Indicus Biological Consultants Pty. Ltd.

Fauna and flora Surveys of North Point and Princess Louise mine sites for GBS Gold Australia Pty. Ltd.

March 2007

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Introduction

Indicus Biological Consultants Pty. Ltd. (IBC) was commissioned by URS Pty. Ltd. to undertake terrestrial vertebrate fauna and flora surveys of the Princess Louise and North Point mine sites and their associated road entrances (Hayes Creek-Grove Hill area) in May 2006 and March 2007. These surveys were conducted before initiating any mining activity by GBS Gold Australia Pty. Ltd (GBS) as per the commitments made in the mine management plans (MMPs') for the Burnside Project Area (URS 2006).

This document outlines the sampling methodology and the results of the fauna and flora surveys conducted between the 2nd May and the 5th May 2006 (two mine sites) and on 9th March 2007 (both road entrances). We discuss potential impacts and mitigation measures for the developments, with regard to terrestrial fauna (vertebrates) and flora species.

Methods

The Princess Louise and North Point mine sites are both located in an area called the East Burnside Project Area (BPA), which is approximately 140 km southeast of Darwin (Figure 1) and is currently being subjected to exploration activities.

Methods for Princess Louise and North Point mine sites

Vertebrate fauna survey
Due to the highly disturbed nature of both sites (Figures 2 and 3) the methodologies used for this survey do not follow the usual guidelines set out by the Biodiversity Conservation group, NT Department of Natural Resources, Environment & the Arts. The methods chosen were best suited to these already disturbed sites and are as follows:

- At Princess Louise, a transect in the order of 400 m was set out around the southeast and east perimeter of the site in areas that had not been cleared. This site was chosen as it was the only undisturbed section within the mine site boundary. The vast majority of the site to be mined was already cleared with subsequently very little fauna habitat (open space) and very few flora species present. It also backed onto relatively uninterrupted rocky eucalypt woodland. Thirty Elliott traps and eight possum-sized cage traps were spaced approximately 10 m apart along this transect. Due to the rocky nature of the substrate only four pitfall traps (20 L buckets) with 10 m drift fence were placed within different microhabitats.

- At the North Point site two transects approximately 240 m long were set on the north and south boundaries of the site in eucalypt woodland as again these areas had been little disturbed. Each transect consisted of 20 Elliott traps and four possum sized cage traps spaced about 10 m apart. Again because of the rocky nature of the north transect, only 2 pitfall traps (20 L buckets) with 10 m of drift fence were placed within different microhabitats. The substrate of the south side transect consisted of more loamy soil and therefore four pitfall traps (20 L buckets) with 10 m of drift fence were placed within different microhabitats.

