



Northern Quoll

Management Plan

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Key Stakeholders

Department	Position
MAu A&I Environment	Manager Environment A & I
Health Safety and Environment	Head of HSE Business Partnering
Environment	Manager – BP HSE Projects Infrastructure and Planning
HSE Business Partnering	Site Based HSE Superintendents

Northern Quoll Management Plan

1. Purpose

This management plan has been prepared to provide guidance for the management of the Northern Quoll (*Dasyurus hallucatus*) across all BHP Western Australian Iron Ore (WAIO) operations. It should be read in conjunction with BHP WAIO's Biodiversity Environmental Management Plan (EMP). The objective of this plan is to manage impacts to the Northern Quoll by WAIO operations through implementation of the management hierarchy (i.e. avoid, minimise and rehabilitate environmental impacts, prior to applying compensatory actions).

2. Northern Quoll Biology

2.1. Conservation Status

The Northern Quoll is listed as Endangered by the International Union for Conservation of Nature (IUCN) and under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and the State *Biodiversity Conservation Act 2016* (BC Act).

The Commonwealth of Australia (2016) identifies the following threats to the Northern Quoll:

- Habitat clearing, resulting in direct mortality or displacement of resident animals.
- Introduction of invasive species, such as Cane Toads (*Bufo marinus*) or weeds, resulting in direct mortality, habitat degradation, competition, increased fire risk and habitat displacement.
- Pastoralism, resulting in habitat degradation and inappropriate fire regimes.
- Traffic, resulting in direct mortality and habitat fragmentation.
- Inappropriate fire regimes, resulting in increased predation risk and loss of denning habitat.
- Feral animals, such as feral cats and dogs, resulting in direct predation, habitat degradation, competition and disease.

Activities arising from BHP WAIO operations (including mining, infrastructure, exploration and pastoralism) have the potential to increase the likelihood or intensity of these threats in the vicinity of its tenure. In addition, the following may threaten Northern Quolls in the Pilbara:

- Attraction to human infrastructure (including water tanks and skip bins); and
- Human interference, such as feeding.

2.2. General Description

The Northern Quoll is the smallest of the Australian quoll species. It has a head to body length ranging from 270-370 mm in adults with weights ranging from 240-1120 g. Males are on average heavier than females (Oakwood, 2002). The Northern Quoll has greyish brown fur, with a cream underside and white spots on its back and rump (Plate 1). Northern Quolls are both arboreal (can climb) and terrestrial (Braithwaite and Begg, 1995). Northern Quolls are primarily nocturnal, foraging at night and residing in den sites during the daytime (Oakwood, 2002).

2.3. Distribution

The Northern Quoll once occurred across most of the northern third of Australia, but its range has significantly declined over the past century to three isolated populations across Queensland, Northern Territory and Western Australia (WA) (Braithwaite and Griffiths, 1994; DotE, 2016; Hill and Ward, 2010). In WA, the Northern Quoll is restricted to the Pilbara and Kimberley regions (Figure 1).

The Pilbara population of Northern Quoll is genetically distinct from northern populations (Hill and Ward, 2010). The Northern Quoll has been recorded across most of the Pilbara region, with recent records obtained from the Eastern Pilbara/ Great Sandy Desert region within Karlamilyi National Park (Figure 2). However, this species is relatively more common in the northern Pilbara region (generally within 150 km of

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the coast) but are much less common in southern and south-eastern parts of the region (Cramer *et al.*, 2016).



Plate 1: Northern Quoll captured in a trap along BHP's Iron Ore mainline rail.

In the Pilbara region, the species tends to prefer the Rocklea, Macroy and Robe land systems (Biota Environmental Services, 2008). These land systems comprise basalt hills, mesas (and buttes of limonites), high and low plateaux, lower slopes, occasional tor fields and stony plains supporting either hard or soft spinifex grasslands (van Vreeswyk *et al.*, 2004). The Northern Quoll has also been recorded in other land systems which comprise sandstone and dolomite hills and ridges, shrub lands, sandy plains, clay plans and tussock grasslands and coastal fringes including dunes islands and beaches (Biota Environmental Services, 2008).

A recent species distribution model for the Northern Quoll developed by Molloy *et al.* (2017), using the Maxent modelling software that was bias corrected for absences. The model shows that Northern Quolls presence conformed strongly with vegetation, slope and topography within the rocky areas Molloy *et al.* (2017). The main areas of occupation in the Pilbara included the western edge of the Hamersley Ranges, granite outcrops of the Abydos Plan and the more rugged areas of the Chichester Ranges Molloy *et al.* (2017). Areas where there is low likelihood of Northern Quolls is the Fortescue River floodplain and its upper catchment, the sandy coastal regions of the Pilbara and the central and southern parts of the Hamersley Ranges.

