Northern Quoll Management Plan

Pilgangoora Project

Pilbara, Western Australia

Rev. B

Prepared for
Pilbara Minerals Limited by
Animal Plant Mineral Pty Ltd.

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1 INTRODUCTION

1.1 PROJECT AND LOCATION

The Pilgangoora Lithium-Tantalum Project (**the Project**) is owned and operated by Pilbara Operations Pty Ltd, a 100% subsidiary of Pilbara Minerals Limited (**PLS**).

The project is located approximately 80 kilometres (**km**) south-southeast of the town of Port Hedland and 30 km northeast of the Wodgina Mine, in the north-eastern Pilbara region of Western Australia (**WA)**. The site is accessed from Port Hedland via the Pippingarra Road. The location of the Project is shown in Figure 1-1.

The disturbance envelope for the Project is the combined boundary of tenements M45/78, M45/333, M45/511, M45/1256, M45/1266, M45/1275, L45/402, L45/411, L45/413, L45/414, L45/417, L45/421, L45/429, L45/430, L45/449, L45/450, L45/454, L45/473, L45/477, L45/478, L45/479, L45/480, L45/481, L45/482 and L45/528.

The current life of mine is approximately 26 years.

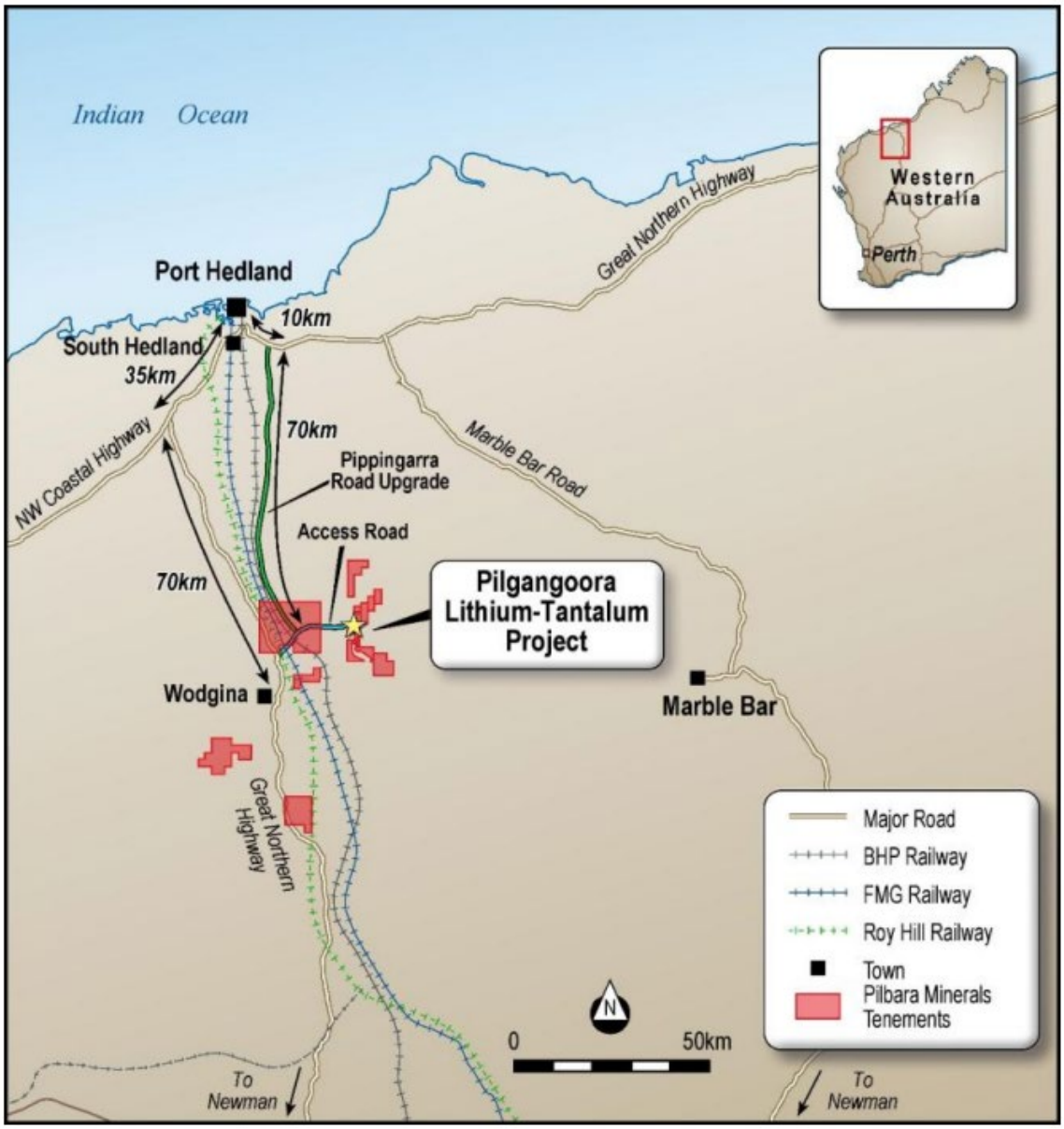


Figure 1-1. Project location

1.2 SCOPE OF WORK

Animal Plant Mineral Pty Ltd (**APM**) was commissioned by PLS to develop a Northern Quoll Management Plan (**NQMP**) for the Pilgangoora Project. The NQMP has been developed as an "Operational Management Plan" for an existing and expanding mine site.

1.3 OBJECTIVE AND INTENDED OUTCOMES

The Objective of the NQMP is to avoid direct and indirect impacts to the Northern Quoll (*Dasyurus hallucatus*) from the Pilgangoora Project where possible. Where not possible to avoid, the objectives are to minimise impacts and implement mitigation strategies which are then to be monitored to gauge effectiveness.

The intended outcomes of the NQMP are to:

- Maintain the abundance, geographic distribution and condition of Northern Quoll within the Pilgangoora area;
- Monitor changes in Northern Quoll populations around the Project and identify whether changes are attributable to natural variations, or to the Pilgangoora Project activities; and
- Adopt an adaptive management approach, based on monitoring outcomes, that identifies management responses to be enacted where trigger and threshold values are exceeded.

2 RELEVANT LEGISLATION

PLS employees and contractors are obliged to comply with all relevant environmental State and Commonwealth legislation. Legislation directly relevant to the management of fauna (including Northern Quoll) is listed in Table 2-1.

Table 2-1. Legislation

Legislation	Description
Environment Protection and Biodiversity Conservation Act 1999 (**EPBC Act**, Commonwealth)	The Commonwealth EPBC Act is administered by the Department of Climate Change, Energy, the Environment and Water (**DCCEEW**). It provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined in the EPBC Act as Matters of National Environmental Significance (**MNES**). If a project has the potential to significantly impact on MNES it is to be referred to the DCCEEW for determination on whether the matter is a 'controlled action' and therefore requiring assessment. Species and communities listed under the EPBC Act are protected and require authorisation by the Minister to take or disturb. The EPBC Act also provides for the development of conservation advice and recovery plans, development of a register of critical habitat, recognition of key threatening processes and the development of threat abatement plans. The Northern Quoll is listed as a Threatened species under the EPBC Act in the category Endangered. Listing Advice (Threatened Species Scientific Committee [**TSSC**], 2005), a National Recovery Plan (Hill and Ward 2010), Survey Guideline (Department of Sustainability, Environment, Water, Population and Communities [**DSEWPaC**], 2011) and EPBC Referral Guideline are in force under the EPBC Act. Threat abatement plans for cane toads, feral cats and five listed invasive grasses are in force under the EPBC Act (Department of the Environment [**DotE**] 2015, DSEWPaC 2011, 2012) are relevant to the Northern Quoll. The Lynas Find Project, a component of the Pilgangoora Project, has been referred under the EPBC Act (EPBC Number: 2023/09471), and determined to be a Controlled Action on the 23/05/2023.
Biodiversity Conservation Act 2016 (**BC Act**, WA)	The BC Act provides a statutory basis for the listing of Threatened species, specially protected species, extinct species, Threatened Ecological Communities, collapsed ecological communities, critical habitat and key threatening processes in WA. Species and communities listed under the BC Act are protected and require authorisation by the Minister to take or disturb. The Northern Quoll is listed as a Threatened species under the BC Act in the category of Endangered.
Animal Welfare Act 2002 (**AW Act**, WA)	The AW Act provides the legal framework for ensuring that all animals in Western Australia have appropriate standards of care. Licensing and Animal Ethics approval is required prior to the implementation of monitoring programs for Northern Quoll.