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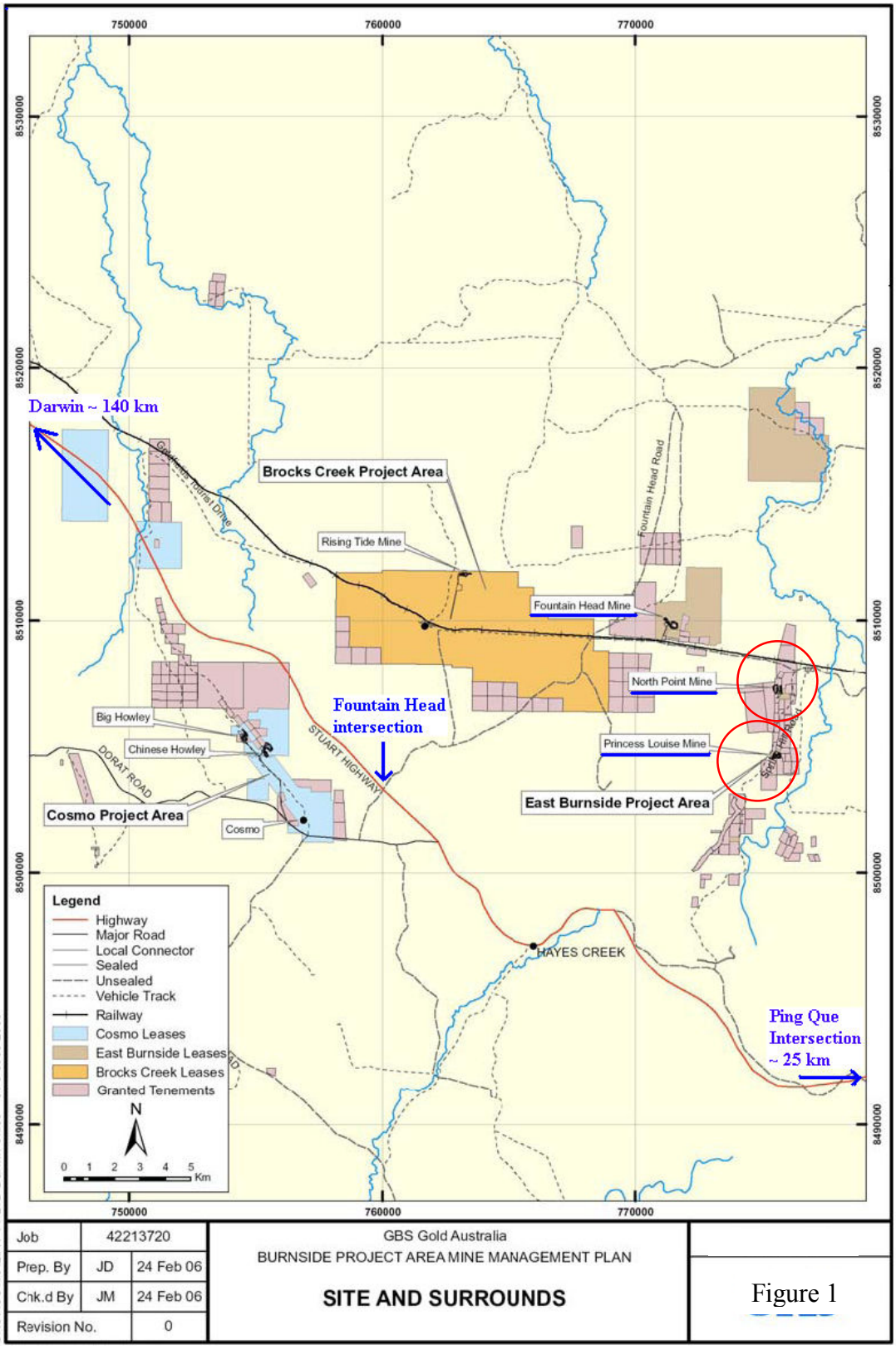

Figure 1. Map showing the two mine sites surveyed (red circles) and their position in the general area.

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Figure 2. Princess Louise mine site.

Figure 3. North Point mine site

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Methods for North Point and Princess Louise road entrances

Flora and vertebrate fauna survey
The proposed areas of disturbance for the Princess Louise road entrance involve the widening of an already existing access track (approximately 200m long) to 20m wide. At North Point the road entrance is approximately 600m long and is again proposed to follow an existing access track. Each proposed road widening was traversed for one day to a width of 50m either side of the track and all terrestrial vertebrate fauna and flora were recorded.

General methods (mine sites)

Bird counts
All transects were censored for birds three times in the morning and three times in the afternoon with an additional two nocturnal visits. Bird counts involved walking along transects and all birds heard or observed utilising transects were recorded. Birds flying overhead were only recorded if utilizing the habitat (e.g. hunting Raptors or Woodswallows).

In addition to the regular bird surveys we undertook specific searches for the endangered Gouldian Finch *Erythrura gouldiae* by sitting at select creek sites and small pools in the general area of the two mine sites at around dawn and/ or dusk. This species is recognized as occurring in the region and is known to visit such sites for water particularly at these times (Woinarski & Tidemann, 1991; Dostine *et al.* 2001).

Active searches
Each transect was actively searched eight times for reptiles, mammals, scats and signs. Each active search lasted for ten minutes and involved turning rocks and logs, raking through leaf litter, looking under bark, in crevices, etc. Six searches were conducted during the day (morning, midday and late afternoon) with an additional two searches at night using spotlights.

At all of the sites traps were baited with oats and peanut butter and were open for 3 nights, with cage and Elliot traps checked and closed each morning and re-baited in the late afternoon.

