Management Plan

The Green and Golden Bell Frog Key Population in the Middle Hunter

June 2007

Catchment Management Authorities
CMA NEW SOUTH WALES

Department of Environment & Climate Change NSW

Department of Environment and Climate Change (NSW)
59–61 Goulburn Street
(PO Box A290)
Sydney South NSW 1232
Phone: (02) 9995 5000 (switchboard)
Phone: 131 555 (information & publications requests)
Fax: (02) 9995 5999
Email: info@environment.nsw.gov.au
Website: www.environment.nsw.gov.au

Requests for information or comments regarding the management plan for the Green and Golden Bell Frog Key Population in the Middle Hunter are best directed to:

The Green and Golden Bell Frog Recovery Plan Coordinator
Biodiversity Conservation Section, Metro Branch
Department of Environment and Climate Change (NSW)
PO Box 1967
Hurstville NSW 2220
Phone: 02 9585 6952

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INTRODUCTION

The Green and Golden Bell Frog

The Green and Golden Bell Frog (GGBF) *Litoria aurea* is a relatively large, muscular frog species with robust form. Adult sizes range from approximately 45mm to 100mm with most individuals being in the 60-80mm size class.

The colouration of the back is quite variable, being a vivid pea green splotched with almost metallic brass brown or gold. The backs of some individuals may be almost entirely green whilst in others the golden brown markings may almost cover the whole back.

The Green and Golden Bell Frog was formerly distributed from the NSW north coast near Brunswick Heads southwards along the NSW coast to Victoria, where it extends into East Gippsland, and west to Bathurst, Tumut and the ACT. In the 1960s, the species was considered widespread, abundant and commonly encountered. Today, the species exists as a series of isolated populations within its former known range.

The Green and Golden Bell Frog is listed as an Endangered Species under Schedule 1 of the NSW *Threatened Species Conservation Act 1995*. At the national level, the species is listed as Vulnerable under Schedule 1 Part 2 of the *Environment Protection and Biodiversity Conservation Act 1999*.

The consequences of being listed as a threatened species under both state and national legislation has been that a recovery plan will be prepared and considerations given to the species when assessing the impacts of developments and activities on populations of the species and its habitats. Whilst preparation of recovery plans has been made optional under the most recent legislation changes, a NSW recovery plan has been drafted for this species. The actions within the Recovery Plan are also listed as Actions within the Department of Environment and Climate Change (DECC) Priorities Action Statement for amphibians -
http://www.threatenedspecies.environment.nsw.gov.au/tsprofile/pas_speciestype_details.aspx?type=Amphibians&kingdom=Animal

The draft Green and Golden Bell Frog Recovery Plan defines Key Populations as conservation management units and gives recognition and focus for conservation to 43 such populations across the former extent of the species' almost state-wide distribution.

The Middle Hunter Management Plan

This Management Plan relates to the Middle Hunter Key Population located in the Hunter Green and Golden Bell Frog (GGBF) Management Region as identified in the draft NSW GGBF Recovery Plan (RP).

This plan has been prepared to satisfy Action 11.3.4 of the draft GGBF Recovery Plan that was developed in accordance with the *Threatened Species Conservation Act 1995.* Action 11.3.4 and the Priority Action Statement (PAS) Action 21 for the GGBF calls for the NSW DECC to prepare and implement a GGBF Management Plan for each key population on its own land and to liaise with other public landowners as necessary (e.g. local councils, government authorities) and encourage other private landowners to prepare and implement site specific Management Plans across the extent of the species' distribution in NSW. The implementation tables of this Management Plan further identify links to other actions, within the draft Green and Golden Bell Frog Recovery Plan and PAS, and which are `further satisfied in part by the implementation of this plan.

Similarly under the Hunter-Central Rivers Catchment Management Authority (HCRCMA) Draft Catchment Action Plan (CAP) Threatened Species WM Target 04 – "Threatened Species Conservation" is of particular priority. This Middle Hunter GGBF Management Plan also inter-links with the above section of the CAP and implementation of this plan will further assist the Hunter-Central Rivers CMA meet this and other related CAP targets.

There is also a requirement under the *Local Government Act 1993* for local councils to develop and implement Management Plans, where GGBFs occur on public land under their care, control and management. It is therefore envisaged that this Management Plan will satisfy the possible requirement of Maitland and Cessnock City Councils (with respect to the Middle Hunter key population components that may occur on relevant public land) to prepare their own Management Plans. This Management Plan is also intended to provide guidance, direction and coordination for other stakeholders and/or land owner/managers within the Middle Hunter where the frog and/or its habitat occurs.

Purpose

The Middle Hunter GGBF Management Plan has been prepared to ensure that the Middle Hunter population is successfully managed and monitored such that the species continues to persist at the location and measures of the population's viability are maintained or improved over time.

There are two aims of the Management Plan.

1. To identify and, where possible, address the threats and other issues/factors affecting or likely to affect the conservation of the species in the Middle Hunter.
2. To manage the species in accordance with the strategies outlined within the draft GGBF Recovery Plan.

Figure 1. *Green and Golden Bell Frog.* Photo ©Garry Daly.

THE MIDDLE HUNTER POPULATION

Location

The Middle Hunter GGBF Key Population is located (see map below) approximately 30 kilometres northwest of the Newcastle CBD, between the settlements of Maitland and Kurri Kurri (32° 45' S, 151° 29' E). It is situated in the lower Hunter River valley and consists of one main diffuse population in or around the Wentworth Swamp area with an outlier element in the vicinity of Ellalong Lagoon to the south of Cessnock.