3 NORTHERN QUOLL RECORDS AND HABITAT

The results of baseline surveys and previous Northern Quoll assessments for the Pilgangoora Project, together with current understanding of the species, have informed the management and monitoring approach for this NQMP.

Surveys that have informed on the presence and distribution of Northern Quoll across the Pilgangoooora Project are listed in Table 3-1.

Table 3-1. Northern Quoll surveys

Author (Year)	Survey effort	Summary of Northern Quoll findings
360 Environmental (2016)	3rd to 7th August 2015 11 Camera traps Habitat Mapping	Recorded rocky areas that comprise suitable habitat, such as rock piles and outcrops. No evidence of Northern Quoll was recorded in the survey, but it was considered Possibly occurring.
Ecologia Environment (2019)	Targeted Search for signs	Recorded scats from five locations in the rocky hills and one location in a small rocky outcrop in the footslopes habitat type.
Terrestrial Ecosystems (2020)	23rd September to 12th November 2019 30 Camera traps with non-reward lures Fauna Habitat mapping	Twelve camera traps recorded Northern Quoll all within rocky hills habitat type along the north-south rocky ridge line. The rocky ridges, breakaways, treed creek lines and adjoining corridors plus a suitable buffer zone of approximately 500 metres would constitute important habitat critical to the Northern Quoll survival (DotE 2016).
APM (2022a)	9th to 25th of August 2022 Fauna Habitat mapping 16 Unbaited Camera traps Targeted search for signs	Two camera traps recorded Northern Quoll and three scats were recorded in boulders/ridge top habitat. Populations and habitat critical to the survival of the Northern Quoll (DotE 2016) was mapped.
APM (2022b)	4th to 21st of October 2022 Fauna Habitat mapping 8 Unbaited Camera traps Targeted search for signs	No records of Northern Quoll and no habitat critical to the survival of the Northern Quoll was mapped.
APM (2023a)	26th to 19th of April 2023 Fauna Habitat mapping 16 Unbaited Camera traps Targeted search for signs	One Northern Quoll scat was recorded in plains habitat and a small area of rocky outcrop habitat potentially suitable for denning was mapped.
APM (2023b)	October 2022 to February 2023 62 Unbaited Camera traps Targeted search for signs	Nine camera traps recorded Northern Quoll – seven in boulder/ridgetop habitat and two at abandoned pits with pit lakes.
DBCA Database	13/08/2018 Opportunistic sighting	A dead quoll was recorded on the main Access Road, past the Monster pit.
PLS Fauna Database	Opportunistic sighting	A dead quoll was recorded next to the warehouse.

Habitat critical to the survival of the Northern Quoll and populations important for the long-term survival of the Northern Quoll are defined in DotE (2016). The animals within the Pilgangoora area are a population important for the long-term survival of the Northern Quoll as it is a population occurring in habitat that is free of cane toads and unlikely to support cane toads upon arrival *i.e.* granite habitats in WA (DotE 2016).

Habitat critical to the survival of the Northern Quoll is present in the Pilgangoora area and includes:

- rocky outcrop/hills/ridgeline habitats;
- areas of native vegetation within 1 km of Rocky outcrop/hills/ridgeline habitats; and
- dispersal and foraging habitat associated with or connecting the population within Rocky outcrop/hills/ridgeline habitats to other nearby populations or foraging habitats.

Northern Quoll record locations and habitat critical to the survival of the Northern Quoll is shown in Figure 3-2.

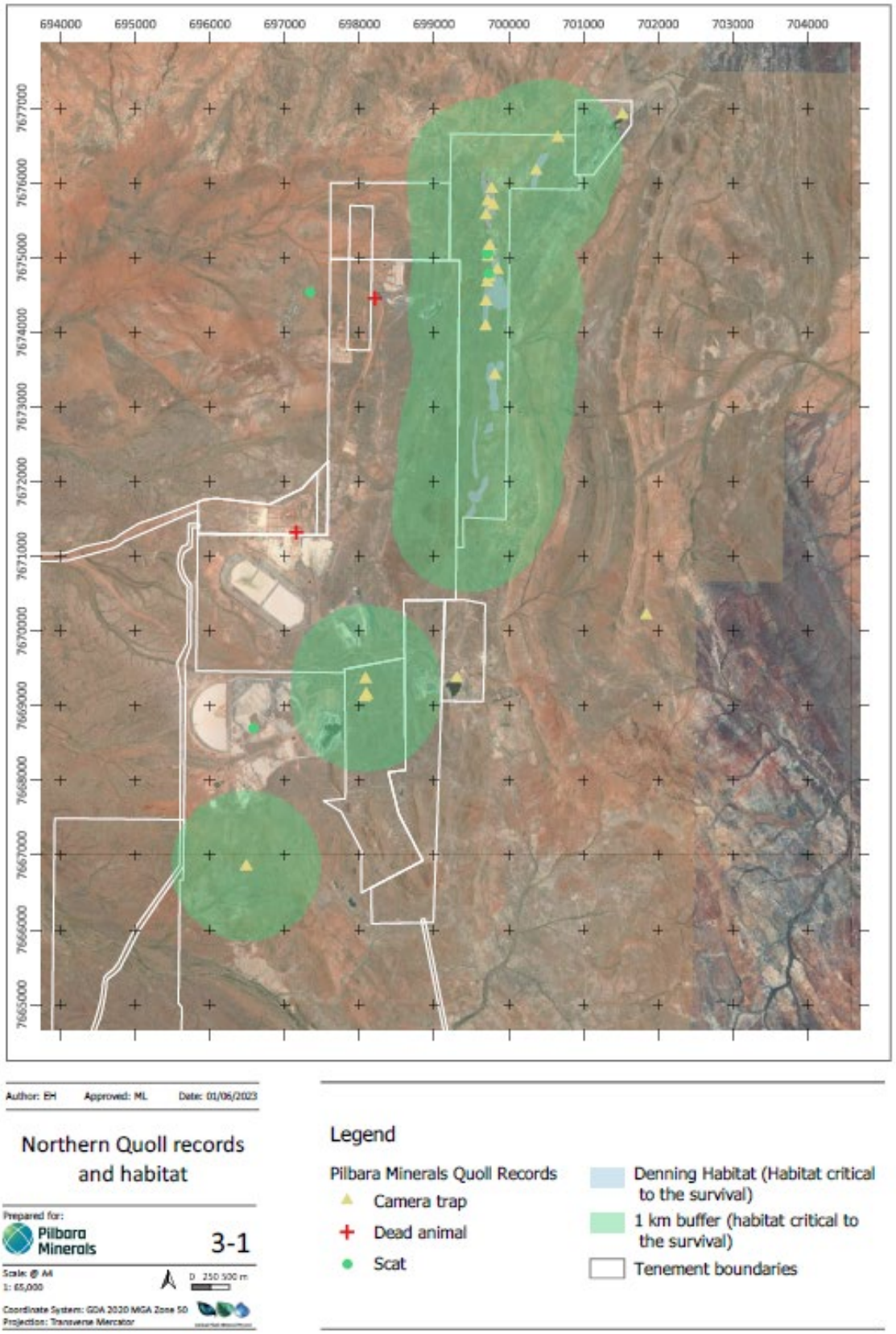


Figure 3-1. Northern Quoll records and habitat

4 NORTHERN QUOLL ECOLOGICAL INFORMATION

4.1 THREATENING PROCESSES

The species was once widely distributed from the Pilbara, Kimberley, across the Top End to southern Queensland, but has now contracted in distribution and density to several disjunct populations within their former range (Braithwaite and Griffiths 1994). Northern Quolls have declined at a rapid rate in association with the spread of the introduced cane toad (*Rhinella marina*), which poisons quolls in their predation attempts (Cramer and Dunlop 2018). Several other ecological factors are contributing to the decline of quolls and other medium-sized mammal species, including predation by feral cats (*Felis catus*), wild dogs (*Canis lupus*), altered fire regimes, total grazing pressure and subsequent habitat modification by introduced herbivores, habitat loss and fragmentation, as well as interactive effects between threatening processes (Cramer and Dunlop 2018; Woinarski *et al.* 2014; Hill and Ward 2010; Braithwaite and Griffiths 1994).

4.2 DIET

The Northern Quoll is primarily carnivorous, feeding on invertebrates and small vertebrates. They will also opportunistically eat eggs and fleshy fruit or scavenge on roadkill or waste (Cramer and Dunlop 2018; Dunlop *et al.* 2017; Radford 2012).

