RioTinto

Draft Environmental Management Plan

Mesa J Hub

February 2019

RTIO-HSE-0325684

Robe River Mining Co. Pty. Limited

152-158 St Georges Terrace, Perth

GPO Box A42, Perth WA 6837

RioTinto

Disclaimer and Limitation

This Environmental Management Plan has been prepared by Rio Tinto's Iron Ore group (Rio Tinto), on behalf of Robe River Mining Co. Pty. Limited (the Proponent), specifically for the Mesa H and J Project (Mesa J Hub). Neither the report nor its contents may be referred to without the express approval of Rio Tinto, unless the report has been released for referral and assessment of proposals.

Document Status					
Rev	Author	Reviewer/s	Date	Approved for Issue	
				To Whom	Date
A-B	Rio Tinto	Approvals Ops Environment	July 2018		
1	Rio Tinto	GM West Angelas and Robe Valley	July 2018	EPA Services	July 2018
2	Rio Tinto		September 2018	EPA Services	September 2018
3	Rio Tinto	Rio Tinto HSES	February 2019	EPA Services	February 2019

Summary

This Mesa H and J Environmental Management Plan (Mesa J Hub EMP) is submitted by Rio Tinto on behalf of Robe River Mining Co. Pty. Limited (the Proponent) in accordance with Ministerial Statement xxxx (MS xxxx).

Summary Table 1 below presents the environmental criteria to measure achievement of the environmental outcomes that must be met through implementation of this EMP.

Summary Table 1: Environmental criteria to measure achievement of environmental outcomes and objectives

Proposal title		Mesa H (Revision to Mesa J Iron Ore Development)
Proponent		Robe River Mining Co. Pty. Ltd.
Ministerial Statement		MS xxxx
Purpose of this EMP		This EMP fulfils the requirements of the Mesa H (Revision to Mesa J Iron Ore Development) Environmental Scoping Document and Conditions x – x of MS xxxx.
Mesa J and Mesa H **Inland Waters; Vegetation; and Aquatic Fauna** - abstraction of groundwater; surface water discharge; riparian vegetation and groundwater dependent ecosystems of the Robe River and Jimmawurrada Creek. **EPA Objective:** *To protect flora and vegetation so that biological diversity and ecological integrity are maintained* *To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.*		
Outcome Based Provisions	**Condition environmental outcome**	The Proponent shall ensure there is no irreversible impact to the semi-permanent and permanent pools of the Robe River, aquatic fauna of the Robe River pools, and health of riparian vegetation communities of the Robe River and Jimmawurrada Creek as a result of groundwater abstraction and discharge for the Revised Proposal (Figure 1-3). The Proponent shall ensure that groundwater abstraction and surplus dewater discharge does not cause long term impacts to the Aboriginal heritage values linked to the physical and/or biological surroundings of the Robe River.

	Trigger criteria	1. The mean vegetation index for the riparian upper canopy (*E. victrix, E. camaldulensis* and *M. argentea*) of Zones 1 & 2 of Jimmawurrada Creek and the Robe River declines by ≥ 2 standard deviations from baseline. 2. A statistically significant decline from baseline ($p<0.05$) in the number and/or cover of native perennial species of Zones 1 & 2 of Jimmawurrada Creek and the Robe River. 3. Detection of new introduced species at a potential impact site, previously not detected within the Development Envelope. 4. Decline of >0.5m between paired Alluvial Aquifer bores in the Robe River near targeted pools. 5. Yeera Bluff (Gnieroora) Pool drops below 2m depth. 6. Water quality in pools exceeds rolling quarterly median measured against the operational guideline SSTV equivalent of 95%ile value of baseline or the ANZECC/ARMCANZ (2000) default TV for toxicants for protection of 95% of species, whichever is higher (except for pH).
	Threshold criteria	1. The mean vegetation index for the riparian upper canopy (*E. victrix, E. camaldulensis* and *M. argentea*) of Zones 1 & 2 of Jimmawurrada Creek and the Robe River declines by ≥ 2 standard deviations from baseline over two consecutive monitoring events. 2. A statistically significant decline from baseline ($p<0.05$) in the number and/or cover of native perennial species over two consecutive monitoring events of Zones 1 & 2 of Jimmawurrada Creek and the Robe River. 3. Detection of new introduced species rated high or very high management priority (by the Department of Biodiversity, Conservation and Attractions) at a potential impact site, previously not detected within the Development Envelope and a significant increase in cover or abundance over successive monitoring events. 4. Decline of ≥1 m between paired Alluvial Aquifer bores in the Robe River near targeted pools. 5. Yeera Bluff (Gnieroora) Pool drops below 1m depth. 6. Three (3) or less species of fish recorded during a sampling event.
Mesa H **Terrestrial fauna – Ghost Bat (*Macroderma gigas*)** **EPA Objective:** *To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.*		
Outcome Based Provisions	**Condition environmental outcome**	The Proponent shall ensure there is no irreversible impact, as a result of the Mesa H Project, to Breakaways and Gullies habitat retained in the escarpments of the Mesa H Mining Exclusion Zone (MEZ), other than exiting and authorised disturbance.
	Trigger criteria	1. Vibration levels exceed 50mm/s peak particle velocity at the potential diurnal/maternal Ghost Bat roost caves. 2. Disturbance, other than approved clearing, within 50m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves.
	Threshold criteria	1. Significant damage to diurnal/maternal Ghost Bat roost caves as shown in Figure 1-4. 2. Disturbance, other than approved than approved clearing, within 40m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves.

Management Based Provisions	**Condition environmental objective**	The Proponent shall improve knowledge of the Ghost Bat population and utilisation of high value habitat in the Robe Valley in order to assist in maintaining biological diversity and ecological integrity.
	Management targets	1. Estimate the local population of Ghost Bats in the central part of the Robe Valley. 2. Indicate how Ghost Bats use caves within the central part of the Robe Valley (e.g. diurnal versus maternal), including the degree of utilisation of caves by pregnant females.
Mesa H **Terrestrial fauna – Northern Quoll (*Dasyurus hallucatus*)** **EPA Objective:** *To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.*		
Outcome based Provisions	**Condition environmental outcome**	The Proponent shall ensure there is no irreversible impact, as a result of the Mesa H Project, to Breakaways and Gullies habitat retained in the escarpments of the Mesa H MEZ (Figure 1-4) other than existing and authorised disturbance.
	Trigger criteria	1. Disturbance of ≥ 5% of potential Northern Quoll denning habitat on the retained escarpment (MEZ) of Mesa H.
	Threshold criteria	1. Disturbance of > 10% of potential denning Northern Quoll habitat on the retained escarpment (MEZ) of Mesa H.
Mesa H **Subterranean Fauna – Troglofauna** **EPA Objective:** *To protect subterranean fauna so that biological diversity and ecological integrity are maintained.*		
Outcome Based Provisions	**Condition environmental outcome**	The Proponent shall ensure there is no irreversible impact, as a result of the Mesa H Project, to the troglofauna habitat retained within the Mesa H MEZ (Figure 1-5).
	Trigger criteria	1. Operational error **during mining** resulting in removal of greater than 0.01% by volume annually of the MEZ at Mesa H.
	Threshold criteria	1. Net loss of the MEZ at Mesa H, at the **completion of mining**.
Management Based Provisions	**Condition environmental objective**	The Proponent shall protect the biological diversity and ecological integrity of the troglofauna assemblages of Mesa H by minimising impacts as far as practicable
	Management targets	1. Total clearing of native vegetation across the surface of the Mesa H MEZ is less than 30% of the MEZ surface area. 2. Troglofauna specimen capture rate is not below the baseline minimum for three (3) consecutive sampling events at Mesa H.
Mesa H and Mesa J **Subterranean Fauna – Stygofauna** **EPA Objective:** *To protect subterranean fauna so that biological diversity and ecological integrity are maintained.*		

Outcome Based Provisions	**Condition environmental outcome**	The Proponent shall ensure there is no irreversible impact, as a result of the Revised Proposal's water management activities, to stygofauna habitat within the CID aquifers and stygofauna / Blind Cave Eel habitat within the alluvial aquifer habitats of Jimmawurrada Creek and the Robe River shown in Figure 1-6.
	Trigger criteria	1. Groundwater levels drop three (3) m below predicted water table heights in the Jimmawurrada Creek alluvial aquifer. 2. Diversity of stygofauna Orders collected during annual survey events reduced to three (3) or less.
	Threshold criteria	1. Alluvial aquifer bores in the margins of Jimmawurrada are dry for two (2) consecutive years. 2. Absence of Blind Cave Eel recorded for two (2) consecutive annual sampling events. 3. Absence of stygofauna specimens for two (2) consecutive annual sampling events.
Management Based Provisions	**Condition environmental objective**	The Proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages within the CID and Alluvial aquifer habitats shown in Figure 1-6 by minimising impacts as far as practicable.
	Management target	5. Understand the distribution and ecology of key stygofauna taxa within the Robe Valley area.

Corporate endorsement

I hereby certify that to the best of my knowledge, the provisions within this Mesa H and J Environmental Management Plan are true and correct and address the legal requirements of MS xxxx.

