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GREEN AND GOLDEN BELL FROG MANAGEMENT PLAN

Kooragang Island Waste Emplacement Facility Closure Works

Submitted to:
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REPORT

Report Number. 117623029-001-R-Rev0





Executive Summary

The Kooragang Island Waste Emplacement Facility (KIWEF) is located on land owned by the New South Wales (NSW) State Property Authority, which is managed under delegated-authority by the Newcastle Port Corporation (NPC).

The KIWEF contains various wastes from the former BHP steelworks at Mayfield. Hunter Development Corporation (HDC) is in the process of closing the KIWEF via implementing certain landfill closure works, which include land-forming of waste emplacement cells and construction of a capping layer over much of the KIWEF site.

Historically, HDC was the holder of an Environment Protection Licence (EPL) over the site for the former BHP Solid Waste facility (refer to Figure 1). That EPL has now been surrendered, subject to the implementation of landfill closure works required by the NSW Office of Environment and Heritage (OEH) (formerly the NSW Department of Environment, Climate Change and Water (DECCW)). HDC, as the Agents for the Crown, are undertaking those necessary landfill closure works, on lands administered by NPC, which encompass the KIWEF (Figure 1).

The KIWEF site supports known populations and habitat of the Green and Golden Bell Frog (*Litoria aurea*). A flora and fauna impact assessment (GHD, 2010a) of the proposed landfill closure works concluded that the works are “*designed to minimise the direct and indirect impacts on biodiversity of the locality, especially in relation to the Green and Gold Bell Frog... The Proposal also addresses the risks posed from the prior disposal of BHP waste on the site*” and is unlikely to result in “*long-term decrease in the size of a population, reduce the area of occupancy of species, fragment an existing population, adversely affect habitat critical to the survival of a species, disrupt the breeding cycle of a population, modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline, result in invasive species that are harmful to an endangered species becoming established in the endangered habitat, or interfere with the recovery of any threatened species*”.

Overall, the flora and fauna impact assessment (GHD, 2010a) reported that the proposed capping strategy is unlikely to impact significantly on Green and Golden Bell Frogs, provided the works are managed through an appropriate environmental management plan.

In order to assist in minimising impacts of the landfill closure works, HDC engaged Golder Associates Pty Ltd (Golder) to develop this Green and Golden Bell Frog Management Plan (the GGBF Management Plan). HDC intend to incorporate this GGBF Management Plan into the detailed design documentation currently being developed for the landfill closure works. An Action Plan has been developed by Golder in conjunction with this GGBF Management Plan and is reported to HDC separately (Golder, 2011).

The Green and Golden Bell Frog is listed as ‘endangered’ under the NSW *Threatened Species Conservation Act 1995*, and ‘vulnerable’ under the federal *Environmental Protection and Biodiversity Conservation Act 1999*. Historically, this species was widespread across much of the Hunter Valley; however, it is now believed to be restricted to four key populations, including a large population on Kooragang Island (including the KIWEF site).

The Green and Golden Bell Frog is a relatively large species and is usually green, most often with irregular large gold spots and/or stripes. The Green and Golden Bell Frog can be regarded as somewhat of a habitat generalist, dispersing widely and maturing early. It is known to inhabit marshes, dams and stream sides and appears to prefer those water bodies where Bulrushes (*Typha* spp.) or Spikerushes (*Eleocharis* spp.) grow (NPWS, 1999). Green and Golden Bell Frogs are also known to inhabit highly disturbed sites (NPWS, 1999), such as the KIWEF site. The Green and Golden Bell Frog is known to travel significant distances across often seemingly inhospitable habitat. Distances of up to 1.5 km day/night are not unknown, particularly associated with significant rain events.



Frog Chytrid Fungus (FCF) has been identified as a key threatening process, at both the state and national level, for the Green and Golden Bell Frog (DSEWPC, 2009). FCF is widespread on Kooragang Island and Hexham Swamp, the other key Green and Golden Bell Frog population in the Newcastle area (DECC, 2007).

Section 3 of this document details the management procedures to be implemented, including identification and delineation of disturbance areas, pre-work surveys, identification of relocation areas, relocation procedures and rehabilitation of disturbed habitat, environmental induction training and site hygiene management for Chytrid fungus.

Section 4 of this document outlines the proposed monitoring programme for Green and Golden Bell Frogs at the KIWEF site. The monitoring programme includes annual review of publicly available baseline and ongoing data from other surveys including frog populations (such as that being undertaken by NCIG across the KIWEF site). An Annual Environmental Monitoring Report (AEMR) discussing the results of analysis of monitoring data will be presented to OEH.

Section 5 of this document identifies specific management and mitigation measures for disturbed areas and triggers for the development of response criteria in the unlikely event that the landfill closure works have an impact on the Green and Golden Bell Frogs. If the results of the monitoring programme indicate a decline in Green and Golden Bell Frog numbers across the site, which cannot be attributed to natural population fluctuations and variability, and is potentially a direct result of the landfill closure works, specific response criteria will be developed by HDC in consultation with the OEH.

Section 6 of this document outlines proposed review and reporting actions. HDC will report to OEH annually for 5 years following completion of the landfill closure works, unless analysis shows that Green and Golden Bell Frog populations are being impacted, then further reporting will be undertaken until a time agreed with OEH.

In accordance with the *Approval of Surrender of Licence Number 6437*, the Director-General will be notified of any incident with actual or potential significant off-site impacts on people or the biophysical environment, as soon as practicable after the occurrence of the incident. The Director-General will be provided with written details of the incident within seven days of the date on which the incident occurred.

The AEMR will be distributed to relevant government agencies and stakeholders, and copies provided to other interested parties, if requested.

In accordance with the *Approval of Surrender of Licence Number 6437*, this Management Plan will be made available on the HDC website.



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1.0 INTRODUCTION

1.1 BACKGROUND

The Kooragang Island Waste Emplacement Facility (KIWEF) is located on land owned by the New South Wales (NSW) State Property Authority, which is managed under delegated-authority by the Newcastle Port Corporation (NPC).

The KIWEF contains various wastes from the former BHP steelworks at Mayfield. Hunter Development Corporation (HDC) is in the process of closing the KIWEF via implementing certain landfill closure works, which include land-forming of waste emplacement cells and construction of a capping layer over much of the KIWEF site.

Historically, HDC was the holder of an Environment Protection Licence (EPL) over the site for the former BHP Solid Waste facility (refer to Figure 1). That EPL has now been surrendered, subject to the implementation of landfill closure works required by the NSW Office of Environment and Heritage (OEH) (formerly the NSW Department of Environment, Climate Change and Water (DECCW)). HDC, as the Agents for the Crown, are undertaking those necessary landfill closure works, on lands administered by NPC, which encompass the KIWEF (Figure 1).

The KIWEF site supports known populations and habitat of the Green and Golden Bell Frog (*Litoria aurea*). A flora and fauna impact assessment (GHD, 2010a) of the proposed landfill closure works concluded that the works are “*designed to minimise the direct and indirect impacts on biodiversity of the locality, especially in relation to the Green and Gold Bell Frog... The Proposal also addresses the risks posed from the prior disposal of BHP waste on the site*” and is unlikely to result in “*long-term decrease in the size of a population, reduce the area of occupancy of species, fragment an existing population, adversely affect habitat critical to the survival of a species, disrupt the breeding cycle of a population, modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that a species is likely to decline, result in invasive species that are harmful to an endangered species becoming established in the endangered habitat, or interfere with the recovery of any threatened species*”.

Overall, the flora and fauna impact assessment (GHD, 2010a) reported that the proposed capping strategy is unlikely to impact significantly on Green and Golden Bell Frogs, provided the works are managed through an appropriate environmental management plan.

In order to assist in minimising impacts of the landfill closure works, HDC engaged Golder Associates Pty Ltd (Golder) to develop this Green and Golden Bell Frog management plan (the GGBF Management Plan) to support the landfill closure works. HDC intend to incorporate this GGBF Management Plan into the detailed design documentation currently being developed by HDC for the landfill closure works.

This GGBF Management Plan has been prepared in accordance with HDC's Request for Tender No. 141 (“Green & Golden Bell Frog Management Plan and Action Plan for K26/32 Ponds: KIWEF”), dated February 2011, and Golder's responding proposal, dated 28 February 2011 as accepted via a letter from HDC emailed to Golder on 16 March 2011. This Management Plan has been prepared via review of documentation provided by HDC to Golder on 22 March 2011, a visual site visit by Golder personnel and written commentary from HDC.

An Action Plan for the K26/K32 Ponds has been developed by Golder in conjunction with this GGBF Management Plan and is reported to HDC in a separate document (Golder, 2011).

1.2 A SUMMARY OF WORKS COMPLETED TO DATE

A range of studies have been completed by others in relation to the Green and Golden Bell Frogs on the KIWEF site since its hand over to the Crown in 2002. The most recent relevant studies are listed in the following. It is noted that other previous studies are summarised in these works, and, therefore, are not identified here.



- Revised Capping Strategy, Flora and Fauna Impact Assessment, Rev 3 (GHD, 2010a).
- March 2011 Green and Golden Bell Frog (*Litoria aurea*) Survey at the Kooragang Island Waste Emplacement Facility (Umwelt, 2011).
- Revised Final Landform and Capping Strategy, Rev 4, (GHD, 2010b).

The key findings of those reports, as relevant to the ongoing management of Green and Golden Bell Frogs on the KIWEF site, are presented below.

1.2.1 Flora and Fauna Impact Assessment

The flora and fauna impact assessment of the revised capping strategy was undertaken as part of the EPL surrender, which the then DECCW required to identify any impacts resulting from the implementation of the final capping strategy on Green and Golden Bell Frogs (and other threatened species). The assessment was also required to identify associated mitigation measures for those species and their habitats.

Key Findings

The key findings of the flora and fauna impact assessment (GHD, 2010a) comprised the following:

- The assessment identified areas of known and potential Green and Golden Bell Frog Habitat (as indicated on Figure 1), and determined the presence, relative abundance and distribution of Green and Golden Bell Frogs on the KIWEF site, and the adjacent Ash Island. A summary of the locations and numbers of Green and Golden Bell Frogs recorded on the KIWEF site is presented in Figure 1. During the assessment (that is February and March 2009), 59 Green and Golden Bell Frogs were recorded from the KIWEF and surrounding area; 38 individuals were recorded on the KIWEF site.
- Two important factors to note, as identified in the report, are:
 - The Green and Golden Bell Frog's ongoing survival on Kooragang Island, and the KIWEF site, may be related to the protection that the brackish wetland habitat provides from the Chytrid fungus (Stockwell, pers. comm., in GHD, 2010a).
 - The terrestrial habitats and ephemeral water bodies supported on the KIWEF site and the larger Kooragang Island may provide important movement corridor refuges for Green and Golden Bell Frogs (Hamer *et al.*, 2008, in GHD, 2010a).
- Potential changes to water quality, especially salinity, may adversely affect the Green and Golden Bell Frogs on the KIWEF site.
- The *in situ* contaminated materials present across the KIWEF site will be addressed by the capping strategy. There is, therefore, the potential for water quality in, and adjacent to, the capped location to remain similar or improve.
- The capping strategy was designed to minimise changes to hydrology. As noted, however, the construction of the NCIG rail loop has impacted on the known Green and Golden Bell Frog habitat supported in the K26 and K32 cells, and potentially already altered the hydrology of these ponds.
- Where the proposed capping strategy would impact on streamside vegetation and banks, and, hence, potential Green and Golden Bell Frog habitat, that vegetation would be reinstated immediately following capping works to a state as close as possible to the original.
- Plague Minnow (*Gambusia holbrooki*), a known predator of Green and Golden Bell Frog tadpoles, was recorded in ponds across the KIWEF site.
- The assessment considered that the capping strategy would result in minimal fragmentation or isolation of currently interconnecting areas of Green and Golden Bell Frog habitat. The capping strategy would



leave areas of appropriate habitat in areas within the KIWEF site and the adjacent Hunter Estuary National Park.