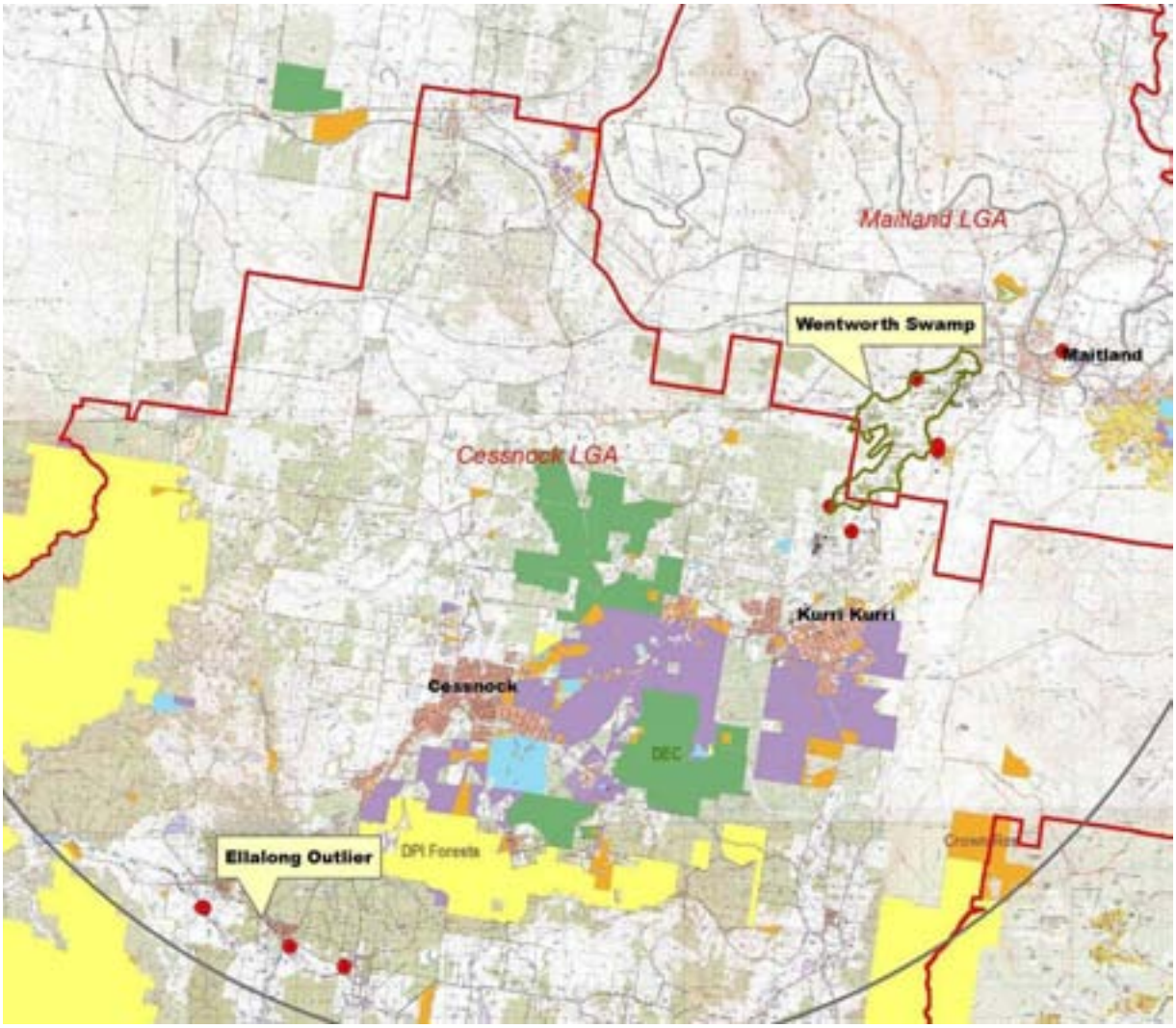

Figure 2. *Map of the Middle Hunter showing the location of all recorded sightings of Green and Golden Bell Frogs (these records include both historic and contemporary observations from the 1970s to the present and are meant to provide an indicative distribution of the species and its habitat in the Middle Hunter) and the location of publicly owned lands. Blue – Crown lease lands, Purple – Crown other lands*

The Hunter River Valley is one of the largest eastern flowing river systems in the state and represents a unique landscape in NSW because the large valley crosses a low and gentle, rather than steep and mountainous, divide. The relatively dry 'Hunter corridor' created by this valley forms a passage from coastal to inland parts of NSW and likely forms (or at least previously formed) a pivotal corridor between coastal and inland populations of the GGBF, as well as for populations of many other species.

This Key Population incorporates the Hunter River and its tributaries, particularly the Wentworth Swamp area, and is an important linkage between Upper and Lower Hunter Key Populations. The Middle Hunter GGBF Key Population is located within the Maitland and Cessnock Local Government Areas (LGA). The known records of this population occur largely on private lands such as those owned by small pastoral landholders and the local aluminium industry, as well as state-owned lands such as Hunter Water Corporation land at Farley. Owners, managers or operators of lands in the vicinity of where the GGBFs or their habitat have been found in the Middle Hunter include:

- Hunter Water Corporation (landowner and infrastructure operator)
- Hardie Holdings (owners of large land parcels south of Cessnock)
- Hydro Aluminium (Aluminium smelter and buffer lands)
- Fame Cove Three (a Hardie Holdings company)
- Crown Land (Dept. of Lands and Councils)
- Yancoal Australia (Austar Coal Mine)
- Winten Property Group (owners of large land parcels at Cliftleigh)
- Small rural landowners

Though most elements of the population exist on private lands there exist large areas of publicly-owned lands such as National Park reserves, State Forest and Crown lands (see Fig. 2.) as well as privately owned remnant vegetation parcels (e.g. Hydro Aluminium buffer lands) that retain significant remnant vegetation that could contain potential and at least likely former habitat for the species. Given that so little is known about the full extent and status of this Key Population, being known from only a small number of verified locations (see Fig 2.), there is currently no known 'centre' of distribution. Consequently, determining the population's distribution and extent is a high priority for action under this Management Plan.

Habitat

The middle Hunter River catchment is generally a rural to semi-rural landscape, with some urban population centres such as Maitland, Cessnock and Kurri Kurri, and several towns and hamlets dotting the landscape. As such, most of the land is utilised for grazing purposes but some significant urban areas also exist. Some small cropping and intensive animal production operate in the general vicinity as well as a substantial area of the Wentworth Swamp drainage utilised by the aluminium industry (largely as vegetated buffer lands) and some open-cut and underground coal mining operations outside this drainage.