Name: **Signed:**

Designation: GM Robe Valley **Date:**

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Figures

Tables

Appendix

1. CONTEXT, SCOPE AND RATIONALE

1.1 Mesa H and J Project (Mesa J Hub)

Robe River Mining Co. Pty. Limited (the Proponent) manages and operates the Robe Valley mining operations, which includes iron ore mines at Mesa J and H as approved by MS XXXX under Part IV of the *Environmental Protection Act 1986* (EP Act). Mesa H is an extension of the existing Mesa J operation and for the purposes of this Environmental Management Plan (EMP) both are referred to as the Mesa J Hub.

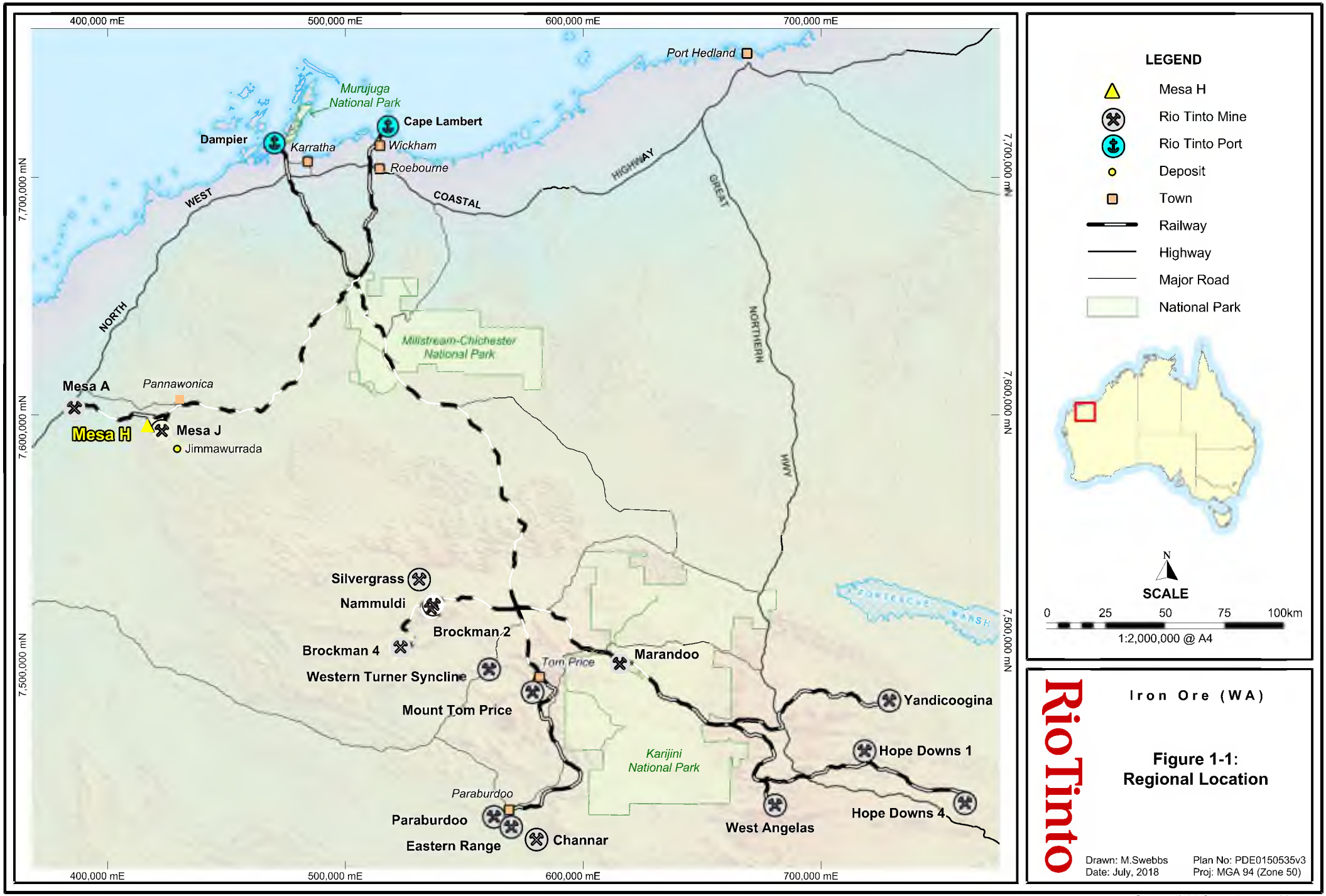
The Mesa J Hub is located approximately 16 km south west of Pannawonica in the Pilbara region of Western Australia (Figure 1-1) and consists of the following:

- Mine Pits:
  - Mesa J – open cut above and below water table pit; and
  - Mesa H - new open cut above and below water table pits.
- Ore processing supported by existing processing facilities at Mesa J, but may require other processing facilities, including, but not limited to waste fines storage facilities.
- Mineral waste management including backfilling, ex-pit waste dumps, low grade ore dumps, topsoil and sub-soil stockpiles.
- Infrastructure including but not limited to the following:
  - Dewatering and surplus water management infrastructure such as bores, pipelines, and discharge outlets, for use in processing, on-site use and controlled discharge to the Robe River and tributaries.
  - Surface water management infrastructure, including surface water diversion drains, levees and culverts.
  - Linear infrastructure, including heavy vehicle and light vehicle access roads, upgrades to existing vehicle access roads, pipelines and power (including sub-stations) and communications distribution networks.
  - Support facilities, including the workshops, power supply infrastructure, hydrocarbon storage, laydown areas, offices and waste water treatment plants.
  - Water supply utilising groundwater abstracted for dewatering, surface water that reports to pits, an expansion to the existing Mesa J borefield (Southern Cutback Borefield).

The Mesa J Hub Development Envelope and the conceptual layout for the Mesa H Project is shown in Figure 1-2.

This EMP will supersede the existing Mesa J Operation Environmental Management Plan (December 2012, RTIO-HSE-0162720).

This EMP has been developed in accordance with the EPA's *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans.*


400,000 mE
500,000 mE
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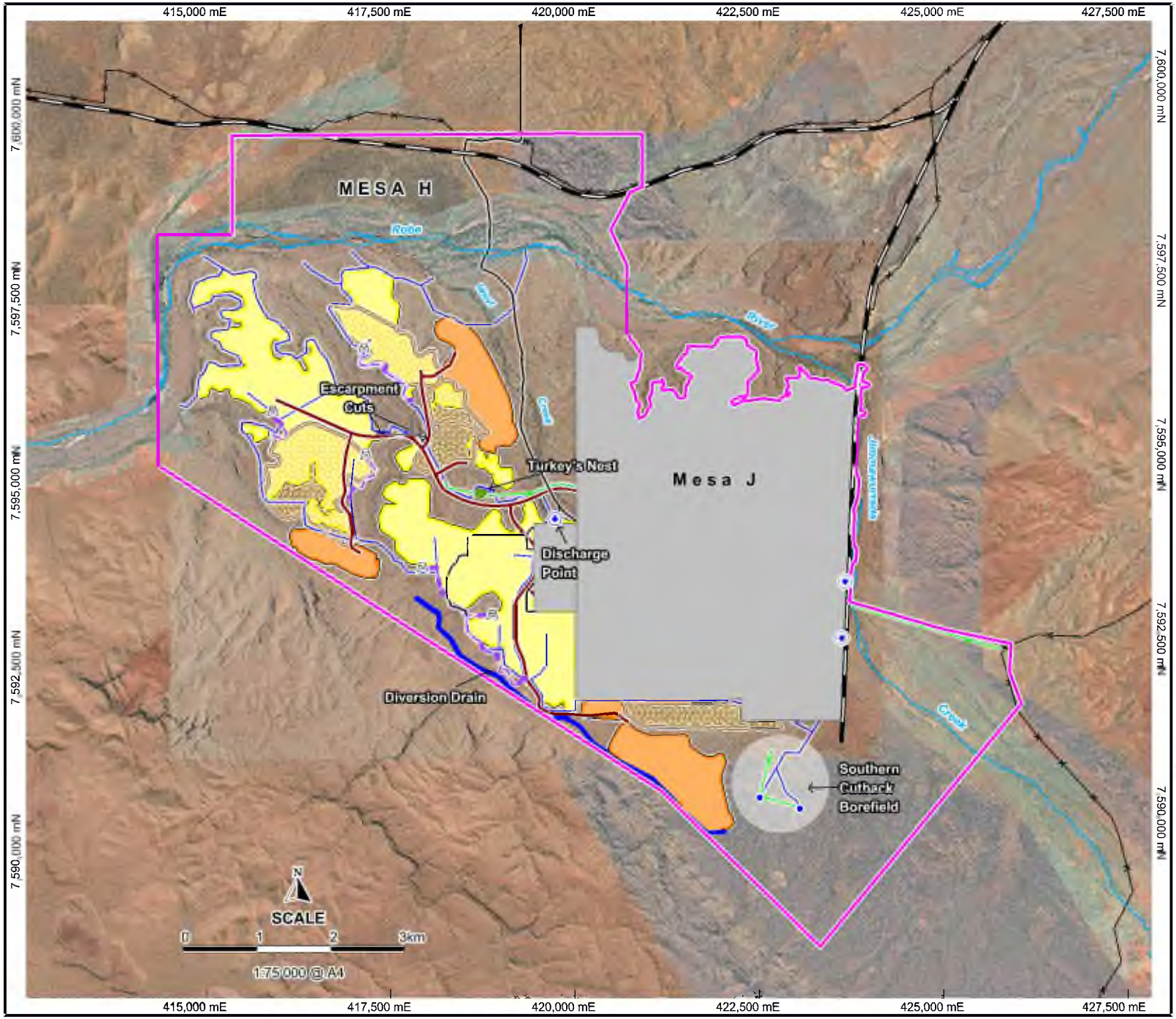
Port Hedland
Murujuga National Park
Cape Lambert
Dampier
Karratha
Wickham
Roebourne
WEST COASTAL HIGHWAY
GREAT NORTHERN HWY
NORTH WEST COASTAL HIGHWAY
Millstream-Chichester National Park
Mesa A
Pannawonica
Mesa H
Mesa J
Jimmawurrada
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Mount Tom Price
Tom Price
Marandoo
Yandicoogina
Hope Downs 1
Hope Downs 4
West Angelas
Karijini National Park
Paraburdoo
Eastern Range
Channar
FORTESCUE MARSH
LEGEND
Mesa H
Rio Tinto Mine
Rio Tinto Port
Deposit
Town
Railway
Highway
Major Road
National Park
N
SCALE
0 25 50 75 100km
1:2,000,000 @ A4
Iron Ore (WA)
Figure 1-1:
Regional Location
Drawn: M.Swebbs
Date: July, 2018
Plan No: PDE0150535v3
Proj: MGA 94 (Zone 50)
Geospatial Information and Mapping