Incidental terrestrial records
Other vertebrate species seen in the general area that were not attributable to transects were recorded separately on an incidental list for the survey area.

Taxonomy and nomenclature
Common and scientific names used in this report follow Strahan (1998) for mammals, Christidis and Boles (1994) for birds, Cogger (2000) for reptiles and Tyler and Davies (1986) for frogs.

Flora surveys
Flora surveys at all sites involved identifying all plants in the upperstorey, midstorey and understorey of the terrestrial vertebrate survey transects as well as any additional species discovered on the sites. Any voucher specimens collected were identified at the N.T. Herbarium.

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Taxonomy and nomenclature
Scientific names in this report follow that found in the checklist of NT vascular plant species from the Northern Territory Herbarium (Cowie & Albrecht, 2005).

Limitations
Cryptic and rare species may not have been recorded due to the relatively short sampling period, and further species may be detected if trapping were conducted over a longer period or at different times of the year.

Relevant literature
Princess Louise and North Point mine sites both come under the jurisdiction of the following legislation and international conservation agreements: *Territory Parks and Wildlife Conservation Act 2001* (TPWC Act) (Parks & Wildlife Commission of the Northern Territory 2001), the *Commonwealth Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Commonwealth of Australia 1999), as well as the China-Australia Migratory Bird Agreement (CAMBA) 1987, the Japan-Australia Migratory Birds Agreement (JAMBA) 1974 and the Bonn Convention for the conservation of migratory species which came into effect in 1979. Species that are covered by these treaties and acts that were recorded on site were noted.

Results

Princess Louise
Four species of mammal, 17 bird species, 8 reptile species and 3 frog species were recorded during the surveys (Table 1). Seventy plant species were identified of which 5 were weeds (Table 2). The majority of this site had been cleared before the surveys were conducted and therefore most of these species were detected on the edges.

Princess Louise road entrance
Eleven species of birds and forty-two species of plants were detected during the one day 'walk-over' of the Princess Louise road entrance (Tables 1 and 2). Two species of weed were also recorded.

North Point
Six species of mammal, 31 bird species, 6 reptile species and 2 frog species were recorded during the surveys (Table 1). Sixty-six plant species were identified of which 3 were weeds (Table 2). This site had also been cleared sometime prior to the surveys and therefore all of the surveying effort was focused on the periphery vegetation of the site, which was little disturbed.

North Point road entrance
During the 'walk-over' of the North Point road entrance, 32 terrestrial fauna species were recorded including 3 mammals, 27 birds and two reptile species. Seventy-two plant species were also recorded (3 weed species, Tables 1 and 2).

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Overall Fauna Survey Results

A total of 79 terrestrial vertebrate species were recorded during surveys of both sites and of these, 10 were mammal species, 55 bird species, 10 reptile species and 4 frog species (Table 1).

Only 2 species the Northern Quoll *Dasyurus hallucatus* and the Patridge Pigeon *Geophaps smithii* are listed under government legislation. The Leaden Flycatcher *Myiagra rubecula* is listed under JAMBA while the Rainbow Bee-eater *Merops ornatus* is covered under the Bonn convention. Although no longer listed on any legislation, the Ghost bat *Macroderma gigas* is of conservation significance in the region because the project area lies within the largest known population of the species anywhere in Australia (see Species of conservation significance and recommendations section). The remaining species are thought of as common and widespread in the Top-End of the Northern Territory. Therefore the remainder of the report will focus on the species of conservation significance and potential impacts of the development on these species.

We failed to detect the Gouldian Finch during our targeted surveys.

Microbats

Surveying for microbats roosting in the many adits of the area (using the Anabat detector) was not possible as the Anabat detector was not available for use from the Biodiversity Conservation group, NT Department of Natural Resources, Environment & the Arts. Adits were found at the Princess Louise and North Point sites and at the North Point entrance road. These were visually inspected for microbat use.

Introduced fauna

The only introduced fauna species recorded during the surveys were cane toads and donkeys (Table 1) all of which were quite common in the area.