- That vegetation that may be cleared or capped is considered unlikely to constitute key foraging habitat for Green and Golden Bell Frogs.
- The potential cumulative impacts on Green and Golden Bell frogs and their habitat across the local area from other proposals, is unknown; particularly impacts on potential movement between populations north and south. Furthermore, inference is made that competition for resources, required by the species, may have potentially increased because of the translocation of individuals into suitable areas on the KIWEF site from areas impacted by other proposals. However, the proposed “*capping strategy aims to avoid increasing these pressures while dealing with the potentially harmful pollutants on site*” and “*is unlikely to add to these previous impacts or add to cumulative adverse impacts on threatened species at the KIWEF site*”.
- Overall, the assessment reports that the proposed capping strategy is unlikely to impact significantly on Green and Golden Bell Frogs, provided the works are managed through an appropriate environmental management plan. Those assessments of significance were undertaken in accordance with the Commonwealth’s *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the NSW *Environmental Planning and Assessment Act 1979* (EPA Act).

Mitigation Measures

The following mitigation measures were recommended in the flora and fauna impact assessment:

- A 30 m buffer zone is proposed around fresh and brackish water wetlands, ponds, and identified areas of Green and Golden Bell Frog habitat.
- If it is identified that works will occur in Green and Golden Bell Frog habitat (such as the fringing habitat near Deep Pond), one week prior to those works commencing, a pre-clearance survey is required to be conducted by a qualified ecologist. In the event that any Green and Golden Bell Frogs are identified, they will be relocated (using appropriate amphibian hygiene protocols).
- Once works are complete, the restoration and rehabilitation of that habitat should be undertaken.
- Control of noxious weeds on the site should be undertaken limiting the use of herbicides, which may be detrimental to Green and Golden Bell Frogs.
- Maintenance of the current hydrological and water chemistry regimes; in particular, low levels of salinity in the brackish wetlands, which may protect amphibian species from the Chytrid fungus. The maintenance of runoff volumes into these areas may help conserve appropriate salinity levels.
- Similarly, general erosion and sediment control should be implemented to limit the transport of other contaminants across the KIWEF site.
- Capping and grading activities should be conducted outside of the Green and Golden Bell Frog’s core breeding period (that is, September to March). If works need to be undertaken during this time, they should be limited to areas outside of recognised breeding habitat. For the purposes of this GGBF Management Plan, breeding habitat is defined as areas within or immediately adjacent to emergent, aquatic macrophytes.
- Standing water should not be transferred between waterbodies, to prevent the spread and establishment of the Plague Minnow.
- Suitable hygiene protocols must be developed and adhered to for all plant and personnel entering the KIWEF site to avoid the spread of Chytrid fungus.



- Compensatory habitat for the Green and Golden Bell Frog may be considered as part of the capping strategy. For example, the capping works may facilitate rehabilitation of suitable Green and Golden Bell Frog habitat. However, HDC has indicated that it is not intending to create artificial habitat, interfere with existing habitat, nor are seeking to modify frog population numbers or habitat.
- Ongoing, long-term monitoring of the Green and Golden Bell Frog population across the entire KIWEF site, and adjacent areas, such as the NCIG facility, should be undertaken seasonally. This data will help identify if any adverse impacts have affected the Green and Golden Bell Frog population and habitat across Kooragang Island.

1.2.2 March 2011 Survey

The March 2011 survey of GGBF (Umwelt, 2011) targeted the rail loop area, including K26 and K32 Ponds (as well as K24 and K31 Ponds). Overall, this survey was suitable for its purpose. However, the following comments are made in relation to the survey scope and its findings. Those comments were used to assist in the development of the Action Plan for the K26/K32 Ponds (Golder, 2011).

- No detailed surface water quality data have been collected and analysed for the standing water in the Ponds.
- It is known that some contaminants are detrimental to frog embryos and development, as well as known to lead to malformations in frogs for example, Abbasi and Soni, 1984; Anon., 1999, Arrieta *et al.*, 2004, Guillermo *et al.*, 2000; Marquis *et al.*, 2006; Rice *et al.*, 2002; Stabenau *et al.*, 2006; Wang and Jia, 2008). Some surface water chemistry data are available (see NCIG, 2008, in GHD, 2010b) that indicate values exceeding ANZECC trigger values for aquatic ecosystems; however, these are limited. In the absence of detailed water chemistry data, there is no baseline to compare for the long-term monitoring of the water quality, correlated with the frog populations. This represents a significant data gap.
- Data on the periodicity of the standing water in the cells has not been collected. Such data would assist in the understanding of the impacts of changes in local hydrology, such as may have occurred during construction of the NCIG rail loop.
- The mere presence of calling males may not be a useful indicator of successful breeding in the ponds. This, to some extent, has been alluded to in both the GHD (2010) and the Umwelt (2011) studies in that no tadpoles were recorded in the cells during either of those studies.
- The presence of juveniles may be a valid indicator of a sustainable population as this species is known to emigrate over large distances. Therefore, it would be useful to confirm that there has been effective breeding over one or more seasons, with tadpoles that survive to adulthood.
- The baseline comparison that the Umwelt (2011) report makes with the GHD (2010) results, in particular, that “There is no substantial change in the numbers recorded from 2009 to 2011.” (page 8) needs to be further qualified. A stable number of frogs each year over a relatively short time frame could result from a variety of factors (such as low mortality or in-migration) and is not necessarily confirmation of sustainable breeding.

To meet HDC’s requirements regarding management of contamination and frog habitat at the Ponds it is recommended that these data gaps are addressed by HDC.

1.2.3 Capping Strategy

The objectives of the capping strategy were to “*reduce risks to the environment associated with migration of contaminated groundwater and to prevent the risk of biological harm associated with contaminated soil and groundwater*” (GHD, 2010b). This objective had the associated objectives of preserving and maintaining habitat for shorebirds and other threatened species, and endangered ecological communities.



The strategy assessed the KIWEF based on sub-areas, with each sub-area assessed for the requirement for capping, and the effects that capping may have on the ecology. The locations of those sub-areas are presented on Figure 1. In terms of impacts to ecology, in particular the ecology of the Green and Golden Bell Frog, the following sub-areas were important:

- K1 – This sub-area presents a low risk to the surrounding environment from contamination. Capping of this area would have a significant impact on the ecology of the area.
- K2 – This sub-area presents a low to moderate risk to the surrounding environment from contamination. Capping of this area could impact on Green and Golden Bell Frog habitat.
- K3 – This sub-area presents a low to moderate risk to the surrounding environment from contamination. Capping of the fringing areas of this sub-area may have an impact on Green and Golden Bell Frog habitat. Therefore, capping is suggested only up to within 30 m of that habitat, with the exception of the area located near K3/1W.
- K4 (deep pond) – Contamination in this sub-area presents a low risk to the environment. However, filling and capping of this sub-area will have a significant impact on Green and Golden Bell Frog habitat, and the overall ecology of the area.
- K6 – This sub-area presents a low risk from contamination. However, capping of this sub-area will have a significant impact on the ecology of the area.
- K7 – The sub-area presents a low to moderate risk to the environment from contamination. Capping of the edges of the site will significantly impact on Green and Golden Bell Frog habitat.
- K26/K32 cells – These cells present a high risk to the environment. However, they also support Green and Golden Bell Frog habitat. Capping is not recommended, but rather a monitoring and risk assessment be completed. Details of recommended actions for the K26/K32 Ponds are presented in an Action Plan (Golder, 2011).

Based on the above assessment, a capping strategy was developed that minimised the impacts to Green and Golden Bell Frog habitat. A brief summary of the other sub-areas, suggested for capping, is provided below.

- K5 (excluding pond 5) – This sub-area presents a low to moderate risk to the environment from contamination. There is no significant Green and Golden Bell Frog habitat in this area; therefore, capping is an option.
- Pond 5 – Migration of contaminants from this sub-area may impact the estuarine aquifer. This sub-area does not support significant Green and Golden Bell Frog habitat. Therefore, capping is an option.
- K10 (excluding K26/K32) – The sub-area presents a low to moderate risk to the environment from contamination. The BOS area presents a moderate risk to the environment. Capping is suggested for this area.



1.3 Other Relevant Management Plans and Guidelines

This GGBF Management Plan should be read and in conjunction with the following management plans and guidelines, which are relevant to the Green and Golden Bell Frog population on Kooragang Island and the KIWEF:

- *Coal Export Terminal Green and Golden Bell Frog Management Plan* (Newcastle Coal Infrastructure Group (NCIG) (Document No. GGBFMP-R01-E.DOC, 2007)) (the NCIG management plan)
- *Draft Management Plan for the Green and Golden Bell Frog Key Population in the Lower Hunter* (Department of Environment and Climate Change (DECC) (NSW) 2007) (the Lower Hunter management plan)
- *Significant impact guidelines for the vulnerable Green and Golden Bell Frog (Litoria aurea)* (Department of Sustainability, Environment, Water, Populations and Communities (DSEWPC), Nationally threatened species and ecological communities; Background paper to the EPBC Act policy statement 3.19, 2009)
- *Best practice guidelines: Green and Golden Bell Frog habitat* (DECC, 2008)
- *Protecting and restoring Green and Golden Bell Frog habitat* (DECC, 2008)
- *Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea)*. (DECC, 2005)
- *Threatened Species Management Information Circular No.6, Hygiene Protocol for the Control of Disease in Frogs* (NPWS, 2001) (the hygiene protocol) (Appendix A).

1.4 Project Approval

This GGBF Management Plan has been developed in order to partly address the KIWEF site's *Approval of Surrender of Licence Number 6437*, dated 8 December 2010, Condition 5.b), which requires the following:

b) The licensee shall prepare and submit a Green and Golden Bell Frog Management Plan to the EPA for approval by 13 April 2011. The Plan shall encompass the entire premises occupied by the licensee and include, but not be limited to:

i) Management measures to be undertaken to minimise the spread of the amphibian Chytrid fungus including:

(i) the training of project personnel in site hygiene management; and

(ii) site hygiene procedures for project personal, mobile plant and equipment, in accordance with the NPWS Hygiene Protocol for the Control of Disease in Frogs 2001; and

ii) Measures to maintain, restore and enhance Green and Golden Bell Frog habitat, including movement corridors across the site.

Additionally, obligations exist under the DSEWPC's *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) as to the protection of this nationally threatened species. These obligations are detailed in the EPBC Act policy statement 3.19 (see above for reference), as well as the significant impact criteria set out in the NSW *Threatened Species Conservation Act 1995* (TSC Act).

1.5 Objectives of this Plan

In relation to Green and Golden Bell Frogs on the KIWEF site, one of the overall aims of the KIWEF landfill closure works is to manage those works in a manner that does not impact threatened species and their habitat, and to restore small areas of temporary disturbance to their original (or better) condition. To that end, the objectives of this GGBF Management Plan are:

- 1) To maintain the existing Green and Golden Bell Frog populations supported on the KIWEF site.