The more recent records of the population are from around the margins of Wentworth Swamp and the associated Swamp Creek catchment. Wentworth Swamp is largely privately owned by various landholders and as such land clearing, grazing and the introduction of weed species have diminished native vegetation cover. Still, the swamp is listed as an Endangered Ecological Community (EEC) (*Freshwater Wetlands on Coastal Floodplains of the NSW North Coast*) under the *Threatened Species Conservation Act 1995*. Little information is available on the original vegetation cover of the swamp but it is known that Swamp Creek and nearby Wallis Creek catchments preserve remnants of several other EECs including Lower Hunter

Spotted Gum – Ironbark Forest, Kurri Sand Swamp Woodland and Hunter Lowland Redgum Forest among others. No doubt GGBF also transiently occupied some of these areas, at least historically, and may still occupy parts of these Hunter River tributary sub-catchments.

Approximately five kilometres of Swamp Creek is channelised between Abermain and Loxford. Aside from this significant modification, Wentworth Swamp is also known to have affectations from receipt of water from two wastewater treatment works and the associated elevated nutrient levels, salts and some heavy metals, as well as sedimentation and weed invasion derived from these and other parts of its catchment.

The GGBF population has survived in the area by using local features such as:

- Breeding habitat – for example in permanent water bodies such as the numerous farm dams and abandoned quarries present in the vicinity, as well as wetlands associated with Wentworth Swamp and Ellalong Lagoon (a portion of which would likely be ephemeral). More ephemeral breeding habitat such as ponds, dams and bunded drainage lines in open pastures that fill after heavy rain fulfill this habitat requirement also. Breeding habitat was known to exist at Gillieston Heights (tadpoles observed) in a waterbody associated with an abandoned quarry. Some of these habitat areas are human constructions made for purposes other than frog habitat.
- Foraging habitat - including areas of native or introduced grasses, tussock vegetation and emergent sedges and reeds such as Cumbungi (*Typha* sp.) and *Juncus acutus* which have been identified as important foraging habitat throughout the GGBFs range and are present in the Middle Hunter. Vegetated dams or ponds (farm or industry) and creeks not subject to heavy cattle grazing may also provide this habitat element in the Middle Hunter. These areas are vital for the GGBF to feed in relative safety from predators and for basking in the sun by day.
- Shelter habitat - includes similar vegetation to that used for foraging and, most particularly, rock piles, ground timber, tussock forming vegetation and other features that are difficult to categorise (e.g. crevices in the ground, around root systems of plants and under ground debris). Rocks and rubble piles are present in abandoned quarries where the GGBF has been found.
- Movement habitat - generally typified by wet areas such as creek lines, drains, periodically damp areas, connecting or partially connecting vegetation, and even open areas that do not restrict movement. Movement habitat is likely to be satisfactory given the presence of the large waterbody that is Wentworth Swamp, and the likely use of its margins.
- Over wintering habitat - some of this habitat is most likely similar to shelter habitat, such as rock and rubble piles, ground timbers and logs and dense tussock vegetation. Fallen timbers in the vicinity of sections of Wentworth Swamp, and areas adjacent to parts of Ellalong Lagoon may provide a component of this habitat function. Abandoned quarries and mining sites may also provide over wintering habitat in the form of strewn rock features associated with such sites. There is evidence that males and females often differ in their selection of over wintering habitat and may seek to shelter in different areas, such as amongst boulders, inside logs or even amongst overgrown or dense and moist vegetation in residential gardens. In the Middle Hunter this is likely to be in the residential/rural interface and creek/river flood plain or swamp margins.

Species status

Up until the early 1970s the GGBF was a common feature throughout the Hunter Valley region. Vast populations inhabited swamps in areas around Maitland, Singleton, Broke and Lake Liddell. Since the dramatic decline of the GGBF in the Hunter Valley during and since the 1970s the species is known in the middle Hunter from a number of discrete sites on the periphery of Wentworth Swamp and Ellalong Lagoon, Quorrobolong Creek and Congewai Creek.

Anecdotal observations indicate the GGBF was known to occur in Swamp Creek and in the south of Wentworth Swamp in the 1970s. An older specimen record also exists for the Hunter River floodplain east of Maitland from the late 1970s, which may potentially signify a connection with Hexham Swamp as records exist there from the same time period. The collective observations from a range of herpetologists over many years have been used to derive and demarcate the area depicted in Figure 2 and covered by this MP. These individuals include Richard Wells, Ian ('Beat') Hill, Andrew Hamer, Michael Mahony, Rodney Parker-Wright and Ross Wellington.

Before more recent range contraction, the Hunter Valley, in addition to acting as a north south coastal connection between populations, is also thought to have acted as a western connective link (the *Hunter Corridor*) between coastal populations and those further inland on the central tablelands. Testament to this east-west connection is the existence of a large population that exists in the Hunter River delta centred around Kooragang Island and Hexham Swamp, and another population further upstream in the Singleton/Muswellbrook area representing a continuum, though likely currently fragmented, along the Hunter River.

This former distribution of GGBFs has now contracted to only four known centres of distribution that are identified in the draft GGBF Recovery Plan as Key Populations in the Hunter Region.

These populations are at:

1. Kooragang Island;
2. Sandgate/Hexham Swamp;
3. Gillieston Heights/East Maitland/Ravensfield (the focus of this plan); and
4. Ravensworth/Liddell.

The GGBF is known from three main localities in the Middle Hunter in recent times. Most are situated in the Swamp Creek (associated with Wentworth Swamp) and Wallis Creek catchments, along with an outlier pocket of distribution at Ellalong Lagoon.

The species was rediscovered at Gillieston Heights in 1995 in a pond associated with an abandoned quarry on private rural land. This habitat encompassed a quarry pond which was linked to a nearby paddock pond via a drainage line, all waterbodies were observed to contain GGBF habitat. Fourteen adult and sub-adult GGBFs were recorded in the quarry pond in 1998. Tadpoles were observed during this period in the quarry waterbody along with calling adult males and adult females in the paddock pond. Extensive damage to this habitat occurred in the summer of 2001/02 involving excavation of the quarry pond, creekline and removal of aquatic and riparian vegetation. No GGBFs have been observed in the area since this time and, whilst they were detectable, no systematic methods were used to gather population size estimates or to document, in detail, the various habitats in use at the site.

