

Carpentarian Rock-rat (*Zygomys palatalis*)

Risk Analysis, Ongoing Management and Monitoring to ensure Persistence of Resident and Neighbouring Populations

DRAFT



Redbank Copper Limited

143 Hay Street Subiaco
Western Australia 6008

Telephone: + 61 8 6389 6400
Facsimile: + 61 8 6389 6410

Date: February 2010

Project: Redbank Copper ERL 94

Purpose: Provide for the conservation of resident and neighbouring Carpentarian Rock-rat populations

Scope: Redbank ERL and surrounds (2010 – 2011)

Authorisation:

Prepared by: Tom Reilly

Date:

Accreditation by:

Date:

Approved by:

Date:



Redbank Copper Limited

Redbank Carpentarian Rock-rat Impact Assessment and Monitoring Proposal

TABLE OF CONTENTS

Purpose	1
Scope of this Plan	1
Linkages with other plans	1
Background information	1
General Description and Distribution	1
Diet and Habitat Requirements	2
Breeding	2
Movements	2
Species Status	2
Carpentarian Rock-rats within the Redbank Area	2
Population size and significance	2
Habitat Values for Redbank and the Surrounding Area	5
Threatening Processes for Redbank Rock-rats and their Preferred Habitat	5
General Threats	5
Potential Impact from Wildfire	5
Proposed Management of Wildfire	6
Potential Impact of Groundwater Drawdown	8
Drawdown due to the Potable Water Extraction Bore	8
Drawdown due to Pit Dewatering	11
Contingency Plan in the Event that Groundwater Drawdown is detected.....	12
Potential Contamination of Rock-rat Water source	12
Potential Contaminants from the Camp	12
Summary of Contamination Risk to the Rock-rat	13
Potential Impact from Cattle and Feral Pigs	13
Potential Introduction or Encouragement of Rock-rat Predators	13
Proposed Predator Management	14
Potential Impact from Human Disturbance and Noise Pollution	14
Proposed Disturbance Management	14
Risk Analysis and Mitigation & Management Priorities	14
Summary of Threats from the Mine	15
Risk Analysis Table	15
Monitoring Proposal for the Carpentarian Rock-rat	17
Key information Gaps	17
Priorities for Ongoing Monitoring	17



Metrics for Calculating Off sets21

Proposed Off sets22

 Increased Survey Effort to Address Information Gaps 22

 Extending Wildfire Management to include off-site Banyan Gorge 22

 Extending Feral Cat Management to Off-site Areas..... 22

 Ensuring longevity of Rock-rat Offsets 23

References24

DRAFT



Purpose

The Carpentarian Rock-rat is a species listed as Endangered under Commonwealth Legislation; *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and listed as Critically Endangered under Northern Territory legislation; *Territory Parks and Wildlife Conservation Act 2000*.

Carpentarian Rock-rats *Zyomys palatalis* inhabit the monsoon forest patch (approximately 2.7 ha) within the northwest corner of ERL94 (the Redbank Project Area). The size and extent of this population is largely unknown due to limited survey effort in the area.

Under the EPBC Act Redbank is required to minimise the impact on these species and provide offset management (off-site) if the impacts are of a magnitude judged to negatively impact local populations of the species.

Scope of this Plan

This plan guides and informs the management of Redbank ERL so as to minimise the impacts on the Rock-rat and outline a direct investment which will contribute to a net gain for the conservation of local populations on or in the vicinity of Redbank ERL.

This plan provides:

- Background information to the Rock-rat, the overall status, significant populations, life strategies and habitat requirements, key threats and management priorities
- The context for the Redbank Local Population and potential habitat for Rock-rats
- The Overall Management Framework
- Local threats by both mining development and other processes
- Risk Assessment for threatening processes to a local population
- Off Set Implications
- Management Priorities
- Ongoing assessment, monitoring and review

Linkages with other plans

Recovery Plan for the Carpentarian Rock-rat *Zyomys palatalis* (Puckey *et al.* 2003).

This plan will also influence and align with the overall pest and fire management Strategy for Redbank ERL and those areas of Wollogorang Station that Redbank can influence.

Background information

General Description and Distribution

This species is endemic to the Gulf of Carpentaria and has only been confirmed within the Northern Territory. The known distribution falls within a 35 km radius of the Wollogorang sandstone range (Puckey and Woinarski 2006). The project area (ERL94) falls within this limited range and contains one of the five known populations of the species (Woinarski *et al.* 2007) (these locations are provided in



Figure 1).

Diet and Habitat Requirements

While little is known of their specific microhabitat requirements, all populations to date have been found within sandstone gorges with rock slopes covered in dry monsoon forest and woodland, and within 100 m of permanent spring water (Trainor *et al.* 2000). Extensive trapping programs in similar habitat within the area have not expanded the Carpentarian Rock-rat's currently known range (Trainor *et al.* 2000).

Fleshy fruits and large seeds from monsoon forest plants, such as *Terminalia subacropa*, *T. carpentariae*, *Ficus spp.* and *Pandanus aquaticus*, are an important component of the Carpentarian Rock-rat's diet (Trainor *et al.* 2000).

Breeding

Breeding occurs throughout most months, however there is thought to be a peak in births during mid to late dry season when food availability in monsoon forests is highest (Trainor *et al.* 1996). Life span of Carpentarian Rock-rats is relatively short, as individuals are unlikely to live for more than two years in the wild.

Movements

Radio tracking research by Puckey *et al.* (2004) found that they maintain a mean home range of 1.1 ha, and individual Rock-rats could travel up to 2 km in one night, not necessarily restricted to the monsoon forest zone. The furthest the radio tracked individuals foraged away from the rainforest edge was 80 m (Puckey *et al.* 2004).

Species Status

The Carpentarian Rock-rat is listed as Critically Endangered in the Northern Territory based on (Woinarski *et al.* 2007):

- Extent of occurrence less than 100 km²;
- Area of occupancy estimated to be less than 10 km²;
- Severely fragmented distribution; and
- Continuing decline, observed, inferred or projected.

The Rock-rat is also listed as Endangered under the Commonwealth *EPBC Act 1999*.

Carpentarian Rock-rats within the Redbank Area

Population size and significance

There are now six known Carpentarian Rock-rat populations – Banyan Gorge, Moonlight Gorge, Aquarium Springs, McDermott Springs, Camel Creek and Redbank Springs (Redbank Springs is called Mastertons Gully in the Redbank EIS). All are within the Northern Territory and all populations are within 35 km of the Redbank Copper Project area (ERL94). Refer to

Figure 1 for locations near the mine where the Carpentarian Rock-rat has been recorded.

Two Carpentarian Rock-rats were captured and released during a standard fauna survey conducted within the monsoon forest of Mastertons Gully. This gully contains a small dense pocket of sandstone monsoon forest



which is fed by a permanent freshwater spring (Muinyin Spring). This is ideal habitat for the Carpentarian Rock-rat.