Key threatening process

The cane toad *Bufo marinus*, which was recorded at Princess Louise mine is recognized as a Key Threatening Process under the EPBC Act due to the adverse biological effects it can cause on native species, the most notable of these being lethal ingestion (Lever 2001). However cane toads are now widespread and common in the region and consequently there is little that can be done to prevent the impacts on fauna caused by this introduced species.

Table 1. Fauna recorded during field surveys.

PL = Princess Louise site. NP = North Point site. NPr = North Point road entrance, PLr = Princess Louise road entrance. I = Incidental sightings.

Species	PL	NP	NPr	PLr	I
Mammals					
Northern Quoll, *Dasyurus hallucatus* # +		+			
Red-cheeked Dunnart, *Sminthopsis virginae*		+			
Northern Brown Bandicoot, *Isoodon macrourus*		+			
Antilopine Wallaroo, *Macropus antilopinus*	+	+	+		
Ghost Bat, *Macroderma gigas*			+		
Black-footed Tree-rat, *Mesembriomys gouldii*	+	+			
Common Rock-rat, *Zyzomys argurus*	+				

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Mammals	PL	NP	NPr	PLr	I
Pale Field Rat, *Rattus tunneyi*	+				
Dingo, *Canis lupis dingo*					
Donkey, *Equus asinus* *		+	+		+
Birds					
Bush Stone-curlew, *Burhinus grallarius*					+
Black-necked Stork, *Ephippiorhynchus asiaticus*					+
Black Breasted Buzzard, *Hamirostra melanosternon*					+
Whistling kite, *Haliastur sphenurus*		+	+		+
Black Falcon, *Falco subniger*		+			
Brown Falcon, *Falco berigora*		+	+		
Brown Goshawk, *Accipiter fasciatus*		+			+
Nankeen Kestrel, *Falco cenchroides*	+				
Bar-shouldered Dove, *Geopelia humeralis*		+	+		
Common bronzewing, *Phaps chalcoptera*		+			
Partridge Pigeon, *Geophaps smithii* # &					+
Peaceful Dove, *Geopelia striata*		+		+	+
Galah, *Cacatua roseicapilla*					+
Red-tailed Black-cockatoo, *Calyptorhynchus banksii*					+
Rainbow lorikeet, *Trichoglossus haematodus*		+	+		+
Varied Lorikeet, *Psitteuteles versicolor*					+
Red-winged Parrot, *Aprosmictus erythropterus*		+			+
Northern Rosella, *Platycercus venustus*			+		+
Hooded parrot, *Melanodryas cucullata*	+	+			+
Brush Cuckoo, *Cacomantis variolosus*			+	+	
Horsefield's Bronze-Cuckoo, *Chrysococcyx basalis*			+		
Pheasant Coucal, *Centropus phasianinus*		+	+	+	
Spotted Nightjar, *Eurostopodus argus*		+			
Rainbow Bee-eater, *Merops ornatus* (J)			+		+
Red-backed Fairy-wren, *Malurus melanocephalus*		+	+	+	
Striated Pardalote, *Pardalotus striatus*	+				
Weebill, *Smicrornis brevirostris*	+	+	+		
Little Friarbird, *Philemon citreogularis*	+	+	+	+	
Silver-crowned Friarbird, *Philemon argenticeps*		+	+		
Blue-faced Honeyeater, *Entomyzon cyanotis*					+
Brown Honeyeater, *Lichmera indistincta*			+		
Singing Honeyeater, *Lichenostomus virescens*		+	+		
White-gaped Honeyeater, *Lichenostomus unicolor*			+		
White-throated Honeyeater, *Melithreptus albogularis*	+	+	+	+	
Grey-crowned Babbler, *Pomatostomus temporalis*	+	+	+	+	
Grey Shrike-thrush, *Colluricincla harmonica*		+	+		
Leaden Flycatcher, *Myiagra rubecula* (B)	+		+		
Rufous Whistler, *Pachycephala rufiventris*	+	+	+	+	+
Northern Fantail, *Rhipidura rufiventris*	+				
Willie Wagtail, *Rhipidura leucophrys*	+	+	+		+
Magpie-lark, *Grallina cyanoleuca*				+	+
Great Bowerbird, *Chlamydera nuchalis*	+	+	+		
Black-faced Cuckoo-shrike, *Coracina novaehollandiae*		+			+