4.3 BREEDING

Northern Quoll mating season is usually in late June, with six to eight young being born to a female in July, whereby they grow in the pouch and are deposited in dens after six to nine weeks (Oakwood 2008; Chan *et al.* 2019). The species undergoes an intense mating period, after which the majority of males experience immune system collapse and eventual death (Fisher *et* al. 2013; Oakwood *et al.* 2001).

4.4 LOCAL POPULATION

Within the Pilgangoora Project area, Northern Quoll records are predominantly occurring within rocky outcrop/hills/ridgeline habitats. In the broader region there are records in the Turner River and larger tributaries of the Turner River, 16 km to the west of the Pilgangoora Project area.

It is unknown whether the population inhabiting the rocky hills to the east of the Pilgangoora Project are connected with the Turner River population, but it would be expected that connectivity between the two populations would occur via the creeks and channels, which provide greater cover and forage potential over the 16 km separation. However, there is currently no evidence of such usage as no scats or other evidence of Northern Quoll in creeklines has been recorded locally. This is possibly due to the lack of large trees with hollows, as a scarcity of denning habitat may be a limiting factor over the 16 km distance.

All habitats occurring within the Pilgangoora Project area may be utilised by the species, at some time, to forage and or during dispersal activities; however, their significance to the species will vary depending on resource availability and connectivity. Denning habitat and the habitat within 1 km of denning habitat is the most critical for the sustainability of the local population.

5 ENVIRONMENTAL IMPACTS AND MANAGEMENT

A risk assessment has been undertaken to identify all potential impacts of the Pilgangoora Project on the local Northern Quoll population (Table 5-4). This has involved the identification of activities that can result in impacts to the Pilgangoora Quoll population, implementing controls to reduce the risk, and monitoring the effectiveness of controls.

The risk assessment has identified the potential and realised risks to the Northern Quoll's abundance health and habitat and from these, an inherent risk (before the implementation of controls) and residual risk (after implementation of controls) have been determined. Management measures have been proposed to reduce the risk to a level based on 'As Low As Reasonably Possible' principles.

The risk matrix ranking is provided in Table 5-1, whilst the categories used to determine the likelihood and consequence are provided in Table 5-2 and Table 5-3.

Table 5-1: Risk Matrix Rating

		Consequences				
		Insignificant	Minor	Moderate	Major	Severe
Likelihood	Rare	Low	Low	Low	Moderate	Moderate
	Unlikely	Low	Low	Moderate	Moderate	High
	Possible	Low	Moderate	Moderate	High	High
	Likely	Moderate	Moderate	High	Extreme	Extreme
	Almost Certain	Moderate	High	High	Extreme	Extreme

Table 5-2: Risk Matrix Likelihood

Likelihood	Frequency	Description
Almost Certain	Twice or more per year	Event will occur during the Project or period under review
		High number of known incidents
Likely	Once per year	Event likely to occur during the Project or period under review.
		Regular incidents known.
Possible	Once in 5 years	Event may occur in some instances during the Project or period under review.
		Occasional incidents known.
Unlikely	Once in 10 years	Event is not likely to occur during the Project or period under review.
		Some occurrences known
Rare	Once in 20+ years	Event will occur in exceptional circumstances during the Project or period under review.
		Very few or no known occurrences

Table 5-3: Risk Matrix Consequence

Consequence ranking	Definition
Insignificant	Alteration or disturbance to an isolated area with no effect on Northern Quoll habitat or ecosystem. No loss of Northern Quoll individuals.
Minor	Alteration or disturbance to <10% of Northern Quoll habitat or ecosystem resulting in impact recovery within 2 years. Loss of Northern Quoll individuals.
Moderate	Alteration or disturbance to 10- 40 % of a habitat or ecosystem resulting in a recoverable impact within 2-5 years. Loss of up to 50% Northern Quoll population within Pilgangoora local area.
Major	Alteration or disturbance to 40- 70 % of a habitat or ecosystem resulting in a recoverable impact within 5-15 years. Loss of up to 80% of individuals of Northern Quoll population within Pilgangoora local area.
Severe	Alteration or disturbance to >70 % of a habitat or ecosystem resulting in a recoverable impact within >15 years. Loss of >80% of Northern Quoll population within Pilgangoora local area.

Table 5-4: Risk Assessment

Risk Pathway	Description of Impact (Unwanted Event))	Likelihood	Consequence	Risk	Controls / Treatment	Likelihood	Consequence	Risk
Vegetation clearing and land disturbance of critical / denning habitat	Decline in Northern Quoll population numbers Fragmentation of habitat restricting movement throughout critical habitat areas / isolation of Northern Quoll population	Likely	Major	Extreme	No disturbance within exclusion areas. Prior to ground-disturbing activities, pre-clearance trapping for Northern Quoll will be conducted within denning habitat. Further assessments of denning habitat will occur to map areas likely to host dens or potential future dens – this will include passive monitoring techniques (e.g. motion-sensor cameras) to establish quoll use. Disturbance to native vegetation will be minimised. A Clearing Permit will be obtained prior to clearing. Staged clearing An internal Land Use Certificate (**LUC**) will be obtained prior to ground disturbance. No unauthorised off-track driving to occur Conduct progressive rehabilitation where possible, using local provenance seed	Possible	Major	High
Vegetation clearing and land disturbance of foraging and dispersal habitat	Decline in Northern Quoll population numbers due to reduced food sources. Fragmentation of habitat resulting in restricted movement to foraging and denning areas.	Possible	Major	High	Prior to ground-disturbing activities, pre-clearance trapping for Northern Quoll will be conducted in foraging and denning habitat. Disturbance to native vegetation will be minimise where practicable. A Clearing Permit will be obtained prior to clearing. Staged clearing An internal LUC will be obtained prior to ground disturbance. No unauthorised off-track driving to occur Conduct progressive rehabilitation using local provenance seed to minimise the time between disturbance and rehabilitation	Unlikely	Major	Moderate
Vegetation clearing and land disturbance Vehicle movements Human and mine site activities	Introduction or spread of weed species resulting in: • an increase of the susceptibility of vegetation to fire and an increase in the intensity of fire. • degradation of Northern Quoll habitat.	Possible	Moderate	Moderate	A total LUC will be in place at the Project unless required for emergency response training (and in these cases only in low-risk weather conditions) Firebreaks will surround all project infrastructure Roads and haul roads will act as fire breaks. No unauthorised vehicle or human access to exclusion areas or off main mine access roads. All vehicles will be clean or vegetation or soil material prior to mobilisation to site. Existing weed species and infestations within operational mining areas will be managed. Wash down bays will be installed for vehicles required to go off main mine roads (e.g. for environmental monitoring, exploration etc.). Where relevant, weed hygiene zones will be established around important habitat areas to maintain the integrity of Northern Quoll habitats. Monitoring of introduced flora will be conducted annually.	Unlikely	Moderate	Moderate

Risk Pathway	Description of Impact (Unwanted Event))	Likelihood	Consequence	Risk	Controls / Treatment	Likelihood	Consequence	Risk
Vehicle movement and human activities increasing the risk of fire ignition	Ignition of fires resulting in habitat loss and Northern Quoll deaths. Reduction of population size.	Possible	Major	High	A total fire ban will be in place unless for emergency response training (and in these cases only in low risk weather conditions) Fire breaks of 5 m will surround project infrastructure Inductions will include fire safety and awareness, including not stopping hot vehicles over dry grass Roads and haul roads will act as fire breaks, Fire fighting equipment (e.g. extinguishers, fire blankets) will be located across site in fire risk areas including workshops, hydrocarbon and chemical storage areas, offices, camp site, mobile and fixed plant areas etc. All light vehicles will be fitted with firefighting equipment. Fire suppression equipment will be made available for all hot works. Hot work permits must be obtained prior to conducting work Specific personnel will be trained in the use of fire extinguishing equipment and fire prevention measures in work areas. An emergency response team will be available to respond to fire where it is safe to do so.	Unlikely	Major	Moderate
Domestic waste, mine site water sources and human activities attracting feral fauna.	Degradation of habitat or habitat loss. Decline in population due to increased predation or competition for resources, disease transmission, poisoning from ingestion of cane toad. Health impacts from ingesting waste or contaminated water	Possible	Moderate	Moderate	Inductions and training will address not feeding fauna, including Northern Quoll Reporting of Northern Quoll sightings by mine site personnel Rubbish bins with lids located around site Educational fauna signage in crib rooms and high traffic areas Lined dams fenced with fauna egress points Feral Animal Management Program-managed by PLS Environmental Team	Unlikely	Moderate	Moderate
Mine site noise	Reduction of habitat utilisation and corresponding reduction of population size; however, key denning habitat is located away from main plant areas. Behavioural changes.	Possible	Minor	Moderate	Engineering controls to minimise noise from plant and equipment All plant and equipment designs will meet occupational noise standards.	Unlikely	Minor	Low
Generation of dust from mine activities	Habitat degradation resulting in reduced use of denning / foraging habitat - key denning habitat is located away from main mining areas. Respiration issues resulting in reduction of population size and health	Possible	Minor	Moderate	Use of water carts along roads and cleared areas to minimise dust generation Staged clearing Use of engineering controls to minimise dust Use of sprinklers and deluge sprays where required. Vehicle speeds restricted on cleared tracks to minimise the generation of dust.	Unlikely	Minor	Low
Blasting and drilling at mine site	Vibrations causing habitat destruction (e.g. cave/den collapse) and loss of significant habitat inside exclusion areas	Possible	Major	Hugh	Vibration impact zones will be mapped in relation to den habitat. Disturbance from blasting and drilling will be minimised where practicable In close proximity, drilling should take place outside of the 'young in den' period. Blasting will occur at nighttime when quoll are less likely to be in dens.-not practical	Unlikely	Major	Moderate