- 2) To reduce the spread of the amphibian Chytrid fungus (*Batrachochytrium dendrobatidis*).
- 3) To protect the existing Green and Golden Bell Frog habitat on the KIWEF site.
- 4) To increase connectivity between the existing areas of Green and Golden Bell Frog habitat on the KIWEF site.
- 5) To restore Green and Golden Bell Frog habitat that may be disturbed during the landfill closure works to a condition as-good or better than prior to the works.

Hence, this GGBF Management Plan aims to assist HDC in the implementation of appropriate environmental management measures during the KIWEF closure works.

1.6 Scope and Use of this Plan

The scope of this GGBF Management Plan covers that area known as the KIWEF (Figure 1), before, during and after landfill closure works.

This GGBF Management Plan has been prepared in accordance with the relevant state guidelines as identified in Section 1.3.

This GGBF Management Plan will be reviewed and updated by those responsible for undertaking the detailed design and associated documentation to ensure that it is current at the time that the landfill closure works are tendered. Once tendered, the Contractor will incorporate the revised GGBF Management Plan into their Environmental Management Plans (EMP). Where there is any conflict between the provisions of this GGBF Management Plan and Contractors' obligations under their respective contracts, including the various statutory requirements (that is, licences, permits, project approval conditions and relevant laws), the contract and statutory requirements are to take precedence. In the case of any real or perceived ambiguity between elements of this GGBF Management Plan and the above statutory requirements, the Contractor shall first gain clarification from HDC, prior to implementing that element of this GGBF Management Plan over which the ambiguity is identified.

It is intended that this GGBF Management Plan should complement those studies identified in Section 1.2. To that end, this management plan should be supplemented by publicly available monitoring results collected by others for projects on Kooragang Island. For example, it is understood that the NCIG plan requires monitoring to occur on an annual basis until 2020, as outlined in the EPBC Act Particular Matter conditions for that project. The NCIG monitoring data will be useful input into management of Green and Golden Bell Frogs on the KIWEF site.

1.7 Structure of this Plan

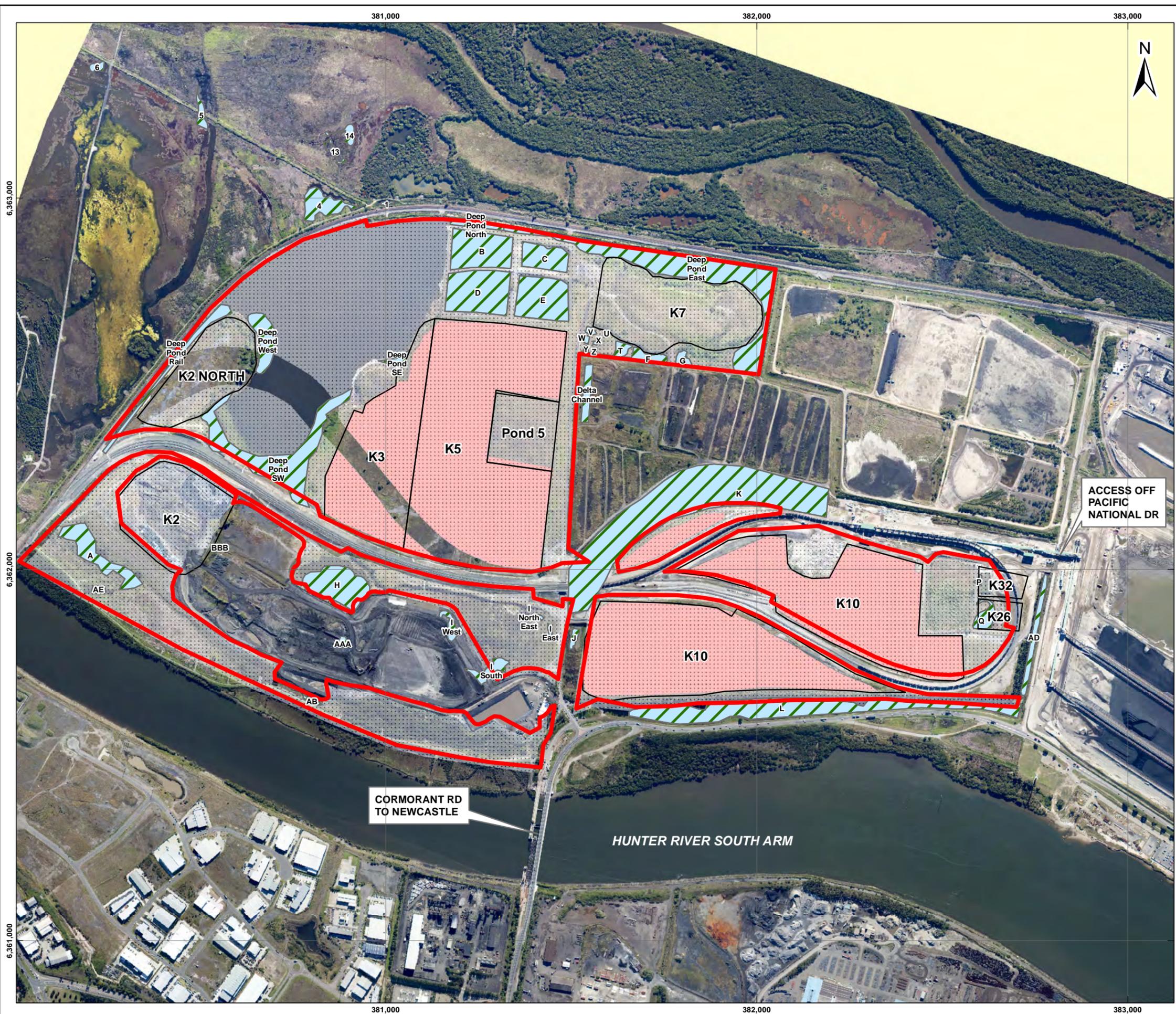
The structure of this GGBF Management Plan is provided below. This structure has been adopted to address the requirements as specified in the HDC brief (document number HDC141), and be in accordance with required guidelines.

- **Section 2:** Provides a profile of the Green and Golden Bell Frog, including its key identifying features in the field, similar species on the KIWEF site, general ecology relevant to the KIWEF site, its conservation status and distribution on the KIWEF site.
- **Section 3:** Details the management procedures to be implemented, including identification and delineation of disturbance areas, pre-work surveys, identification of relocation areas, relocation procedures and rehabilitation of disturbed habitat, environmental induction training and site hygiene management for Chytrid fungus.
- **Section 4:** Outlines the monitoring programme for the KIWEF site.
- **Section 5:** Response criteria and mitigation measures, including comparison with previous data collected at the site, and procedures to be followed if a decline in the Green and Golden Bell Frog population is detected.

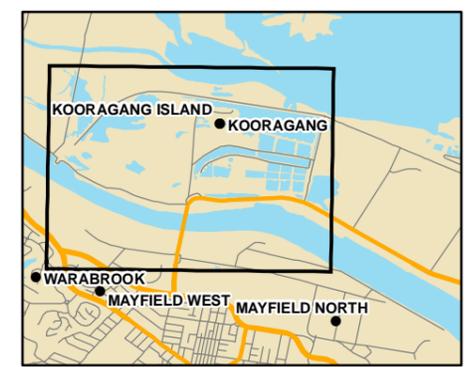


GGBF MANAGEMENT PLAN

- Section 6: Lists the reporting and review requirements of this management plan.
- Section 7: Lists references cited in this Green and Golden Bell Frog Management Plan and other supporting information.



**GREEN AND GOLDEN BELL
FROG MANAGEMENT PLAN**
HUNTER DEVELOPMENT CORPORATION
SITE LOCATION



- LEGEND**
- Kooragang Island Waste Emplacement Facility License Area
 - Known and Potential Habitat Areas (GHD, 2010)
 - Capping Extent Landfill Closure Works
 - HDC Closure Area 2010

NOTES

Imagery provided by The Hunter Development Corporation 16/03/2011
 Data digitised from Land & Property Management Authority Request for Tender - RFT No. HDC141, February 2011
 Appendix A - Site and Access Map

0 40 80 160 240 320 400 metres
SCALE (at A3) 1:10,000
 Coordinate System: GDA 1994 MGA Zone 56

PROJECT: 117623029
DATE: 18/04/2011
DRAWN: AJW
CHECKED: TC

FIGURE 1



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2.0 SPECIES PROFILE – GREEN AND GOLDEN BELL FROG (*LITORIA AUREA*)

2.1 Conservation Status

2.1.1 Listing

The Green and Golden Bell Frog's conservation status is listed as follows:

- **Endangered** under the NSW *Threatened Species Conservation Act 1995*
- **Vulnerable** under the federal *Environmental Protection and Biodiversity Conservation Act 1999*.

2.1.2 Known Populations

The Green and Golden Bell Frog is estimated to have disappeared from 90% of its former range within NSW over the last 30 years (Pyke and White, 1996; DECC, 2007), although populations in Victoria are believed to be secure (Gillespie, 1996).

There are about 45 known populations of Green and Golden Bell Frog within NSW (DECC, 2007). Of these, only a few occur in conservation reserves; Kooragang Island Nature Reserve supports the closest protected population to the KIWEF site (DECC, 2007). Historically, this species was widespread across much of the Hunter Valley; however, it is now believed to be restricted to four key populations:

- a large population on Kooragang Island (including the KIWEF site)
- small, isolated populations at Sandgate on the margins of Hexham Swamp
- a meta-population in the Gillieston Heights/East Maitland, Ravensdale areas (also including Wentworth Swamp)
- a meta-population in the Ravensworth/Liddell/Bayswater area.

2.1.3 Management and Recovery Plans

To “ensure that the Lower Hunter population is successfully managed and monitored such that the species continues to persist in the Lower Hunter and that ‘measures’ of the two populations’ viability are maintained or improved over time”, the following key documents are important:

- *Draft Management Plan for the Green and Golden Bell Frog Key Population in the Lower Hunter* (Department of Environment and Climate Change (DECC) (NSW) 2007) (the Lower Hunter management plan)
- *Draft Recovery Plan for the Green and Golden Bell Frog (Litoria aurea)*(DECC, 2005).

2.2 Key Distinguishing Features

The following provides some key diagnostic features that are important for quick and easy field-identification of this species.

2.2.1 Adult Frogs

- Relatively large, muscular species with robust body form and smooth skin compared to other species known to inhabit the KIWEF site (Barker *et al.*, 1995).
- The background colouration is usually green, most often with irregular large spots and/or stripes of gold (Barker *et al.*, 1995), refer to Figure 2. It should be noted that adults can vary considerably in pattern; however, the background colouration will always be green.



- Males vary in size from 60 to 70 mm (snout to vent length (SVL)); females vary from 65 to 110 m SVL (Tyler and Knight, 2009). Typically, most individuals being in the range of 60 to 80 mm SVL (DEC, 2005).
- A white or cream stripe extends from above the nostril, over the eye and ear (tympanum) and continues as a fold down the side (Robinson, 1998). There is usually a darker stripe below the white stripe, and another pale stripe from below the eye, extending to the base of the forearm (Robinson, 1998).
- The groin area, and behind the thighs, is usually pale blue or bluish-green, particularly in breeding males (Tyler and Knight, 2009). Mature males may also have a yellowish darkening of the throat area (DEC, 2005).
- The tympanum is usually brown (Tyler and Knight, 2009).
- The belly is usually creamish-white (DEC, 2005); the lower sides of the body are adorned with raised glandular, creamish-coloured spots of irregular size.
- The eye has a horizontally elliptical pupil and a golden yellow iris. The toes are three-quarters to nearly fully webbed (Robinson, 1998).