LEGEND

- Development Envelope
- Ministerial Statement 208
- Railway
- Powerline
- LV Road
- Major Watercourse
- Existing Discharge Point

Conceptual Mine Layout

- Mine Pit
- Waste Dump
- Topsoil / Subsoil Stockpile
- Turkey's Nest
- Diversion Drain
- Haul Road
- Discharge Pipeline
- Electrical Services
- Communicaiton Route
- Communication Tower
- Water Bore

Rio Tinto

Iron Ore (WA)

Figure 1-2: Mesa J Hub Development Envelope and Conceptual Layout

Drawn: M.Swebbs
Date: Aug, 2018

Plan No: PDE0152228v8
Proj: MGA94 Zone50

Geospatial Information and Mapping

1.2 Key Environmental Factors

Management of the following key aspects of the Mesa J Hub are incorporated in this EMP:

- **Inland Waters; Flora and Vegetation; and Aquatic Fauna** - abstraction of groundwater; surface water discharge; riparian vegetation and groundwater dependent ecosystems of the Robe River and Jimmawurrada Creek.
- **Terrestrial fauna** – conservation significant fauna species (Ghost Bat and Northern Quoll).
- **Subterranean fauna** – troglofauna and stygofauna.

Inland Waters

Pools and Aquatic fauna

The Robe River is predominantly an ephemeral river which carries a significant base-flow in its alluvial bed, which maintains permanent and semi-permanent pools, a number of which are contained within the Development Envelope. These pools are maintained by groundwater in the absence of surface water inputs, with a range in seasonal groundwater variability of up to 3m, as recorded in alluvial bores within the Study Area. These pools along the Robe River support “River Pool Ecosystem” type GDEs. These ecosystems are an important component of the river ecosystem, supporting a diverse range of aquatic fauna and specialised flora, and rely on consistent surface expressions of groundwater. The fringing vegetation surrounding the pools generally support a high diversity of flora species and the pools themselves were found to have elevated to high macrophyte (including sedges) and ephemeral taxa diversity

Groundwater abstraction for pit dewatering will result in localised groundwater drawdown in CID aquifers that may have some connectivity to the Robe River alluvial aquifer. Modelling indicates the potential for a reduction in water levels in the Robe River alluvial aquifer and the Robe River semi-permanent and permanent pools may be up to 1m. This is not anticipated to change the permanent or semi-permanent nature of any of the pools, but shallow pools (<1m) have the potential to dry out as a result.

Riparian Vegetation

Riparian ecosystems occur along the Robe River and along and Jimmawurrada Creek, supporting woodlands comprising silver cadjeput (*Melaleuca argentea*) and eucalypt species (*Eucalyptus camaldulensis, E. victrix*).

The riparian vegetation of Jimmawurrada Creek predominantly comprises facultative phreatophytic species (i.e. species that utilise groundwater for a portion of their water requirements, but can also satisfy their water requirements through stored soil water reserves). Riparian vegetation of the Robe River differs from Jimmawurrada Creek due to the dominance of obligate phreatophytic species, which are considered groundwater dependent.

The Mesa J Hub operations require groundwater abstraction to facilitate mining of the CID ore located below the water table, which has the potential to lower groundwater levels in the adjacent sections of the Robe River. Additional groundwater abstraction for water supply (predominantly for wet ore processing) is sourced from the Southern Cutback Borefield. The additional abstraction will result in further lowering of the groundwater table around the borefield. Combined with the cumulative effects of the Coastal water Supply Project and mine pit dewatering, the drawdown cone of depression is modelled to extend below Jimmawurrada Creek and further lower the water table between 1 – 9 m below a 12 km section of Jimmawurrada Creek.

This may reduce the availability of water to GDV occurring within the Development Envelope and adjacent sections of Jimmawurrada Creek immediately upstream of the Development Envelope, potentially resulting in health decline of these riparian communities and in some cases death of obligate phreatophytes.

All abstracted water is planned to be used on site for operational requirements however during wet season or significant rainfall events when storage capacity is exceeded, surplus water will be periodically discharged. Discharge of surplus water will be via a number of existing Mesa J discharge outlets into Jimmawurrada Creek and / or West Creek, and may intermittently result in a surface water expression extending up to 8 km from the discharge outlet(s) depending on seasonal water availability and processing plant water demand. Given the intermittent nature of discharge and discharge continuing within the existing Mesa J operational discharge footprint, no additional significant impact to riparian communities are expected.

Discharge directly into the Robe River is not proposed unless required as a mitigation strategy for maintaining the pools.

Terrestrial fauna

The most important habitat types for the Ghost Bat and Northern Quoll within the Development Envelope includes Gorge and Breakaway habitat for their cave forming characteristics providing potential shelter and foraging habitat and Riverine and Drainage Line habitats for foraging and dispersal.

Potential impacts of the Project on the Ghost Bat and the Northern Quoll are loss or fragmentation of habitat, including breeding, foraging and dispersal habitat, due to clearing; indirect disturbance to critical habitat (potential diurnal/maternal Ghost Bat roosts) via blast vibrations; and indirect impacts to foraging habitat in the Major River/Creek habitat due to groundwater drawdown and surplus water discharge.

Subterranean Fauna – troglofauna and stygofauna

The target ore body in the Mine Development Envelope comprises Robe Pisolite which is considered to be high prospectivity habitat for troglofauna and stygofauna. Most species of obligate troglofauna are considered to be Short Range Endemic (SRE) with many species believed to be endemic to individual mesas in the Robe Valley. Stygofauna are also commonly considered to be SRE's however species' distribution is linked to aquifer extent. Mine pit excavation to be conducted as part of the Project will result in direct loss of troglofauna and stygofauna habitat and a loss of individuals, which in turn has the potential to result in changes to community assemblages. Groundwater abstraction for mine pit dewatering and water supply will also result in direct loss of stygofauna habitat, loss of individuals and potential changes in community assemblages. Clearing of vegetation may lead to a reduction in organic inputs into the subterranean environment which may reduce the quality of troglofauna and stygofauna habitat.

1.3 Condition Requirements

The proposed EMP condition and the associated proposed environmental objectives for the Mesa J Hub are detailed below in Table 1-1.

Table 1-1 Proponent proposed conditions for the Mesa J Hub

Condition		Section in EMP
5	**Condition Environmental Management Plans**	
5-1	The proponent shall prepare and submit a Condition Environmental Management Plan to the satisfaction of the CEO. This plan shall demonstrate that the environmental outcomes specified in in condition 6-1, condition 7-1, condition 8-1, and condition 9-1 will be met.	
5-2	The Condition Environmental Management Plan shall: (1) specify the environmental outcomes to be achieved, as specified in condition 5-1;	Table 2-1 to Table 2-5

	Condition	Section in EMP
	(2) specify trigger criteria that must provide an early warning that the threshold criteria may not be met; (3) specify threshold criteria to demonstrate compliance with the environmental outcomes specified in condition 5-1. Exceedance of the threshold criteria represents non-compliance with these conditions; (4) specify monitoring to determine if trigger criteria and threshold criteria are exceeded; (5) specify trigger level actions to be implemented in the event that trigger criteria have been exceeded; (6) specify threshold contingency actions to be implemented in the event that threshold criteria are exceeded; and (7) provide the format and timing for the reporting of monitoring results against trigger criteria and threshold criteria to demonstrate that condition 5-1 has been met over the reporting period in the Compliance Assessment Report required by condition 3-6. For management based provisions, the Condition Environmental Management Plan shall: (8) specify the environmental objectives to be achieved, as specified in condition 5-1; (9) specify management actions to meet the environmental objective; (10) specify management targets; (11) specify monitoring to determine if management targets are being met (12) provide the format and timing for the reporting of monitoring results against management targets to demonstrate that condition 5-1 has been met over the reporting period in the Compliance Assessment Report required by condition 3-6.	
5-3	After receiving notice in writing from the CEO that the Condition Environmental Management Plan satisfies the requirements of condition 5-2 the proponent shall: (1) implement the Condition Environmental Management Plan, or any subsequent approved versions; and (2) continue to implement the Condition Environmental Management Plan until the CEO has confirmed by notice in writing that the proponent has demonstrated the objectives specified in condition 5-1 have been met.	N/A