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Birds	PL	NP	NPr	PLr	I
White-bellied Cuckoo-shrike, *Coracina papuensis*	+	+	+		
White-winged Triller, *Lalage sueurii*		+			
Black-faced Woodswallow, *Artamus cinereus*	+				+
Little Woodswallow, *Artamus minor*					+
Pied Butcherbird, *Cracticus nigrogularis*	+			+	
Silver-backed Butcherbird, *Cracticus argenteus*		+			+
Toressian Crow, *Corvus orru*	+	+			+
Golden-headed Cisticolla, *Cisticola exilis*		+	+	+	
Double-barred Finch, *Taeniopygia bichenovii*		+	+		+
Long-tailed Finch, *Poephila acuticauda*					+
Masked Finch, *Poephila personata*					+
Mistletoebird, *Dicaeum hirundinaceum*	+	+	+		
Amphibians					
Toadlet, *Uperolia sp*.		+			
Peter's Frog, *Litoria inermis*	+	+			
Wotjulum Frog, *Litoria wotjulumensis*	+				
Cane Toad, *Bufo marinus* *	+				
Reptiles					
Freshwater Crocodile, *Crocodylus johnstoni*					+
Bynoes Gecko, *Heteronotia bynoei*	+	+			
Gilberts Dragon, *Lophognathus gilberti*	+				
Northern Two-lined Dragon, *Diporiphora bilineata*	+	+	+		
Arboreal Snake-Eyed Skink, *Cryptoblepharus sp*.	+	+			
Robust Ctenotus, *Ctenotus robustus*	+	+			+
Storr's Snake-eyed Skink, *Morethia storri*	+				
Striped Rainbow Skink, *Carlia munda*	+	+			
Two-Spined Rainbow Skink, *Carlia amax*	+	+			
King Brown Snake, *Pseudechis australis*			+		

= species listed under the EPBC Act, & = species listed under TPWC Act, * = introduced species, B = Bonn convention for the conservation of migratory species and J = Japan-Australia migratory bird agreement.

Overall Flora Survey Results

A total of 136 terrestrial plant species were recorded during the surveys (Table 2). None of the plants recorded during the surveys are of conservation significance and therefore they are not listed under the TPWC Act or the EPBC Act.

Introduced flora

Eight introduced species were recorded while conducting the surveys: *Chloris virgata* (Purple top chloris), *Crotalaria goreensis* (Gambia pea), *Hibiscus sabdariffa* (Rosella), *Hyptis suaveolens* (Hyptis or horehound), *Passiflora foetida* (wild passion fruit), *Pennisetum pedicellatum* (annual mission grass), *Pennisetum polystachion* (mission grass) and *Stachytarpheta australis* (snake weed). All of these weeds are quite common in the general survey area, particularly along roadsides (Table 2).

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Table 2. Flora recorded during field surveys.

PL = Princess Louise site. NP = North Point site. NPr = North Point road entrance, PLr = Princess Louise road entrance.

Species	PL	NP	NPr	PLr
Cheilanthes fragillima	*		*	*
Gomphrena sp.	*	*		
Gomphrena canescens		*		
Buchanania obovata	*	*	*	*
Trachymene didiscoides			*	
Wrightia saligna	*	*	*	
Livistona humilis	*	*	*	
Marsdenia viridiflora			*	*
Pterocaulon sp.	*			
Cochlospermum fraseri	*		*	
Erythrophleum chlorostachys	*	*	*	*
Polycarpaea holtzei		*		*
Denhamia obscura			*	
Terminalia ferdinandiana	*	*		
Cartonema spicata	*	*	*	
Ipomoea eriocarpa	*			
Ipomoea heppleana			*	
Xenostegia tridentata	*			
Cyperus sp.	*	*		
Cyperus pulchella			*	
Rhynchospora sp.		*		
Rhynchospora heterochaeta	*			
Scleria sphacelata	*			
Drosera burmanni			*	
Erythroxylum ellipticum	*		*	*
Antidesma ghessaembilla	*		*	
Croton arnhemica	*	*	*	
Euphorbia schultzii	*		*	
Petalostigma pubescens		*		*
Petalostigma quadriloculare	*		*	
Phyllanthus minutiflorus				*
Alysicarpus sp.	*			
Alysicarpus schomburgkii	*			
Crotalaria goreensis #	*	*		
Crotalaria montana			*	*
Galactia sp. litchfield (working name)	*			
Galactia tenuiflora				*
Indigofera colutea			*	
Tephrosia bifacialis			*	