Helen Puckey (2003) suggests that as the rats have been observed to travel approximately 2 km in just one night, and their travel is not restricted to monsoon forest, it is possible that individuals may move back and forth from the nearest known population, Banyan Gorge (7 km from Masterton's Gully).

In 1996, the population of Carpentarian Rock-rats at Banyan Gorge was estimated to be 450 (Trainor 1996, documented in Woinarski *et al.* 2007).

DRAFT



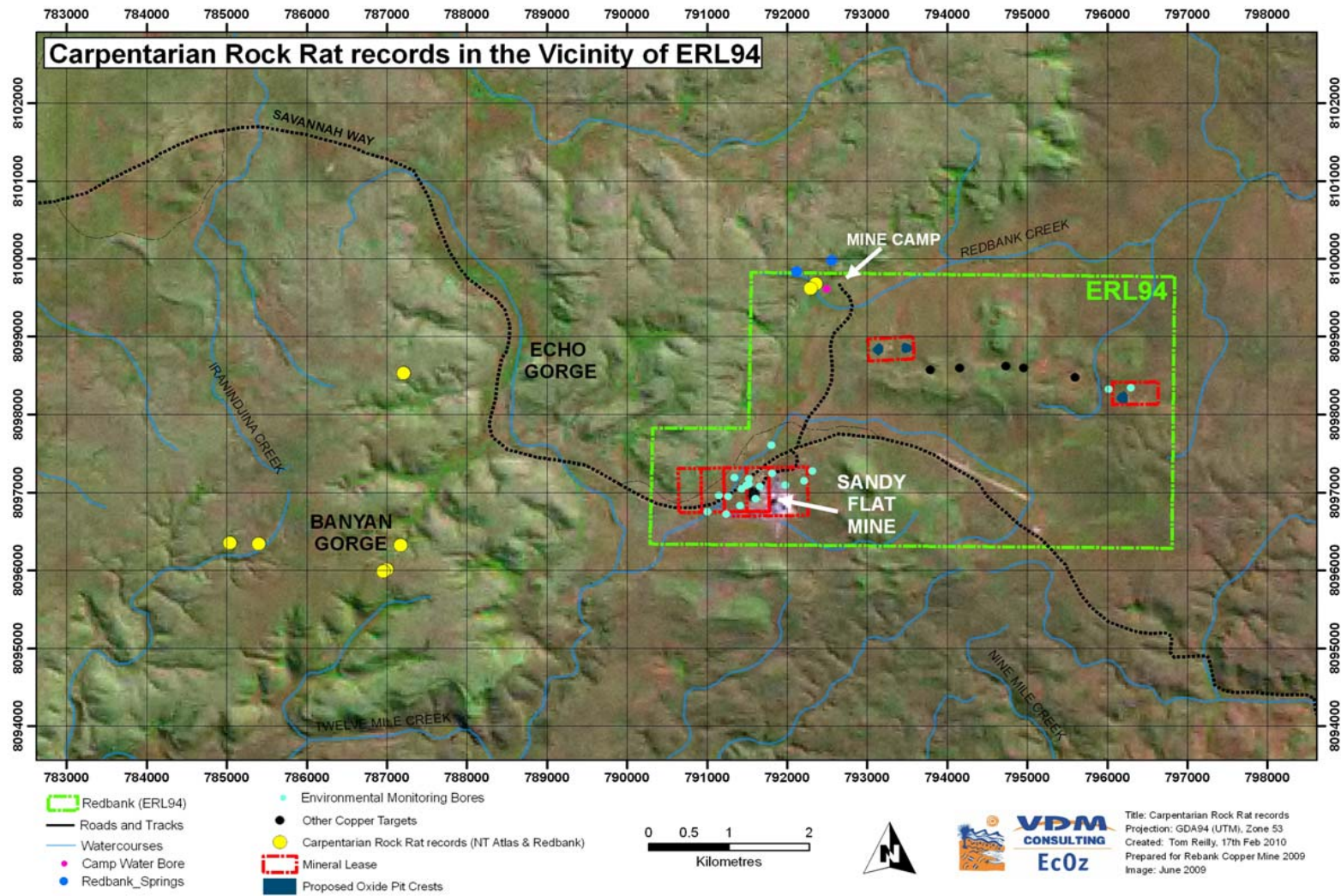


Figure 1: Carpentarian Rock-rat Records in the Vicinity of the Mine



Habitat Values for Redbank and the Surrounding Area

Critical habitat for Carpentarian Rock-rats includes sandstone gorges with rock and scree slopes associated with monsoon forest patches and permanent freshwater (Trainor *et al.* 2000; Puckey *et al.* 2001; Puckey *et al.* 2004). The home range of the species has been identified to be largely focused within the gorge habitat (valleys and slopes), however radio-tracking studies have identified that adults can forage up to 1.5km from the gorge habitat and into the plateau sandstone habitat containing broadleaf woodlands (Puckey *et al.* 2004). This highlights the needs for including management of not only monsoon forest pockets but also their surrounding broadleaf woodland zone located on the plateau (mainly focused at reducing fuel loads).

Threatening Processes for Redbank Rock-rats and their Preferred Habitat

General Threats

The major threat to this species is its extremely limited range (and hence population), and its apparent dependence upon a core monsoon rainforest habitat (Woinarski *et al.* 2007). Fire is regarded as the number one threat to Carpentarian Rock-rats (Puckey *et al.* 2004; Puckey *et al.* 2003; Brook *et al.* 2002; Trainor *et al.* 2000). High intensity dry season wildfires could degrade, diminish or alter the flora species composition of core monsoon forest patches (Trainor *et al.* 2000). This could result in loss of monsoon forest habitat and also change the food availability and type.

Impacts that could occur to Carpentarian Rock-rat populations if their habitat is not protected from wildfire include (Puckey *et al.* 2004):

- Reduced population numbers through direct loss of animals (and the following indirect effects);
- Reduced resource availability through loss of plant species, seeds fruits, nest places and refuge;
- Increased predation through loss of vegetation cover;
- Reduced individual fitness due to lower breeding success associated with fewer resources;
- Potentially fewer lactating females in the year after fire and lower juvenile recruitment (which has been observed in other rock rat species); and
- The gradual loss of fire-sensitive species that occur in the slope and gully floors are a major concern as the fruits of these species are an essential part of the rock rat's diet.

Population modelling has indicated that cattle grazing may also detrimentally affect Rock-rat habitat and water sources (Woinarski *et al.* 2007). The potential impact of feral cats on the populations is unknown (Woinarski *et al.* 2007).

Climate change and regionally occurring vegetation type shifts may result in the loss of critical monsoon forest habitat.