Risk Pathway	Description of Impact (Unwanted Event))	Likelihood	Consequence	Risk	Controls / Treatment	Likelihood	Consequence	Risk
Insufficient recording and reporting leading to lack of data on Northern Quolls	Impacts to Northern Quoll population going unnoticed Failure to identify all critical habitat or populations resulting in unintentional clearing of habitat and Northern Quoll deaths Reduction in Northern Quoll population in the Pilgangoora area	Possible	Major	High	Additional surveys conducted prior to construction to identify all potential dens-construction of ? Do we need more surveys? Identification of blasting vibration zone of impact prior to construction Camera trap monitoring to identify active denning and foraging areas	Unlikely	Major	Moderate
Vehicle movement and collision with Northern Quoll	Mortality to individuals through road kills	Likely	Moderate	High	Vehicle speed will be restricted to 60 km/hr Roadkill will be moved off road to discourage scavenging and further strikes. Records of vehicle incidents involving fauna will be recorded.	Possible	Moderate	Moderate
Poor waste management	Ingestion of waste material causing illness and mortality in individuals. Entrapment within waste material causing mortality in individuals	Possible	Moderate	Moderate	Inert and putrescible waste will be disposed of in a licensed landfill facility at the mine site. Waste will be regularly buried Landfill will be fenced-not going to fence current landfill. New facility will be fenced. Rubbish bins will have lids to prevent dispersal of waste by wind and birds. Inductions will include fauna component and appropriate disposal of waste.	Rare	Moderate	Low
Attraction to mine site water sources	Death via drowning of individuals in dams Illness or death of individuals through consumption of contaminated water.	Possible	Moderate	Moderate	Fauna egress mats will be in place in dams.	Rare	Moderate	Low
Interaction with mine site personnel	Feeding of Northern Quolls causing illness, mortality and reliance on human food sources resulting in a decline in population and health. Northern Quoll behavioural change.	Possible	Minor	Moderate	Training on the identification and reporting of Northern Quoll will be included in environmental inductions and toolbox training presentation. Feeding of Northern Quoll (and other native species) will be banned. This will be communicated to personnel in environmental inductions and environmental awareness sessions.	Unlikely	Minor	Low

6 MANAGEMENT APPROACH

Management provisions to avoid, minimise and mitigate risks are outlined in Table 6-1. Management provisions are applied in a hierarchical order:

1. Avoid impacts – preserve populations and habitat to avoid further loss.
2. Mitigate impacts – prevent habitat degradation and retain habitat function.
3. Monitor effectiveness of mitigation – ensure mitigation is effective and feeds back into an adaptive management plan.

These provisions include the establishment of an exclusion zone for the avoidance of denning habitat areas where possible (Table 6-1).

Table 6-1: Northern Quoll Management Plan provisions

Factor	Terrestrial Fauna
Objective	Avoid the direct and indirect impacts to the Northern Quoll from the Pilgangoora Project where possible. Where not possible to avoid, minimise impacts and implement mitigation strategies. Monitor the effectiveness of mitigation strategies.
Key environmental values	Northern Quoll and its habitat (denning and foraging)
Key impacts	Loss of Northern Quoll significant habitat and/or injury to or loss of individual Northern Quoll
Key risks	Destruction of critical habitat / denning habitat Direct and indirect impacts to critical habitat / denning habitat Fragmentation of Northern Quoll habitat

Management targets	Management actions	Monitoring	Reporting
Maintain the abundance, geographic distribution, and condition of Northern Quoll within the Pilgangoora area.	Record observations of feral predator animals (foxes, wild dogs, feral cats) within operational areas and monitoring points. Continue with artificial denning program and regularly monitor dens to establish success of program.	Opportunistic observations within the Project area. Motion triggered camera monitoring.	Record keeping of all sightings or evidence of feral fauna. Regulator reporting as required by approvals.
No disturbance to Northern Quoll habitat within exclusion zones.	Enter Northern Quoll habitat areas and exclusion zones into PLS GIS system. No entry of unauthorised personnel into exclusion zones. Install signage at all access points to exclusion zones. Include access limitation in site inductions. No works in exclusion zones unless for survey / monitoring purposes. No clearing of Northern Quoll habitat without appropriate regulatory and internal approvals (e.g., DMIRS Native Vegetation Clearing Permit and LUC). Conduct further investigations to establish the extent of vibration risk (potential impact zone) from drilling and in pit blasting to quantify at-risk dens / denning habitat.	Inspections following clearing and ground disturbance. Audit to ensure appropriate signage in place for exclusion zones. Annual audits / inspections to check habitat areas and disturbance areas. Motion triggered camera monitoring.	Regulator reporting as required by approvals. Internal reporting of incidents. Record keeping and data management through site Environmental Management System. Reporting of any incidents to appropriate Regulator as required.

Management targets	Management actions	Monitoring	Reporting
	Identify sites used, or with the potential for use, as dens. Map the occurrence of dens along the ridgeline and assess their physical conditions e.g. temperature and humidity.		
Minimise impacts of mine activities on Northern Quoll habitat and Northern Quoll population from vegetation clearing and land disturbance.	Prior to ground-disturbing activities, pre-clearance trapping for Northern Quoll will be conducted in foraging and denning habitat. Further assessments of denning habitat will occur to map areas likely to host dens or potential future dens – this will include passive monitoring techniques (e.g. motion-sensor cameras) to establish quoll use. Disturbance to native vegetation will be minimised. A Native Vegetation Clearing Permit issued by DMIRS will be obtained prior to clearing (if required). An internal Land Use Certificate will be obtained prior to ground disturbance. No off-track driving to occur unless required for monitoring or survey purposest. Demarcation of approved clearing areas. Conduct progressive rehabilitation where possible, using local provenance seed. No disturbance to denning habitat within exclusion areas.	Inspections following clearing and ground disturbance. Annual audits / inspections to check habitat areas and disturbance areas.	Regulator reporting as required by approvals. Reporting under Ground Disturbance Permit system for completion of clearing.- LUC Internal reporting of incidents. Reporting of any incidents to appropriate Regulator as required.
Minimise impacts of mine activities on Northern Quoll habitat from weeds.	No unauthorised vehicle or human access to exclusion areas or off main mine access roads. All vehicles will be clean or vegetation or soil material prior to mobilisation to site. Existing weed species and infestations within operational mining areas will be managed. Wash down bays will be installed for vehicles required to go off main mine roads (e.g., for environmental monitoring, exploration etc.). Monitoring of introduced flora will be conducted annually.	Site weed inspections to check for new infestations. Annual weed assessments and mapping.	Regulator reporting as required by approvals. Records kept of all infestations and weed species. Records kept of weed management and techniques used.

