. This is in response to field surveys not being exhaustive and the ability of some frogs to move relatively large distances in short time periods. For example, Giant Barred Frog has the capacity to move hundreds of metres over a small time period of 1-2 nights whilst the clearing footprint will rarely extend beyond 120 m. This equates to frogs moving into and out of the clearing footprint.

In an unexpected finds instance, the management strategies and any other deemed necessary by the Project Ecologist should be adopted. Some examples include:

1. Protection of threatened frog habitat including provisions for its protection from ancillary areas and their associated impacts;
2. Temporary and if required permanent frog fencing;
3. Additional pre-clearing surveys as deemed appropriate by the Project Ecologist or frog specialist;
4. Consideration for the implementation of new findings into any current monitoring program.

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