Two sub adults were subsequently recorded in 1999 in a small irrigation ditch on Hunter Water Corporation land near the township of Ravensfield (west of Maitland) on the north-western fringe of Wentworth Swamp. In the same year, approximately 17 adults and sub adults were recorded in several ponds associated with an abandoned quarry 1km west of this previous Ravensfield record. Again in 2000, the

species was recorded in this same waterbody and, significantly, this sighting is the last known official record of the GGBF in the Middle Hunter. A recent unconfirmed sighting at the newly rehabilitated Tenambit Wetland at East Maitland, could indicate this habitat has been reoccupied (A. Hamer pers. comm.) or alternatively rediscovered.

The Ellalong Lagoon outlier exists from a single adult specimen collected in 1993 along with two more anecdotal records reported around the same time period on Congewai and Quorrobolong Creeks respectively. A general flora and fauna survey was subsequently undertaken at the site during 2004/5 by Harper Somers O'Sullivan on behalf of Hardie Holdings, the land owner. The survey failed to detect the species. It is understood that the conditions at the time of this survey were less than ideal for frogs and that the species was not directly targeted (M. Roderick pers. comm.). However it is understood that there is a Memorandum Of Understanding between the NSW Government and Hardie Holdings regarding the future reservation of parts of Ellalong Lagoon along with other lands in the Hunter. The outcomes of this agreement are yet to be finalised.

The primary concern regarding the Middle Hunter GGBF population is the unknown population status and its location. The key population was known to primarily occupy private lands and broad scale surveying/monitoring of the area has not been undertaken. Based on the somewhat transient nature of appearance and disappearance of the species at other sites and the unconfirmed observation at the newly rehabilitated Tenambit Wetland at East Maitland, it is herein assumed that the population is extant and merely occupying varying components of the extensive potential habitat existing in and around the margins of Wentworth Swamp and at Ellalong Lagoon. The resolution of the status of this population is a high priority.

THREAT ASSESSMENT

The major factors that potentially threaten the Middle Hunter GGBF Key Population are small population size, loss of habitat, disease, habitat degradation, and introduced predators.

The identified threats to the Middle Hunter Key Population of the Green and Golden Bell Frog that are known to be operating include:

1. Small population size - The current small population size, or what is presumed to be so, leaves the population vulnerable to stochastic and catastrophic events that might otherwise, with more robust population size, be overcome. Lack of genetic diversity in smaller populations may be a significant threat, 'bottleneck', that has been overlooked in the past. For example, it is known that a large population may not always represent high genetic diversity and thus protect against environmental changes. Particularly when considering the GGBFs noted fecundity and how this could benefit them in initially overcoming catastrophic population crashes.
2. Loss of habitat - Destruction of habitat on private lands and the rezoning and development in parts of the Middle Hunter pose a significant threat in terms of habitat loss. For example there are a number of proposed and approved rezonings and developments in the vicinity of Ellalong and Paxton for residential, tourism and commercial purposes. In addition there are other rezonings, to residential, proposed for areas such as Cliftleigh near Gillieston Heights and Heddon Greta. The severe drought, prevalent to some extent over the last several years, is also placing continued pressure on the GGBF population through loss of vegetation cover and at times extended loss of breeding habitat through drying of ponds.

3. Disease - Frog Chytrid fungus (*Batrachochytrium dendrobatidis*) is listed as a Key Threatening Process at state and national levels. This disease is rapidly emerging as possibly the single biggest threat to the species (as well as to many other species of frogs). Frog Chytrid fungus is suspected to be widespread in the Middle Hunter, although this remains to be confirmed by recent swabbing methods.
4. Habitat degradation - Cattle use of waterbodies, including trampling and foraging riparian shelter vegetation (such as Cumbungi) and through increased turbidity and nutrient levels in waterbodies. Additionally, developments such as the Roads and Traffic Authority F3 Minmi to Branxton link to pass through Kurri Kurri/Weston have the potential to also affect Wentworth Swamp and thus degrade GGBF habitat.
5. Introduced predators that include:
    - Plague Minnow – *Gambusia holbrooki* (Listed as a Key Threatening Process) is present in Swamp Creek catchment and in many other water bodies and stream systems in the middle Hunter River catchment.
    - Carp (*Cyprinus carpio*) and also possibly Goldfish (*Carassius auratus*) among possibly other introduced fish species.
    - The Red Fox - *Vulpes vulpes* (listed as a Key Threatening Process for a number of threatened species) is known to inhabit the entire Hunter Valley.
    - Feral and Domestic Cats - *Felis catus.*
6. Water quality - Runoff from the largely deforested catchment with high phosphorous, sediment and faecal loads may pollute or alter GGBF habitat. Two wastewater treatment works discharge into Wentworth Swamp, one of which has had elevated phosphorous levels in its discharge. Stormwater from urban areas, the propensity of the area for acid sulfate soils, domestic sewage systems and a salinity problem could also be factors affecting GGBF populations and their habitat.
7. Native predators - Predation on the GGBF by native predators may also be considered a threat to the species where populations have declined to small size and are no longer robust. Native predators in various locations may include Eels *Anguilla* spp., Red-bellied Black Snake *Pseudechis porphyriacus,* and the Australian White Ibis *Threskiornis molucca*, along with other wader bird and snake species that may occur within the region.
8. Anthropogenic climate change (listed as a Key Threatening Process) may result in changes to rainfall patterns that could affect the breeding habitat of the GGBF. For example, long term reduction of rainfall could reduce recruitment and lead to population decline or collapse at some sites. This may especially be the case where populations are represented only by mature adults, due to previous repeated breeding failures and lack of recruitment. Resultant senescent populations may then be unable to recover even when/if conditions do become suitable.

MANAGEMENT ACTIONS

Strategic considerations

The Middle Hunter GGBF Key Population is little known and has not been reliably detected in approximately 7 years. The population's status and location are currently unknown, partly as a result of a lack of surveying and the species apparent tendency to often inhabit private lands. Thus the primary strategic issue that needs to be considered in attempts to manage GGBF in the Middle Hunter is the unknown population status and its extent. Consequently, all future management activities are dependent on determining population status and location. The need to identify breeding habitat and the 'vital' habitat areas that the population is dependent on is paramount if the population is to be secured.