Figure 2: Adult Green and Golden Bell Frog (Litoria aurea)
(Source: A. White (2007), as in the NCIG plan)



2.2.2 Tadpoles

- Relatively large, reaching 65 to 100 mm at limb bud development stage (DEC, 2005). May be confused with other large-bodied tadpoles of species in the KIWEF site; for example, Peron's Tree Frog (*Litoria peronii*).
- Deep bodied and possess long tails with a high fin that extends almost half way along the body (refer to Figure 3).
- Although not typically used in field identification given the need for a microscope, the mouthparts consist of two upper and three lower labial rows (Anstis, 2002).



Figure 3: Tadpole Green and Golden Bell Frog (*Litoria aurea*)
(Source: A. White (2007), as in the NCIG plan)

2.2.3 Similar Species within the KIWEF Area

The Green and Golden Bell Frog should not be confused with any other species in the KIWEF area, given its very distinctive features and large size, wart-free skin, expanded finger and toe pads, and lack of spotting or marbling on the hind side of the thigh (Robinson, 1998).

Nevertheless, to the untrained eye, metamorphosing individuals may be confused with the adults and metamorphs of the following species that are known to occur on the KIWEF site:

- Eastern Dwarf Tree Frog (*Litoria fallax*)
This species is also green, but lacks any of the golden markings on the back and presents with a plain, single colour.
- Peron's Tree Frog (*Litoria peronii*)
Adults have bright yellow with black mottling on armpits, groin, and backs of thighs. The back texture is rough, and often is covered with faint, emerald spots, giving its other common name, the Emerald-spotted Treefrog.
- Broad-palmed Rocket Frog (*Litoria latopalmata*)



This species ranges from light to dark brown on its back, sometimes with darker blotches. The backs of the thighs are yellow and dark brown.

■ Spotted Marsh Frog (*Limnodynastes tasmaniensis*)

Adults usually have large regularly-shaped olive green blotches on the back and sometimes have a yellow, red, or orange mid-dorsal stripe. The background colouration is not green.

2.3 Aspects of Ecology Important for Management

2.3.1 Preferred Habitat

The Green and Golden Bell Frog can be regarded as somewhat of a habitat generalist, dispersing widely and maturing early. It is known to inhabit marshes, dams and stream sides and appears to prefer those water bodies where Bulrushes (*Typha* spp.) or Spikerushes (*Eleocharis* spp.) grow (NPWS, 1999). In the Lower Hunter region, such plant species as Salt Marsh Rush (*Juncus kraussii*), Coast Club Rush (*Schoenoplectus subulatus*), and Salt Couch (*Sporobolus virginicus*) are indicators of habitat suitability for Green and Golden Bell Frogs (DECC, 2007). Such habitat is typically unshaded, free of Plague Minnow (*Gambusia holbrooki*), have a grassy area nearby and diurnal sheltering sites (NPWS, 1999).

Green and Golden Bell Frogs are also known to inhabit highly disturbed sites (NPWS, 1999), such as the KIWEF site.

Typically, Green and Golden Bell Frogs will require habitat for breeding, foraging, shelter, movement and over wintering. All such habitat types occur across the KIWEF site, and have been incorporated under the banner of known and potential Green and Golden Bell Frog habitat by GHD (2010a). These habitat areas are indicated on Figure 1.

2.3.2 Habits

The Green and Golden Bell Frog is frequently active during the day, although it is known to forage at night on insects, as well as other frogs (Cogger, 2000; Barker *et al.*, 1995; NPWS, 1999). Tadpoles are known to feed on algae and other vegetative matter (NPWS, 1999; Anstis, 2002).

The Green and Golden Bell Frog exhibits strong migration tendencies, and is known to travel significant distances across often seemingly inhospitable habitat (DECC, 2007). Distances of up to 1.5 km in a single day/night are not unknown (Wellington, 1998; Pyke and White, 2001; DECC, 2007). It should be noted that such movements most often occurred during or immediately after significant rain events.

2.3.3 Breeding

The Green and Golden Bell Frog usually breeds in summer when conditions are warm and wet, typically after rain (Cogger, 2000; Barker, *et al.*, 1995). The core breeding period for this species is generally accepted to be between September and February (DECC, 2007), provided sufficient rainfall occurs during this time.

Males call while floating in water and females produce a floating raft of eggs, which gradually settle to the bottom (NPWS, 1999).

Tadpoles take around six weeks to develop depending on environmental conditions (for example, temperature) (Pyke and White, 1996; NPWS, 1999).

Adult male Green and Golden Bell Frogs may only live for around two years in a hostile environment but, typically, life expectancy is likely to vary markedly according to the quality of the habitat (Goldingay and Newell, 2005).

2.3.4 Threats

Frog Chytrid Fungus (FCF) has been identified as a key threatening process, at both the state and national level, for the Green and Golden Bell Frog (DSEWPC, 2009). FCF is widespread on Kooragang Island and Hexham Swamp, the other key Green and Golden Bell Frog population in the Newcastle area (DECC, 2007).



Recent evidence suggests that occasional exposure to saline influences and/or certain contaminants may be attenuating the effects of the FCF (DECC, 2007). Such saline and polluted conditions occur on the KIWEF site. Hypotheses supporting this scenario are presently being tested by M. Stockwell and M. Mahoney from the University of Newcastle (NCIG, 2007).



3.0 MANAGEMENT PROCEDURES

3.1 Identification and Delineation of Disturbance Areas

Known and potential Green and Golden Bell Frog habitat is located across the KIWEF site and surrounds. GHD (2010a) identified and mapped that habitat (as identified in Figure 5.5 of their report), which is presented in Figure 1 of this GGBF Management Plan. Prior to capping works commencing, this habitat will be clearly identified on the ground (with appropriate signage), and the locations of it communicated to personnel undertaking works on the site. This communication will be undertaken as part of the site induction (refer to section 3.3), and will include obligations of personnel to maintain and protect that habitat.

Ponds P and Q (that is, cells K26 and K32) will be subject to a separate Action Plan (Golder, 2011) due to their significance as habitat and the presence of contaminated soil and groundwater.

3.2 Identification of Areas of Disturbance to Habitat

As part of the capping strategy, a small proportion of the known and potential Green and Golden Bell Frog habitat may be disturbed. This habitat area comprises the fringing habitat adjacent to Deep Pond, that is the area located near K3/1W and the BOS area (Figure 1).

The frogs will be relocated within the KIWEF during the capping works.

3.3 Environment Induction and Training

All HDC personnel, contractors and sub-contractors will undergo environmental induction and training before commencing work on-site. As it pertains to the Green and Golden Bell Frog, information addressed during this training will include (NCIG, 2007):

- Green and Golden Bell Frog profile and identification (Section 2).
- Identification of Green and Golden Bell Frog habitat areas. Project personnel will be prohibited from entering Green and Golden Bell Frog habitat areas located outside defined works areas.
- Site hygiene management in accordance with the Hygiene Protocol (Section 3.4).
- Procedures to be followed in the event Green and Golden Bell Frogs are found (Section 3.6).

3.4 Site Hygiene Management

The proposed hygiene management protocol described below largely follows that prepared by NCIG (2007), which has been accepted by OEH.

FCF (refer to section 2.3.4) has the potential to adversely affect Green and Golden Bell Frogs. It is known to occur on Kooragang Island, and potentially on the KIWEF site. Infection occurs through waterborne zoospores released from an infected amphibian in water (NPWS, 2001) and the fungus infects both frogs and tadpoles (Berger *et al.*, 1999). Therefore, the spread of FCF can occur via the movement of water around the site and/or soil attached to equipment (both plant and personal protective equipment).

Typical clinical signs of frogs infected with FCF (after Berger *et al.*, 1999) include:

- lethargy
- loss of appetite
- skin discoloration
- presence of excessive sloughed skin
- sitting unprotected during the day with hind legs held loosely to the body.



3.4.1 Hygiene Training

To reduce the likelihood of spreading FCF, all HDC employees and contractors involved in activities in areas of known habitat for the Green and Golden Bell Frog (and other amphibian species) will be trained in site hygiene management in accordance with the hygiene protocol (Appendix A). This will be part of the environmental induction and training (Section 3.3).

3.4.2 Inspection and Disinfection of Mobile Plant

Any mobile plant entering and leaving the KIWEF site during the closure and capping activities will be routinely disinfected at a designated wash bay.

Similarly, personal protective equipment (PPE) of HDC employees and contractors entering and leaving the site will be disinfected as a matter of routine, following the methods outlined in the Hygiene Protocol (Appendix A).

Inspection and disinfection of mobile plant, and affected PPE, will be undertaken at a designated, concrete-bunded disinfection area at the entrance of the KIWEF site. The location of this area, and the disinfection procedure, will be incorporated into the site induction and training programme (refer to Section 3.3).

3.5 Pre-works Surveys for Disturbance Areas

Pre-works surveys will include targeted active searches of potential Green and Golden Bell Frog habitat located within proposed disturbance areas. These surveys will be undertaken by a suitably qualified and licensed ecologist.

The pre-works surveys (and, if applicable, relocation activities) will be conducted to minimise disruption to breeding activities and the need to relocate tadpoles or metamorphs, where practicable. All these activities will be conducted in accordance with the relevant measures outlined in the hygiene protocol (Section 3.4).

Habitat resources typically associated with the lifecycle components of the Green and Golden Bell Frog (for example, ponded areas, rocks, logs, tussock forming vegetation and other cover) will be searched during a diurnal visual inspection.

Following the diurnal habitat searches, a nocturnal habitat search may be conducted to assess nocturnal usage (that is, breeding/calling) in the habitat supported in the disturbance area, if the surveys are conducted during the core breeding season. The nocturnal habitat searches may include:

- searching of habitat features, which were searched during the day
- spotlighting
- call play-back.

In the event that any Green and Golden Bell Frogs are observed during the diurnal or nocturnal searches, the relocation procedures outlined in Section 3.6 will be initiated prior to the commencement of disturbance works. In some cases a frog-proof fence may be used to protect the frogs in-situ or to exclude frogs from the surveyed area.

The results of the pre-works surveys will be recorded and reported in the Annual Environmental Management Report (AEMR) (Section 6).

3.6 Green and Golden Bell Frog Relocation Procedures

The proposed relocation procedure described below largely follows that proposed by NCIG (2007), which has been accepted by OEH.

3.6.1 Relocation Procedure during Pre-works Surveys

In the event a Green and Golden Bell Frog is identified within the disturbance areas during pre-works surveys, the following relocation procedure will be initiated:



- a) The ecologist undertaking the pre-clearance survey will capture the frog.
- b) If the frog appears to be healthy:
 - a. A suitable release location in the immediate vicinity of the disturbance area, yet outside of potential areas of disturbance, will be identified by the ecologist.
 - b. The frog will be released into the relocation area. Any frog to be relocated will be held in a cool, dark, moist place until nightfall. Where practicable, relocation will be timed to coincide with periods of recent rainfall to optimise chances of survival of the frog.
- c) If the frog appears to be sick, or is dead:
 - a. the procedures outlined in Section 3.6.3 will be followed.

Relocation of Green and Golden Bell Frogs during pre-works surveys will be conducted in accordance with the relevant measures outlined in the hygiene protocol (Section 3.4).

Details of Green and Golden Bell Frogs that are relocated (that is, lifecycle stage and sex of individual [if possible], location where found and location of release) conducted during pre-works surveys will be recorded and reported in the AEMR (Section 6).