	Condition	Section in EMP
5-4	In the event that the monitoring indicates an exceedance of the threshold criteria specified in the Condition Environmental Management Plans, the proponent shall: (1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified; (2) implement the threshold level contingency actions specified in the Condition Environmental Management Plans within 24 hours and continue implementation of those actions until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria are being met and the implementation of the threshold contingency actions is no longer required; (3) investigate to determine the cause of the threshold criteria being exceeded; (4) investigate to provide information for the CEO to determine potential environmental harm that occurred due to the threshold criteria being exceeded; and (5) provide a report to the CEO within twenty one (21) days of the exceedance being reported as required by condition 5-6(1). The report shall include: a. details of threshold contingency actions implemented; b. the effectiveness of the threshold contingency actions implemented, against the threshold criteria; c. the findings of the investigations required by condition 5-5(3) and 5-5(4); d. measures to prevent the threshold criteria being exceeded in the future; e. measures to prevent, control or abate the environmental harm which may have occurred; and f. justification of the threshold remaining, or being adjusted based on better understanding, demonstrating that outcomes would continue to be met.	Table 2-1 to Table 2-5
5-5	The proponent: (1) may review and revise the Condition Environmental Management Plan, or (2) shall review and revise the Condition Environmental Management Plan as and when directed by the CEO.	N/A
5-6	The proponent shall implement the latest revision of the Condition Environmental Management Plan, which the CEO has confirmed by notice in writing, satisfies the requirements of condition 5-1 and condition 5-2.	

	Condition	Section in EMP
6	**Mesa H and J Inland Waters** **Dewatering of groundwater and groundwater dependent ecosystems of the Robe River and Jimmawurrada Creek; surface discharge of surplus water and riparian vegetation of the Robe River and Jimmawurrada Creek.**	
6-1	The proponent shall manage the implementation of the Proposal to meet the following environmental outcomes: (1) No irreversible impact, as a result of the proponent's water abstraction, to the health of groundwater dependent vegetation within the Robe River. (2) No irreversible impact, as a result of the proponent's water abstraction, to the health of riparian vegetation communities within Jimmawurrada Creek. (3) No irreversible impact, as a result of the Proponent's discharge of surplus water, to the health of riparian vegetation communities of Jimmawurrada Creek and the Robe River. (4) No irreversible impact, as a result of the Proponent's drawdown and discharge, to the pool ecosystems of the Robe River.	Table 2-1
7	**Mesa H Terrestrial Fauna** **Conservation significant fauna species; Ghost Bat (*Macroderma gigas*) and Northern Quoll (*Dasyurus hallucatus*)**	
7-1	The proponent shall manage the implementation of the Proposal to meet the following environmental outcome: (1) No irreversible impact, as a result of the proponent's activities, to Breakaways and Gullies habitat retained in the escarpments of Mesa H.	Table 2-2 Table 2-3
7-2	The proponent shall manage the implementation of the Proposal to meet the following environmental objective: (1) The proponent shall improve knowledge of the Ghost Bat population and utilisation of high value habitat in the Robe Valley in order to assist in maintaining biological diversity and ecological integrity.	Table 2-3
8	**Mesa H Subterranean fauna – Troglofauna**	
8-1	The proponent shall manage the implementation of the Proposal to meet the following environmental outcome: (1) No irreversible impact, as a result of the proponent's activities, to the troglofauna habitat retained within the Mesa H MEZ.	Table 2-4
8-2	The proponent shall manage the implementation of the Proposal to meet the following environmental objective: (1) The Proponent shall protect the biological diversity and ecological integrity of the troglofauna assemblages of Mesa H by minimising impacts as far as practicable.	Table 2-4
9	**Mesa H and Mesa J Subterranean fauna – Stygofauna**	
9-1	The proponent shall manage the implementation of the Proposal to meet the following environmental outcome: (1) No irreversible impact, as a result of the proponent's water management activities to the stygofauna habitat within the CID aquifer and stygofauna and Blind Cave Eel habitat within the alluvial aquifer habitat of Jimmawurrada Creek and the Robe River.	Table 2-5
9-2	The proponent shall manage the implementation of the Proposal to meet the following environmental objective:	Table 2-5

Condition			Section in EMP
	(1)	The Proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages within the Robe River and Jimmawurrada Creek alluvial aquifer habitats by minimising impacts as far as practicable.	

1.4 Rationale and Approach

This EMP addresses environmental factors (and relevant environmental outcomes and objectives) which were determined by the Department of Water and Environmental Regulation – EPA Services (EPA Services) as being relevant to the management of groundwater abstraction, surface water discharge, conservation significant vegetation communities and fauna species associated with the Mesa J Hub.

This EMP identifies:

- The environmental criteria that the Proponent will use to monitor performance of the management measures to ensure environmental objectives are met.
- The management actions that will be implemented in response to monitoring results.

Results of baseline surveys, monitoring and a number of assumptions and uncertainties inform the management approach for meeting the environmental outcomes and objectives stated in conditions 6, 7, 8 and 9 of MS xxxx.

The identified trigger criteria, threshold criteria, management targets and response actions are aligned with the overall management approach.

Monitoring data is used to evaluate compliance with the trigger and threshold criteria to achieve the environmental outcomes and management targets are used to assess whether the management actions are effective in meeting the environmental objectives.

1.4.1 Survey and Study Findings

a) Inland Waters – Pools and Aquatic Fauna

Permanent and semi-permanent pools exist along the Robe River due to the significant subsurface flow in the coarse channel gravels of the Robe River alluvial aquifer. There is potentially a strong hydraulic correlation between the Robe River alluvium and the underlying aquifer, the direction of interaction changes seasonally in response to stream flow events and evapotranspiration. Streamflow events also recharge groundwater, causing the groundwater level to rise, creating large and continuous pools. After a period of no flow, the hydraulic gradient between the groundwater and the pools reverse and groundwater discharges into the pools. Ephemeral pools eventually become disconnected from intermittent pools and as surface water evaporates, these pools reduce in size or disappear.

Drought conditions and declining groundwater levels result in shallower pool depths and semi-permanent pools becoming disconnected from the groundwater. Permanent pools have long-term connectivity to the groundwater and are expected to be maintained by natural groundwater discharge during drought periods.

The history of isolation of river systems of the Pilbara results in a low biodiversity of freshwater fish being recorded from the Pilbara (12 species) (Allen *et al*. 2002 cited in Streamtec 2017). A total of ten species have been recorded in the Robe River during aquatic surveys since 1991 (Streamtec 2017).

The baseline aquatic survey in 2016 (WRM 2017) recorded a total of 3,515 fish in the Development Envelope including seven true freshwater taxa. There was no significant difference in abundance of fish upstream and downstream of the Jimmawurrada-Robe confluence; however, there was a significant difference in mean species richness between upstream and downstream, with significantly higher richness downstream of the Jimmawurrada-Robe confluence, adjacent to the Mesa J Hub.

b) Inland Waters - Riparian Vegetation

Robe River

The Robe River is an ephemeral river with significant base-flow in its alluvial aquifer, which maintains permanent and semi-permanent pools; a number of which are within the Development Envelope. These pools are maintained by groundwater in the absence of surface water inputs, with a range in seasonal groundwater levels of up to 3m, as recorded in alluvial bores. As groundwater levels drop during prolonged dry periods, the semi-permanent pools may dry out.

Key features of the vegetation associated with the Robe River in the Development Envelope (as summarised by Astron 2018) include:

- No Threatened or Priority Ecological Communities (TECs/PECs) and no Threatened flora; however does contain Priority flora (primarily *Rhynchosia bungarensis* P4).
- Permanent and semi-permanent pools - these pools generally support high species diversity. Vegetation surrounding these pools is typically dominated by dense *Melaleuca argentea* and *Eucalyptus camaldulensis* subsp. *refulgens* over sedge, grass and herbaceous species.
- Pools and main channels support Groundwater Dependant Ecosystems including groundwater dependant vegetation dominated by *M. argentea.*
- Vegetation condition varies from 'Very Poor' to 'Excellent' in the Robe River and its tributaries. Poorer condition is generally as a result of weed proliferation, grazing and trampling. **Cenchrus* species (spp.) (Buffel and Birdwood Grasses) are a common component of the vegetation in some areas.

Jimmawurrada Creek

Jimmawurrada Creek is an ephemeral system with negligible base-flow, and possesses stretches of riparian vegetation which has been modified by changes to drainage lines; drawdown associated with the Mesa J Project, the Southern Cutback Borefield and the Coastal Water Supply; and mine dewatering discharge through existing licensed outlets.

Key features of the vegetation associated with Jimmawurrada Creek in the Development Envelope and within the extent of the modelled groundwater drawdown include:

- No TECs or PECs and no Threatened flora.
- No permanent and semi-permanent pools.
- Vegetation is dominated by *Eucalyptus camaldulensis* subsp. *refulgens* and *E. victrix*
- Vegetation condition varies from 'Very Poor' to 'Excellent' with poorer condition generally as a result of weed proliferation, grazing and trampling. **Cenchrus* species (Buffel and Birdwood Grasses) are a common component of the vegetation in some areas.