Potential Impact from Wildfire

Documentation (Puckey 2004) suggests that the scree slopes leading up to Masterton's Gully have been regularly burnt over the past years, threatening the integrity of the monsoon habitat. Fire information and mapping from the North Australia Fire Information (NAFI) website (<http://www.firenorth.org.au>) indicate that:



- In 2004, a large area was late burnt (Nov/Dec), including all of the monsoon forest of Masterton's Gully, but excluding Echo Gorge;
- 2005, no fires in the vicinity;
- 2006, a large proportion of the mine area was burnt, excluding Masterton's Gully and Redbank Creek;
- 2007, early burns over most of the mine area, and Wologorang Station, excluding Masterton's Gully;
- 2008-2010, no burns in the vicinity of the mine or Masterton's Gully.
- 1997-2008 (1km mapping), Masterton's Gully has been late burnt once in this period, indicating that the 2004 late burn was the only fire to impact Masterton's Gully since 1997.

Increased activity at the camp and at Sandy Flat through this proposed oxide mine expansions has the propensity to increase the risk of wildfire in the vicinity of Masterton's Gully. For example, more personnel at the camp increases risk of fire started through cigarette butts, vehicles, increased fuel storage requirements and generator use.

Proposed Management of Wildfire

Fire Management proposed at Redbank mine will involve Redbank engaging Indigenous land managers in conjunction with permission from Wologorang Station owners to conduct early dry season (late wet season) patchy burns in the greater mine region. The methodology would likely involve ground based targeted burning of areas requiring direct protection followed by broader scale dropping of incendiaries from light aircraft at points identified through NAFI (North Australia Fire Information) and part of the greater region fire management strategy. Creation of a patchy fire regime has been identified by many northern fire experts as the best fire regime to promote biodiversity. Creation of this fire regime around the monsoon forest that the Rock-rat inhabits is also likely to dramatically reduce risk of late dry season hot wildfires that would threaten monsoon forest vegetation.

In addition to investing in fire management in the greater region, Redbank also propose to engage Indigenous land managers to create a buffer of controlled fuel loads surrounding the monsoon forest of Masterton's Gully. The habitat surrounding the monsoon forest contains a high fuel load Spinifex understorey (refer to photographs in **Figure 2**) which, if left unmanaged, poses a risk of hot fires over large stretches of country rather than in a preferred mosaic pattern (Puckey *et al.* 2004). Northern fire experts, including Jeremy Russell-Smith and Jarrad Holmes have identified that, as wildfires generally go through the region every two or less years, fuel loads can build up sufficiently within two years to support damaging wildfire. As such, if vegetation surrounding the monsoon forest to 500 metres is burnt away from the monsoon forest every second year, this practice should provide a sufficient buffer of reduced fuel loads in order to protect the Rock-rat habitat from wildfire. Redbank will have the ability to extinguish fires that may threaten these habitats, especially Masterton's Gully, during years that controlled burning is not prescribed.

Redbank are also aware that old growth spinifex (>5 years) on the plateau is a critical food source for the Carpentarian Grasswren (Endangered in the Northern Territory, not listed Nationally), however controlled burns on the plateau will not be extensive as they will be targeted at buffering the monsoon forests from wildfire (500 m from the monsoon forest). To date, there have been no records of the Carpentarian Grasswren in the area, however the cryptic nature of this species limits the adequacy of standard surveys in detecting the Grasswren. The annual Carpentarian Rock-rat surveys will be complemented with targeted birdwatching surveys within the plateau to try and determine the presence of the Carpentarian Grasswren. Controlled burning on the plateau is estimated to include a maximum radius of 500 m, which is only a small proportion of the surrounding spinifex country. All burns will be conducted by personnel appropriately qualified in fire management and



programs will be tailored toward threatened species management (the Rock-rat is of highest priority). Relevant government authorities will be informed when the activity is planned (and also the outcome of the burn).



■ **Figure 2: Photographs of Typical Habitat in the proposed Fuel-load Control Buffer**



Potential Impact of Groundwater Drawdown

Potential dewatering of pits and the camp water supply bore are the potential sources of groundwater drawdown in the vicinity of this spring.

Drawdown due to the Potable Water Extraction Bore

Permanent freshwater springs are considered to be an important component of Carpentarian Rock-rat habitat requirements. Loss or reduced flow rates of freshwater springs within the gully/gorge drainages, and / or groundwater drawdown could have the following impacts on the Carpentarian Rock-rat population:

- Reduced/loss of surface water availability could affect the fitness and therefore population strength due to individuals dehydrating or needing to migrate in search of alternative water sources;
- Changes to the ecological balance of the monsoon forest which could alter fruiting patterns and quantities, an important dietary resource for the species (they are frugivores);
- Habitat decline over the medium to long-term which could open up the canopy and reduce shelter/refuges within the gorges; and
- Canopy reduction may also lead to encroachment of *Spinifex* or invasive species that may further increase the threat of wildfire.

Redbank understands that it is essential that Muinyin Spring (the freshwater spring that feeds Masterton's Gully) be protected from impact resulting from the proposed operations in terms of water quality and ground and surface water availability in the gully habitat.

The impact of groundwater drawdown from the proposed oxide mining dewatering is considered negligible due to the fact that groundwater was encountered in gravel and fractured sandstone bedrock at a depth between 15m and 24m in formations underlying the Masterson Sandstone in which Muinyin Spring is located (refer **Figure 4** and estimations below).

The current potable water extraction bore is about 440 m downstream and 72 m below the elevation of Muinyin Spring. The bore is located 154 m from the confirmed Rock-rat habitat of Masterton's Gully (refer to

Figure 3). This existing camp bore has provided good quality water to the mine camp for almost 20 years and has supplied sufficient water qualities for up to 30 personnel during the operation of Sandy Flat Mine in the 1990s.

When the camp is fully occupied (40 persons for 12 months of the year; 20 extra persons for 4 months) at a consumption of 100L/p/day for potable water, ablution and cooking purposes, less than 2,100kL/a (or 6m³/day on average) will be abstracted from the bore.

The construction log of the bore indicated that the bore:

- Encountered river gravel between 15m and 18m depth and sandstone between 18m and 30m;
- Has a 203mm DIA and was screened between 18m and 24m with a 150mm DIA PVC screen with 8mm apertures and a yield of 2.0L/s;
- Static water level was at 5.1m below ground level; and
- Ground water has a pH of 5.4 and an Electrical Conductivity of 23µS/cm.



By using the Jacob Equation:

$$s = (2.3 * Q) / (4 * \pi * T) * \log(2.25 * T * t / (r^2 * S))$$

- Where:
- s = drawdown (m).
 - Q = discharge rate (6m³/day).
 - T = aquifer transmissivity (100m²/day).
 - t = time (180 days; maximum time without rain recharge).
 - r = radius of drawdown (m).
 - S = aquifer storativity (10⁻³, dimensionless).

The drawdown after 180 days can be calculated at the locations of interest (radii of drawdown):

- Drawdown at the bore: 0.08m
- Drawdown at the rock rat populations: 0.04m.
- Drawdown at the springs: 0.03m.

The daily water requirement implies that the bore is utilised for about 1hr. There is no drawdown after 1hr at the rock rat population. The distance of zero drawdown, or the radius of the cone of depression surrounding the bore is estimated at 82m.