3.6.2 Relocation Procedure Outside of Pre-works Surveys

In the event a frog is observed within the KIWEF site outside of the designated pre-works surveys (for example, within an area already disturbed), and is thought to be a Green and Golden Bell Frog, the following relocation procedure will be initiated if the frog is likely to be harmed by the capping works:

- a) The observer will notify the HDC's Environmental Representative, or suitably-qualified ecologist, of the frog's location.
- b) The Environmental Representative, or suitably-qualified ecologist, will determine whether the frog is likely to be harmed by works.
- c) If the frog is likely to be harmed by works, a suitably-qualified ecologist, will capture the frog.
- d) If the frog appears to be healthy:
 - a. A suitable release location (that is, one of the potential relocation areas identified on Figure 1) will be identified by the ecologist.
 - b. The frog will be released into the relocation area. Any frog to be relocated will be held in a cool, dark, moist place until nightfall. Where practicable, relocation will be timed to coincide with periods of recent rainfall to optimise chances of survival of the frog.
- e) If the frog appears to be sick, or is dead:
 - a. the procedures outlined in Section 3.6.3 will be followed.

Relocation of Green and Golden Bell Frogs outside pre-works surveys will be conducted in accordance with the relevant measures outlined in the hygiene protocol (Section 3.4).

Details of Green and Golden Bell Frogs that are relocated (that is, lifecycle stage and sex of individual [if possible], location where found and location of release) during pre-work surveys will be recorded and reported in the AEMR (Section 6).

3.6.3 Procedures for Handling Sick or Dead Green and Golden Bell Frogs

Table 1 presents the range of symptoms that may be exhibited by sick or dying frogs, while Table 2 provides diagnostic behaviour tests, which can be used to determine if a frog is sick (for example, infected with FCF) (after NCIG, 2007).



Table 1: Symptoms of sick and dying frogs

Appearance	Behaviour
<ul style="list-style-type: none"> ■ Darker or blotchy upper (dorsal) surface ■ Swollen hind limbs ■ Very thin or emaciated ■ Reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes ■ Skin lesions (sores, lumps) ■ Infected eyes ■ Obvious asymmetric appearance 	<ul style="list-style-type: none"> ■ Lethargic limb movements, especially hind limbs ■ Abnormal behaviour (e.g. a nocturnal burrowing frog sitting in the open during the day and making no vigorous attempt to escape when approached) ■ Little or no movement when touched

Source: after NPWS (2001)

Table 2: Diagnostic behaviour tests – sick frogs will fail one or more of the following tests

Test	Healthy	Sick
■ Gently touch with finger	■ Frog will blink.	■ Frog will not blink.
■ Turn frog on its back	■ Frog will flip back over.	■ Frog will remain on its back.
■ Hold frog gently by its mouth	■ Frog will use its forelimbs to try to remove grip	■ No response from frog

Source: after NPWS (2001)

In the event that a Green and Golden Bell Frog appears to be sick, or is dead, the following procedures will be followed (after NPWS, 2001):

- Disposable gloves will be worn when handling all frogs, as well as sick or dead frogs.
- To prevent cross-contamination, new gloves and a clean plastic bag will be used for each frog specimen.
- Frogs exhibiting one or more of the symptoms for sick frogs listed in Table 1 or 2, and considered unlikely to survive transportation will be euthanised¹.
- Sick frogs likely to survive transportation will be placed into either a moistened cloth bag with some damp leaf litter, or into a partially-inflated, clean plastic bag with damp leaf litter. All frogs will be kept separate during transportation.
- Dead frogs will be kept cool and preserved as soon as possible. The belly of the frog will be cut open and the specimen placed in preservative (approximately 10 times the volume of the specimen). Specimens will be preserved in either 65% ethanol or 10% buffered formalin.
- The recipient of the sick or dead frog will be contacted to confirm the appropriate procedure prior to transport².

¹ Terminally ill frogs will be placed into a container with the bottom covered with 3% chloral hydrate (NPWS, 2001).



- Containers will be labelled with the following details: date, location and species (if known).
- Standardised collection form will be filled out and a copy sent with the specimen (in Appendix A).
- Individual containers will be used for each specimen.

Details of sick or dead Green and Golden Bell Frogs found at the KIWEF site will be recorded and reported in the AEMR (Section 6).

² A list of potential sick and dead frog recipients is provided in Attachment 4 (NPWS, 2001), including Associate Professor Michael Mahony of the School of Biological Sciences, University of Newcastle.



4.0 GREEN AND GOLDEN BELL FROG MONITORING PROGRAMME

Baseline monitoring of the Green and Golden Bell Frog has been undertaken by GHD (2010 and Umwelt (2011).

NCIG has also implemented a monitoring programme that collects data that includes the Green and Golden Bell Frog populations on the KIWEF site.

The NCIG monitoring will be conducted annually until 2020 and then three-yearly till 2030. On the basis that the NCIG monitoring programme continues to be implemented, HDC do not propose to undertake any further monitoring, other than that specified in the Action Plan for the K26/K32 Ponds (Golder, 2011).

HDC propose to annually review the NCIG data to ensure that it meets HDC's requirements. The overall objective of HDC's review of the Green and Golden Bell Frog monitoring programme is to monitor the dynamics of the Green and Golden Bell Frog populations supported within known and potential habitat areas within the KIWEF site. The intention of the review programme will be to ascertain if the landfill closure works have an effect on the population.

Monitoring parameters that will be used for comparison will include, yet not be limited to:

- a) Green and Golden Bell Frog presence/absence, distribution, habitat utilisation, behaviour and abnormalities.
- b) observations of other frog species distribution, relative abundance and abnormalities.
- c) habitat condition.
- d) date
- e) time of day
- f) rainfall (mm)
- g) site location (GPS co-ordinates and map location)
- h) survey method utilised
- i) sampling effort
- j) habitats surveyed
- k) weather conditions (including temperature)
- l) number of observers
- m) photographs taken

HDC will report to OEH annually for 5 years following the completion of the landfill closure works, unless analysis shows that Green and Golden Bell Frog populations are being impacted, then further reporting will be undertaken until a date agreed with OEH.

Monitoring and research to understand better the extent and dynamics of Green and Golden Bell Frog populations is a proposed action of the Draft Recovery Plan (DECC, 2005). This action has been adopted as a strategy to achieve the objectives of the Lower Hunter Management Plan. The results of this monitoring programme would contribute to this action/strategy.

The results of the monitoring programme will be recorded and reported in the AEMR (Section 6).



5.0 RESPONSE CRITERIA AND SPECIFIC MITIGATION AND MANAGEMENT MEASURES

The following proposed mitigation measures have been developed based on a review of information provided by GHD (2010a) and a review of site conditions.

5.1 Management of All Disturbance Areas

The following mitigation measures will be implemented to manage areas proposed for disturbance.

- The boundaries of all Green and Golden Bell Frog habitat will be clearly identified on the ground.
- Appropriate erosion and sediment control structures will be installed at least 30 metres upslope of all such habitat areas. These erosion and sediment control structures will be regularly inspected and maintained, particularly after significant rainfall events.
- All plant entering and leaving the KIWEF site will be, as a matter of routine, disinfected via a wash bay. The location and procedures involved at this wash bay will form part of the site induction and training (see Section 3.3). Records will be kept.
- Similarly, all HDC employees and contractors involved in activities in areas of known habitat for the Green and Golden Bell Frog (and other amphibian species) will be trained in site hygiene management in accordance with the hygiene protocol (Appendix A). This will be part of the environmental induction and training (Section 3.3). Records will be kept.
- All PPE in contact with soil, particularly boots, of HDC employees and contractors entering and leaving the site will be disinfected as a matter of routine, following the methods outlined in the Hygiene Protocol (Appendix A).
- All disinfection processes will be monitored and controlled at the KIWEF site's entry and exit point. The location of these disinfection bays, and the obligations of disinfection, will be communicated during the site induction and training (Section 3.3).
- All water required for dust suppression will be drawn from ponds established for the purpose. No water for dust suppression will be drawn from current ponds on the site. The establishment of dedicated dust suppression ponds will be undertaken to prevent the potential spread of Plague Minnow into ponds currently free of this species. The location and procedure for those dedicated dust suppression ponds will be communicated during the site induction and training (Section 3.3).
- Stormwater diversion measures, if required, will be put in place to maintain the current hydrological regime for the site.
- If practicable, the capping and grading activities will be scheduled to occur outside of the core Green and Golden Bell Frog breeding period (that is, September to March), especially in areas adjacent to known and potential breeding habitat.

5.2 Specific Management Measures for Disturbed Areas

The following mitigation measures will be implemented to manage areas proposed for disturbance. It should be noted that these measures do not negate the need for the measures outlined in Section 5.1.

- The disturbance area will be clearly delineated on the site plan and on the ground. The boundaries of the area and its location will be made known to all personnel involved during the site induction (refer to Section 3.3).
- One week prior to works commencing in the disturbance area, a pre-works survey will be conducted by a qualified ecologist (refer to Section 3.5 for a suggested survey protocol).



- In the event that any Green and Golden Bell Frogs are identified in the area, they will be relocated (using appropriate amphibian hygiene protocols) to known and suitable Green and Golden Bell Frog habitat areas immediately adjacent to the disturbance footprint (refer to Section 3.6 for appropriate relocation procedures).
- The works will be scheduled to occur outside of the core breeding period for Green and Golden Bell Frogs, that is, September to March.
- An on-site, suitably-qualified ecologist will be available during all clearing and capping works undertaken in the habitat areas to be disturbed. This person will be available to relocate Green and Golden Bell Frogs that may be found in the disturbance footprint during capping activities.
- In an attempt to limit the potential for Green and Golden Bell Frogs to enter the disturbance footprint, and if practicable, a frog-proof barrier will be erected around the disturbance footprint.
- Appropriate erosion and sediment control measures will be put in place around the disturbance area, prior to any works commencing, to prevent sediment from moving into adjacent habitat.
- Once works are complete, the restoration and rehabilitation of that habitat will be undertaken in accordance with a rehabilitation and revegetation plan.

5.3 Measures to Enhance Restore and Maintain Habitat

It is noted that the proposed capping works have been designed to minimise impacts on Green and Golden Bell Frog Habitat and will impact upon only two small areas.

It is anticipated that the mitigation measures presented in Sections 5.1 and 5.2 will assist in the management of the Green and Golden Bell Frogs, and their habitat on the KIWEF site, during and immediately following the landfill closure work, and the associated activities. In addition to those, the following mitigation measures have been developed to assist, where practicable, in the enhancement, restoration and maintenance of Green and Golden Bell Frog habitat following the completion of the landfill closure works.

- The capping strategy has been designed to limit and ultimately reduce the exposure of potential Green and Golden Bell Frog habitat, and the wider ecosystems of Kooragang Island, to soil and groundwater contaminants.
- As part of the rehabilitation and revegetation plan for the KIWEF site, open stormwater infrastructure across the KIWEF site may be planted with species known to be favoured by Green and Golden Bell Frogs. This revegetation and rehabilitation strategy will include a 2 metre wide buffer on either side of the stormwater drains. The intention of these areas is to provide movement corridors for Green and Golden Bell Frogs across the site.
- The capped areas will ideally be designed to shed water to table drains, which, in a similar manner to other stormwater infrastructure, will be vegetated with species known to be favourable to Green and Golden Bell Frogs.
- Drainage culverts will, where practicable, be vegetated and lined with rocks and objects that may provide temporary frog refuge, in the event that a frog seeks to traverse the future capped area of KIWEF.
- The drainage culverts in the NCIG rail loop may provide additional areas that can be rehabilitated to facilitate the migration and dispersal of the Green and Golden Bell Frog (Connell Hatch, 2008, in GHD, 2010b).