Systematic surveying of habitat where older and more recent GGBF records are located are recommended. These include the Hydro Aluminium lands, East Maitland around Tenambit Wetland, Gillieston Heights, the north-western periphery of Wentworth Swamp, and Ellalong Lagoon and surrounds. In addition, GGBF have been known to occupy less than ideal habitat on industrial lands with potential contamination issues such as industry ponds (e.g. settling or wastewater ponds), STPs and/or those that receive water/runoff from industrial lands. Therefore it is suggested that surveying be undertaken in the vicinity of any such waterbodies on Hydro Aluminium or Weston Aluminium lands as this may prove fruitful in detecting additional GGBFs for the area.

As a whole, the area has not been surveyed extensively even after considering the records that were collected as part of a Masters project at the University of Newcastle in the late 1990s (Andrew Hamer), that constitute the bulk of the most recent GGBF observations. Similar to the Upper Hunter GGBF key population, there is a vast area throughout which the population could operate and a comparatively small human population to detect its presence. Both of these factors further impede clarifying population status and location.

It is recommended the Ellalong Lagoon outlier, whilst considered unlikely to exhibit any current connections to those population elements in the vicinity of Wentworth Swamp, be given immediate attention to determine its population status, location and importance in the greater Middle Hunter. Again, extensive surveying of this wetland and surrounding suitable habitat along Congewai and Quorrobolong Creeks during suitable climatic and seasonal conditions should help resolve the status of this outlying population element.

Given that the most recent population records exist from waterbodies on the periphery of Wentworth Swamp, the Middle Hunter GGBF key population seems to be linked, in large part, to the health of Wentworth Swamp and the Swamp Creek catchment. This wetland complex is currently being managed in a joint HCRCMA and Maitland City Council project that aims to restore the wetland to a more sustainable condition. Thus it is recommended that any GGBF management that also relates to swamp management should be undertaken in collaboration with these bodies to maximise conservation outcomes and reduce duplication of resource use and save time.

The middle Hunter Valley region is experiencing continued development pressure as a result of its ideal position as a hinterland area in proximity to Newcastle, Sydney and the intervening central coast. Some significant developments active in the area include: the Roads and Traffic Authority (RTA) F3 link that will run from the F3 at Seahampton to Branxton, cutting a line through the southern fringe of Wentworth Swamp; the rezoning of the Cliftleigh Precinct, south-east of Wentworth Swamp, to

allow residential and neighbourhood commercial and industrial developments by Winten Property Group; and the proposed rezoning of Ellalong Lagoon to allow for a significant Hardie Holdings development that could encompass residential, tourist and commercial development adjacent to and surrounding the significant Ellalong wetland. Such developments highlight the importance of assessing the GGBF in development proposals that will undoubtedly continue to arise in the future in Maitland and Cessnock LGAs.

In the event of the populations' detection, and of sufficient numbers existing to do so, it is an option to consider the establishment of a captive breeding program of local provenance stock for the Middle Hunter GGBF population. Such a program would likely require establishment at an appropriate zoo or research institution and have the established aim of ultimately supplementing the GGBF population in the Middle Hunter. Alternatively, if the situation arises where no population is detected after extensive surveying over a number of seasons conducive to GGBF activity; it may become a consideration to translocate individuals from the nearby Lower Hunter GGBF population. This would ideally require an assessment of genetic similarity and defining Evolutionary Significant Units (ESU) and consequently appropriateness of such supplementation/translocations. Such an option is a last resort, and will only be performed at DECCs discretion given results of genetic analysis of the interrelatedness of the Middle and Lower Hunter GGBF populations and the likely effectiveness of such an action. That is, such an action shall only be undertaken if the threats that eliminated the population are identified (e.g. performed as a component of a research project) and ameliorated or undertaken in such away that risks to translocated individuals are minimised.

The evolutionary interrelatedness of populations is outside the scope of this site-specific management plan but does have potential implications for any future reintroduction initiatives. Preliminary studies have been undertaken but would be worthy of independent assessment to verify relatedness issues or identify further investigation necessary to clarify the provenance related concerns.

Planning Process

This Plan is intended to build upon past or current actions to better manage wetlands and catchments in the Middle Hunter. Given the relative anonymity of the population and its location largely on private land there has been no known GGBF-specific management actions enacted in the past for this area. Actions listed below, whilst not directly enacted in the interest of GGBFs nevertheless may benefit the GGBF and its habitat in the Middle Hunter. Such actions are not currently coordinated or integrated in any particular fashion. This plan aims to coordinate and integrate further actions to more effectively use time and resources available for GGBF conservation.

Local actions enacted or currently being undertaken to manage the species include:

- The HCRCMA in conjunction with Maitland City Council has completed a study on Wentworth Swamp rehabilitation and is proceeding with rehabilitation works. The key focus is on riparian restoration, weed management, revegetation and consultation with landholders regarding exclusion of cattle from the wetland.
- Maitland City Council has received a number of grants to restore Tenambit Wetland as part of its 'Melaleuca to Tenambit' rehabilitation project. This venture which commenced in 2003 is linking remnant vegetation and revegetated areas with additional plantings and other environmental works. The first stage of the project focussed on re-establishing the native tree cover with the second aiming to re-establish the understorey and semi-aquatic species. The success of the project is evidenced by the reappearance of

much native wildlife, including a possible GGBF sighting recently (as mentioned above).