The 82m cone-of-depression (8cm maximum) around the bore will be well outside the monsoon forest of Masterton's Gully and outside the extent of the scree slopes identified as seasonal foraging habitat for the Rock-rat (Puckey *et al.* 2004).



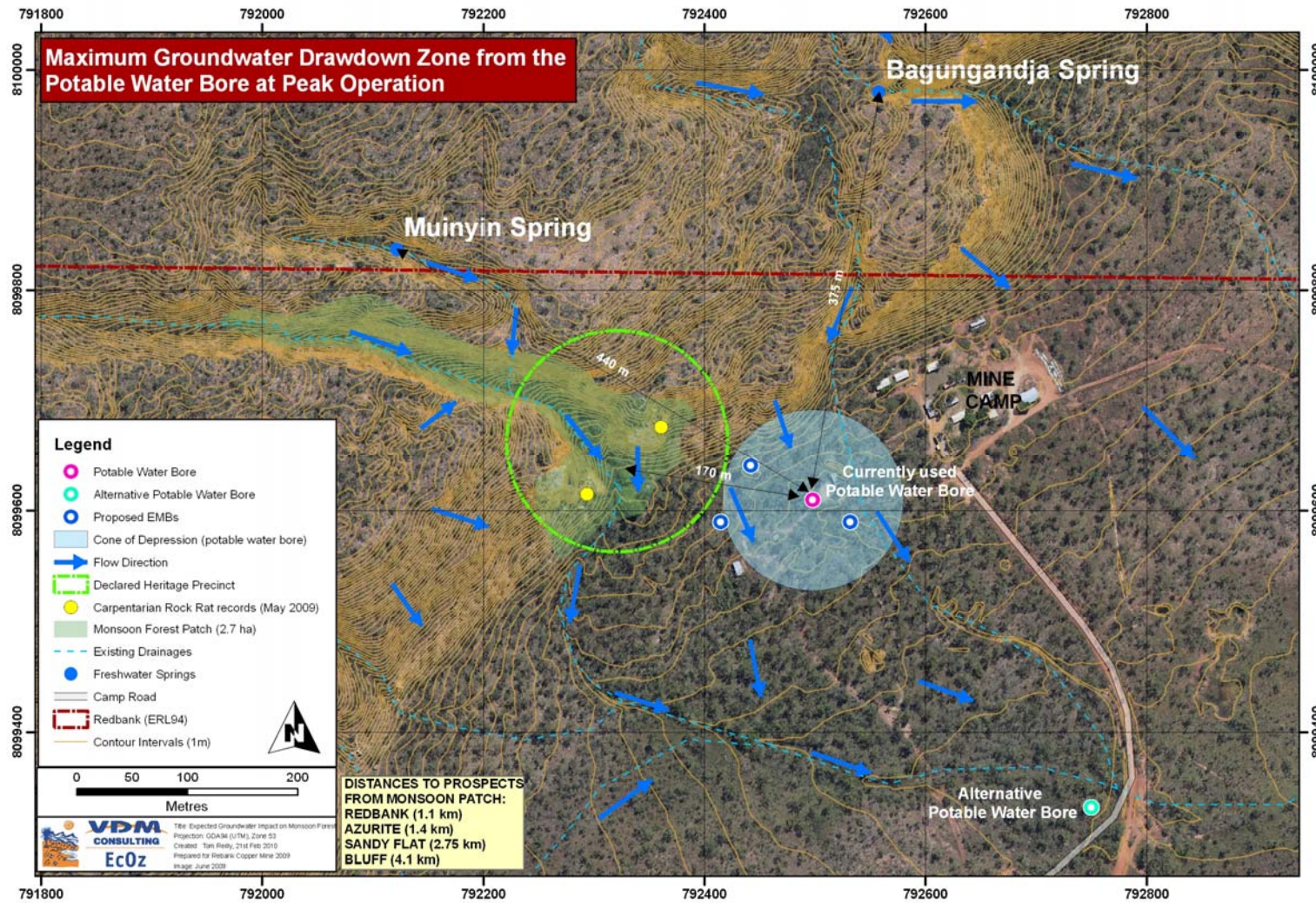


Figure 3: Maximum Groundwater Drawdown Zone from the Camp Bore



Figure 3 also shows the expected cone-of-depression surrounding the bore, estimated to not exceed 82m from the bore. To ensure that groundwater drawdown does not impact on the monsoon forest, Redbank have proposed to establish Environmental Monitoring Bores (EMBs) between the extraction bore and the monsoon forest site (see

Figure 3 for proposed EMB locations). Standing water levels will be checked on a weekly basis, and water quality sampling will occur monthly. Additional to this, stream flow volume monitoring will also occur within the spring to quantify changes in stream flow volumes to enable early detection of significant change and surface water availability. This data will be interpreted using hydrogeological modelling. In the event that drawdown is detected through monitoring, an alternative potable water source will be used to the east of Redbank Camp (expected location shown on

Figure 3). This alternative potable water bore will be established at the same time as the additional EMBs and is currently proposed to be at least 700 m to the south of Muinyin Spring. This location also provides an adequate distance from other monsoon patches located along the sandstone escarpment (in case that future Carpentarian Rock-rat surveys discover additional populations in these patches).

Drawdown due to Pit Dewatering

As the long term groundwater level sits at the base of the oxidised zone, the need for dewatering of the pits for oxide mining is limited to times during and immediately after the wet season when the groundwater level is likely to have risen, and from any surface water inflows into the pit. Dewatering is not expected take place during the late dry season when the potential impacts on the groundwater dependant ecological communities are of greatest concern. The proposed oxide mining pits of Redbank, Azurite and Bluff are also distant from the spring in the gully that supports the population of Carpentarian Rock-rats.

The risk of drawdown from dewatering open cut pits is similar to the risk level identified for the potable water bore; very low.

The following points identify the reasoning behind stating that the risk of drawdown through pit dewatering is very low. The Carpentarian Rock-rat population within the Mastertons Gully is located:

- Approximately 1,000 m north-west of the Redbank and Azurite;
- Approximately 2,800 m north-north-east of Sandy Flat; and
- Approximately 4,500 m west of Bluff.

Redbank and Azurite. There may be a requirement to dewater Redbank and Azurite pits during the final stage of oxide mining. The water table in this area has been identified (through exploration drilling) to sit between 30 and 35 m below ground level, and as the pit depth will not extend past 35 m, it is expected that dewatering requirements will be minimal. If dewatering is required at this site, a cone-of-depression will not exceed 200 m from the pit crests.

Due to the elevation difference and minimal dewatering requirements, operation at Redbank and Azurite pits is expected to have no impact on the groundwater aquifer levels and flow rates at Muinyin Spring (spring that feeds Mastertons Gully where the Carpentarian Rock-rat population resides).

Bluff. The groundwater levels in the Bluff area have been identified as being at 99m during late 2009 when the EMB's were installed, which is significantly lower than the depth of the proposed oxide open cut pit. Furthermore, the Bluff is over 3.5 km from the closest monsoon forest patch (Camel Springs) and 4.5 km from the known Carpentarian Rock-rat population at Mastertons Gully.