Refined Riparian Mapping

Given the local and sub-regional significance of the riparian zone vegetation, a refined riparian mapping program was undertaken across both the Robe River and Jimmawurrada Creek (Rio Tinto 2017a, 2017b) in order to attribute an impact 'risk rating' to each vegetation association. This involved an interpretation of the degree of sensitivity (or vulnerability) of each community to hydrological change and the risk that "measurable" impact/change to a community could result from significant hydrological changes.

Within the Development Envelope, Astron (2016a) mapped two riparian communities which they identified as potential GDE's: MaEcCv (representing the obligate phreatophytic (OPV) or generally "high risk" type communities mapped by Rio Tinto (2017a); and EcEvAtrApyPlTw) (representing the

facultative phreatophytic (FPV) or generally “moderate risk” type communities mapped by Rio Tinto (2017a)).

Vegetation association MaEcCv was considered a GDE due to the dominant species being *Melaleuca argentea* (an obligate phreatophyte) and *E. camaldulensis var. refulgens* (a facultative phreatophyte). *M. argentea* and *E. camaldulensis* var. *refulgens*, and therefore the vegetation in which they predominate, is highly likely to be sensitive to changes in groundwater depth and availability. These two vegetation associations are typical of riparian vegetation that occurs along minor and major channels within the River Land System in the Pilbara.

The two riparian vegetation units identified by Astron (2016a, 2016b) as GDE’s equate to ten ‘refined’ units mapped by Rio Tinto (2017a, 2017b), only three of which are considered to contain obligate phreatophytes (Table 1-2). The differentiation by Rio Tinto (2017a, 2017b) is a result of differences in canopy structure, the dominance or co-dominance of *E. camaldulensis* versus *E. victrix*, and differences in mesic understorey composition observed through detailed field mapping (Rio Tinto 2017a, 2017b).

The three key vegetation associations identified by Rio Tinto (2017a, 2017b) as representing GDE communities and dominated by obligate phreatophytes comprise: C1AA (a&b); C1A; and C1B. The C1AA (a&b) and C1A communities possess relatively mature OPV, while the C1B community comprises relatively immature OPV. The mature community was generally uniform in its presence and spatial extent in the environment, indicating more consistent groundwater access, whereas the immature community is likely to be more transient in nature, have less consistent groundwater access and likely to have established in response to dewatering discharge. The C1AA communities have a canopy dominated by *Melaleuca argentea,* which generally form an open forest overstorey, whereas C1A and C1B communities had an overstory only co-dominated by *Melaleuca argentea (*and *Eucalyptus* spp.*)*.

Table 1-2: Significant riparian vegetation units in the Development Envelope

Astron (2016a, 2016b) vegetation association	Equivalent (or associated) Rio Tinto (2017a, 2017b) units*	Broad Rio Tinto (2017) GDE classification type	Rio Tinto (2017) Residual Significance
MaEcCv	**C1AA (a&b), C1A, C1B**	OPV-A, B and C (vegetation at least co-dominated by the obligate phreatophyte *Melaleuca argentea* of varying age structure)	High to Moderate (locally and sub-regionally significant)
EcEvAtrApyPITw	**C2AA**, C2AACr, C2A, C2B, C2A-B, C2B-B, C3A	FPV-A and FPV-B (vegetation at least co-dominated by the facultative phreatophyte *Eucalyptus camaldulensis*)	Moderate to Minor (locally restricted but common regionally to common locally and regionally)

*Bold and underlined units indicate significant vegetation

Of the Rio Tinto (2017a) refined riparian vegetation units, only the *Melaleuca argentea* dominated and co-dominated communities (C1AA(a&b), C1A, and C1B) are considered locally and sub-regionally significant as potential GDE’s (Rio Tinto 2017a, 2017b). Unit C2AA (*Eucalyptus camaldulensis* open forest) is considered to be locally and potentially sub-regionally significant and similar to Astron’s (2016a) EcEvAtrApyPITw community.

Unit C2A (*Eucalyptus camaldulensis* woodland-open forest) mapped on Jimmawurrada Creek is broadly similar to the significant C2AA community but the conservation significance was reduced based on it being restricted to creek landforms, possessing lower species diversity, having reduced condition due to grazing pressure and alteration of the community from discharge. The remaining units are typically found in mesic riparian environments and are widely represented in creek and river systems in the Pilbara (Rio Tinto 2017a).

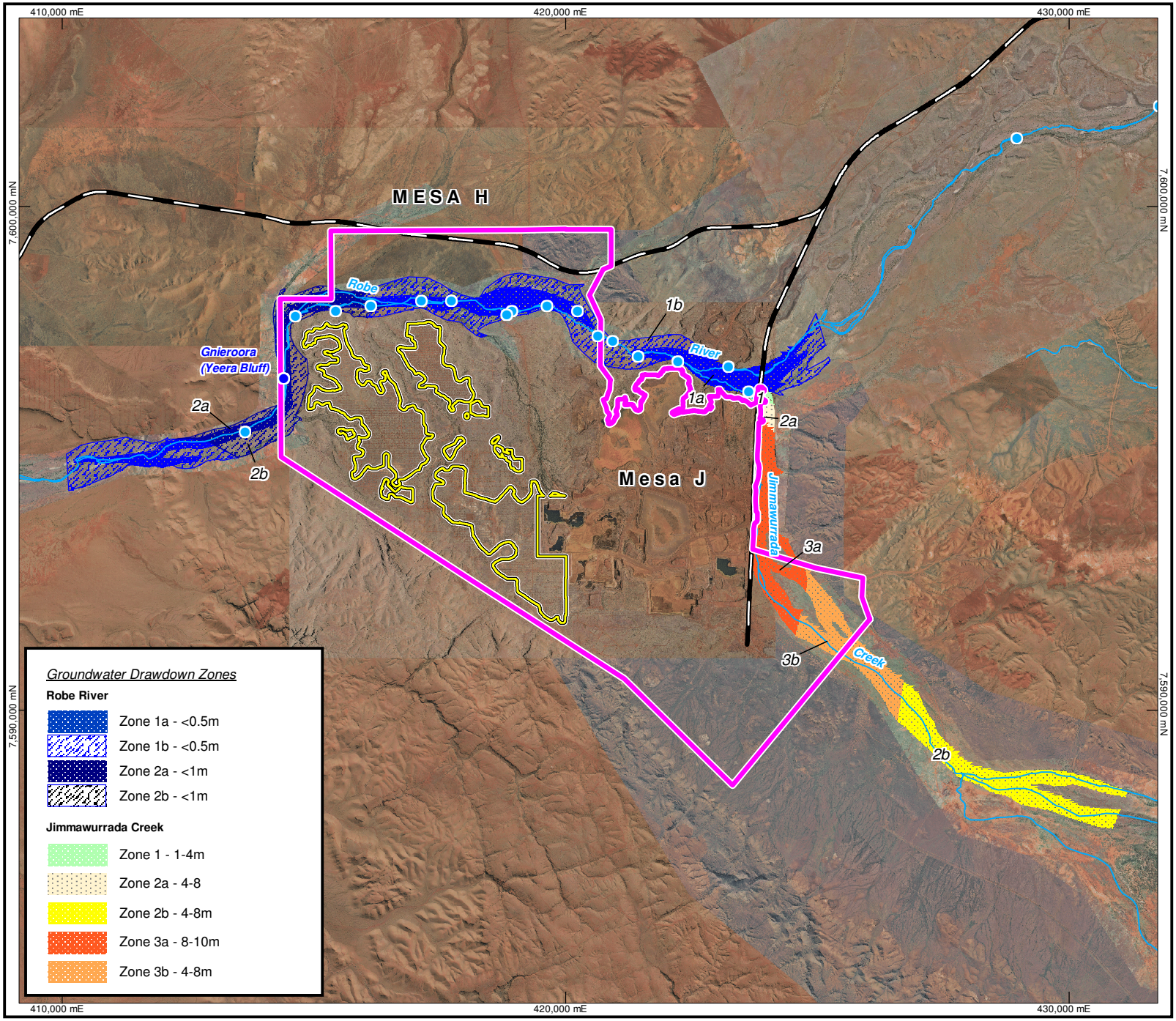
Based on the refined riparian mapping and likely sensitivity of the riparian vegetation units to changes in groundwater levels, combined with predicted extent and depth of groundwater drawdown, a number of impact 'Zones' have been defined along Jimmawurrada Creek and the Robe River as provided in

Table 1-3 and shown in Figure 1-3.