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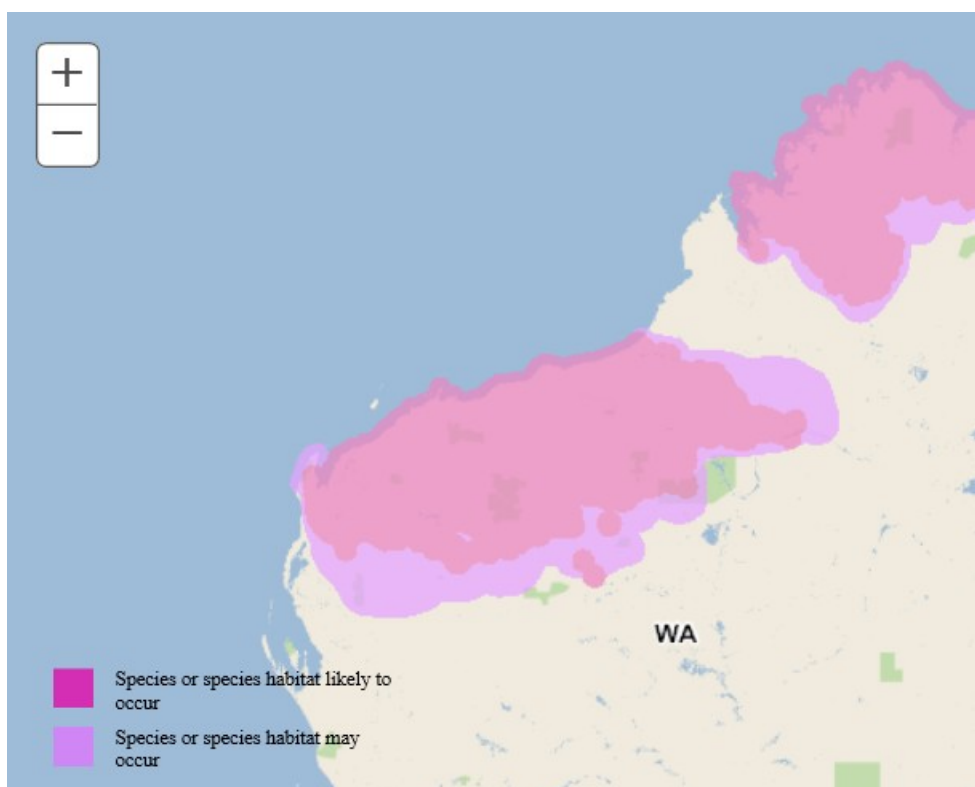


Figure 1: Modelled distribution of Northern Quolls in the Pilbara region (reproduced from Department of the Environment, 2019).

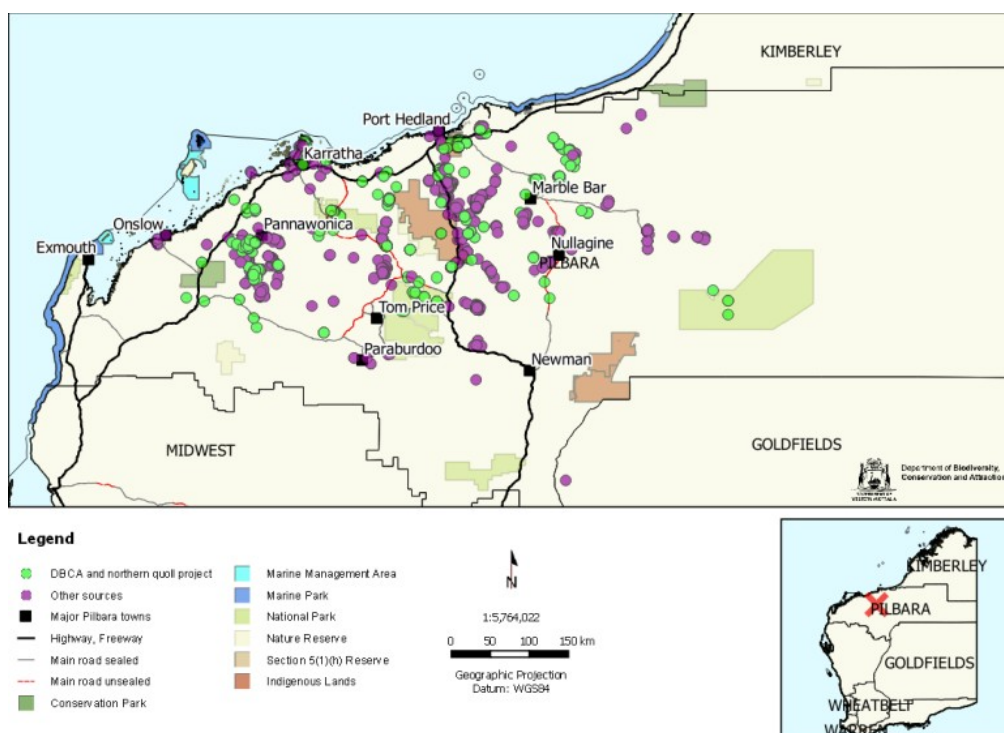


Figure 2: Records of Northern Quoll in Pilbara (reproduced from Dunlop et al., 2018).