Therefore, dewatering the open cut pit proposed at Bluff (if required) will not impact on groundwater levels at Muinyin Spring.

Sandy Flat. Please note that the proposed oxide mining operation does not include extracting ore from Sandy Flat Pit, as only sulphidic ore is available at this site. Therefore, any further dewatering operation at this pit is not included as part of this approvals process. Sandy Flat Pit water levels have been reduced during 2009 in order to reduce interaction between the contaminated water held within the pit and the groundwater. Sandy Flat is 3 km from Muinyin Spring (the freshwater source for the Carpentarian Rock-rat population in Mastertons Gully). The SFP is currently in an unnatural state where it collects and holds water from a catchment of 40 hectares, artificially impacting the surrounding groundwater resources. Water quality monitoring and initial hydrogeological investigations have demonstrated that it is unlikely that there is any interaction between the unnatural ground water influences of the SFP area and the aquifer feeding Muinyin Spring.

Contingency Plan in the Event that Groundwater Drawdown is detected

Redbank's monitoring program has been designed to ensure early detection of impacts on the springs as a result of drawdown on the aquifer. Should significant drawdown be detected, and the spring flows impacted Redbank will immediately cease use of the camp bore, and recharge the aquifer from a water source of known high quality that does not support threatened species, nor their preferred habitat.

Potential Contamination of Rock-rat Water source

Water samples have been taken from the spring and sampling of the groundwater in the area has occurred by testing the drinking water from the kitchen. All samples from the kitchen have returned results acceptable to the Australian Drinking Water Guidelines (ADWG) 2004. Surface water samples from Muinyin Spring have also returned results within guideline levels. Most parameters were within the Australian and New Zealand Water Quality Guidelines (ANZECC) for aquatic ecosystems 2000 95% protection level. Two parameters, Copper and Aluminium, appear to occur naturally at high levels, exceed guideline limits, however this is consistent with natural levels in the area and is reflected in selected reference sites. The pH levels in Muinyin Spring were also within guideline levels specified in relevant standards.

Potential contaminants of water that have been highlighted as possible threats to the Carpentarian Rock-rat are

From the camp

- Diesel from the generator (hydrocarbons);
- E.coli and faecal chloroforms;

From mining processes

- Copper
- Aluminium; and
- Acidity.

Potential Contaminants from the Camp

Due to the close proximity of the mine camp with Muinyin Spring and the Carpentarian Rock-rat population, there is a risk that diesel spills at the mine camp and septic waste may impact on the water quality. However, even if the septic system failed, or there was a major diesel spill at camp, contaminating substances are not likely to reach the spring (the Rock-rat's water source) through ground or surface water as the camp is down gradient and over 70 m from the spring.



The landfill is located 2.5 km south of Muinyin Springs in a geologically different area within the current Sandy Flat Processing area. The Landfill area has a groundwater flow direction to the southwest away from Muinyin Springs. Therefore, we have not considered the landfill to be a possible source of contamination of concern to the groundwater associated with the rock rat population. The landfill will be managed such that it does not attract wildlife and feral animals, for example, dumped putrescibles will be covered immediately.

Summary of Contamination Risk to the Rock-rat

The Carpentarian Rock-rat population within the Mastertons Gully is located:

- Over 1,000 m north-west of the proposed Redbank and Azurite Pits;
- Approximately 2,800 m north-north-east of Sandy Flat;
- Approximately 4,500 m west of the proposed Bluff Pit; and
- Upstream of the Redbank Camp bore water supply.

In addition, Redbank and Azurite open pits are located in the Redbank Creek catchment draining into the easterly flowing Redbank creek at a location downstream of the populations; and Sandy Flat is located in the southerly draining Hanrahans Creek, which will not impact on the Redbank Creek catchment.

The above points have been considered and as a result, risk of groundwater contamination of the Rock-rat's water source through proposed mining operations has been identified to be negligible.

Ongoing sampling in the gully will ascertain that the spring is not contaminated as a result of mining processes.

Potential Impact from Cattle and Feral Pigs

Redbank is situated within Wollgorang pastoral station, an active cattle station, and as a result, cattle have often been seen in the vicinity of Masterton's Gully and have had access to this area over many years. Cattle may be drawn to the gully for the permanent water source or for shade and shelter. Cattle have disturbed and denuded river banks in the surrounding areas, impacting upon vegetation and the quality of springs and creeks. If not managed appropriately, they have the potential to do the same within Masterton's Gorge. The steep nature of the gully itself and the close proximity to human activity may deter cattle activity, however suitable management will still be applied as required.

Feral Pigs have been observed in the mouth of Masterton's Gully, presumably drawn there by the permanent water source and the supply of mangoes from trees planted by Masterton himself (fruiting occurs during the late dry season). In consultation with Wollgorang Station personnel, an opportunistic management program has been established and two pigs (of 2) have been removed from the area in recent months. This management program will continue in order to ensure that feral pigs do not have a destructive influence on the permanent pools of water and surrounding vegetation in the Gully, thus maintaining the habitat used by the Carpentarian Rock-rat.

Potential Introduction or Encouragement of Rock-rat Predators

Native and introduced species could potentially prey on Carpentarian Rock-rats, some examples of these species that have been recorded in local monsoon forest patches include feral cats *Felis catus*, dingos *Canis familiaris*, pythons (*Liasis olivaceus*, *L. children* and *Aspidites melanocephalus*), ghost bats *Macroderma gigas*, Northern Quolls *Dasyurus hallucatus* and Rufous Owls *Ninox rufa* (Trainor *et al.* 2000). Redbank have limited control on how to reduce this threat to the population within Mastertons Gully, however there is a chance that Feral Cats in the area may visit more frequently when the camp expands (potential for increased scavenging options).



Impact of Feral Cats on the rock-rat populations is unknown, therefore Redbank can only assume that cats are a threat to the survival of the species (and many other species within ERL94) and that management of Feral Cats is essential.

Proposed Predator Management

Six traps that will be baited and activated upon reported cat sightings. The traps will be set in the vicinity of the camp and landfill due to the camp's proximity to the Rock-rat habitat, and the landfill's potential to attract or encourage feral cats. Staff and contractor inductions provided by Redbank will include feral animal awareness training, importantly feral cats, and inductions will identify a requirement to report to Redbank management on number and location of sightings.

The camp landfill and waste storage will be managed to ensure general waste is covered and that land fill is regularly burnt. If cats are observed by staff or contractors, the trapping and euthanasia program will be immediately commenced by trained onsite personnel (as Redbank keep six live capture cat traps at the mine and train staff on trapping methods and acceptable euthanasia techniques).

Opportunistic intensive trapping of Masterton's Gully, Banyan Gorge, Echo Gorge and other suitable and accessible sites will be performed throughout the year.

Potential Impact from Human Disturbance and Noise Pollution

William Masterton and associates lived at the entrance to the gully for approximately 50 years and directly utilized the spring water for all of their needs including a substantial garden.