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Species	PL	NP	NPr	PLr
Tephrosia polyzyga	*		*	
Uraria lagopodoides				*
Vigna lanceolata			*	*
Goodenia sp.	*			
Goodenia heppleana			*	
Goodenia holtzeana	*			*
Goodenia janamba		*		
Hyptis suaveolens #	*			
Planchonia careya	*	*		
Amyema sanguinea	*	*	*	
Hibiscus sabdariffa #			*	
Owenia vernicosa	*	*	*	*
Tinospora smilacina			*	
Acacia difficilis		*		*
Acacia hemignosta	*		*	
Acacia holosericea	*		*	
Acacia lamprocarpa			*	*
Acacia sp.	*	*		
Ficus aculeate			*	
Calytrix achaeta	*	*		
Calytrix brownii		*		
Calytrix exstipulata		*	*	
Corymbia bleeseri				*
Corymbia dichromophloia	*			
Corymbia confertiflora	*	*		
Corymbia ferrugenia		*		
Corymbia latifolia		*		
Corymbia polysciada				*
Corymbia porrecta			*	*
Corymbia setosa	*	*	*	
Eucalyptus alba	*	*		
Eucalyptus miniata	*	*	*	*
Eucalyptus tectifica	*	*	*	*
Eucalyptus tetrodonta		*	*	*
Eucalyptus tintinnans			*	
Melaleuca nervosa		*		
Xanthostemon paradoxus	*	*		
Desmodium trichostachyum				*
Passiflora foetida #	*	*	*	
Alloteropsis semialata			*	*
Aristida sp.	*	*		
Aristida holothera			*	
Arundinella nepalensis	*			

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Species	PL	NP	NPr	PLr
Chloris virgata #	*			
Chrysopogon fallax	*	*		
Cymbopogon bombycinus	*	*		
Digitaria sp.				*
Ectrosia sp.	*			
Eulalia mackinlayi	*			
Ectrosia leporina		*	*	*
Eragrostis sp.	*	*	*	*
Eriachne sp.	*	*	*	
Eriachne avenacea	*	*	*	
Eriachne stipacea		*		
Heteropogon triticeus	*	*	*	
Mnesithea formosa		*	*	*
Mnesithea rottboellioides		*	*	*
Panicum mindanaense			*	
Pennisetum pedicellatum #	*	*		
Pennisetum polystachion #				*
Pogonolobus reticulatus	*	*	*	
Pseudopoganatherum contortum	*	*		
Sarga intrans	*	*	*	*
Schizachyrium fragile	*	*		
Sehima nervosum			*	
Shizachrium fragile			*	
Sporolobus spp.			*	
Themeda triandra	*	*	*	*
Urochloa holosericea			*	
Polygala sp. glaucoides (working name)	*			
Polygala longifolia	*	*	*	
Grevillea decurrens		*		
Grevillea dryandrii			*	
Grevillea heliosperma			*	
Grevillea mimosoides		*		
Grevillea pteridifolia		*		
Persoonia falcata	*	*	*	
Gardenia megasperma	*	*	*	*
Pavetta brownii			*	
Pavetta muelleri	*			
Spermacoce sp.	*	*		
Spermacoce leptoloba	*	*	*	
Buchnera asperata	*	*		
Buchnera linearis		*		
Stemodia lathraia		*		

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Species	PL	NP	NPr	PLr
Striga curviflora			*	*
Brachychiton megaphyllus		*	*	*
Brachychiton paradoxus	*			
Helicteres spp. Darwin			*	*
Waltheria indica				*
Stylidium semipartitum	*	*		
Tacca leonpetaloides			*	
Thecanthes punicea		*		*
Chlerodendrum floribundum			*	*
Stachytarpheta australis #			*	*
Ampelocissus frutescens			*	*
Cayratia trifolia		*	*	*

= Weed species.