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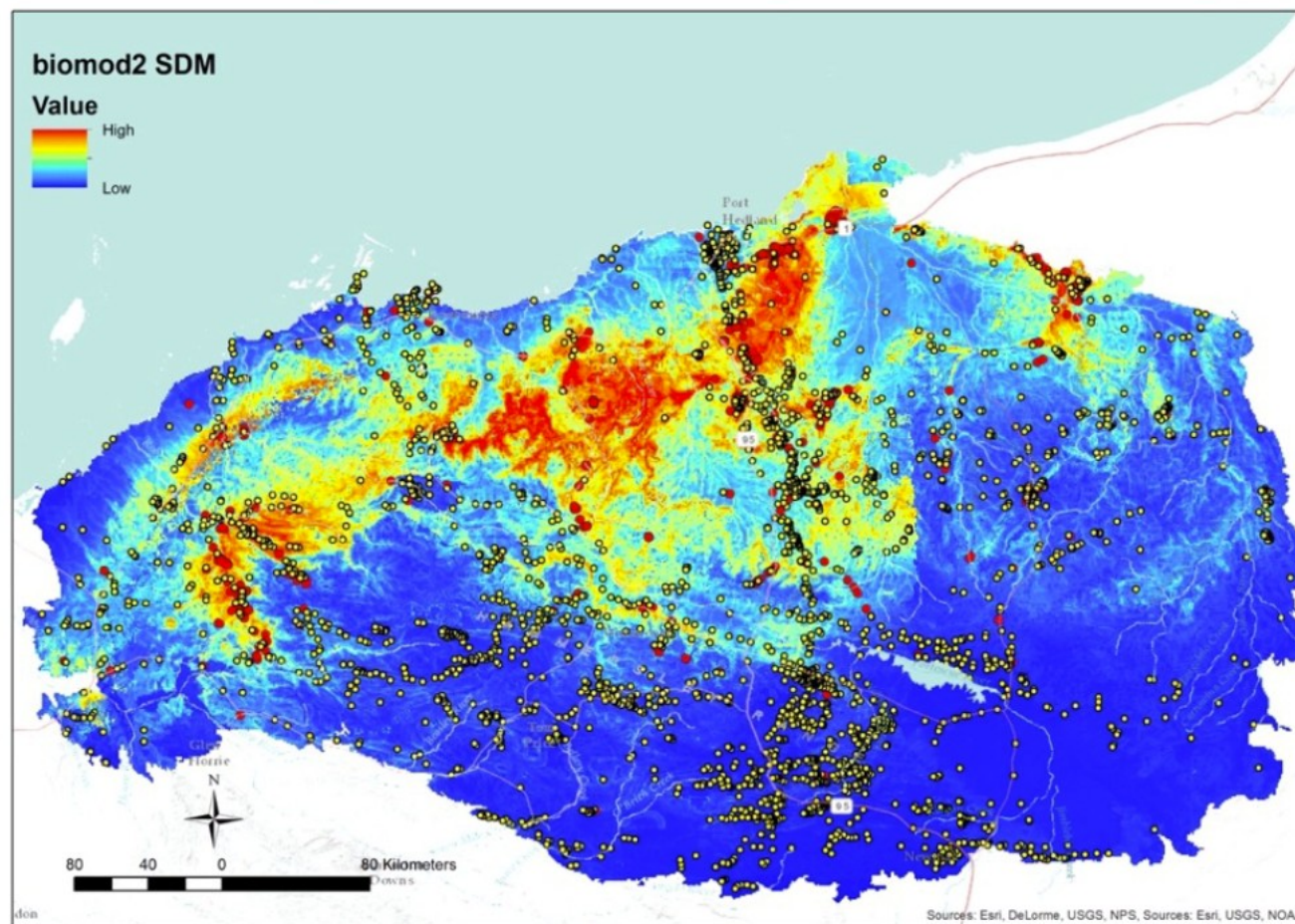


Figure 3: Heatmap of likely Northern Quoll presence in the Pilbara; likelihood ranges from high (red) to low (blue) (reproduced from Molloy et al., 2017).

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2.4. Habitat

The Northern Quoll occupies a range of habitats, including ironstone and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats (Braithwaite & Griffiths, 1994; Oakwood, 2002), dissected rocky escarpments, open forest of lowland savannah and woodland (Oakwood, 2002, 2008). Rocky habitats tend to support higher densities, as they offer protection from predators and are generally more productive in terms of availability of resources (Braithwaite & Griffiths, 1994; Oakwood, 2000). Other microhabitat features important to the species include: rock cover; proximity to permanent water and time-since last fire (Woinarski *et al.*, 2008).

Research into the preferred denning, foraging and dispersal habitats for the Northern Quoll is ongoing, particularly in the Pilbara. Denning habitat generally comprises some form of rocky area where quolls can be protected from predators and temperature extremes. Dens occur in a wide range of situations including rock overhangs, Man-made materials are also used (e.g. rail ballast or artificially constructed rock piles). Denning habitat needs to be surrounded by foraging habitat, which is generally considered to be native vegetation within one kilometre of denning habitat (DotE, 2016). Native vegetation needs to be maintained between denning areas to enable dispersal of animals following weaning of juveniles and for males during the breeding season.