A 40mm polyethylene pipe remains in the gully as it piped the spring water to supply the current mining camp prior to the installations of the bores, and continued to supply the dwellings in which traditional owners resided on site up until the late 1990's. These dwellings were within 100metres of the entrance to the gully.

The closest current human activity the monsoon patch is the mine camp, which is approximately 250m east.

It is assumed that frequent visits to Masterton's Gully by Redbank personnel, contractors and historical site visitors may adversely impact on the monsoon forest species by scaring animals, accidental damage to habitat, introduction of weeds and fire ignition (amongst several other possible impacts). Noise does not travel far in the dense vegetation of the monsoon forests and complex sandstone rock structure of the gully. Currently, the camp diesel generator is positioned 200 m from the gully entrance and cannot be heard. No other noise pollution sources that could possible impact on the species within the monsoon patches are significant.

Proposed Disturbance Management

Access to all monsoon patches with the Redbank project area (especially Masterton's Gully) will be highly regulated and only authorised personnel that are required to enter these areas for monitoring purposes will occur. All personnel that are allowed to access monsoon forest patches will need to be inducted to do so.

Risk Analysis and Mitigation & Management Priorities

From ISO31000:2009: *“Risk analysis involves developing an understanding of the risk and provides for input to risk evaluation and to decisions on whether risks need to be treated. Risk is analysed by determining consequences and their likelihood, and other attributes of the risk. Existing controls and their effectiveness and efficiency should also be taken into account. The confidence in determination of the level of risk and its sensitivity to preconditions and assumptions should be considered in the analysis, and communicated effectively. Factors such as divergence of opinion among experts, uncertainty, availability, quality, quantity and ongoing*



relevance of information, or limitations on modelling should be stated and can be highlighted. Analysis can be qualitative, semi-quantitative or quantitative, or a combination of these, depending on the circumstances. Consequences and their likelihood can be determined by modelling the outcomes of an event or set of events, or by extrapolation from experimental studies or from available data. Consequences can be expressed in terms of tangible and intangible impacts.”

Table 1: Risk Matrix adapted from a standard risk matrix for the purposes of the qualitative and semi-quantitative analysis.

		Consequence				
		Very Low	Low	Medium	High	Very High
Likelihood	Very Low	Low Risk	Low Risk	Low Risk	Low Risk	Medium Risk
	Low	Low Risk	Low Risk	Low Risk	Medium Risk	High Risk
	Medium	Low Risk	Low Risk	Medium Risk	High Risk	High Risk
	High	Low Risk	Medium Risk	High Risk	High Risk	Extreme Risk
	Very High	Medium Risk	High Risk	High Risk	Extreme Risk	Extreme Risk

For the purposes of Redbank Mine’s proposed mine expansions involving risk of impact to the nationally endangered Carpentarian Rock-rat, any risk greater than a low risk should be considered for offsetting.

Summary of Threats from the Mine

Potential adverse impacts on the Carpentarian Rock-rats resulting from proposed oxide mine expansions are as follows:

- A. Impact on habitat and food and water availability through
 - Increased frequency of hot dry season wildfires;
 - Groundwater drawdown (from increased camp bore use or dewatering pits);
- B. Impact on predation through
 - Introduction or encouragement of predators (i.e. feral cats, dingos, pythons, ghost bats, Northern Quoll, owls etc); and
- C. General disturbance through
 - Human disturbance associated with increased traffic and camp noise.

These threats are described below in terms of their apparent risk, after Redbank implement strategies to manage/mitigate these threats.

Risk Analysis Table

The following table outlines a **qualitative and semi-quantitative** risk assessment for potential impacts to the Redbank Carpentarian Rock-rat population in Masterton’s Gully.

Table 2: Risk Analysis of the Proposed Mine Activities on the Carpentarian Rock-rat

Potential Threat to Rock Rat	Existing and Proposed Controls	Available Data	Risk Level considering controls	Confidence in Risk Level
Increased risk of wildfire in monsoon forest.	<ul style="list-style-type: none"> Patchy burn regime to reduce overall risk of late dry season wildfire. 500 m buffer of fuel-load controlled vegetation surrounding Masterton's Gully. 	Many Rock-rat researchers agree that wildfire constitutes a major risk to Rock-rat persistence.	<p>Likelihood of risk = Very Low due to proposed improved fire management regime.</p> <p>Consequence of risk = Very High as reflected in published Rock-rat research papers.</p> <p>=</p> <p>Medium Risk Level</p>	If experienced Indigenous fire managers are engaged as committed, the likelihood of residual risk of late dry wildfire is confidently low, thus risk level determination is Confident .
Groundwater drawdown from increased camp bore use or dewatering Pits.	<ul style="list-style-type: none"> Extensive monitoring and additional Environmental Monitoring Bores proposed to allow early detection of potential drawdown. Contingency to find alternative aquifer or to recharge the aquifer related to Muinyin Spring. 	Elevation data indicates that Muinyin Spring is over a separate aquifer to the camp bore. Calculated cone of depression from Pit dewatering does not intercept Rock-rat foraging area. Further hydrogeographic studies proposed.	<p>Likelihood of risk = Very Low according to available data, and in reflection of contingency actions.</p> <p>Consequence of risk = Very High due to the restricted range and small area of available Rock-rat habitat.</p> <p>=</p> <p>Medium Risk Level</p>	Available data and hydrogeological studies to date provide reasonable confirmation that risk likelihood is very low, and available Rock-rat research indicates the species is highly restricted, thus there is reasonable confirmation that the risk consequence is very high, thus risk level determination is Confident .
Predator introduction or encouragement.	<ul style="list-style-type: none"> Staff and Contractor Inductions to include feral cat and Rock-rat predator awareness. Feral cat sightings will be responded to through a targeted trapping regime. Landfill will be managed in order to reduce risk of attracting pest animals and predators. 	Research has not determined affect of feral cats on Rock-rats, nor the potential for landfills to attract these predators.	<p>Likelihood of risk = Very Low due to proposed staff and contractor awareness training in inductions.</p> <p>Consequence of risk = High due to the restricted nature and small size of the population, introduction of feral cats is likely to impact upon the local Rock-rat population.</p> <p>=</p> <p>Low Risk Level</p>	Due to lack of concrete data on the affects of feral cats on this species, confidence in risk level determination is Limited .
Increased traffic and noise disturbance.	<ul style="list-style-type: none"> Access to Masterton's Gully will be permitted by authorised personnel only Authorised personnel will need to undergo a separate induction in order to access the Gully. 	Lacking.	<p>Likelihood of risk = Very Low due to proposed access restrictions and distance from camp to Masterton's Gully.</p> <p>Consequence of risk = Low due to nocturnal nature of the Rock-rat.</p> <p>=</p> <p>Low Risk Level</p>	Due to lack of available data on the affects of noise and human disturbance on this species, confidence in risk level determination is Limited .