Species of conservation significance and recommendations

Of the species that were recorded during the survey only two, the Partridge Pigeon and the Northern Quoll are listed under both state and federal legislation, the TPWC Act and EPBC Act.

Partridge Pigeon
Partridge Pigeons are listed as near threatened under the TPWC Act and vulnerable under the EPBC Act and have declined noticeably in some regions, possibly due to feral predators, altered fire regimes, grazing and hunting. This species prefers to feed in habitats with an open ground layer, but roosts in areas with dense ground cover and these habitats are common in the region. Given that the only Partridge Pigeons seen in the area were as incidentals and not on any of the surveyed sites suggests that these developments will have little impact on this species, particularly as the mine sites have already been cleared or partially cleared.

Northern Quoll
The Northern Quoll has recently been updated to Critically Endangered under the TPWC Act and endangered under the EPBC Act. One individual was recorded while spotlighting at the North Point site. This species has declined considerably in many areas of the Top End since the arrival of the highly fecund and toxic cane toad, presumably due to ingestion derived mortalities. The cane toad is therefore recognised as a key threatening process due to the impacts this species has on native fauna such as the Northern Quoll. Northern Quolls live for a maximum of 2.5 years (Braithwaite & Griffiths 1994) and cane toads have been in the general survey area for approximately three years. Therefore either the individual recorded at North Point does not attempt to predate upon cane toads or is not adversely affected by cane toad toxin, with the former being the most likely (because individual variation in prey choice is more probable than a series of genetic mutations that inhibit the actions of toxins hitherto not encountered). This individual and any others in the immediate area are therefore very important to the conservation of this species.

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Accordingly, this individual and any others in the general area of the North Point mine site that are likely to be impinged on by mining in any way should be trapped and relocated to suitable habitat some distance from the mine site. Northern Quolls are known to have average home ranges sizes of 35 ha for females and 84 ha for males and they may also use up to 55 different den sites in their territory (Oakwood, 2002). Therefore any individual that uses this area must be moved far enough away so that it's forays do not come into contact with the mine area. Suitable habitat should also be located prior to releasing any captured individuals.

Ghost Bat

The Ghost Bat is Australia's only carnivorous bat. The reason Ghost Bats have undergone a major range contraction in the recent past is still unclear but it has been suggested that individuals are highly philopatric (displaying a strong tendency to stay in the same place) to the extent that each population of bats can be considered an independent entity (Worthington *et al.* 1994). Despite being listed in the now repealed Endangered Species Protection Act 1992, and unequivocal range contraction over the past 200 years, this species could not be matched against any of the criteria to justify listing in a threatened category under the federal EPBC Act. It is currently listed as vulnerable by the IUCN (Groombridge 1994) and is currently not listed under the TPWC Act.

Ghost Bats are now restricted around a few, highly disjunct maternity sites. They shelter in large caves, mines or deep rock fissures during the day (Richards and Hand 1995). They are heavily reliant on old mines in Australia, (Phillips 1990) with one site containing 1500 animals out of a total population of 10,000. The present survey area is within the region of this site (Pine Creek) which is the largest known roost site in Australia. During the March 2007 survey approximately fifteen individuals were flushed from a mine adit within 30m from the proposed entrance road to North Point mine in March 2007 (0775915 8506968 UTM, GDA 94). Upon closer inspection more individuals could be heard inside the adit.

Many other adits in the region were surveyed during this and in surveys of other mine sites throughout the region and no Ghost Bats could be found (Firth *et al.* 2006a, Firth *et al.* 2006b). The adit in which the Ghost Bats were present is one of the few that had a small lateral (as well as vertical) entrance at its base, providing approximately 10 m of underground overhang inside which the Ghost Bats were roosting (Figures 4 and 5). It is unclear whether this is a requirement for Ghost Bats (a smaller space in which to hide and shelter from rain which vertical adits do not provide) and/ or whether they use multiple adits in the region. Ghost Bats are a highly mobile species and during the wet season they disperse and may use other roost sites within the general area. During the dry season they congregate, sometimes in large colonies.