The Department of the Environment (2016) defines habitat critical to the survival of the species as:

- Rocky habitats, such as ranges, escarpments, mesas, gorges, breakaways, boulder fields, major drainage lines or treed creek lines.
- Structurally diverse woodland or forest areas containing large diameter trees, termite mounds or hollow logs.
- Off-shore islands where the Northern Quoll is known to exist.

For the purposes of this management plan, the following habitat definitions are used:

- Critical habitat - denning habitat.
- Supporting habitat - foraging and dispersal habitats.

Refer to Table 1 for further habitat detail.

Table 1: Classification of Northern Quoll Habitat

Habitat type	Definition
Critical habitat	<p>Denning habitat within the distribution of the Northern Quoll, and / or where evidence of the Northern Quoll has been recorded that is:</p> <ul style="list-style-type: none"> • Rocky habitats such as ranges, escarpments, mesas, gorges, breakaways, boulder fields. • Structurally complex (contains rock fragments ranging from large boulders to small stones with a number of crevices for Northern Quolls to shelter inside providing protection from predators). • Surrounded by foraging habitat. <p>Note that drainage lines with substantial trees (e.g. eucalypts) containing hollows can be utilised as denning habitat, but in the Pilbara are predominantly utilised for dispersal.</p>
Supporting habitat	<p>Foraging habitat that is located within approximately five kilometres of critical habitat and includes:</p> <ul style="list-style-type: none"> • Shrub lands, spinifex plains and other areas of native vegetation. • Small rock piles without the structural complexity for denning habitat. <p>Dispersal habitat is considered to be riverine or drainage line habitats.</p>

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2.5. Diet

Northern Quolls are opportunistic omnivores, consuming a wide range of invertebrates and small vertebrates, in addition to fruit, nectar, carrion and human refuse (Dunlop *et al.*, 2017). Northern Quolls will scavenge road kills and refuse sites. Free water is taken when available but individuals can obtain sufficient water from their food sources (Oakwood, 2008).

2.6. Breeding

Much of the current knowledge relating to the Northern Quoll is based on surveys conducted in the Kimberley and Northern Territory however, recent work undertaken by the Department of Parks and Wildlife (DPaW) and monitoring of Northern Quolls within BHP Billiton Iron Ore's decommissioned rail quarries provides some insight to breeding within the Pilbara. In the Kimberley, Northern Quolls breed mid-year between late May and June (Oakwood, 2002). Based on current data for the Pilbara, the breeding season is thought to occur between June and September, with young born between September and December, although can remain in the pouch as late as February (How *et al.*, 1991).

Young are deposited in a den between October and February and juveniles are weaned and disperse between December and March (Table 2). A conservative approach to these timeframes has been taken for the purpose of this management plan given the lack of current knowledge relating to Northern Quolls in the Pilbara.

Northern Quolls are short-lived, with a breeding strategy of male semelparity with most males dying in their first year of breeding (i.e. at one year of age). Females usually live for longer than one breeding season and the oldest recorded female in the wild being three years old. As a result of facultative die-off, the abundance of the species is cyclical, and the annual reproduction is highly synchronised (Oakwood *et al.*, 2001). In the Pilbara, abundance is lowest toward the end of winter into early spring after the mating season, as a significant proportion of adult males die off and young have not yet begun to forage independently (Braithwaite & Griffiths, 1994; Oakwood, 2000). Conversely, the population density is thought to be highest in the summer months, prior to the mating season and when juveniles have begun foraging independently (Oakwood, 2000).

The number of young generally varies from five to nine, but most females have eight (Oakwood, 2008). At eight to nine weeks of age, young are deposited in a series of nursery dens. The mother forages alone but returns regularly to allow suckling. Juveniles are not fully weaned until six months old and become reproductively mature at 11 months (Oakwood, 2008).

Table 2: Approximate breeding cycle of Northern Quolls in the Pilbara

Month	Breeding Stage
June – September	Mating (males disperse long distances to find a mate)
September – October (potentially up to February)	Young born, remain in pouch of female
October – December (potentially up to March)	Young deposited in a den where they remain until they are weaned and able to disperse
Late December – Early March	Juveniles weaned and leaving dens to disperse

2.7. Social and Spatial Organisation

The demography of Northern Quolls is complex and they use habitats in a variety of ways for denning and foraging. Northern Quolls are generally considered to be solitary, with females having mutually exclusive denning areas. Females can have overlapping foraging areas, with territoriality likely to be related to the abundance, dispersion and renewability of food (Oakwood, 2002). Both sexes usually change dens every night, with females each using up to 55 different den locations (Oakwood, 2008).