Due to the fact that the Rock-rat population at Redbank is one of 5 known populations, and the proposed oxide mine expansions will not directly impact upon this species or its habitat, the most applicable risk to the Rock-rat is as follows (Department of Environment and Climate Change NSW 2007):

“Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process”



The greatest risk to the Rock-rat is that Redbank’s proposed mine expansion will exacerbate existing threats to this population through; increasing risk of wildfire, reducing water quality and water availability, introduction of feral predators, introduction of weed species, and increase of general disturbance. All of these risk factors are at least manageable.

Monitoring Proposal for the Carpentarian Rock-rat

Key information Gaps

The key information gaps regarding Carpentarian Rock-rats in the Redbank area include:

- The extent and size of the Rock-rat population in Masterton’s Gully and nearby Banyan Gorge;
- Potential for connectivity between known populations;
- Critical water quality requirements for this species;
- Specific microhabitat requirements;
- Food tree species response to groundwater drawdown; and
- Potential for other existing populations that remain undocumented.

Priorities for Ongoing Monitoring

There are several monitoring components necessary to monitor potential impacts to the Carpentarian Rock-rats. These are outlined in the following table.

Note the monitoring program will be refined when the population status and habits are better understood.

Table 3: Monitoring Priorities for the Carpentarian Rock-rat

What is to be Monitored & Why	Method & Frequency
Population size and status, including home range and population connectivity to nearby gorges	Method: <i>Population Surveillance Monitoring Program</i> (trapping regime according to current SOP used by the Biodiversity Unit of NRETAS) Frequency: Annual
Groundwater Monitoring to ensure water quality is not impacted and also to detect groundwater drawdown	Method: Integrated into the project-wide groundwater monitoring program. Based on standing water levels and contaminant levels within each environmental monitoring bore, especially focused on newly proposed bores between the camp potable water bore and Masterton’s Gully. Frequency: Monthly.
Habitat Condition Monitoring to gauge effects of fire and other types of management on habitat value to threatened species.	Method: Habitat condition monitoring plots will be established at several locations in the ERL, including one in Masterton’s Gully, one on the escarpment above the Gully and one on the scree slopes that may provide foraging habitat for the Rock-rat. Frequency: Annually, in early dry season.
Stream Flow Monitoring to detect significant changes in stream flow volumes fed by	Method: Calibrated V-notches at suitable locations (narrow part of stream where most flow can be captured). Samples of water for analysis of pH, electrical conductivity, major cations and anions, and dissolved



What is to be Monitored & Why	Method & Frequency
Muinyin Spring (Rock-rat water source) – indicating drawdown affects.	metals are to be taken at these locations also. The flow data and selected hydro-chemical parameters are to be graphically presented and correlated with rainfall. Frequency: Implemented immediately, repeated monthly.
Feral Predator Monitoring to gauge success of feral cat management.	Method: The efficacy of feral cat control will be monitored through trapping success and reported sightings. Evident booms in cat numbers will be responded to through increased trapping effort. Frequency: In response to sightings; cat traps will be maintained open and baited between the camp and Masterton’s Gully. Trapped animals will be euthanased and disposed of in accordance with Animal Ethics Guidelines.

Population Surveillance Monitoring Program

Currently, the Carpentarian Rock-rat population within Masterton’s Gully is not very intensively surveyed and therefore, Redbank proposed to increase the dataset for this area by commissioning annual targeted surveys.

The NRETAS Biodiversity Unit currently monitors each population as part of the current Recovery Plan for the species. Redbank would like to complement this program by undertaking relevant works within the Redbank Springs population (which is located within ERL94), and also searching for addition populations in the surrounding monsoon patches containing permanent springs. Currently, the size and extent of the population within Masterton’s Gully (Redbank Springs) is largely unknown, as only two surveys have occurred at the location, including a survey conducted by Puckey *et al.* (2003) and the survey conducted by EcOz for the Redbank EIS 2009.

Redbank aims to commission annual (late dry season) Carpentarian Rock-rat surveys within the Redbank Springs population (Masterton's Gully). Survey methodology targeting the species will include at least 150 Elliott traps and 6 trap nights, and will largely reflect the Standard Operating Procedure developed by Biodiversity Unit – *Long-term Population Monitoring of the Carpentarian Rock-rat Zyzomys palatalis at Wollgorang Station* (Parks and Wildlife Commission NT, May 2006). Redbank will directly work with the NRETAS Biodiversity Unit to help fill in current information gaps on the species or this particular site. Other surrounding monsoon patches with permanent freshwater springs will also be explored in the surrounding area to possibly discover additional populations as the monsoon forest habitat patch within Masterton’s Gully is only approximately 2.7 hectares in area.

The Biodiversity Unit of NRETAS will be informed prior to each survey. All data will be supplied to the government in the requested format for inclusion into the master dataset maintained by NRETAS.

From recent discussions with Dr Alaric Fisher (Senior Scientist, Biodiversity Unit NRETAS), including ear clippings for DNA tissue will provide important information on population dynamics.

Groundwater Monitoring

Groundwater levels and quality will be monitored between the potable water bore and the mouth of Masterton’s Gully. Drilling of two environmental monitoring bores (actual number will be determined after geophysical traversing at the indicated locations) 75m from the camp bore at the suggested locations in

Figure 3 has been proposed for 2010. Should any drawdown be detected following 72-hr pump testing, a new water supply bore is to be drilled further afield towards the south-east along the access road to the camp. This



alternative bore will be installed during the next drilling program. (2010 dry season)

Monthly monitoring of standing water levels at these new Environmental Monitoring Bores (EMBs) between the camp bore and the Rock-rat population is anticipated to enable early detection of groundwater drawdown through increased camp water use. Installing EMBs within the monsoon forest patch is not a preferred monitoring option due to the long-term disturbance that would be associated with the drilling process. Furthermore, this area is a declared Heritage Precinct.

Please refer to

Figure 3 for proposed EMB locations and other spatial information relevant for the site.

DRAFT



- **Figure 4: Elevational** Cross-Section of the Masterton's Gully Area



Habitat Condition Monitoring

The monitoring of permanent vegetation plots in early dry (vegetation under least stress) annually over successive years will provide data with which long term changes in vegetation condition can be determined.

We propose using the Australian Government's Executive Steering Committee for Australian Vegetation Information (ESCAVI) proposed interim vegetation condition monitoring framework. ESCAVI's system will allow national consistency in vegetation condition monitoring and ESCAVI have started to prepare a refined set of indicators and protocols for native vegetation condition monitoring. ESCAVI's approach is based on the 'Habitat Hectares' approach (Parkes *et al.* 2003), an approach also adopted as a likely national framework across Australia.

It is expected that five permanent vegetation monitoring plots will be established (metal markers low to the ground at each corner); including one in Masterton's Gully monsoon forest, one in the escarpment vegetation (within the 500m fire control buffer), one on the scree slopes that may constitute Rock-rat foraging habitat (within the 500m fire control buffer). Data from the four sites will be compared to a *de facto* baseline of ideal condition against which targets could be set and future change assessed and reported.