Management targets	Management actions	Monitoring	Reporting
Minimise impacts of mine activities on Northern Quoll habitat and Northern Quoll population from human-induced fire.	A total fire ban will be in place unless for emergency response training (and in these cases only in low-risk weather conditions) Fire breaks of 5 m will surround project infrastructure. Inductions will include fire safety and awareness, including not stopping hot vehicles over dry grass. Roads and haul roads will act as fire breaks. Firefighting equipment (e.g. extinguishers, fire blankets) will be located across site in fire risk areas including workshops, hydrocarbon and chemical storage areas, offices, camp site, mobile and fixed plant areas etc. All light vehicles will be fitted with firefighting equipment. Fire suppression equipment will be made available for all hot works. Hot work permits must be obtained prior to conducting work. Specific personnel will be trained in the use of fire extinguishing equipment and fire prevention measures in work areas. An emergency response team will be available to respond to fire where it is safe to do so.	Regular audits of all high-risk areas, vehicles etc. to check for firefighting equipment. Regular inspections of fire breaks. Audits of hot works to ensure appropriate controls are being implemented to prevent fire ignition.	Regulator reporting as required by approvals. Reporting of incidents.
Minimise impacts of mine activities on Northern Quoll habitat and population from waste and hydrocarbon or chemical contamination.	Inert and putrescible waste will be disposed of in a licensed landfill facility at the mine site. Waste in landfill will be regularly buried (every 48 hours). Cell to be buried to depth once cell is full. Landfill will be fenced. -not getting fenced Rubbish bins will have lids to prevent dispersal of waste by wind and birds. Inductions will include fauna component and appropriate disposal of waste. Hydrocarbons and chemicals will be stored, used, transported and disposed of in accordance with Dangerous Goods Regulations.	Regular inspections of landfill. Audit following installation of fencing and safeguards. Regular inspections of hydrocarbon and chemical storage areas.	Reporting of incidents. Regulator reporting as required by approvals or legislation. Records kept of any incidents.

Management targets	Management actions	Monitoring	Reporting
	Hydrocarbon and chemical spills will be immediately cleaned up and contaminated material appropriately disposed of. Hydrocarbons and chemicals will be stored in bunded containers.		
Minimise impacts of mine activities on Northern Quoll population from vehicle collision.	Vehicle speed restrictions of 60 km/hr will apply. Roadkill will be moved off road to discourage scavenging and further strikes. Records of vehicle incidents involving fauna will be recorded.	Monitoring of vehicle speeds.	Records kept of incidents. Regulator reporting as required by approvals or legislation.
Minimise impacts of mine activities on Northern Quoll habitat and Northern Quoll population from noise, light and dust.	Noise emissions from plant and equipment will be minimised through engineering controls All plant and equipment design will meet occupational noise standards. Artificial light will be directed towards active mine areas and away from undisturbed vegetation. Dust generation from project activities will be minimised by engineering controls and use of dust suppression measures, such as water trucks, sprinklers, and deluge sprays. Vehicle speeds will be restricted on cleared tracks to minimise the generation of dust.	Noise monitoring. Audits of lighting. Dust monitoring.	Records kept of incidents. Regulator reporting as required by approvals or legislation.
Minimise impacts of mine activities on Northern Quoll habitat and Northern Quoll population from vibrations from blasting.	Vibration impact zones will be mapped in relation to den habitat. Critical habitat / dens will be inspected following blasting to check for damage. Blasting will be conducted at night when Quoll are less likely to be in dens.	Monitoring of dens and critical habitat following blasting to assess impacts. Monitoring of vibrations when blasting.	Records kept of incidents. Regulator reporting as required by approvals or legislation.
Minimise impacts of mine activities on Northern Quoll population from human interactions.	Inductions and training will address not feeding fauna, including Northern Quoll. Reporting of Northern Quoll sightings by mine site personnel. Rubbish bins located around site. Educational fauna signage in crib rooms and high traffic areas.	Audits of inductions and putrescible waste management.	Record keeping of sightings.

Management targets	Management actions	Monitoring	Reporting
Minimise impacts of mine activities on Northern Quoll population from entrapment in dams or consumption of contaminated water.	All lined dams will be fenced and have fauna egress matting at regular intervals along the dam.	Audits / inspections of fencing and egress points.	Records kept of incidents. Regulator reporting as required by approvals or legislation.

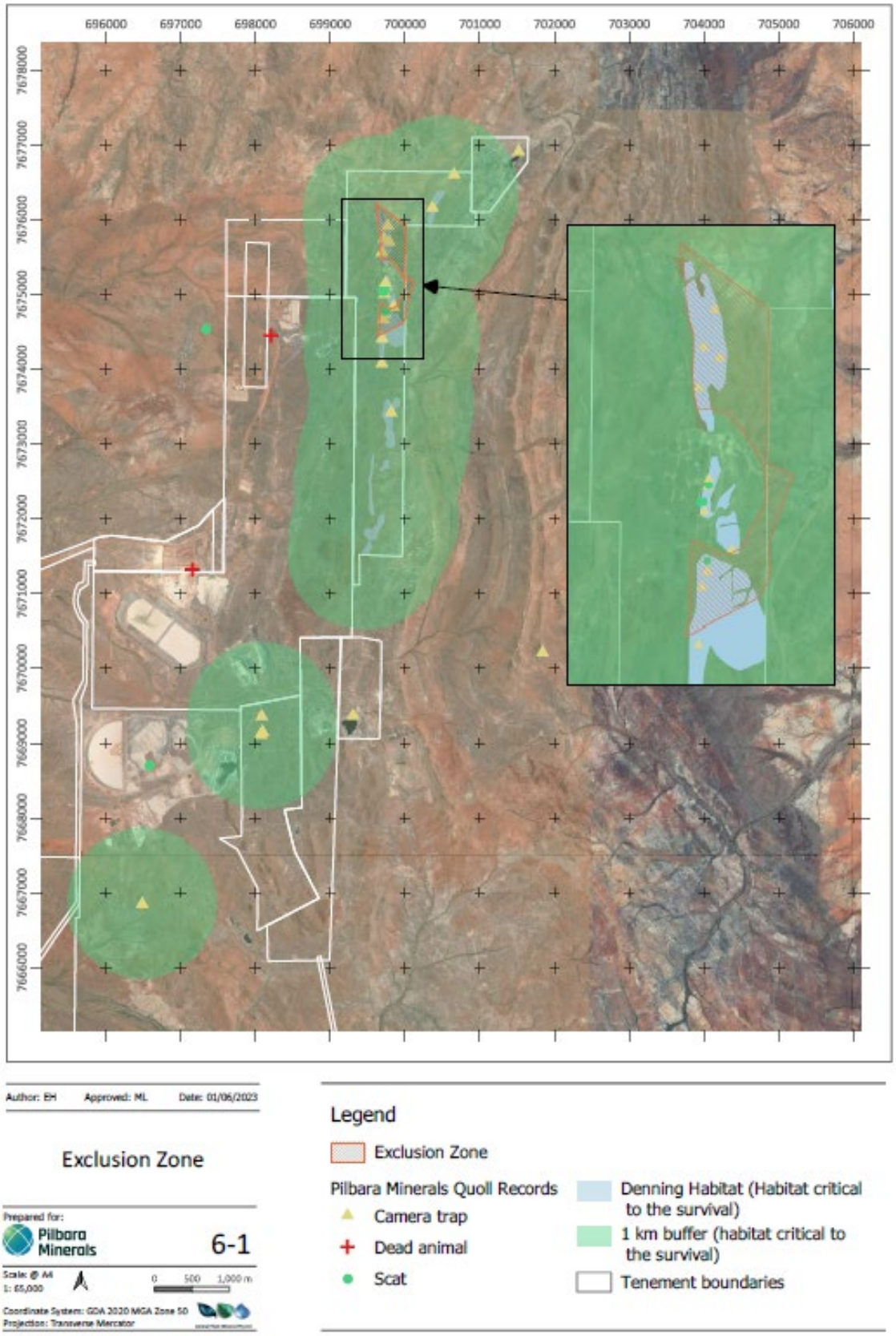


Figure 6-1. Exclusion zone

7 MONITORING PROGRAM

7.1 ENVIRONMENTAL OUTCOMES AND PERFORMANCE INDICATORS

A monitoring program for Northern Quoll will be conducted to track the geographic distribution, abundance, and condition of the local population.

Monitoring has not yet commenced at the Pilgangoora Project. Surveys conducted during baseline investigations have provided an understanding of where Northern Quoll activity is concentrated and this has been applied in the identification of monitoring sites.

Table 7-1 outlines the Environmental Objective and Performance Indicators for the Northern Quoll at the Project.