- The National Parks and Wildlife division of the DECC conducts annual fox baiting programs in all its Hunter reserves. However, efforts to coordinate fox baiting programs on public and private lands, as has occurred to some extent in the past, should continue and aim to extend the areas of fox management.
- Hydro Aluminium (a local Aluminium smelter) has conducted comprehensive flora and terrestrial fauna surveys of their property. Ecological studies will be undertaken in the future as a component of their Property Management Plan This plan, which was approved by the DECC, includes actions to manage land including that relating to soil, weed, pest, fire, stock access and vehicle access management, as well as those relevant to natural regeneration and selective planting.
- The RTA, as part of their Flora and Fauna Assessment for the F3 Seahampton to Branxton Link, identified suitable GGBF habitat that occurred where the Link crosses Wallis Creek. This area was a focus for surveys under the *Threatened Species Conservation Act 1995* and *Environment Protection and Biodiversity Conservation Act 1999,* the assessment of significance concluded that the F3 Link was unlikely to have a significant impact on the GGBF. However conditions of consent should include proactive micro-habitat creation initiatives in the vicinity of identified potential GGBF habitat as a proactive/precautionary offset.

A stakeholder workshop was facilitated by consultants Molino Stewart Pty Ltd to identify these and other possible management initiatives as a basis for preparing this plan as an identified action of the draft GGBF Recovery Plan. The workshop was held on 2 May 2007 with representation from:

- Maitland City Council (MCC) and Cessnock City Council (CCC)
- NSW Department of Environment and Climate Change (DECC)
- Hydro Aluminium
- Hunter Water Corporation
- The Maitland Greens
- University of Newcastle Researchers
- Resource Strategies Consultants
- Hunter-Central Rivers Catchment Management Authority

This plan was then distributed in draft form for comment to these and other stakeholders including the RTA, Mindaribba Local Aboriginal Land Council (LALC), Winten Property Group, Society of Frogs and Reptiles (SOFAR), Eco Trades Pty Ltd (Hardie Holdings), Weston Aluminium, Hunter Region Landcare Network (HRLN), the Department of Primary Industries - Forests, Yancoal Australia, and the Australian Rail and Track Corporation (ARTC). Other stakeholders that may have involvement in the implementation of this plan or are mentioned in the table below include the Declining Frog Working Group (DFWG), the National Heritage Trust (NHT), Hunter Central Coast Regional Environmental Management Strategy (HCC REMS or Hunter Councils – Environment) and the Threatened Species Network (TSN).

Further comments by any interested parties are encouraged as the plan is implemented. These comments should be sent to DECC (see details in Contacts).

Objectives

The three objectives of the Middle Hunter GGBF Management Plan are as follows:

1. To determine GGBF population status and location;
2. If required, maintain the existing GGBF key population and enhance existing GGBF habitat and thus measures of population viability for this Key Population; and
3. If required, to increase connectivity within the Key Population.

Strategies

The following six strategies will be used to achieve these objectives:

1. Further development of GGBF breeding and other habitat components on public and private lands;
2. Improvement of habitat within the GGBF key populations;
3. Education and communications to build awareness of the GGBFs and encourage further on-ground actions;
4. Reduction of external threats to GGBFs;
5. Monitoring and research to better understand the extent and dynamics of the Middle Hunter GGBF population; and
6. Coordination and communication between the various stakeholders, land managers and the community.

Duration

The duration of this plan will be three years i.e. start mid 2007 to mid 2010.

Implementation Plan

The following implementation plan provides a framework for management actions related to the above strategies and the draft GGBF Recovery Plan. It describes the actions in a priority-based order, links to the draft Recovery Plan and CAP, responsibilities for the management actions, a cost estimate for the actions and possible sources of funding. A time frame for undertaking the various tasks is also provided. This plan should be read and actioned with appropriate reference to the draft GGBF Recovery Plan.

It should be noted that some management actions are relevant to more than one strategy in the plan.

IMPLEMENTATION PLAN

ACTION	RECOVERY PLAN LINKS	PAS LINKS	RESPONSIBILITY	COST*	FUNDING SOURCES	TIMEFRAME
1.1 Establish a standardised survey protocol which includes the use of GGBF call playback, 'to scale' photos, diurnal and nocturnal (spotlighting) searching, and appropriate timing specification.	Action 12.3.1	31	SOFAR, University of Newcastle, DECC, DFWG	<$5,000	DECC, NHT	2008
1.2 Implementation of the NPWS Frog Hygiene Protocol during any interaction with GGBF or its habitat to prevent the spread of chytrid fungus.	Action 11.3.5	15	All	Nil	In-Kind	2007-2010
1.3 Ground truthing for GGBF presence at locations of historic and recent GGBF sightings such as Ellalong Lagoon, Gillieston Heights, Ravensfield, and Wentworth Swamp (link to Actions 1.1, 1.6).	Action 12.3.1	31	University of Newcastle, HRLN	<$10,000	NHT, CMA,	2007-2009
1.4 Targeted survey of Tenambit Wetland and surrounding likely habitat at East Maitland so as to confirm anecdotal GGBF sighting (link to Actions 1.1, 1.13).	Action 12.3.1	11, 31	University of Newcastle	<$5,000	undetermined	
1.5 Mapping of known and potential habitat in proximity to and including Wentworth Swamp and Ellalong Lagoon.	Action 12.3.1		Consultants, University of Newcastle, HRLN, CCC, Hunter Councils/REMS, HCRCMA and MCC.	<$25,000	NHT, CMA, sponsorship	2007- 2008

* **Costs are indicative only and subject to available funding**

ACTION	RECOVERY PLAN LINKS	PAS LINKS	RESPONSIBILITY	COST*	FUNDING SOURCES	TIMEFRAME
1.6 A centralised recording mechanism to be established that will involve the use of digital photos for id, location and date details etc to be channelled through SOFAR (or other frog group) and to GGBF experts at University of Newcastle if required. A link to DECC is also necessary.	Action 12.3.1	4	SOFAR, University of Newcastle, DECC	Undetermined	To be determined	2007 - 2008
1.7 Prepare and distribute a community-wide survey (including information leaflet) that focuses on locating and formalising GGBF sightings, and seeking community support in GGBF conservation initiatives. This should include landholders, industry around identified habitat, local schools and environmental groups (link to Action 1.6, 1.21).	Actions 12.3.1, 14.3.2	31	DECC, MCC, CCC, Mindaribba LALC	<$8,000 survey; <$5,000 leaflet	Environmental Trust	2007-2008
1.8 DECC to organise GGBF field days and nights for local students focussing on surveying recent and potential GGBF habitat (link to Actions 1.1, 1.5, 1.6).	Action 14.3.2	32	DECC, HRLN, Newcastle University	In- kind	Recurrent funding or voluntary	2007- 2008
1.9 Engage the community using existing events e.g. Environmental Youth Forum at Tocal, to raise awareness of GGBF in the local area and encourage frog-friendly actions.	Action 14.3.2	32	HCRCMA, DECC	In-kind	Recurrent funding of participating organisations	2007 - 2009
1.10 Liaise with Hunter/Central Coast Directorate of Department of Education and Training (DET) as to participation of students in GGBF field days/excursions and implementation of GGBF education programs in local schools and possibly assisted by Env Ed Centres (e.g. Lower Hunter Threatened Species Teacher Resource Kit – see references).	Action 14.3.1, 14.3.2	32, 33	DECC, DET- Env Ed Centres, Middle Hunter GGBF Friends Group, GGBF researchers	Minimal; <$5,000 development of curriculum materials	ET	2008 - 2009