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Male and female home ranges are thought to be similar in size outside of the breeding season, at approximately 35 ha, but this is based on studies in the Northern Territory. Male home ranges expand significantly during the breeding season, overlapping extensively with several female ranges and numerous other male ranges up to 100 ha (Oakwood, 2002). During the breeding season, males adopt a roving strategy, regularly visiting several widely spaced females in rapid succession, presumably to monitor onset of oestrus. The energetic cost of this behaviour is a likely cause of annual male die-off (Oakwood, 2008).

Little is known about the home range of the Northern Quoll in the Pilbara however, a radio tracking survey in ironstone hills near the Fortescue River indicated that female quolls had activity areas between 75 and 443 ha, and male quolls from five to 1109 ha. Females were recorded travelling distances up to 1.55 km, and males up to 3.5 km (King, 1989), which has recently been supported by studies in the northern Pilbara where quolls were observed to commonly move distances of two to three kilometres in one night (DPaW workshop, 2013). Recent studies on Koolan Island showed one quoll moving seven kilometres (time frame unknown; DPaW workshop, 2013).

3. Management

3.1. Environmental Objective

The objective of this management plan is to minimise impacts to the Northern Quoll from BHP WAIO's activities in the Pilbara. Where impacts are unavoidable, then a series of controls are outlined that will reduce/mitigate impacts on Northern Quolls, and also monitor the effectiveness of these controls (Section 3.2).

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3.2. Management Zones

Table 3: Zone 1 Management Procedures for Northern Quolls

Habitat Type	Management Procedure
Critical Habitat	<ul style="list-style-type: none">• Projects are to be designed to avoid disturbance to denning habitat and habitat within 50 m of mapped denning habitat, where practicable.• If clearing of denning habitat is unavoidable the project should be designed to reduce to the amount of clearing to the smallest amount practicable, and retain movement corridors.• If any area greater than five hectares of denning habitat is to be cleared, then consultation with BHP WAIO's Biodiversity team is to be undertaken to determine the extent of mitigation measures that are to be implemented (Section 3.4).• Where practicable, clearing of habitat should be avoided between October and February, to avoid impacting on young deposited in dens.• Blasting occurring within 500 m of a known den site should be undertaken outside the months of October to February, where practicable. This is to avoid impacting young within dens.• Night-time activities and driving should be restricted within 500 m of denning habitat. If night-time driving is required in these areas, vehicle speed limits should be restricted to 40 km/hr.• Implement controls listed in Table 5 – General Management Procedures for Northern Quolls.
Supporting Habitat	<ul style="list-style-type: none">• Avoid/ minimise clearing of Northern Quoll foraging/ dispersal habitat, where practicable.• Project design should consider the retention of habitat corridors, where practicable.• Implement controls listed in Table 5 – General Management Procedures for Northern Quolls.

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Table 4: General Management Procedures for Northern Quolls

Identified Risk	Management Procedure
Operation of Equipment and Machinery	<ul style="list-style-type: none"> Minimise night-time activities within 50 m of denning habitat, where practicable (excluding trains). Minimise illumination of denning habitat (e.g. via the use of directional lighting) if night time activities are required.
Vehicle Strike	<ul style="list-style-type: none"> Vehicles are to comply with local speed limits. All personnel to be educated on the importance of adherence to speed limits to minimise the potential for road kills. Signage alerting drivers to Northern Quolls is to be placed on roads within 50 m of denning habitat.
Human Interference	<ul style="list-style-type: none"> Site personnel to be informed how to minimise impacts to Northern Quolls (e.g. via inductions, tool box talks, posters, environmental alerts). Only licensed and qualified personnel are permitted to trap or handle Northern Quolls. The feeding of all native and feral animals is prohibited.
Vegetation Clearing	<ul style="list-style-type: none"> Minimise clearing to the smallest amount practicable. Locate infrastructure in degraded areas where practicable. Temporary disturbance areas¹ are to be revegetated as soon as practicable. Dust suppression should be used in areas adjacent to denning habitat, where practicable.
Storage of Materials (e.g. rubbish, site materials, metal, wood sleepers, storage containers etc.)	<ul style="list-style-type: none"> Materials are to be stored greater than five kilometres from known denning habitat, where practicable. In areas within five kilometres of denning habitat, material is to be stored such that crevices/cavities are minimised to prevent access by quolls. Material stockpiles within five kilometres of denning habitat should be assessed regularly by the site Environmental Advisor (or delegate) to determine if stored material is being used by Northern Quolls for foraging and/or denning. If usage is observed in storage piles (presence of scats, animal captured by appropriate trapping methods (DBCA 2017)), then prevention measures should be implemented (such as alternative methods of storage) and the success of these prevention measures should be reviewed.

¹ Disturbed areas, which are unlikely to be required either on a permanent or intermittent basis and can therefore be rehabilitated.