5.4 Response Criteria

5.4.1 General Site Environmental Management

As part of the overall environmental management plan for the site, during the landfill closure works, the HDC's environmental representative will conduct weekly inspections of all the management measures identified in Sections 5.1, 5.2 and 5.3. The results of these inspections will be recorded and a summary provided in the AEMR.

Should non-conformances be identified, HDC's environmental representative will contact the Site Foreman within 24 hours and request a remediation action. The Site Foreman will have 48 hours to correct the non-conformance.

5.4.2 Population Monitoring

If the results of the monitoring programme indicate a decline in Green and Golden Bell Frog numbers across the site, which cannot be attributed to natural population fluctuations and variability, and is potentially a direct result of the landfill closure works, specific response criteria will be developed by HDC, in consultation with the OEH. The aim of these response criteria will be to determine whether declining populations (if evident from the monitoring programme [Section 4]) are directly attributable to the capping project.



6.0 REPORTING AND REVIEW

In accordance with the *Approval of Surrender of Licence Number 6437*, the Director-General will be notified of any incident with actual or potential significant off-site impacts on people or the biophysical environment, as soon as practicable after the occurrence of the incident. The Director-General will be provided with written details of the incident within seven days of the date on which the incident occurred.

HDC will prepare an Annual Environmental Management Report (AEMR) that:

- a) Reviews the performance of the capping project against this management plan.
- b) Provides an overview of environmental management actions and summarises monitoring results over the 12 month reporting period.
- c) Continues on an annual basis for a minimum of five years following completion of the Landfill Closure Works.
- d) Will be phased out on presentation of adequate information to establish that the Landfill Closure Works have had no measurable impacts to Green and Golden Bell Frog populations on the KIWEF site. In the unlikely event that changes in the Green and Golden Bell Frog population are observed, which appear to be attributable to the Landfill Closure Works, extended review will be undertaken. This may involve a more detailed monitoring and investigation programme to address the potential cause of the decline in those areas. The programme will aim to identify direct evidence indicating that the Landfill Closure Works contributed to the decline. The details of that programme will be developed through discussion with OEH.

The AEMR will be distributed to relevant government agencies and stakeholders, and copies provided to other interested parties, if requested.

In accordance with the *Approval of Surrender of Licence Number 6437*, this management plan will be made available on the HDC website.



7.0 REFERENCES

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Report Signature Page

GOLDER ASSOCIATES PTY LTD

A handwritten signature in black ink, appearing to read 'M Mason', with a long horizontal flourish extending to the right.

Mervyn Mason
Senior Ecologist

MCM/TC/mcm

A.B.N. 64 006 107 857

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APPENDIX A

Hygiene Protocol for the Control of Disease in Frogs

Threatened Species Management Information Circular No. 6



hygiene protocol for the
control of disease in

frogs

April 2008

Department of **Environment & Climate Change** NSW



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This hygiene protocol is an adaptation of the Declining Amphibian
Population Task Force (DAPTF) Fieldwork Code of Practice and
the recommendations of Speare et al. (1999) and has drawn on
recommendations from earlier guidelines prepared by Environment
ACT.

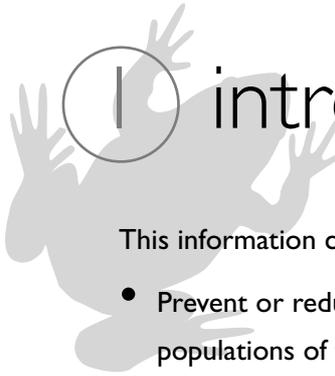
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hygiene protocol for the control of disease in

frogs

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I introduction

This information circular outlines measures to:

- Prevent or reduce disease causing pathogens being transferred within and between wild populations of frogs.
- Ensure captive frogs are not infected prior to release.
- Deal safely with unintentionally transported frogs.
- Assist with the proper identification and management of sick and dead frogs in the wild.

1.1 Who should read this document?

This protocol is intended for use by all researchers, wildlife consultants, fauna surveyors and students undertaking frog field-work. In addition, the protocol should be read by Department of Environment and Climate Change (DECC) personnel, frog keepers, wildlife rescue and carer organisations, herpetological/frog interest groups/societies, fauna park/zoo operators/workers and other individuals who regularly deal with or are likely to encounter frogs.

This protocol outlines the expectations of the DECC regarding precautionary procedures to be employed when working with frog populations. The intention is to promote implementation of hygiene procedures by all individuals working with frogs. New licences and licence renewals will be conditional upon incorporation of the protocol. The DECC recognises that some variation from the protocol may be appropriate for particular research and frog handling activities. Such variation proposals should accompany any licence application or renewal to the DECC.

1.2 Background

1.2.1 Amphibian Chytrid Fungus

The apparent decline of frogs, including extinctions of species and local populations, has attracted increased international and national concern. Many

potential causes for frog declines have been proposed (eg see Pechmann et al., 1991; Ferrero and Bergin, 1993; Pechmann and Wilbur, 1994; Pounds and Crump, 1994; Pounds et al., 1997). However, the patterns of decline at many locations suggest that epidemic disease maybe the cause (Richards et al., 1993; Laurance et al., 1996; Alford and Richards, 1997). Recent research has implicated a water-borne fungal pathogen *Batrachochytrium dendrobatidis* as the likely specific causative agent in many of these declines both in Australia and elsewhere (Berger et al., 1998; 1999). This agent is commonly known as the amphibian or frog chytrid fungus and is responsible for the disease Chytridiomycosis (Berger et al., 1999).

B. dendrobatidis is a form of fungus belonging to the phylum Chytridiomycota. Most species within this phylum occur as free-living saprophytic fungi in water and soil and have been found in almost every type of environment including deserts, arctic tundra and rainforest and are considered important primary biodegraders (Powell 1993). *B. dendrobatidis* is a unique parasitic form of Chytridiomycete fungi, in that it invades the skin of amphibians, including tadpoles, often causing sporadic deaths with up to 100% mortality in some populations. Chytridiomycosis has been detected in over 40 species of native amphibian in Australia (Mahony and Workman 2000). However, it is not currently known whether the fungus is endemic or exotic to Australia.

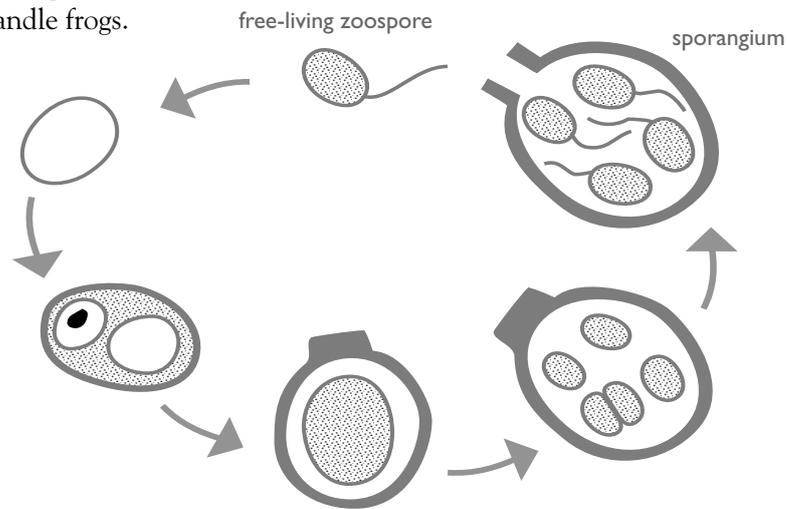
The infective stage of *B. dendrobatidis* is the zoospore and transmission requires water (Berger et al., 1999). Zoospores released from an infected amphibian can potentially infect other amphibians in the same water. More research is needed on the dynamics of infection in the wild. *B. dendrobatidis* is known to be susceptible to seasonal temperature changes, dehydration, salinity, water pH, light, nutrition and dissolved oxygen (Berger et al., 1999).

1.3 Objectives

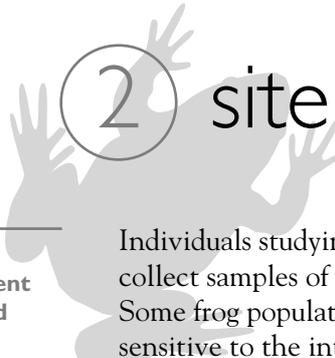
The objectives of the hygiene protocol are to:

- Recommend best-practice procedures for DECC personnel, researchers, consultants and other frog enthusiasts or individuals who handle frogs.

- Suggest workable strategies for those regularly working in the field with frogs or conducting fieldwork activities in wetlands and other aquatic environments where there is the potential for spreading pathogens such as the frog chytrid fungus.
- Provide background information and guidance to people who provide advice or supervise frog related activities.
- Provide standard licence conditions for workers engaged in frog related activities.
- Inform Animal Care and Ethics Committees (ACEC) for their consideration when granting research approvals.



Life cycle of frog chytrid fungus from infective free-living zoospore stage to sporangium (adapted from L. Berger).

A large, light grey silhouette of a frog is positioned behind the page number '2'. The number '2' is enclosed in a circle and placed to the left of the frog's head. The frog's body extends across the top of the page, with its legs and arms spread out.

2 site hygiene management

A checklist of risk management procedures and recommended standard hygiene kit is provided in Appendix I. Please note Footnote I on page 4.

Individuals studying frogs often travel and collect samples of frogs from multiple sites. Some frog populations can be particularly sensitive to the introduction of infectious pathogens such as the frog chytrid fungus. Also, the arrangement of populations in the landscape may make frogs particularly vulnerable to transmission of infectious pathogens. Therefore, it is important that frog workers recognise the boundaries between sites and undertake measures which reduce the likelihood of spreading infection.

Where critically endangered species or populations of particular risk are known to occur, this protocol should be applied over very short distances ie a single site may need to be subdivided and treated as separate sites.

When planning to survey multiple sites, always start at a site where frog chytrid fungus is not known to be present before entering other infected areas.

2.1 Defining a site

Defining the boundary of a site maybe problematic. In some places, the boundary between sites will be obvious but in others, less so. Undertaking work at a number of sites or conducting routine monitoring at a series of sites within walking distance creates obvious difficulties with boundary definitions. It is likely that defining the boundary between sites will differ among localities. It may be that a natural or constructed feature forms a logical indicator of a site boundary eg a road/ track, a large body of water such as a river or the sea, a marked habitat change or a catchment boundary.

As a guiding principle, each individual waterbody should be considered a separate site.

When working along a river or stream or around a wetland or a series of interconnecting ponds it is reasonable, in most instances, to treat such examples as a single site for the purposes of this protocol. Such a case would occur in areas where frogs are known to have free interchange between ponds.

Where a stream consists of a series of distinctive tributaries or sub-catchments or where there is an obvious break or division then they should be treated as separate sites, particularly if there is no known interchange of frogs between sites.

2.2 On-site hygiene

When travelling from site to site it is recommended that the following hygiene precautions be undertaken to minimise the transfer of disease from footwear, equipment and/or vehicles.

Footwear

Footwear must be thoroughly cleaned and disinfected at the commencement of fieldwork and between each sampling site.

This can be achieved by initially scraping boots clear of mud and standing the soles in a disinfecting solution. The remainder of the boot should be rinsed or sprayed with a disinfecting solution that contains *benzalkonium chloride* as the active ingredient. Disinfecting solutions should be prevented from entering any water bodies.

Rubber boots such as 'gum boots' or 'Wellingtons' are recommended because of the ease with which they can be cleaned and disinfected.