Known threats to the ghost bat include disturbance to roost sites from mining operations, collapse of old mines, or human disturbance (Churchill 1998). Given the uncertainty about the importance and seasonal use of this roost site, we recommend a number of management strategies for this colony:

- The access road should be placed as far from the adit as is practically possible. The proposed widening of the access road at present will place the edge of the road some 10 m from the adit known to contain roosting Ghost Bats. There is however, another small access track 50 m away from the adit. This track should be used for the proposed new road and if possible the road should be placed further away to minimize possible disturbance.

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- A further survey in the dry season (May-September) should be carried out to ascertain whether this site is used by many more bats in this season and/or whether the new road and mining activities have caused animals to desert this adit.

The two other vertical adits adjacent to the proposed road entrance route appear less likely to harbour Ghost Bats as they lack a horizontal component. All adits should be avoided as much as possible when realigning the road route but the highest priority for avoidance should given to the Ghost Bat roost.

Figure 4. The horizontal adit adjacent to North Point road entrance in which Ghost Bats are known to roost. The vertical entrance is approximately 10 m behind this hole, atop of the hill amongst the trees in the background.

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Figure 5. A close-up of the horizontal entrance out of which Ghost Bats were flushed.

Rainbow Bee-eater and Leaden Flycatcher

The Rainbow Bee-eater and Leaden Flycatcher inhabit a range of habitats and are listed under the JAMBA and Bonn agreements respectively. The Rainbow Bee-eater and Leaden Flycatcher are unlikely to be breeding/ nesting in the area as they are known to breed in southern Australia and then migrate to northern Australia during the winter. Given that these species are common throughout Australia it is extremely unlikely that mining will have a significant impact on them, either in the local area or in a broader context.

Other threats to biodiversity

Other potential threats to fauna biodiversity associated with the proposed mining activity include the introduction or further spread of weeds that already exist on the sites (*Chloris virgata* (Purple top chloris), *Crotalaria goreensis* (Gambia pea), *Hibiscus sabdariffa* (Rosella), *Hyptis suaveolens* (Hyptis or horehound), *Passiflora foetida* (wild passion fruit), *Pennisetum pedicellatum* (annual mission grass), *Pennisetum polystachion* and *Stachytarpheta australis*). These introduced weeds will most probably be linked to an increase in traffic to the area associated with mining activity. The result of impacts such as these are difficult to determine, therefore every effort should be made to monitor and manage these sites for weeds throughout the life of the mine and the subsequent rehabilitation that should occur in these areas.

A rehabilitation program that aims to return vegetation communities similar to, and in comparable proportions to those existing prior to mining would result in the minimum long-term impact of mining activity on these areas.

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General management issues

Particular attention should be paid to developing ways of retaining native vegetation that are consistent with road design and traffic engineering requirements.

Recommendations

- The installation of temporary fencing of adjacent native vegetation and large trees prior to any road works.
- Avoid the widespread dumping of soil and other materials from construction. This will aid in maintaining the ecological values of remnant native vegetation throughout the site.
- Select and clearly define an area (areas) within the construction area for future deposition of all rubbish and soil. This site (sites) should be located away from any area that supports native trees or other native vegetation.
- Do not place stockpiles of materials including grass clippings within any area that supports native trees or other native vegetation.

Fire

Existing fire management plans should be developed and implemented to include appropriate fire regimes that will minimize the impact of fire on the surrounding areas The management plan should take into account the necessity for early dry season fires that are of low intensity and on a small scale, to create a spatial diversity of habitat structures. Such mosaic burning is already practiced by GBS to reduce fuel loads on all of their sites (URS, 2006).

Weeds and feral animals

The spread of introduced weed species can be facilitated by disturbances such as land clearance, and construction works (particularly by using machinery that is carrying weeds from other areas) and feral animals. Minimising further disturbance to native vegetation should aid in reducing the spread of weed species. Monitoring of management actions, notably weed control, and changes in vegetation condition should be used to guide future management decisions. Establishment of permanent photo points is a simple method of monitoring such changes.

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