ACTION	RECOVERY PLAN LINKS	PAS LINKS	RESPONSIBILITY	COST*	FUNDING SOURCES	TIMEFRAME
1.11 Further opportunistic surveying based on sightings originating from community surveys (link with Action 1.7, 1.8).	Action 12.3.1	8	SOFAR, University of Newcastle	<$8000	Sponsorship, TSN, Research funding	August 2007 seasonally ongoing
1.12 Review of existing management plans and habitat conservation measures active in the Cessnock and Maitland LGAs to identify project linkages and minimise duplication.	Actions 10.3.1, 12.3.2		DECC, Consultant	<$5,000	Undetermined	2008-2009
1.13 Liaise with landholders where GGBFs are known to occur. Encourage protection of habitat through HCRCMA biodiversity programmes, Voluntary Conservation Agreements under the NPW Act, or other appropriate incentive schemes (link to Action 1.5).	Action 10.3.1	9, 18	DECC, HCRCMA, MCC & CCC	Undetermined	HCRCMA, DECC	2008 - 2010
1.14 Re-establishment of Gillieston Heights GGBF habitat, including permanent pond to pre-destruction size, revegetation of pond borders and drainage line. For full details see references for M.Mahony report to MCC.	Action 11.3.3	9, 18	DECC, Landholder, MCC	~$25,000 but undetermined	Proponent	2007-2008
1.15 If GGBF is not detected following surveys during several suitable seasons, habitat construction will be trialled on the periphery of Wentworth Swamp, incorporating all known habitat components, to attract GGBFs to the site. The site(s) will be monitored for effectiveness.	Action 11.3.3	9, 18	Relevant landowners, MCC, HWC, CCC, Hydro Aluminium, HCRCMA, DECC	Undetermined but at least $20,000	NHT, CMA, sponsorship	2007-2010
1.16 Liaise with HCRCMA in regard to incorporating GGBF habitat (appropriate plantings, ephemeral scrapes etc) into current Wentworth Swamp rehabilitation program.	Action 10.3.1, 11.3.3	9, 18	DECC, HCRCMA, MCC	Minimal; <$5,000	Existing	2007-2010

ACTION	RECOVERY PLAN LINKS	PAS LINKS	RESPONSIBILITY	COST*	FUNDING SOURCES	TIMEFRAME
1.17 Liaise with Maitland City Council in regard to incorporating GGBF habitat (appropriate plantings, ephemeral scrapes etc) into ongoing Tenambit Wetland rehabilitation.	Action 10.3.1, 11.3.3	9, 18	DECC, MCC	Minimal; <$5,000	Existing	2007 -2008
1.18 Pending a positive GGBF population status and location, investigate possibilities of linkage within population elements using habitat creation/improvement measures.	Action 11.3.3	9	DECC, Consultant, University of Newcastle	Undetermined	To be determined	2008-2009
1.19 Survey of GGBF habitat to identify where *Gambusia holbrooki* occurs Implement *Gambusia* Threat Abatement Plan to prevent further spread to unoccupied GGBF habitat and employ steps to eradicate where possible.	Action 11.3.2	6	DECC, DPI Fisheries, MCC & CCC	<$5,000	DECC, NHT, CMA	2007-2008
1.20 Landholder education program to be targeted at grazing properties in and around Wentworth Swamp, regarding a reduction of cattle grazing in riparian zones and around farm dams (link to Action 1.18).	Action 14.3.1		HCRCMA, MCC	Negligible	Recurrent funding salaries of extension/field officers	2008 - 2010
1.21 Identifying landholders in proximity to Wentworth Swamp, Tenambit Wetland and Ellalong Lagoon that are conducive to GGBF conservation initiatives (link with Action 1.7).	Action 10.3.1	9	HCRCMA, MCC, CCC	<$5,000	NHT, CMA, ET	2007-2008
1.22 Incorporation of GGBF habitat into development approvals where appropriate, e.g. rezoning and development at Cliftleigh and at Ellalong in Cessnock LGA.	Action 11.3.3	9, 18	DECC, Winten Property Group, Hardie Holdings	Undetermined	Proponent, s94 Contributions	2007-2010
1.23 Liaise with Hunter Water Corporation as to possibility of improving potential GGBF habitat on their 'Walka Water Works' site.	Action 11.3.3	9, 18	DECC, Hunter Water Corporation	<$10,000	NHT, CMA	2007-2008