Table 7-1: Environmental Outcomes and Performance Measures

Outcome	Performance Measure	Timeframe
No change to the local geographic distribution of the Northern Quoll	Northern Quoll presence is confirmed during annual monitoring with a distribution that is not different to baseline.	Annual
No change to the abundance of Northern Quoll in the local Pilgangoora area	Trap success is not statistically significantly lower than base line.	Annual
No decline in population condition	Female Health Condition Index does not decline over time. Mean mass of males and females does not decline over three or more consecutive monitoring years.	Annual

The annual monitoring program has been developed to determine whether the Performance Indicators are being met. Baseline data will be collected prior to the commencement of the Lynas Find deposit development.

7.2 MONITORING PROGRAM DESIGN

The following publications and guidelines have been applied to the monitoring program:

- Pilbara Northern Quoll Project, Surveying and Monitoring *Dasyurus hallucatus* in the Pilbara, Western Australia (Dunlop, *et al.,* 2014);
- Survey guidelines for Australia's threatened mammals, EPBC Survey Guideline 6.5 (DSEWPAC, 2011a); and
- Referral guidelines for the endangered Northern Quoll (DSEWPAC, 2011b) have also been considered.

7.3 SITE SELECTION

Monitoring sites are fixed locations that are to remain accessible throughout the life of the monitoring program. Indicative monitoring sites have been located that are:

- within existing Pilbara Minerals tenements;
- are accessible by vehicle;
- are of a length equal to the Pilbara Northern Quoll Project where possible;
- are near to habitats suitable for Northern Quoll denning (as baseline survey indicates a concentration of Northern Quoll activity in these habitats);
- are outside of areas where development is expected to occur; and
- near to where direct impact is expected to occur (i.e. surrounding the Lynas Find deposit area), and at the maximum distance from the expected direct impact but within the constraints of the above conditions.

Figure 7-1 shows the indicative site locations. Sites are indicative as they will need to be established and marked during baseline survey.

The monitoring program has been designed to align with relevant components of the Pilbara Northern Quoll Project such that regional comparisons to capture rates and health conditions can be made where required (See Section 8).

7.4 TRAPPING METHODOLOGY

Northern Quoll trapping should be conducted between 1st April to 1st August to avoid the periods of the year when females have pouch young or denned young (Dunlop, et al., 2014).

Annual monitoring should be conducted in the same month every year, as factors such as population dynamics, food availability and animal growth stage can have significant impacts on the interpretation of datasets.

Annual monitoring is recommended to be undertaken in June/July. The timing is nominated to coincide with cooler climatic conditions to reduce physiological stress to animals during the trapping process. Note consent from both the Western Australian and Commonwealth Ministers of Environment, DBCA permits and animal ethics approval is required prior to the implementation of the monitoring program. Ministerial consent, permits and ethics approval can be a lengthy process and stakeholder engagement and application preparation should commence with sufficient lead time to ensure an June/July survey period is possible.

7.4.1 Primary Trapping Program

Reconnaissance level survey has indicated a concentration of Northern Quoll activity in the linear rocky habitats, therefore trapping transects (in line with the Pilbara Northern Quoll Project) is applied rather than grids (as recommended by the Northern Quoll Referral Guideline). The program consists of either medium aluminium box or cage traps placed along permanent monitoring transects. Two parallel lines of 25 traps each are laid for each monitoring site.

Monitoring sites are initially described using the Pilbara Northern Quoll Survey habitat data sheet. Each monitoring site consists of:

- Layout: 50 traps, each spaced 50 m apart, in two lines of 25 traps with at least 50 m between transects;
- Trap type: Either medium aluminium box traps or small wire cage traps. Traps covered in hessian or shade cloth covers (see Plate 7-1);
- Bait type: Universal bait (peanut butter, oats) with sardines;
- Duration: Traps opened for four consecutive nights at each site (200 trap nights). Traps are checked in accordance with Animal Ethics and DBCA license/approval conditions; and
- Location: Individual trap locations are fixed and marked with GPS and a physical fire-proof marker (see Plate 7-1) for the duration of the monitoring program.

Plate 7-1: Example: Elliot trap covered by shade cover, marked with a labelled survey peg

The following data will be recorded for captured Northern Quolls:

- Short pes (foot) length (mm) – taken from the left 'heel' of the hind foot to the distal end of the foot pads;
- Head length (mm) – taken from the occipital condyles to the tip of the nose;
- Mass (g);
- Sex and reproductive condition (M/F; F only: dirty pouch/new pouch);
- Age class (7 – 12 months old (**mo**), 13 – 24 mo, 25 – 36 mo);
- Tail circumference;

- Presence/absence of bite marks and parasites; and
- A small area of fur will be shaved and a non-toxic marker used to mark animals so as to identify individuals recaptured within the same survey period.

7.4.2 Supplementary Targeted Search Program

Where a transect that has recorded Northern Quoll captures and Baseline survey does not return captures in subsequent surveys, a Targeted Search for signs of Northern Quoll will be made (See Section 11). Signs would be predominantly the presence of scats, however if soft material (e.g. sand) is present, tracks may also be visible. When initiated, targeted searches will consist of:

- Duration: 10 person hours; and
- Area: a radius of 500 m surrounding the trapping transect.

If signs of Northern Quoll are recorded during the Targeted Search, the status of Northern Quoll at that site will be recorded as Present with a capture rate of one capture for the transect.

7.4.3 Supplementary Camera Trap Program

Where remedial actions require (See Section 11), a camera trap program will be deployed to supplement the Primary trapping program. The camera trap program consists of:

- Trap type: downward facing motion cameras (or equivalent to allow recognition of Northern Quoll markings);
- Bait type: Universal bait (peanut butter, oats) with sardines or similar in a non-reward bait pod;
- Layout: 10 motion sensor cameras approximately 100 m apart;
- Duration: four consecutive nights at each site; and
- Location: Individual trap locations targeting suitable denning habitat that are within 500 m of a Primary transect and are fixed and marked by GPS for the duration of the monitoring program.