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Skip Bins	<ul style="list-style-type: none"> Putrescible waste is to be stored in bins/containers and lids firmly placed to prevent access by Northern quolls. Putrescible waste is to be regularly removed from sites or buried in landfill. All skip bins located within five kilometres of Northern Quoll denning habitat must be regularly inspected to determine if they are being utilised by Northern Quolls. If they are found to be accessing the skip bin (presence of scats, individual seen in the skip bin) then preventative measures should be implemented and the success of these prevention measures should be reviewed.
Water Tanks	<ul style="list-style-type: none"> Lids are to always be placed on water tanks to prevent Northern Quoll access, and measures put in place to ensure that lids cannot easily be removed or be displaced. Areas surrounding overhead tanks, potable water treatment tanks and wastewater treatment tanks shall be kept clear of any items that may enable Northern Quolls to access openings to the tanks. All water tanks within five kilometres of denning habitat should be sign posted advising personnel of the importance of excluding Northern Quolls from water tanks. Commissioning and inspections of all water tanks within five kilometres of denning habitat are to be undertaken by area owners or delegate to ensure compliance with these procedures.
Trenching	<ul style="list-style-type: none"> Any trenching left overnight should have egress points established to allow trapped animals to escape.
Lighting	<ul style="list-style-type: none"> Directional lighting should be used to minimise light overspill and illumination of denning habitat.
Fire	<ul style="list-style-type: none"> Fire prevention and management to be undertaken in accordance with relevant site procedures.
Weeds	<ul style="list-style-type: none"> Weed prevention and control to be undertaken in accordance with relevant site procedures.
Feral animals	<ul style="list-style-type: none"> Feral animal prevention and control to be undertaken in accordance with relevant site procedures. Any sightings of cane toads are to be reported to the relevant site Environmental Specialist and the Superintendent Biodiversity within 24 hours of the sighting. If possible, the animal is to be captured, photographed from the back, front and side with a scale for reference, and a global positioning system (GPS) location recorded. The animal is then to be euthanised by placing in a freezer. The Biodiversity team should be contacted to determine the ultimate fate of the animal (i.e. disposal or lodgement with the WA Museum).

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3.3. Monitoring

For the purpose of this management plan, monitoring of the Northern Quoll will be undertaken:

- if required to meet approval conditions;
- to meet compliance requirements;
- for research purposes; and/or
- to determine the efficacy of management measures.

Any monitoring programme should consider the DotE (2016) referral guidelines, the regional Northern Quoll research being undertaken by the Department of Biodiversity Conservation and Attractions (DBCA), and comply with current trapping guidelines (DBCA, 2017). It should also be developed in consultation with the Biodiversity team on a case by case basis. Monitoring should consider utilising two different approaches:

- Cage traps – to be used in areas where there is a known and persistent population of quolls and there is a requirement to take genetic samples or morphometric measurement of the animals. Remote sensing cameras may also be used to supplement the cage trapping or during periods when the use of cage traps may have significant impacts on quolls (i.e. when females have young or during extremely hot weather).
- Remote sensing cameras – to be used in areas of suitable habitat where quolls have not been recorded, or there are very few records, or genetic samples/ morphometric measurements are not required.

Monitoring sites generally are to be located within proximity to impact areas (within 500 m of disturbance) and reference sites are to be located in areas of suitable Northern Quoll habitat at least 3-5 km away from any mining related impacts.

3.3.1. Trapping

Monitoring programmes should employ methodologies used in the regional Northern Quoll monitoring programme undertaken by the DBCA, which includes trapping being conducted from May to September to avoid times when females have large or denned pouch young. As Northern Quolls frequently live in linear rocky habitats, population monitoring is also generally undertaken utilising trapping transects rather than grids. Transects are configured to achieve optimal cover of the sites. Two parallel lines of 25 traps each are laid across broader habitat types such as breakaways or granite outcrops.

Specific Northern Quoll trapping methods (Dunlop *et. al.*, 2018) include:

- Trap type: wire cage traps covered with hessian or similar (e.g. small Sheffield traps: 45 cm x 17 cm x 17 cm).
- Bait type: universal bait (peanut butter, oats) with sardines.
- Layout: 50 traps, each spaced 50 m apart, in two lines of 25 traps, with at least 50 m between each transect.
- Duration: traps opened for four consecutive nights at each site (200 trap nights). Traps are checked and closed within three hours of sunrise, rebaited and opened in the late afternoon.
- Marking: individual trap locations are fixed and marked (GPS) for the duration of the monitoring programme. Sites are marked with permanent markers such as metal site tags.
- Searches: to verify a zero-capture record, personnel should also undertake a total of 10 person-hours of scat searches per site and use at least five remote cameras at the site/surrounding area during the four nights of trapping.

Any trapping programme would require an approved DBCA fauna licence and a Department of Primary Industries and Regional Development (DPIRD) ethics licence.

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3.3.2. Remote Sensing Cameras

Remote cameras can be utilised to supplement trapping, for initial area searches to detect Northern Quolls and to assess presence and activity in an area. Unlike traps, cameras can be used at any time of year. Duration of camera trapping will depend on the circumstances and goals of the individual programme, but more information is collected from a longer set time. In general, camera traps should not be baited with food rewards for longer than five consecutive nights to prevent impacts on normal animal behaviour (Dunlop *et. al.*, 2018). It is also considered more ethical to 'bait' the cameras with non-reward lures to prevent negative interactions within predators, such as Feral cats (*Felis catus*).