Table 1-3: Riparian vegetation Zones in the Development Envelope and extent of modelled groundwater drawdown

Zone	Max water table depth - (bgl)		Magnitude of Drawdown	Mitigating factors	Presence/Absence of OPV or FPV in the Riparian Zone
Jimmawurrada Creek					
JIM 1	*<7		*1-4	Discharge and Robe River alluvial aquifer; large scale influence. Surface water flows; moderate to large scale influence (due to creek attenuation by range).	Some OPV present, although FPV broadly dominant. Potential baseline OPV restricted to low flow channels skirting the west bank within this zone. The remainder of OPV in this zone appears to have established post mining. Single riparian corridor present.
JIM 2	A	*7-11	*4-8	Discharge; large scale Influence. Robe River alluvial aquifer; moderate to large scale influence. Surface water flows; moderate to large scale influence (due to creek attenuation by the range).	Some pre and post-mining (augmented) OPV present, however creek broadly dominated by FPV. OPV generally restricted to a strip surrounding the low flow channel skirting the west boundary of the creek. Single riparian corridor present.
	B			Discharge; low to negligible influence. Surface water flows; moderate scale influence.	OPV absent. Creek dominated by FPV. Single riparian corridor present in the west, dual corridors (Channel splits to Bungaroo and Jimmawurrada Creeks) in the eastern end of polygon.
JIM 3	A	*11-14	*8-10	Discharge; minor to moderate scale influence. Surface water flows; moderate to large scale influence.	Some post-mining (augmented) OPV present, however creek broadly dominated by FPV. OPV generally restricted to a thin strip surrounding the low flow channel skirting the west boundary of the creek. Single riparian corridor present in the north, dual corridors in the southern 1/3 of polygon.
	B		*4-8	Discharge; low to negligible scale influence. Surface water flows; moderate scale influence.	No OPV present; area dominated by FPV. Dual riparian corridor present in two sections, with a central section where a single corridor is present.
Robe River					
RR-1A	Zone A*: Low flow and secondary	~1.5-3m	~<0.5m	Discharge; minor to moderate scale influence. Surface water flows and subsurface base-flow; large scale influence.	OPV represents the dominant riparian vegetation present. FPV is also common and relatively widespread.

Zone	Max water table depth - (bgl)		Magnitude of Drawdown	Mitigating factors	Presence/Absence of OPV or FPV in the Riparian Zone
	channel Zones.				
RR-1B	Zone B*: Outer/flanking, and generally more elevated cobbled bed zones – includes minor channels.	~3 - 5.5m	<0.5m	Discharge; minor scale influence. Surface water flows and subsurface base-flow; large to moderate scale influence.	FPV represents the dominant riparian vegetation present. OPV is also common throughout.
RR-2A	Zone A*: Low flow and secondary channel Zones.	2 - 3.5m	*<1m	Discharge; minor to moderate scale influence. Surface water flows and subsurface base-flow; large scale influence.	OPV represents the dominant riparian vegetation present. FPV is also common and relatively widespread.



LEGEND

- Development Envelope
- Railway
- Major Watercourse
- Pool
- Gnieroora (Yeera Bluff)

Conceptual Mine Layout

- Mine Pit

N

SCALE

0 2 4 6km

1:100 000 @ A4

Rio Tinto

Iron Ore (WA)

Figure 1-3: Riparian Zones, Pools and extent of groundwater Impact Zones

Drawn: T.M.
Date: July, 2018

Plan No: PDE0161882v4
Proj: MGA 94 Zone 50

Geospatial Information and Mapping

c) Terrestrial fauna – Ghost Bats

Roost sites used permanently by Ghost Bats are generally deep natural caves with a relatively stable temperature of 23-28^{o}C and humidity above 50%. Individuals require a range of cave sites and move between roosts seasonally or according to weather conditions. The most significant habitats in the Development Envelope for the species are the Breakaways and Gullies (including the mesa escarpments) and the Major River/Creek habitat (Figure 1-4); these areas represent potential roosting and foraging habitat. Habitat loss through impact or disturbance to roost sites, specifically caves that play a role in breeding activities (maternal roosts), and nearby areas is seen as a key risk to this species conservation status.

Previous assessments of caves in the Mesa H Survey Area and Development Envelope (Astron 2014; Bat Call 2017a) have collectively identified two diurnal roosts (with maternity roost potential) and ten nocturnal feeding roosts (two were part of the one system) (Astron 2017a) Figure 1-4.

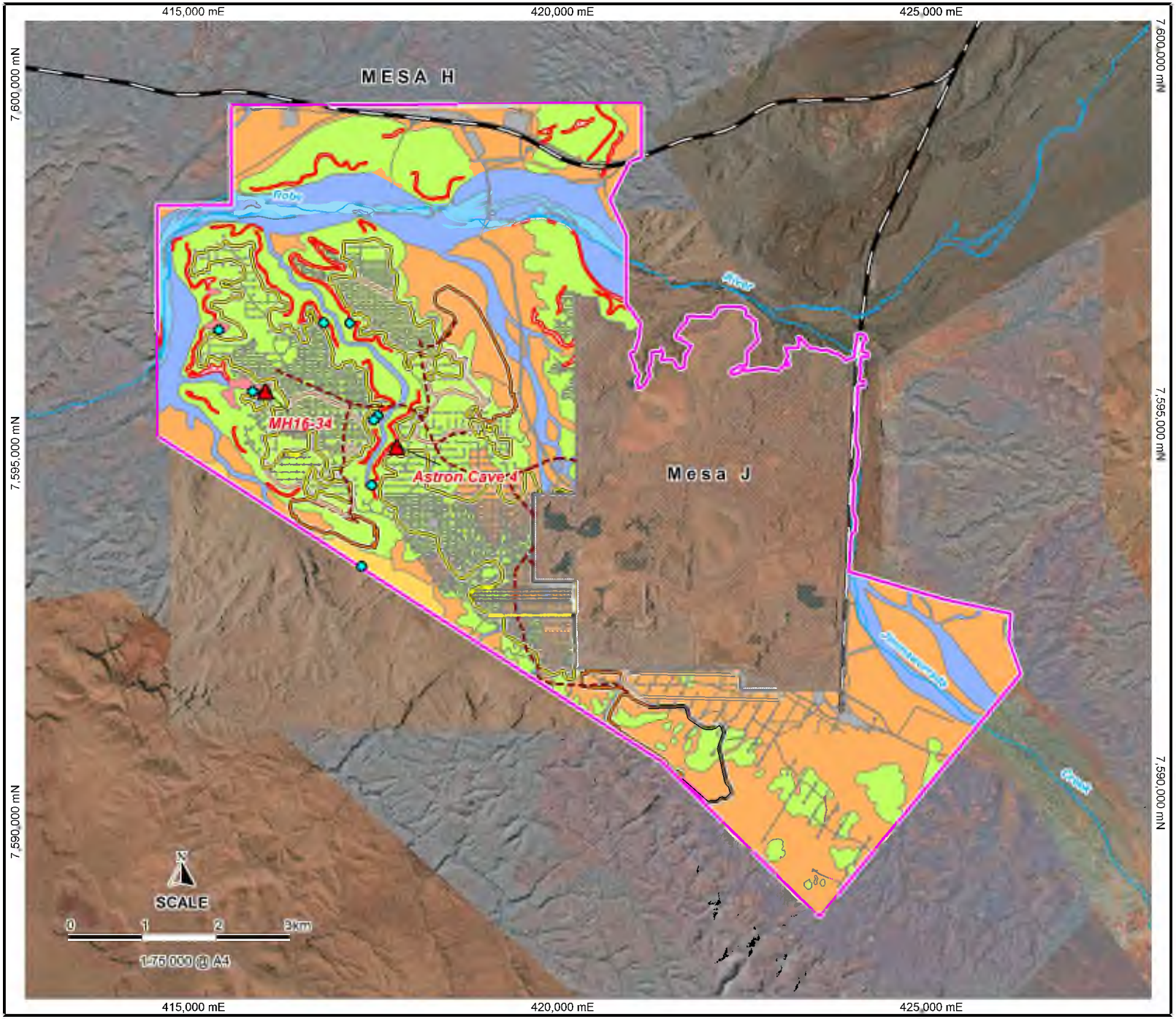
An assessment of the conservation value of caves associated with Ghost Bats at Mesa H indicated that Ghost Bat presence at the mesa is intermittent, with the mesa being used for nocturnal foraging and occasional diurnal roosting (Bat Call 2017a). The Ghost Bats at Mesa H likely originate from Buckland Hills to the south, Yeera Bluff (Gnieroora) between Mesa's G and H or the Three Peak hills to the north-west (Bat Call 2017a).

d) Terrestrial fauna - Northern Quoll

In the Pilbara, the Northern Quoll favours rocky gorges, breakaways and hills, usually of high relief and often along drainage lines for denning purposes. Adjacent plains and vegetated areas provide habitat suitable for foraging and dispersal of young (Van Dyck and Strahan 2008), but are considered to be of less importance for the species' conservation (DSEWPaC 2011). The rocky facades of the mesa landforms are important sources of shelter, food and moisture for species of conservation significance.

The Northern Quoll was recorded in the Development Envelope, with the majority of records occurring in Breakaway habitat with some in Riverine and Gorge habitat types; however, the species is also likely to utilise Rocky Hills habitat (Astron 2017a). Historical surveys have also recorded the Northern Quoll from scat records within the Rocky Hills habitat type immediately south of the Development Envelope and within Riverine and Breakaway habitats within the Development Envelope (Astron 2015 and Biota 2011). All previous records of this species in the Development Area were from sites consistent with the preferred habitat for this species.

The most important habitat types for the Northern Quoll likely includes the Gorge and Breakaway habitat (Figure 1-4), which contain rocky environments of high relief that are particularly important for Northern Quolls as they provide potential denning sites for breeding and shelter and diverse microhabitats for foraging (Astron 2017a). The Riverine and Rocky Hills habitats, especially adjacent to Gorge and Breakaway habits provide microhabitats for (e.g. crevices and cracks) for foraging (Astron 2017a).