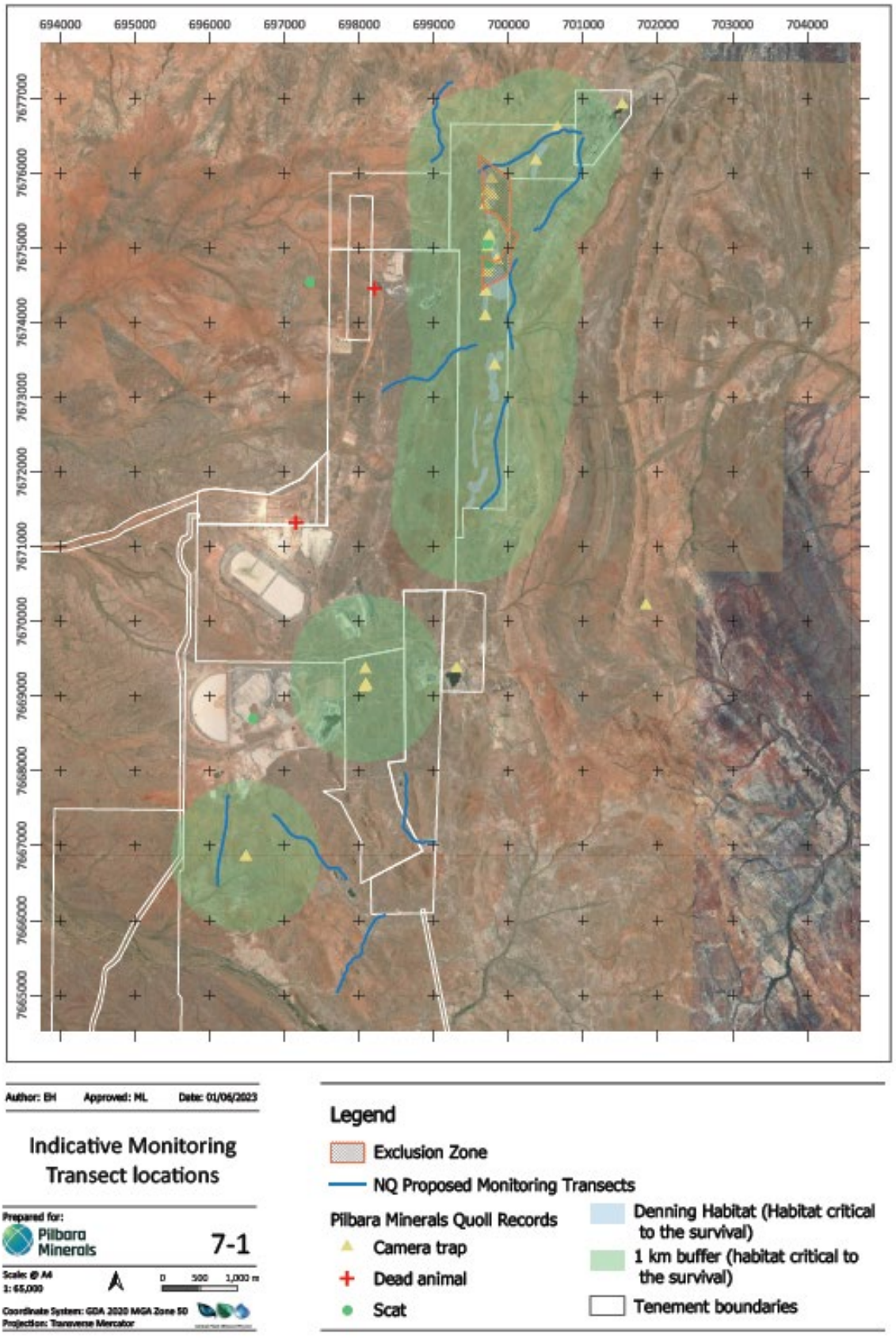


Figure 7-1 Indicative monitoring transect locations

7.5 DATA ANALYSIS

Monitoring data will be analysed to determine whether the local Northern Quoll population has been impacted between monitoring events. The number of Northern Quoll individuals trapped will be compared over space and time.

7.5.1 Individual Quoll Captures

Trap success is measured through Individual Quoll Captures (**IQC**). Trap success is used as a directly proportional indicator of population abundance to monitor fluctuations and impacts on the Northern Quoll populations.

The IQC is defined as the number of new captures where all animals are counted as new captures unless determined to be a recapture from within the same year.

Trap success = (IQC / total trap nights) x 100.

7.5.2 Sex Ratio

Sex ratio is defined as the number of males divided by the total number of individuals (Wilson and Hardy 2002).

Sex ratio = males / (males + females)

7.5.3 Health Condition Index

Population condition is measured using a Health Condition Index (**HCI**). The HCI is calculated only from new captures of females.

HCI is calculated as the cube root of body weight (g) divided by the short pes length (mm).

HCI = $\sqrt[3]{}$body weight (g) / short pes length (mm)

7.5.4 Performance indicators

Data collected from Baseline monitoring will form the basis of performance indicators used to develop trigger and threshold levels to determine if the management approach is successful in minimising impacts on Northern Quoll. Should the results from Northern Quoll monitoring exceed the performance indicators, then contingency responses outlined in Section 11 will be implemented.

The performance indicator approach and hierarchy has been developed in accordance with EPA, 2015). Two levels of performance indicators have been developed: 1. Trigger level; and 2. Threshold level. The trigger level has been established to forewarn of the approach to threshold criteria level, and therefore "trigger" the response of actions to prevent a threshold level from being reached. Exceedance of the threshold level represents an unacceptable impact that requires substantive review of the NQMP and associated procedures/management plans. Trigger and threshold levels for specific performance indicators are listed in Table 7-2.

Table 7-2. Trigger and Threshold Levels

Outcome	Trigger	Threshold
No change to the local geographic distribution of the Northern Quoll	Northern Quoll distribution is lower than baseline, with Northern Quoll not recorded at an equal number of sites to baseline, and the change is not attributable to climatic conditions or fire ignited from natural sources.	Less than 50% of transects return Northern Quoll compared to baseline, during annual monitoring, for two consecutive years
No change to the abundance of Northern Quoll in the local Pilgangoora area	Trap success is significantly lower than baseline for two years, and the change is not attributable to climatic conditions or fire ignited from natural sources.	Trap success is significantly lower than baseline for three years
No decline in population condition	HCI declines over two consecutive monitoring years, and the change is not attributable to climatic conditions or fire ignited from natural sources.	HCI declines at a significant rate over a period of three years

The timeframes identified for the trigger and threshold levels acknowledges that fluctuations in quoll condition and abundance occur in natural cycles and it will be necessary to monitor sites over multiple years to detect trends in abundance and other demographic parameters. For this reason, the decline trend needs to be observed over consecutive monitoring events to provide a margin of error given the lack of certainty that exists regarding what is considered within the range of a normal population.

7.5.5 Environmental and Project Management Attributes

Northern Quoll populations are known to fluctuate naturally according to resource availability (Cook, 2010), therefore environmental attributes will be assessed in conjunction with Northern Quoll monitoring results. Environmental attributes that are to be recorded from the Project to provide contextual value for interpretation of trapping program data include:

- Rainfall (preceding months to years to allow for lag in population response) – recorded at an on-site weather station; and
- Fire history (years since last fire) – recorded through the PRO-WHS-INC – Incident Management Procedure, and supported by DBCA Fire History spatial layer DBCA_060.

Management actions have been designed to avoid, minimise, mitigate or manage impacts to Northern Quoll animals and their habitat. It is necessary to monitor the implementation of these actions to ensure they are effective. Project Management attributes that are to be recorded from the Project to provide contextual value for interpretation of trapping program data include:

- Roadkill records – recorded through the PIL01-PRO-0000-G-007 Fauna Management Procedure and the PRO-WHS-INC – Incident Management Procedure;
- Feral animal numbers – recorded through the PIL01-PRO-0000-G-007 Fauna Management Procedure;

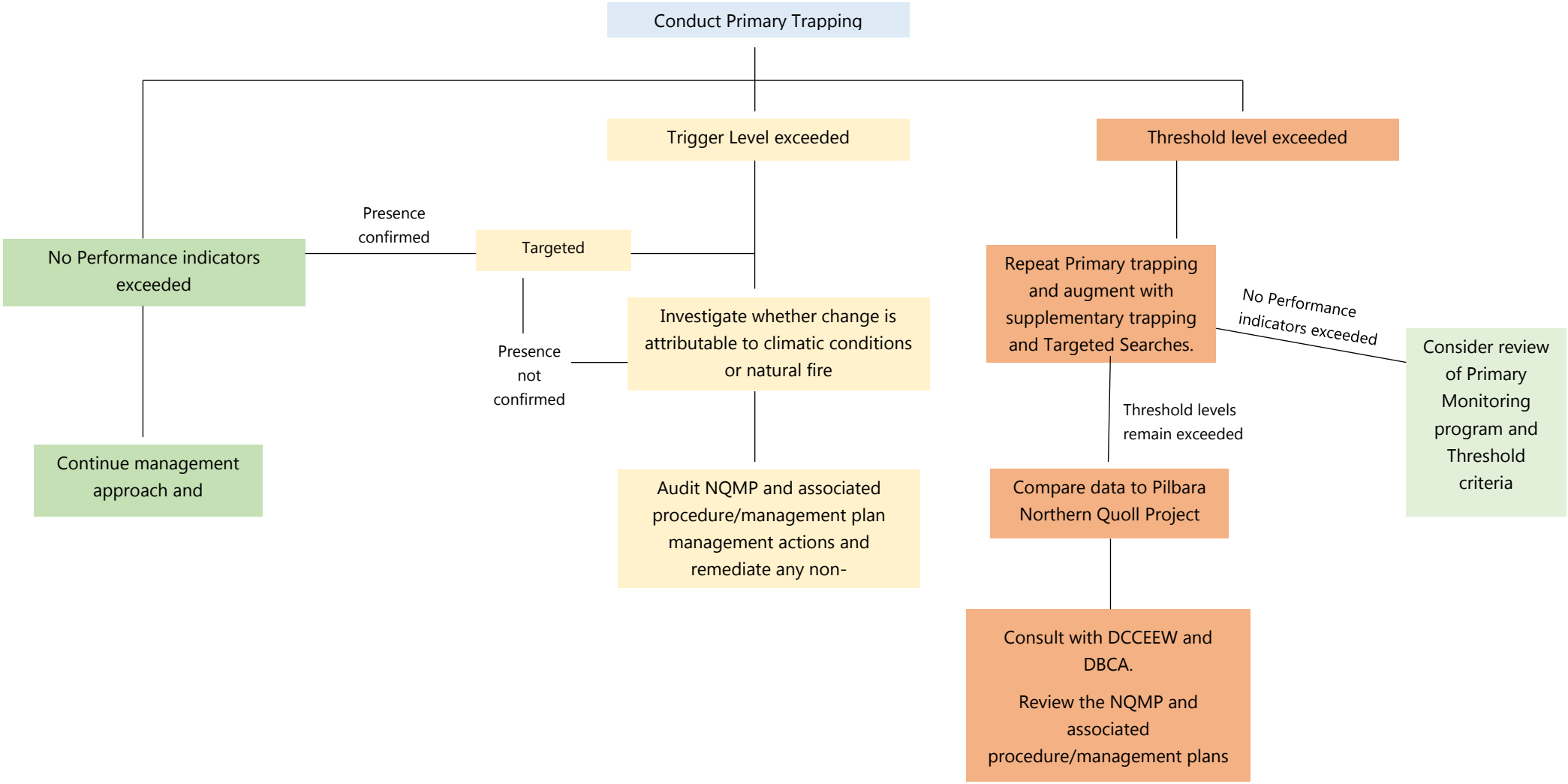
- Vegetation/habitat clearing – recorded through the PIL01-PRO-0000-G-008 Ground Disturbance Permit Procedure, PRO-ENV-LAN Land Management Procedure, Land Use Certificate procedure;
- Dust levels; and
- Noise and Vibration levels.