Several changes of footwear bagged between sites might be a practical alternative to cleaning.

Equipment

Equipment such as nets, balances, callipers, bags, scalpels, headlamps, torches, wetsuits and waders etc that are used at one site must be cleaned and disinfected before re-use at another site.

Disposable items should be used where possible. Non-disposable equipment should be used only once during a particular field exercise and disinfected later or disinfected at the site between uses using procedures outlined in 2.4 below.

Vehicles

Where necessary, vehicle tyres should be sprayed/flushed with a disinfecting solution in high-risk areas.

Transmission of disease from vehicles is unlikely to be a problem. However, if a vehicle is used to traverse a known frog site, which could result in mud and water being transferred to other bodies of water or frog sites, then wheels and tyres should undergo cleaning and disinfection. This should be carried out at a safe distance from water bodies, so that the disinfecting solution can infiltrate soil rather than run-off into a nearby water body.

Spraying with 'toilet duck' (active ingredient *benzalkonium chloride*) is recommended to disinfect car wheels and tyres.

Cleaning of footwear before getting back into the car will prevent the transfer of pathogens from/to vehicle floor and control pedals.

2.3 Handling of frogs in the field

The spread of pathogenic organisms, such as the frog chytrid fungus, may occur as a result of handling frogs.

Frogs should only be handled when necessary.

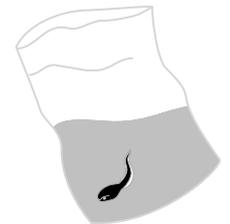
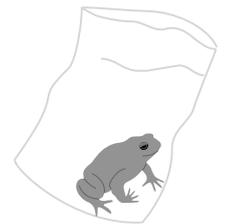
Where handling of frogs is necessary the risk of pathogen transfer should be minimised as follows:

- Hands should be either cleaned and disinfected between samples or a new pair of disposable gloves used for each sample¹. This may be achieved by commencing with a work area that has a dish containing a disinfecting solution and paper towels.
- A 'one bag – one frog' approach to frog handling should be used especially where several people are working together with one person processing frogs and others doing the collecting. Bags should not be reused.
- A 'one bag – one sample' approach to tadpole sampling should be used. Bags should not be reused.

Researchers who use toe clipping or Passive Integrated Transponder (PIT) tagging are likely to increase the risk of transmitting disease between frogs due to the possibility of directly introducing pathogens into the frogs' system. This can be minimised by using:

- Disposable sterile instruments
- Instruments disinfected previously and used once
- Instruments disinfected in between each frog

Disinfecting solutions containing *benzalkonium chloride* are readily available from local supermarkets. Some brands include Toilet Duck, Sanpic, New Clenz and Pine Clean.



¹ As a principle, this protocol assumes that not all frogs in an infected pond will be contaminated by the frog chytrid fungus. The infective load of a body of water may not be high enough to cause cross contamination of individual frogs in the same pond. Therefore care should be taken to use separate gloves and bags and clean hands for each sample, to avoid transmission of high infective loads between individuals.

Open wounds from toe clipping and PIT tagging should be sealed with a cyanoacrylate compound such as *Vetbond*® to reduce the likelihood of entry of pathogens. The DECC ACEC further recommends the application of topical anaesthetic *Xylocaine*® cream and *Betadine*® disinfectant (1% solution) before and after any surgical procedure. This should then be followed by the wound sealant.

All used disinfecting solutions, gloves and other disposable items should be stored in a sharps or other waste container and disposed or sterilised appropriately at the completion of fieldwork. Disinfecting solutions must not come into contact with frogs or be permitted to contaminate any water bodies

2.4 Disinfection Methods

Disinfecting agents for hands and equipment must be effective against bacteria and both the vegetative and spore stages of fungi. The following agents are recommended:

- Chloramine and Chlorhexidine based products such as *Halamid*®, *Halasept*® or *Hexifoam*® are effective against both bacteria and fungi. These products are suitable for use on hands, footwear, instruments and other equipment. The manufacturers instructions should be followed when preparing these solutions.
- Bleach and alcohol (ethanol or methanol), diluted to appropriate concentrations can be effective against bacteria and fungi. However, these substances may be less practical because of their corrosive and hazardous nature.

When using methanol either:

- immerse in 70% methanol for 30 minutes or
- dip in 100% methanol then flame for 10 seconds or boil in water for 10 minutes

Fresh bleach (5% concentration) may be also effective against other frog pathogens such as Rana Virus.

Some equipment not easily disinfected in these ways can be effectively cleaned using medical standard 70% isopropyl alcohol wipes – *Isowipes*®.



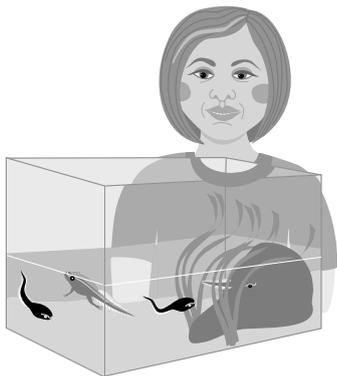
3 captive frog hygiene management

3.1 Housing frogs and tadpoles

Frogs and tadpoles should only be removed from a site when absolutely necessary.

When it is necessary for frogs or tadpoles to be collected and held for a period of time, the following measures should be undertaken:

- Animals obtained at different sites should be kept isolated from each other and from other captive animals.
- Aquaria set up to hold frogs should not share water, equipment or any filtration system. Splashes of water from adjacent enclosures or drops of water on nets may transfer pathogens between enclosures.
- Prior to housing frogs or tadpoles, ensure that tanks, aquaria and any associated equipment are disinfected.
- Tanks and equipment should be cleaned, disinfected and dried immediately after frogs/tadpoles are removed.



Careful maintenance of your enclosures will ensure a safe and hygienic environment for captive frogs and tadpoles.

When contemplating a release of captive bred tadpoles for conservation purposes a Translocation Proposal should be submitted to the DECC and pathological screening for disease should be undertaken (see also DECC Translocation Policy). Tadpoles can be tested by randomly removing 10 individuals at 6 weeks and again at 2 weeks before anticipated release. Testing could be undertaken by the pathology section at Taronga Zoo, Newcastle University, CSIRO Australian Animal Health Laboratories at Geelong and James Cook University at Townsville. Such an arrangement would need to be negotiated by contacting one of these institutions well before the anticipated release date. (see Appendix 2 for contact details)

DECC have licenced NSW Schools to allow students and/or teachers to remove tadpoles for classroom life cycle studies. They are authorised to remove individuals from only one location, each school also requires endorsement from Department of Education and Training Animal Care and Ethics Committee and comply with this protocol.

Tadpoles collected for these purposes are to be obtained from the local area of the school and are not to be obtained from DECC Reserves. As soon as tadpoles have transformed, froglets must be returned to the exact point of capture. Tadpoles from different locations are not to be mixed.

Antifungal cleansing treatments to clear tadpoles of the frog chytrid fungus are currently being trialed. In the future, such a treatment may be an added procedure required prior to froglet releases.

Detailed information on safely maintaining frogs in captivity is provided in Voigt (2001).

3.2 Tadpole treatment

In most instances:

Release to the wild of tadpoles held or bred in captivity should be avoided.



3.3 Frog treatment

The rigour with which frogs must be treated to ensure pathogens are not introduced to native populations means that any proposal for the removal of adult frogs (particularly threatened species) from wild populations should be given careful consideration.

When it is essential for frogs to be removed from the wild, the following should apply.

Individuals to be released should be quarantined for a period of 2 months and monitored for any signs of illness or disease.

Frogs must not be released if any evidence of illness or infection is detected. If illness is suspected, further advice must be sought from a designated frog recipient (Appendix 2) as soon as possible to determine the nature of the problem. Chytridiomycosis can be diagnosed in live frogs by microscopical examination of preserved toe clips or from shedding skin samples. Research is still in progress on the development of a simple technique for the detection of Chytridiomycosis and a treatment for infected frogs.

Current methods which may be used include:

- A technique for the treatment of potentially infected frogs is to place the frogs individually in a 1mg/L benzalkonium chloride solution for 1 hour on days 1, 3, 5, 9, 11 and 13 of the treatment period. Frogs are then isolated/quarantined for two months. This and other possible treatments are documented in Berger and Speare (1998)
- *Betadine*© and *Bactone*© treatments have also been used on adult frogs with some success (M. Mahony, Newcastle University pers. comm.)
- *Itraconazole*© is an expensive drug

which has been used successfully (Lee Berger CSIRO Australian Animal Health Laboratory pers. comm.). Information on this method is available on the Website <http://www.jcu.edu.au/school/PHTM/frogs/adms/attach6.pdf>.

Frogs undergoing treatment should be housed individually and kept separate from non-infected individuals.

3.4 Displaced frogs

Displaced frogs are those native frog species and introduced Cane Toads (*Bufo marinus*) which have been unintentionally transported around the country with fresh produce, transported produce and landscaping supplies. Procedures to be undertaken when encountering introduced/displaced native frog species (as well as Cane Toads) are as follows.

3.4.1 Banana box frogs

'Banana Box' frog is the term used to describe several native frog species (usually *Litoria gracilentata*, *L. infrafrenata*, *L. bicolor* and *L. caerulea*) commonly transported in fruit and vegetable shipments and landscaping supplies. In the past, well meaning individuals have attempted to return these frogs to their place of origin but this is usually impossible to do accurately. There is risk of spread of disease if these frogs are transferred from place to place.

It is strongly recommended that:

Displaced Banana Box frogs should be treated as if they are infected and should not be freighted anywhere for release to the wild unless specifically approved by DECC.

When encountering a displaced frog:

- Contact a licensed wildlife carer organisation to collect the animal. The frog should then undergo a quarantine period of 2 months along with an approved disinfection treatment.
- Post-quarantine, the frog (if one of the species identified above) may be transferred to a licensed frog keeper. All other species require the permission from DECC Wildlife Licensing and Management Unit (WLMU) prior to transfer. Licensed carer groups are to record and receipt frogs obtained and disposed of in this way.
- Licensed Frog Keepers are to list these frogs in their annual licence returns to DECC.

Frogs held by licensed frog keepers are not to be released to the wild except with specific DECC approval.

Displaced frogs may be made available to recognised institutions for research projects, display purposes or perhaps offered to the Australian Museum as scientific specimens once approval has been provided by the DECC WLMU.



Frogs are often unintentionally transported with fresh produce and landscaping supplies. They are collectively known as 'banana box' or displaced frogs.

3.4.2 Cane toads

Cane toads are known carriers of the Frog chytrid fungus and should not be knowingly transported or released to the wild.

If a cane toad is discovered outside of its normal range, it should be humanely euthanased in accordance with the recommended NSW Animal Welfare Advisory Council procedure (see Appendix 3). Care should be taken to avoid euthanasia of native species due to mistaken identity.

3.4.3 Local frog species

Frogs encountered on roads, around dwellings and gardens or in swimming pools should not be considered as displaced frogs.

Frogs encountered in these situations should be assisted off roads, away from dwellings, or out of swimming pools preferably to the nearest area of vegetation or suitable habitat.

Incidences of frogs spawning or tadpoles appearing in swimming pools should be referred to a wildlife carer/rescue organisation for assistance (see Appendix 4).

Contact the Frogwatch Helpline if you are unsure whether a frog is a local species or displaced.

An NPWS information brochure titled 'Cane Toads in NSW' provides further information on cane toads and assistance with identification of some of the commonly misidentified native species. This information is also available on the DECC website.