LEGEND

- Development Envelope
- Ministerial Statement 208
- Railway
- Major Watercourse
- Ghost Bat Roost (Nocturnal Feeding)
- Ghost Bat Roost (Diurnal/ potential maternal)

Conceptual Mine Layout

- Mine Pit
- Waste Dump
- Topsoil / Subsoil Stockpile
- Haul Road

Fauna Habitat

- Breakaway
- Loamy/stony plain
- Gorge
- Rocky hills
- Riverine
- Low hills and slopes
- Drainage
- Disturbed

Rio Tinto

Iron Ore (WA)

Figure 1-4: Ghost Bat and Northern Quoll habitat in the Development Envelope

Drawn: T.M.
Date: Mar, 2019

Plan No: PDE0161883v5
Proj: MGA94 Zone50

e) Subterranean fauna - Troglofauna

Troglofauna were first recorded at Mesa A in 2003 as by-catch of stygofauna sampling. Since 2003 numerous troglofauna surveys and assessments have been undertaken across the Robe Valley. The combined coverage of these surveys provides a considerable knowledge base of the troglofauna present in the Mesa H and J Development Envelope.

One of the key characteristics of geological units known to provide habitat for troglofauna relates to the physical features, particularly the presence of fractures and cavities sufficient in size to accommodate troglofauna. Throughout the Pilbara, a range of geological formations contain the necessary physical characteristics that have been shown to provide habitat for troglofauna. In the Development Envelope the Robe Pisolite is considered to be the geological unit that provides primary habitat for troglofauna as it contains the necessary cavities to accommodate troglofauna. The clay pockets and lenses within the Robe Pisolite may also contribute to the suitability of the habitat for troglofauna as the retention of water in, or on top of, certain clay types may assist in maintaining high humidity levels in the subterranean environment. Troglofauna habitat is shown in Figure 1-5.

Compilation of all troglofauna sampling to date has recorded 34 troglofauna species from the Development Envelope and all are considered potential SRE species.

Two Priority 1 PECs relevant to troglofauna are present in the Development Envelope:

- *Subterranean invertebrate communities of mesas in the Robe Valley region*; and
- *Subterranean invertebrate community of pisolitic hills in the Pilbara*

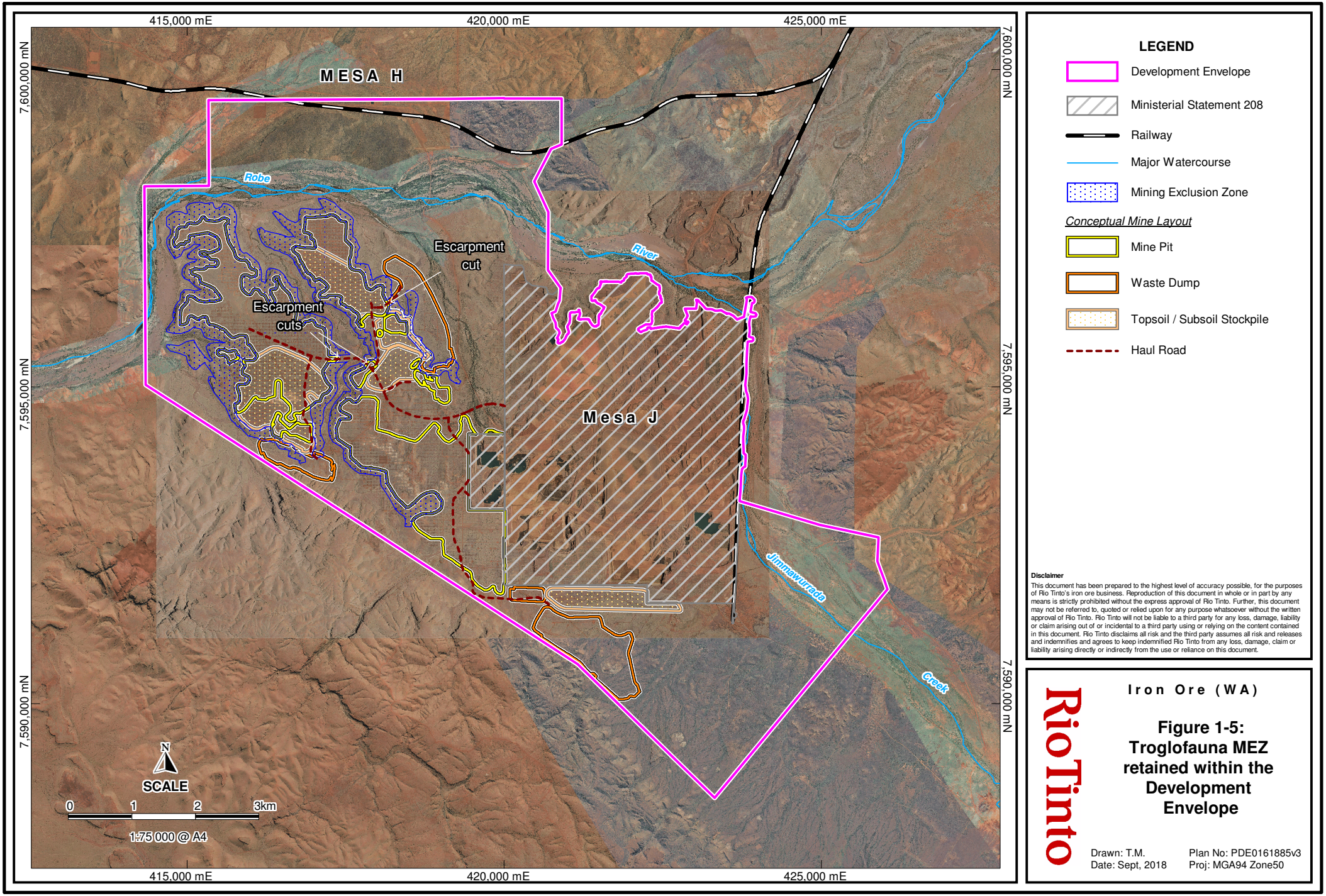
No troglofauna of conservation significance (i.e. those listed as Priority, Schedule or Vulnerable at State or Federal levels) were recorded in the Development Envelope.

f) Subterranean fauna - Stygofauna

Compilation of all stygofauna sampling to date has recorded:

- 46 stygofauna species have been recorded in and around the Development Envelope.
- 16 key species are recorded from within the Mesa J Hub potential drawdown impact area, including:
    - 9 widespread species;
    - 7 potential SRE species, including a number of listed threatened species:
        - *Nedsia hurlberti* – Schedule 3;
        - *Nedsia sculptilis* – Schedule 3; and
        - Blind Cave Eel, *Ophisternon candidum* – Vulnerable; Schedule 3;
- One Priority 1 PEC (*Stygofaunal Community of the Bungaroo Aquifer)* overlaps with the Development Envelope.

Stygofauna habitat and the modelled extent of groundwater drawdown is shown in Figure 1-6.



LEGEND

- Development Envelope
- Ministerial Statement 208
- Railway
- Major Watercourse
- Mining Exclusion Zone