Specific remote sensing camera methods (Dunlop *et. al.*, 2018) include:

- Transects of ten baited remote motion sensor cameras spaced at least 100 m apart for four consecutive nights.
- Consideration to at least two cameras per transect being positioned to capture dorsal section of the individual for individual spot-recognition (Plate 2).



Plate 2: Northern Quoll motion camera trap site setup

3.4. Relocation and Translocation

For the purposes of this document, the following definitions have been applied:

- Relocation – movement of an animal to an area that falls within its home range.
- Translocation – movement of an animal to an area that falls outside its home range.

All relocations and translocations are subject to approval of a relevant DBCA fauna licence and DPIRD ethics licence.

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3.4.1. Relocation

Relocation of animals may be undertaken if clearing will remove an area of Northern Quoll denning habitat but the clearing is not to an extent that the entire denning habitat within the home range of the resident Northern Quolls is removed and there is sufficient habitat remaining to support the population. Any relocation should be managed through the Biodiversity team in accordance with and approved by the DBCA, subject to approval of the appropriate DBCA fauna licence. Relocation can only be undertaken by a qualified zoologist in accordance with the relevant DBCA licence Conditions.

Trapping for a Northern Quoll relocation should be undertaken immediately prior to the clearing operation. Trapping should be undertaken for two nights, or until the quoll(s) are captured up to but not exceeding seven nights as determined by a qualified zoologist. The number and location of traps is to be determined by the zoologist based on the size and complexity of the habitat. Cage traps and/or large Elliot traps are to be used and baited daily with universal bait.

The animals are to be transported according to DBCA guidelines (DBCA, 2017), as follows:

- Traps are to be cleared as soon as possible after sunrise.
- The animal is placed immediately in a calico bag/fleece material bag and preferably placed inside a pet pack animal transport container.
- The animal is to be transported in the cabin of an air conditioned vehicle (maximum time allowed is 12 hours). The animal is to be securely placed so that the box/bag does not move around.
- The animal is to be temporarily stored in a cool (<25 °C, but not less than 10 °C), dark and quiet room until transport to the release site.
- The animal is to be released within 24 hours of capture, preferably as soon as possible after dusk.
- The release site is to be within the home range (three kilometre) of resident Northern Quolls where possible. If this is not an option an appropriate release site needs to be determined in conjunction with the DBCA and may fall under the parameters of a Translocation as outlined in Section 3.4.2.

Clearing of the habitat should ideally be undertaken whilst the Northern Quoll is in holding off-site (maximum of 24 hours), to prevent the animal returning to the area. If clearing will take greater than 24 hours then the zoologist is to remain on site during clearing and to capture any additional animals that may not have been captured during the initial trapping programme. Additional trapping and relocation of Northern Quolls may be necessary and will be determined on a case-to-case basis by the Biodiversity team.

3.4.2. Translocation

In general, translocation of animals is considered a last resort management strategy for Northern Quolls. Translocation of resident animals should only be undertaken in the following circumstances:

- All of the denning habitat within the home range (five kilometre) for a known resident population of Northern Quolls is to be cleared or greater than 100 ha of core denning habitat is to be removed from an area.
- A translocation site of similar size and habitat complexity is available into which the animals can be moved.
- The translocation site must be more than 10 km away from the source location to prevent animals returning to the source location.
- The translocation site to move individuals is to be determined by the Biodiversity team and to be approved by the DBCA. The area must have evidence of historic quoll usage over a continual period, but no resident quolls should be present at the time of the relocation. Trapping is required for seven days prior to introduction of new animals to confirm no resident animals are present.

It is important to note that the translocation process is very stressful to quolls. If animals are moved to an area where there are already resident quolls, then this will lead to competition for resources (food, dens and/or mates) and it is likely that the new quolls will not be able to establish themselves within the area. If quolls are moved to an area where there is no historic evidence of quoll usage, it is likely that the area is not suitable to support a population of quolls due to lack of food or habitat resources.

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Trapping for relocation should be undertaken over a period of seven nights to ensure all animals are captured. The number and location of traps is to be determined by the zoologist based on the size and complexity of the habitat. Cage traps and/or large Elliot traps are to be used and baited daily with universal bait (oats, peanut butter and sardines).

All translocations are to be undertaken in compliance with DBCA's Corporate Policy Statement No. 35 (DPaW 2015a) and DBCA Corporate Guideline No. 36 (DPaW 2015b).

The animals are to be transported according to DBCA guidelines (DBCA, 2017), as follows:

- Traps are to be cleared as soon as possible after sunrise.
- The animal is placed immediately in a calico bag/fleece material bag and preferably placed inside a pet pack animal transport container.
- The animal is to be transported in the cabin of an air conditioned vehicle (maximum time allowed is 12 hours). The animal is to be securely placed so that the box/bag does not move around.
- The animal is to be temporarily stored in a cool (10 °C - 25 °C), dark and quiet room until transport to the release site.
- The animal is to be released within 24 hours of capture, preferably as soon as possible after dusk on the day of capture.