4 sick or dead frogs

Unless an obvious cause of illness or death is evident (eg predation or road mortality): Sick or dead frogs encountered in the wild should be collected and disposed of in accordance with the procedures described in section 4.2 below.

4.1 Symptoms of sick and dying frogs

Sick and dying frogs exhibit a range of symptoms characteristic of chytrid infection. Symptoms may be expressed in the external appearance or behaviour of the animal. A summary of these symptoms are described below. More detailed information can be found in Berger et al., (1999) or at the James Cook University Amphibian Disease website at: <http://www/jcu.edu.au/school/phtm/PHTM/frogs/ampdis.htm>.



Appearance (one or more symptoms)

- darker or blotchy upper (dorsal) surface
- reddish/pink-tinged lower (ventral) surface and/or legs and/or webbing or toes
- swollen hind limbs
- very thin or emaciated
- skin lesions (sores, lumps)
- infected eyes
- obvious asymmetric appearance

Behaviour (one or more symptoms)

- lethargic limb movements, especially hind limbs
- abnormal behaviour (eg a nocturnal, burrowing or arboreal frog sitting in the open during the day and making no vigorous attempt to escape when approached)
- little or no movement when touched

Great barred frog (*Mixophyes fasciolatus*) with severe Chytrid infection — note lethargic attitude and sloughing skin. Photo: L. Berger

Diagnostic behaviour tests

Sick frogs will fail one or more of the following tests:

test	healthy	sick
Gently touch with finger	Frog will blink	Frog will not blink above the eye
Turn frog on its back	Frog will flip back over	Frog will remain on its back
Hold frog gently by its mouth	Frog will use its forelimbs to try to remove grip	No response from frog

4.2 What to do with sick or dead frogs

A procedure for the preparation and transport of a sick or dead frog is given below². Adherence to this procedure will ensure the animal is maintained in a suitable condition for pathological examination and assist the DECC and researchers to determine the extent of the disease and the number of species affected.

- Disposable gloves should be worn when handling sick or dead frogs. Avoid handling food and touching your mouth or eyes as this could transfer pathogens and toxic skin secretions from some frog species.
- New gloves and a clean plastic bag should be used for each frog specimen to prevent cross-contamination. When gloves are unavailable, use an implement to transfer the frog to a container rather than using bare hands.
- If the frog is dead, keep the specimen cool and preserve as soon as possible (as frogs decompose quickly after death making examination difficult). Specimens can be fixed/preserved in 70% ethanol or 10% buffered formalin.

Cut open the belly and place the frog in about 10 times its own volume of preservative. Alternatively, specimens can be frozen (although this makes tissues unsuitable for some tests). If numerous frogs are collected, some should be preserved and some should be frozen. Portions of a dead frog can be sent for analysis eg a preserved foot, leg or a portion of abdominal skin.

- The container should be labelled showing at least the species, date and location. A standardised collection form is provided in Appendix 5.
- If the frog is alive but unlikely to survive transportation (death appears imminent), euthanase the frog (see Appendix 3) and place the specimen in a freezer. Once frozen, the specimen is ready for shipment to the address provided below.
- If the frog is alive and likely to survive transportation, place the frog into either a moistened cloth bag with some damp leaf litter or into a plastic bag with damp leaf litter and partially inflated before sealing. Remember to keep all frogs separated during transportation.
- Preserved samples can be sent in jars or wrapped in wet cloth, sealed in bags and placed inside a padded box.
- Send frozen samples in an esky with dry ice (available from BOC/CIG Gas outlets).
- Place live or frozen specimens into a small styrafoam esky (available from K-Mart/Big W for approximately \$2.50).
- Seal esky with packaging tape and address to one of the laboratories listed in Appendix 4.
- Send the package by courier.

Further information on sick and dying frogs is available on the Amphibian Disease Home Page at <http://www.jcu.edu.au/dept/PHTM/frogs/ampidis.htm> — in particular refer to 'What to do with dead or ill frogs'.

²The measures described below are standard procedures and may vary slightly depending on the distance and time required to reach the intended recipient. Contact the intended recipient of the sick or dead frog prior to sending to confirm the appropriate procedure.



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appendix I

hygiene protocol checklist and field kit

The following checklist and field kit are designed to assist with minimising the risk of transferring pathogens between frogs.

Have you considered the following questions before handling frogs in the field:

- Has your proposed field trip been sufficiently well planned to consider hygiene issues?
- Have you taken into account boundaries between sites (particularly where endangered species or populations at risk are known to occur)?
- Have footwear disinfection procedures been considered and a strategy adopted?
- Have you planned the equipment you will be using and developed a disinfection strategy?
- Are you are planning to visit sites where vehicle disinfection will be needed (consider both vehicle wheels/tyres and control pedals) and if so, do you have a plan to deal with vehicle disinfection?
- Have handling procedures been planned to minimise the risk of frog to frog pathogen transmission?
- Do you have a planned disinfection procedure to deal with equipment, apparel and direct contact with frogs?

If you answered NO to any of these questions please re-read the relevant section of the DECC Hygiene Protocol for the Control of Disease in Frogs and apply a suitable strategy.

Field hygiene kit

When planning to survey frogs in the field a portable field hygiene kit should be assembled to assist with implementing this protocol. Recommended contents of a field hygiene kit would include:

- Small styrofoam eski
- Disposable gloves
- Disinfectant spray bottle (atomiser spray) and/or wash bottle
- Disinfecting solutions
- Wash bottle
- Scraper or scrubbing brush
- Small bucket
- Plastic bags large and small
- Container for waste disposal
- Materials for dealing with sick and dead frogs (see section 4.2)



appendix 2

Always contact the relevant specialist prior to sending a sick or dead frog. In some cases, only wild frogs will be assessed for disease. Analysis may also attract a small fee per sample.

designated sick and dead frog recipients

Contact one of the following specialists to arrange receipt and analyse sick and dead frogs. Make contact prior to dispatching package:

Karrie Rose
Australian Registry of Wildlife Health
Taronga Conservation Society, Australia
PO Box 20
MOSMAN NSW 2088
Phone: 02 9978 4749
Fax: 02 9978 4516
Krose@zoo.nsw.gov.au

Diana Mendez or
Rick Speare
School of Public Health,
Tropical Medicine and
Rehabilitation Sciences
James Cook University
Douglas Campus
TOWNSVILLE QLD 4811

Phone: 07 4796 1735
Fax: 07 4796 1767
Diana.Mendez@jcu.edu.au
Richard.Speare@jcu.edu.au

Michael Mahony
School of Biological Sciences
University of Newcastle
CALLAGHAN NSW 2308

Phone: 02 4921 6014
Fax: 02 4921 6923
bimjm@cc.newcastle.edu.au

For information on frog keeping licences and approvals to move some species of displaced frog contact:

Co-ordinator, Wildlife Licensing
Wildlife Licensing and Management Unit
DECC
PO Box 1967
Hurstville NSW 1481
Ph 02 9585 6481
Fax 02 9585 6401
wildlife.licensing@environment.nsw.gov.au

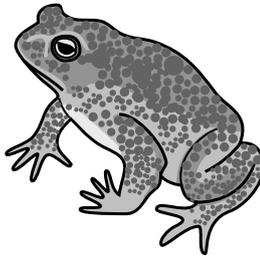
For information on the possible identity of displaced frogs contact:

Frog and Tadpole Society (FATS)
Frogwatch Helpline
Ph: 0419 249 728

appendix 3

NSW Animal Welfare Advisory Council methodology

The NSW Animal Welfare Advisory Council procedure for humanely euthanasing cane toads or terminally ill frogs is stated as follows:



- Using gloves, or some other implement, place cane toad or terminally ill frog into a plastic bag.
- Cool in the refrigerator to 4°C.
- Crush cranium with a swift blow using a blunt instrument.

Note: Before killing any frog presumed to be a cane toad, ensure that it has been correctly identified and if outside the normal range for cane toads in NSW (north coast) that local DECC regional office is informed.

appendix 4

licensed wildlife carer and rescue organisations

Following is a list of wildlife rehabilitation groups licensed by
Department of Environment and Climate Change (NSW):

Northern NSW

Australian Seabird Rescue
For Australian Wildlife Needing Aid
(FAWNA)
Friends of the Koala
Friends of Waterways (Gunnedah)
Great Lakes Wildlife Rescue
Koala Preservation Society of NSW
Northern Rivers Wildlife Carers
Northern Tablelands Wildlife Carers
Tweed Valley Wildlife Carers
Seaworld Australia
WIRES branches in Northern NSW

Southern NSW

Looking After Our Kosciuszko Orphans
(LAOKO)
Native Animal Network Association
Native Animal Rescue Group
Wildcare Queanbeyan
WIRES branches in Southern NSW

Sydney, Hunter and Illawarra

Hunter Koala Preservation Society

Ku-ring-gai Bat Colony Committee
Kangaroo Protection Co-operative
Native Animal Trust Fund
Organisation for the Rescue and Research of
Cetaceans (ORRCA)
Sydney Metropolitan Wildlife Services
Wildlife Aid
Wildlife Animal Rescue and Care (Wildlife
ARC)
Waterfall Springs Wildlife Park
Oceanworld
Wildlife Care Centre, John Moroney
Correctional Centre
Koalas in Care
WIRES branches around Sydney, Hunter and
Illawarra

Western NSW

Rescue and Rehabilitation of Australian
Native Animals (RRANA)
RSPCA Australian Capital Territory Inc.
Wildlife Carers Network (Central West)
WIRES branches in Western NSW
Cudgegong Wildlife Carers

appendix 5 — sick or dead frog collection form

Sender details:

name: _____ address: _____ postcode: _____
 phone: (w) _____ (h) _____ fax: _____ email: _____

Collector details: (where different to sender)

name: _____ address: _____ postcode: _____
 phone: (w) _____ (h) _____ fax: _____ email: _____

Specimen details:

record no: _____ no. of specimens: _____ species name: _____ date collected: _____
day/month/year

time collected: _____ sex: _____ status at time of collection: _____ date sent: _____
male/female healthy(H)/ sick(S)/ dead(D) day/month/year

location: _____ map grid reference: _____
(easting) (northing)

reason for collection: _____

Batch details for multiple species collection:

species	no.	locality	(AMG)	date	sex	status (H/S/D)

habitat type: _____ vegetation type: _____ micro habitat: _____
eg creek, swamp, forest eg rainforest, sedgeland eg creek bank, under log, amongst emergent vegetation,
on ground in the open

unusual behaviour of sick frogs: _____
eg lethargic, convulsions, sitting in the open during the day, showing little or no movement when touched.

dead frogs appearance: _____
eg thin, reddening of skin on belly and/or toes, red spots, sore, lumps or discolouration on skin

deformed frogs: _____ dead/sick tadpoles: _____
eg limb(s) missing, abnormal shape or length eg numbers/behaviour

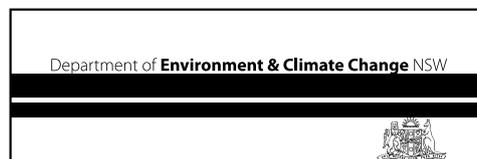
unusual appearance of egg masses: _____ recent use of agricultural chemicals in area: _____
eg grey or white eggs eg pesticides, herbicides, fertilisers

other potential causes of sickness/mortality/comments/additional information: _____



**NSW
NATIONAL
PARKS AND
WILDLIFE
SERVICE**

General inquiries: PO Box A290 South Sydney 1232
Phone: 9995 5000 or 1300 361967
Fax: 02 9995 5999 **Web site:** www.environment.nsw.gov.au





APPENDIX B

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LIMITATIONS

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