ACTION	RECOVERY PLAN LINKS	PAS LINKS	RESPONSIBILITY	COST*	FUNDING SOURCES	TIMEFRAME
1.24 Pending mapping of known and potential GGBF habitat, liaise with Landowners regarding incorporation of GGBF habitat features on their lands within proximity to Ellalong Lagoon (link to Action 1.5).	Action 11.3.3	9, 18	DECC, Yancoal Australia, Hardie Holdings	Undetermined	Sponsorship, landowners, NHT, CMA, TSN	2008-2010
1.25 Ensure Maitland and Cessnock Councils flag GGBFs as an endangered species to be considered in any new rezonings or developments that coincide with areas identified as potential or past GGBF habitat.	Action 11.3.1	1	DECC, MCC & CCC	Minimal	Recurrent Funding	2007 - 2010
1.26 Pending detection of GGBF on or in the vicinity of identified habitat on Scheduled Premises. Give consideration to applying existing regulatory mechanisms to encourage relevant landowners to take management actions for the benefit of GGBF and its habitat.	Action 11.3.1	1	DECC, all relevant landholders	Nil	In-Kind	2007 - 2010
1.27 Conduct an independent review of GGBF genetic studies determining variability within and between populations to identify evolutionary significant units, so as to inform re-introduction, supplementation and translocation schemes and establish definitive baseline data. A report on recommended actions regarding provenance be provided.	Action 12.3.2	26	Expert evolutionary geneticist	<$3,000	Undetermined	2008
1.28 Control of feral predators (e.g. trapping, fox baiting) on private and public lands in proximity of Wentworth Swamp and Ellalong Lagoon to be coordinated with any other active baiting programs, e.g. DECC fox baiting program.	Actions 10.3.1, 11.3.2	3	Councils, DECC	<$10,000	NHT, Env Trusts, sponsors	2008

ACTION	RECOVERY PLAN LINKS	PAS LINKS	RESPONSIBILITY	COST*	FUNDING SOURCES	TIMEFRAME
1.29 Establish GGBF group which will then establish an email forum to distribute updates on MP implementation.	Action 14.3.2	7, 24	DECC, CMA, SOFAR	<$5,000	Sponsorship, NHT, CMA	2008
1.30 Liaise with local media (newspapers, newsletters, radio, TV) so as to encourage GGBF reporting (e.g. implementation of management plan) and raise awareness. (Link with GGBF Brochure/Survey Action 1.7)	Action 14.3.1	33	DECC, SOFAR, CCC, MCC, GGBF Friends Group	In-kind	Minimal	2007 - 2010
1.31 Undertake translocation of GGBF tadpoles, when/if population or breeding event is detected and of sufficient size, for use in captive breeding programme to supplement existing population. Under supervision of DECC (link to	Action 13.3.1	13	DECC, Australian Reptile Park (ARP)	<$20,000	Project Sponsors, NHT, Env. Trust	2008 - 2010

REVIEW

A meeting of stakeholders will be organised to occur following the activity period each season where results and trends will be discussed and recommendations for adding to and modifying management actions in the plan made.

A review of the plan is required after 2.5 years as a basis for its next iteration after three years.

Informal review of the plan is also encouraged both within organisations and through networks and partnerships. All recommendations to improve the plan should be directed to the DECC contact below.

THE FROG HYGIENE PROTOCOL

Individuals studying or surveying frogs often travel and collect samples of frogs from multiple sites. Green and Golden Bell Frogs can be particularly sensitive to the introduction of infectious pathogens, such as the frog chytrid fungus. Therefore, it is important that frog workers recognise the boundaries between sites and undertake measures which reduce the likelihood of spreading infection. The detailed procedures and measures are provided in the "Hygiene protocol for the control of disease in frogs", which can be obtained from the Department of Environment and Climate Change, or downloaded from:
http://www.nationalparks.nsw.gov.au/pdfs/hyprfrog.pdf

GGBF CAPTIVE BREEDING AND TRANSLOCATION

The Department and Environment and Climate Change is currently guided by a Policy for the Translocation of Threatened Fauna in NSW that will apply to all proposals to translocate threatened fauna species (see NPWS 2001 Policy and Procedures Statement No. 9). This Policy outlines four possible justifications for translocation of threatened fauna that include: species recovery, biodiversity reconstruction, emergency transfer and research.

The merits and usefulness of captive breeding and translocation for GGBFs to supplement or re-establish a population as a conservation measure have also been identified in the draft GGBF Recovery Plan for investigation. Whilst captive breeding and reintroduction/supplementation may be deemed a desirable initiative as part of this Management Plan, in situ conservation of the existing population is always a priority, even if later focus is drawn to reintroduction or supplementation initiatives. In any event all proposals for reintroduction/supplementation will have to be subject to the Policy for the Translocation of Threatened Fauna in NSW. It should not be assumed that such measures will be a simple solution to the decline or disappearance of a local population or population sub-unit and gain automatic approval from DECC.

Several trials have already been undertaken to determine the feasibility and merits of undertaking captive breeding and release as reintroduction or supplementation exercises. Such trials have been undertaken both in concert with habitat creation/enhancement measures as well as without any habitat manipulation. To date there have been several reintroduction failures where releases of tadpoles or juvenile frogs have shown initial promise and survived to transformation or early adult stage but have then failed to survive to maturity and establish a self sustaining population eg Joseph Banks Reserve, Botany and Long Reef Golf Course, Dee Why. Other sites have had supplementation releases of captive bred stock but where there was also a remaining residual element of the population in that area. At such sites releases have appeared to initially benefit the local population. However because releases have also been in concert with habitat creation initiatives it is difficult to determine whether the habitat creation has benefited and boosted breeding success of the remnant population, or if apparent increases can be attributed to recruitment of released captive bred specimens eg Arncliffe M5 East site and Edgewood site Woonona.

It should be emphasised here that the Policy for the Translocation of Threatened Fauna in NSW indicates that in no way should translocation be considered as a mitigative measure when determining the significance of a proposal on a local population of a threatened species. The NSW DECC has prepared Environmental Impact Assessment (EIA) Guidelines that provide guidance to development proponents, consultants and consent authorities. These guidelines further reaffirm the DECC position on translocation and the general inappropriateness of it being considered as a component of development proposals.

Ultimately decisions to conduct GGBF translocations and captive breeding are at the NSW DECC's discretion and will be assessed on merit and on a site-by-site basis. Factors such as the provenance of translocated individuals, whether threatening processes continue to operate at a site, as well as costs and an ability to monitor outcomes for an extended period will all be considerations for the benefit of understanding and future proposals.

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Appendices

Appendix 1 - Photos of some of the locations referred to in this Management Plan

Aerial photo of Ellalong Lagoon and surrounding water courses likely to be GGBF habitat in the Cessnock LGA.. Aerial photo of Ellalong Lagoon and surrounding water courses likely to be GGBF habitat in the Cessnock LGA..