The zoologist is to remain on site during clearing to capture any additional animals that may not have been captured during the trapping programme.

3.5. Death or Injury of Animals

Any Northern Quoll death or injury must be managed as follows:

- The incident must be reported as soon as possible to the relevant site environmental advisor and reported in 1SAP as an environmental event. HSE is to report to DBCA.
- If a camera is available, a photograph of the animal should be taken *in situ*, along with photographs of the surrounding area (to assist with an investigation). If possible, the sex of the animal should be identified. If a GPS is available, then a co-ordinate should be taken of the exact location. If a GPS is not available, sufficient information should be collected on the location so that a subsequent GPS co-ordinate can be collected.
- If the animal is deceased, then it is to be removed from the location, placed in two plastic garbage bags, and placed in a freezer.
- If the animal is injured, then the nature of the injury is to be determined (please contact a veterinarian for advice, if necessary) and if the animal requires additional care or veterinary treatment, then the animal is to be captured by trained zoologist, environmental advisor or employee trained in wildlife caring, ensuring minimal stress to the animal. The animal is to be placed in the appropriated container and transported according to DBCA guidelines (DBCA, 2017) to seek veterinary treatment or is to be given to a licensed wildlife carer as approved by DBCA, if deemed appropriate in accordance with the following procedure:
 - The injured animal is placed immediately in a calico bag/fleece material bag and preferably placed inside a pet pack animal transport container.
 - The animal is to be transported in the cabin of an air conditioned vehicle (maximum time allowed is 12 hours). The injured animal is to be securely placed so that the box/bag does not move around.
 - If the injured animal is to be temporarily stored then it should be in a cool (<25 °C, but not less than 10 °C), dark and quiet room with treatment to be sought for the animal by a qualified veterinarian as soon as possible.
 - Should a rehabilitated animal require release, then the release site is to be within suitable Northern Quoll denning habitat in close proximity to where the animal was found (within the home range of the animal).

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- An event investigation is to be conducted as per BHP Iron Ore's event protocols.
- This management plan is to be reviewed as part of the incident investigation, and if appropriate, the plan is to be revised to incorporate additional control actions. Where relevant, site risk registers should also be updated.
- The DBCA Pilbara Regional Office is to be notified by the Superintendent Biodiversity or delegate within 48 hours of the completion of the event investigation.
- The Superintendent Biodiversity (or delegate) should contact the Western Australian Museum as soon as possible to determine if lodgement of the animal or genetic material is required.

4. Research

BHP Iron Ore will continue to undertake research into Northern Quolls in the Pilbara as required. Research will consider the research priorities identified in Cramer *et al.* (2016) and results from on-going Northern Quoll studies in the Pilbara undertaken by the DBCA and others. Where relevant, the results from these studies will inform future revisions of this management plan.

5. Audit and Review

This document shall be reviewed every two years, or following the death or injury of a Northern Quoll (see Section 3.8).

The site environmental advisor (or delegate) shall undertake half yearly audit of all operations and projects within five kilometres of Northern Quoll denning habitat to ensure adherence of works to this plan. Any breaches to the plan shall be reported within 24 hours to the relevant site HSE Superintendent and the Biodiversity Superintendent.

6. Responsibilities

Position	Role	Description of Task
HSE Manager Projects Infrastructure and Planning	Approval	<ul style="list-style-type: none"> • Approval of management plan • Sign off of annual reporting
HSE Superintendents	Accountability	<ul style="list-style-type: none"> • Implementation of the management plan, including provision of funding
HSE Superintendent Biodiversity and/ or Principal	Advice	<ul style="list-style-type: none"> • Technical review and development of plan • Liaison with relevant external stakeholders
Environment Specialist	Implementation	<ul style="list-style-type: none"> • Implementation of management plan • Reporting • Information dissemination to site personnel

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7. Definitions and Abbreviations

Term	Description
CEMP	Compliance Environmental Management Plan
°C	Degrees Celsius
cm	Centimetre
DBCA	Department of Biodiversity, Conservation and Attractions (formally DPaW)
DEC	Department of Environment and Conservation (WA) – then DPaW, now DBCA
DotE	Department of the Environment (Federal)
DPaW	Department of Parks and Wildlife (formally DEC)
DPIRD	Department of Primary Industries and Regional Development
EPA	Environmental Protection Authority
g	Grams
ha	Hectare
HSE	Health Safety and Environment
Km	Kilometre
Km/hr	Kilometres per hour
m	Metre
mm	Millimetre
WAIO	Western Australian Iron Ore

8. References

8.1. BHP Internal Procedures

Reference	Title
0120098	Biodiversity Strategy
TBA	Compliance Environmental Management Plan

8.2. Technical References

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9. Appendices

Nil