8 CONTINGENCY ACTIONS

The key objectives for the Northern Quoll and the monitoring program are outlined in Table 7-1, with management targets outlined in Table 6-1. Where monitoring indicates that these objectives and targets are not being met, the actions listed in Table 8-1 will be taken. The performance indicator process is presented in Table 8-1.

Table 8-1: Contingency Actions

Outcome	Trigger level exceedance actions	Threshold level exceedance actions
No change to the local geographic distribution of the Northern Quoll	Undertake 10 person-hours of track and scat searches per site where Northern Quoll was not recorded. Audit NQMP and associated procedure/management plan management actions and remediate any non-conformances.	Repeat trapping monitoring program Deploy Camera Traps Consult the Regional Pilbara Northern Quoll Monitoring Program outcomes to investigate whether a Region wide decline is occurring. Consult with DCCEEW and DBCA. Review the NQMP and associated procedure/management plans
No change to the abundance of Northern Quoll in the local Pilgangoora area	Audit NQMP and associated procedure/management plan management actions and remediate any non-conformances.	Repeat trapping monitoring program Deploy Camera Traps Consult the Regional Pilbara Northern Quoll Monitoring Program outcomes to investigate whether a Region wide decline is occurring. Consult with DCCEEW and DBCA. Review the NQMP and associated procedure/management plans
No decline in population condition	Audit NQMP and associated procedure/management plan management actions and remediate any non-conformances.	Repeat trapping monitoring program Deploy Camera Traps Consult the Regional Pilbara Northern Quoll Monitoring Program outcomes to investigate whether a Region wide decline is occurring. Consult with DCCEEW and DBCA. Review the NQMP and associated procedure/management plans


Conduct Primary Trapping
Trigger Level exceeded
Threshold level exceeded
No Performance indicators exceeded
Presence confirmed
Targeted
Presence not confirmed
Investigate whether change is attributable to climatic conditions or natural fire
Continue management approach and
Audit NQMP and associated procedure/management plan management actions and remediate any non-
Repeat Primary trapping and augment with supplementary trapping and Targeted Searches.
No Performance indicators exceeded
Consider review of Primary Monitoring program and Threshold criteria
Threshold levels remain exceeded
Compare data to Pilbara Northern Quoll Project
Consult with DCCEEW and DBCA.
Review the NQMP and associated procedure/management plans

9 REPORTING

Pilbara Mineral site environmental team will only report internally and to Pilbara Minerals Corporate environmental team, who will report externally if required.

10 ROLES AND RESPONSIBILITIES

Accountability for fulfilling the requirements of this Plan is dependent on the stage of project development (construction, operations, decommissioning).

During construction activities, the Project Manager (Construction) will be accountable for ensuring the requirements of the Plan are met, irrespective of whether construction activities are undertaken by an external service provider or internal personnel.

During operational, decommissioning and closure stages, the Site Senior Executive is accountable for ensuring the requirements of the Plan are met.

Responsibility for specific tasks may be delegated to the Site Environment Manager or other personnel. Where responsibilities are delegated, this must be clearly recorded and communicated.

Specific tasks that are likely to be delegated are listed in Table 10-1.

Table 10-1. Roles and responsibilities

Role	Responsibilities
Site Senior Executive	• Ensure overall implementation and compliance with the Northern Quoll Management Plan. • Communicate with the Contractor/Work Supervisor and Site Environment Manager delegated tasks of the Northern Quoll Management Plan. • Record delegated duties.
Contractor/Site Manager/Work Supervisor	• Ensure compliance with the Northern Quoll Management Plan. • Ensure work activities occurring adjacent to Northern Quoll exclusion zones minimise potential for direct and indirect impacts (e.g. dust management, consideration of quoll habitat for blasting etc). • Provide information for LUC applications regarding disturbance activities including start date, duration, location, description of all activities and total area of disturbance. • Provide proposed disturbance area location maps and coordinates for LUC applications. • Ensure an LUC is in place prior to conducting clearing and ground disturbance. • Implement requirements in the approved LUC. • Avoid operation of ground-engaging machinery and equipment in Northern Quoll exclusion areas. • Ensure disturbance areas do not exceed LUC boundaries.

	• Communicate Northern Quoll management requirements to applicable work crews.
Site Environment Manager / Superintendent	• Ensure disturbance activities are approved by the appropriate Regulator e.g. Environmental Protection Authority (EPA), Department of Climate Change, Energy, the Environment and Water (DCCEEW), Department of Water and Environmental Regulation (DWER), Department of Mines, Industry Regulation and Safety (DMIRS). • Conduct or coordinate field validation of survey and pegging of disturbance areas. • Inspect proposed disturbance area prior to clearing for significant environmental values or weed infestations. • Conduct regular inspection of work activities to ensure disturbance areas are within LUC boundaries and appropriate controls are in place. • Communicate and promote awareness of Northern Quoll management with the Construction Manager, Contractor/Works Supervisor and applicable work crews. • Ensure Contractor/Operator and work crews have undertaken applicable environmental training and inductions. • Ensure Northern Quoll and Northern Quoll habitat monitoring is scheduled and undertaken annually. • Ensure personnel undertaking annual monitoring have the requisite permits and animal ethics approval.
Tenure/GIS provider	• Review LUC applications for disturbance to ensure proposed excavations are within approved project boundaries and outside Exclusion Areas • Communicate with the PLS Environmental Advisor and the Contractor/Works Supervisor to facilitate the Northern Quoll Management Plan • Regularly update the LUC register tracking total disturbance in accordance with project approvals requirements. • Ensure Exclusion zones and mapped Northern Quoll habitat is uploaded into GIS systems.

11 ASSOCIATED MANAGEMENT PLANS

Management of impacts to Northern Quoll involves management of impacts across a range of mine activities. The following PLS management plans and documents are relevant to managing impacts to Northern Quoll:

- PIL01-PRO-0000-G-007 Fauna Management Procedure;
- PIL01-PRO-0000-G-008 Ground Disturbance Permit Procedure;
- PRO-ENV-LAN Land Management Procedure;
- PRO-WHS-INC – Incident Management Procedure;
- PIL01-PRO-0000-G-009 Spill response Procedure;
- PIL01-PRO-0000-G-010 Weed Management Procedure;
- PIL01-PRO-0000-G-011 Topsoil Management Procedure;
- PIL01-PRO-0000-G-012 Waste Management Procedure;
- Land Use Certificate Process; and
- Mine Closure Plan.

12 TRAINING AND AWARENESS

Minimising impacts to quoll across site will involve implementing training and education for mine site personnel and raising awareness of Northern Quolls and managing impacts. The following training and awareness programs will be implemented:

- Site inductions will include a fauna component, with a focus on conservation significant fauna, including Northern Quoll;
- Site inductions will include components on how mine site personnel can minimise impacts on fauna including by not feeding fauna and managing food wastes;
- Toolbox meetings will be utilised to undertake education and refreshers regarding fauna management and Northern Quoll; and
- Educational posters will be placed around crib rooms and high traffic areas to help identify conservation significant fauna and feral predators. Posters will include information on how to report sightings.

13 ADAPTIVE MANAGEMENT AND REVIEW

PLS will implement an adaptive management approach for the NQMP. The Plan will be reviewed in the following circumstances:

- Every four years; or
- In response to additional data that indicates risks have changed; or
- If ongoing monitoring indicates that thresholds have been breached and objectives are not be able to be met.

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