Data sheets and methodologies will be developed such that vegetation condition monitoring will be consistent across years and survey teams. Monitoring habitat condition at these vegetation monitoring plots will allow follow up on potential impacts to habitat value for threatened species through burn regimes and wildfire.

Stream flow Monitoring

Spring flow measurements in Muinyin Spring with calibrated V-notches at suitable locations (narrow part of stream where most flow can be captured) are to be implemented immediately. The V-notch is to be installed outside the Declared Heritage Precinct (refer to

Figure 3) in the western tributary to Masterton's Gully. Samples of water for analysis of pH, electrical conductivity, major cations and anions, and dissolved metals are to be taken at these locations. The flow data and selected hydro-chemical parameters are to be graphically presented and correlated with rainfall.

Feral Predator Monitoring

Staff and contractor inductions provided by Redbank will include feral animal awareness training, importantly feral cats, and inductions will identify a requirement to report to Redbank management on number and location of sightings.

The feral cat trapping program conducted by Redbank will be ad-hoc in nature, involving trapping during late dry season near permanent waterholes to which the cats and their prey are likely to be attracted. Up to six cat traps will be set in the vicinity of Masterton's Gully, or other locations within the ERL for three to four nights and checked daily. Opportunistic intensive trapping of Masterton's Gully, Banyan Gorge, Echo Gorge and other suitable and accessible sites will be performed throughout the year. Trapped cats will be euthanased according to Animal Ethics guidelines.

Metrics for Calculating Off sets

Although the proposed oxide mine expansion does not pose threat of direct impacts to the Carpentarian Rock-rat through habitat reduction, there remains a risk that the Carpentarian Rock-rat population within the project area will be impacted upon indirectly through increased risk of fire (medium risk), groundwater drawdown (medium risk), introduction of predators (low risk), and increased levels of disturbance (low risk).



Proposed Off sets

Increased Survey Effort to Address Information Gaps

Redbank plan to complement the current Recovery Plan for the Carpentarian Rock-rat *Zyzyomys palatalis* that is under the responsibility of NRETAS (Puckey *et al.* 2003). The specific objectives for the recovery plan are as follows:

- Develop and implement appropriate management strategies to maintain known populations;
- Continue research into ecology and population demography to fill current information gaps;
- Continue to adapt established (population viability assessment) PVA models as new information becomes available;
- Maintain a viable captive breeding population;
- Investigate aspects of the biology of Carpentarian Rock-rats using captive animals;
- Experimentally release captive bred individuals into potentially suitable areas not currently occupied; and
- Raise the profile of Carpentarian Rock-rat in the community.

Redbank will commit to providing monitoring and survey data on prescribed fire and cat trapping activities, which will inform and assist the first three recovery objectives listed for the Rock-rat.

For offset purposes, survey effort will also be extended to include the nearby Carpentarian Rock-rat population in Banyan Gorge, which may be continuous with the population in Masterton's Gully.

Extending Wildfire Management to include off-site Banyan Gorge

Fire Management proposed will include investment into applying a patchy burn regime over not only the Redbank Mine ERL, but over the greater Wollongorang region. This is expected to promote biodiversity over a greater region and also to reduce risk of late dry season wildfire. Creation of this fire regime is also likely to dramatically reduce risk of late dry season hot wildfires that would threaten monsoon forest vegetation and potential Rock-rat habitat in the region.

Redbank also propose to extend the buffer of controlled fuel loads surrounding the monsoon forest of Masterton's Gully to include the nearby Banyan Gorge and resident Rock-rat population. Fuel loads in vegetation to a 500 m radius surrounding the patchy belt of monsoon forest including Masterton's Gully and Banyan Gorge will be controlled through a biennial burn regime.

This proposed offset will provide greater assurance of persistence of these two known Rock-rat populations (which may be a continuous population) though reducing the risk of wildfire, this nationally endangered species' greatest threat. Similar fire management of potential habitat such as Echo Gorge will also be investigated.

Extending Feral Cat Management to Off-site Areas

The feral cat trapping program will be extended to include ad-hoc trapping during late dry season near permanent waterholes to which the cats and their prey are likely to be attracted. Up to six cat traps will be set at a chosen area for three to four nights and checked daily. Trapped cats will be euthanased according to Animal Ethics guidelines. Selected areas will include Banyan Gorge and Echo Gorge, and may extend to target suspected source points of feral cats, such as nearby communities. Should reports indicate that feral cat



populations are booming despite the trapping program, Redbank will consider investment into a de-sexing program for cats at communities in the vicinity of Masterton's Gully and Banyan Gorge.

Ensuring longevity of Rock-rat Offsets

Redbank do not commit to investing in offsets after the end of this proposed oxide mining phase anticipated to span 3-4 years. However, longevity of Redbank's proposed actions will contribute to the long term conservation of the Carpentarian Rock-rat over and above the mining period through up-skilling and capacity development of Indigenous land managers through engagement in the fire and feral management regime. Prescribed monitoring will also be a key in ensuring longevity of management through providing monitoring results to relevant research bodies and authorities regarding the Rock-rat population responses to prescribed fire and feral management practices, thus enhancing future management planning for this species.

DRAFT



References

- Department of Environment and Climate Change NSW (2007). *Threatened Species Assessment Guidelines – the assessment of significance*. Viewed 24 February 2010, <http://www.environment.nsw.gov.au/resources/threatenedspecies/tsaguide07393.pdf>
- Parkes D, Newell G & Cheal D (2003). Assessing the quality of native vegetation: The 'habitat hectares' approach. *Ecological Management and Restoration*: Vol 4 Supplement February 2003.
- Puckey H (2003). Additional records of the Carpentarian Rock-rat *Zyomys palatalis* at Redbank, close to the type locality. *Northern Territory Naturalist* 17: 43-45.
- Puckey H, Lewis M, Hooper D, & Michell C (2004). Home range, movement and habitat utilisation of the Carpentarian rock-rat (*Zyomys palatalis*) in an isolated habitat patch. *Wildlife Research* 31, 327-337.
- Puckey H & Woinarski J (2006). *Threatened Species of the Northern Territory: Carpentarian Rock-Rat Zyomys palatalis*, NRETAS, Northern Territory Government, viewed 31 July 2009, http://www.nt.gov.au/nreta/wildlife/animals/threatened/pdf/mammals/carpy_rockrat_cr.pdf
- Trainor C (1996). Carpentarian Rock-rat (*Zyomys palatalis*) survey to clarify species status. *Final report to Endangered Species Unit ANCA*.
- Trainor, C, Fisher A, Woinarski J & Churchill S (2000). Multiscale patterns of habitat use by the Carpentarian rock-rat (*Zyomys palatalis*) and the common rock-rat (*Z. argurus*). *Wildlife Research*. 27: 319-332.
- Woinarski J, Pavey C, Kerrigan R, Cowie I and Ward S (2007). *Lost from Our Landscape: Threatened species of the Northern Territory*. Published by Department of Natural Resources, Environment and The Arts (2007).