Conceptual Mine Layout

- Mine Pit
- Waste Dump
- Topsoil / Subsoil Stockpile
- Haul Road

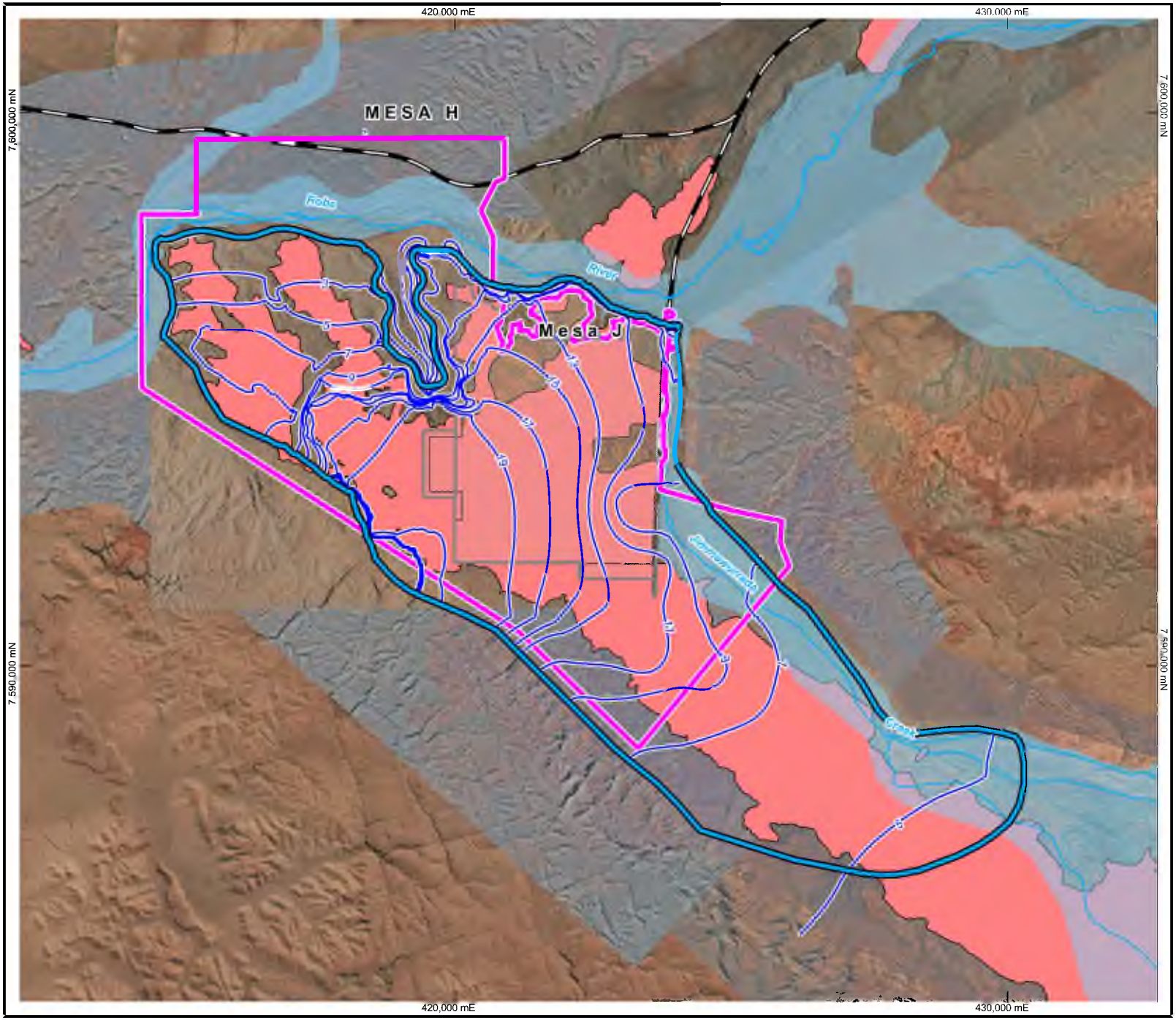
Rio Tinto

Iron Ore (WA)

Figure 1-5: Troglofauna MEZ retained within the Development Envelope

Drawn: T.M.
Date: Sept, 2018

Plan No: PDE0161885v3
Proj: MGA94 Zone50



LEGEND

- Development Envelope
- Ministerial Statement 208
- Major Watercourse
- Railway
- Drawdown extent
- Drawdown contour (m)

Potential Stygofauna Habitat

- Alluvials
- CID

N

SCALE

0 2 4km

1:100 000 @ A4

Rio Tinto

Iron Ore (WA)

Figure 1-6: Stygofauna Habitat and extent of groundwater drawdown

Drawn: T.M.
Date: Mar, 2019

Plan No: PDE0161886v5
Proj: MGA94 Zone50

1.4.2 Key Assumptions and Uncertainties

The key limitations relating to the information used for this EMP include:

- Limited hydrogeological data on the Jimmawurrada Alluvial Aquifer and Robe River Alluvial Aquifer, to better inform the hydraulic connectivity between the CID and alluvial aquifers and hence possible impacts to pools and vegetation.
- Limited understanding of the response of riparian vegetation to cumulative stressors e.g. dewatering, water abstraction, climate variability.
- Inherent difficulty in interpolating local groundwater table elevation from limited groundwater data available in the Robe River and Jimmawurrada Creek to predict the groundwater dependence of riparian vegetation.
- Limited regional population studies for Ghost Bat and Northern Quoll, to provide an understanding of the long-term natural population variability and movements of these species.
- Limited data on the sensitivity of the Ghost Bat and Northern Quoll to noise and vibration.
- Inherent limitations in troglofauna and stygofauna sampling methodology that limit predictive ability of habitat modelling. Limitations include limited access to the subterranean environment (via drill holes only); modification of potential habitat through establishment of drill holes; trapping and scraping methodology may not be appropriate for some species depending on species preferences and mobility; sampling bias towards orebodies; difficulty in determining the specific geological strata that specimens originate from therefore limiting predictive ability of habitat modelling.
- Lack of taxonomic framework and specialist expertise to identify and determine conservation significance of many groups of subterranean fauna.
- Limited knowledge of troglofauna and stygofauna distribution patterns, ecological requirements and resilience.

The key assumptions relating to this EMP are:

- The hydrogeological modelling of groundwater abstraction from the CID aquifers provide accurate estimates of the extent and depth of groundwater drawdown, however may not capture the full range of climatic variables experienced in an arid environment (which may vary on a decadal-scale). The hydrogeological models will be updated as additional data become available hence revisions to the proposed management of pools, phreatophytic vegetation and stygofauna may be required.
- Facultative phreatophytic vegetation along Jimmawurrada Creek may be utilising groundwater to varying degrees despite the current depth to water table potentially being close to the limit of accessibility in some areas for facultative phreatophytic species, thus there is potential for impacts from abstraction of groundwater to the Jimmawurrada Creek Alluvial Aquifer.
- Baseline data collected for riparian vegetation, fish, the Ghost Bat, the Northern Quoll and subterranean fauna provide representative species inventories and reflect sampling over variable seasonal conditions, however may not necessarily capture the full range of climatic variables experienced in an arid environment (which may vary on a decadal-scale).
- Baseline surveys provide complete representative species inventories and reflect sampling over variable seasonal conditions.
- Tolerance of conservation significant fauna species to some level of noise, vibration and light emissions without any significant impact to their normal behaviours or survival.

- The effectiveness of blast management measures to prevent disturbance to the mesa façades. The Proponent has a strong record of maintaining landform stability, as demonstrated at Mesa A and J, with no record of mesa façade collapse or failure.

1.4.3 Management Approach

A risk-based approach has been taken through the Environmental Impact Assessment processes to identify the key environmental values that may be impacted by the Mesa J Hub and warrant additional management. Regional data, baseline survey data and, where available, ongoing monitoring data have been used to assess the potential impacts of the Mesa J Hub on environmental values.

The key environmental values that have been identified as warranting additional management are:

- riparian vegetation associated with the Robe River and Jimmawurrada Creek;
- semi-permanent and permanent pools and aquatic fauna;
- conservation significant fauna - Ghost Bat and Northern Quoll; and
- subterranean fauna - troglofauna and stygofauna.

This EMP adopts a combination of an outcome-based approach and a management-based approach.

- For parts of the environment that can be objectively measured and monitored an outcome-based approach is adopted with establishment of trigger and threshold criteria and associated contingency actions if the environmental criteria are not met. Trigger criteria are set at a conservative level to ensure management actions are implemented well in advance of the environmental outcome being compromised. Thus, trigger criteria are set at a level below the threshold criteria to signal the need to focus and investigate and where applicable, mitigate the impact.
- For parts of the environment that are not amenable to objective measurement, a management-based approach is adopted with a management objective that relates to the EPA's environmental objective for the relevant environmental factor, management actions to meet the environmental objective and management targets to assess the effectiveness of the management actions.

This EMP also describes the monitoring that will be undertaken to measure performance against the environmental outcomes and to assess the effectiveness of management actions in meeting management-based objectives. The monitoring to be undertaken as part of this EMP has been designed to build upon and improve on existing monitoring programs conducted as part of the Mesa J Project and build upon data from baseline surveys.

Key to the overall environmental management approach for the Mesa J Hub is avoidance of direct disturbance to key environmental values such as pools and riparian vegetation of the Robe River and Jimmawurrada Creek. Specific to the Mesa H Project is avoidance of direct disturbance to potential diurnal/maternal Ghost Bat roosts and denning habitat of the Northern Quoll. Where avoidance is not practicable, the management approach is to minimise disturbance to key environmental values, particularly habitats, such as troglofauna and stygofauna habitat and the mesa escarpments as detailed in this EMP.

1.4.4 Rationale for choice of provisions

Environmental criteria have been developed based on consideration of:

- Threatening processes and risks associated with each environmental factor;
- The current state of knowledge for each environmental value;
- The availability of suitable monitoring methods; and
- Relevance to the condition environmental outcomes sought for each environmental factor.

The specific trigger and threshold criteria and actions defined in Table 2-1 to Table 2-5 have been chosen as they provide a basis for detecting and avoiding or otherwise managing potential impacts, such that the condition environmental outcomes stated in conditions 6, 7, 8 and 9 of MS xxxx can be achieved.

Trigger criteria are set at a conservative level to ensure management actions are implemented well in advance of the environmental objective being compromised. Exceedance of a trigger criterion will, therefore, not be treated as a non-compliance. There is potential for the threshold criteria for vegetation to be exceeded due to natural variability; this must be accounted for in the management response. Exceedance of a threshold criterion will be treated as a potential non-compliance against the environmental objective if the exceedance is attributable to the Mesa J Hub.

The tables of EMP provisions (Table 2-6 to Table 2-10) contain environmental outcomes that include 'no irreversible impact'. For the purpose of this EMP, an irreversible impact is defined as, 'an impact resulting in a permanent loss of environmental value(s); or where intensive, and/or un-proven management intervention, potentially over a long timeframe, would be required to restore the environmental value(s)'.

The tables of EMP provisions (Table 2-6 to Table 2-10) include monitoring to measure performance against the environmental outcome and to determine whether trigger or threshold levels have been exceeded. Table 2-7, Table 2-8, Table 2-9 and Table 2-10 also include supporting monitoring that will be undertaken. Supporting monitoring is not directly required as a measure of performance but will be used to provide context, to assess the impact on the environmental value and to investigate possible causes should the trigger or threshold criteria be exceeded

The rationale for selection of provisions for each environmental value is discussed below.

a) Inland waters

Two environmental outcomes have been adopted for riparian vegetation, semi-permanent and permanent pools and aquatic fauna for different aspects of the Mesa J Hub:

- Ensure there is no irreversible impact to the semi-permanent and permanent Pools (water quality / integrity) and aquatic fauna of the Robe River pools and health of riparian vegetation communities of the Robe River and Jimmawurrada Creek as a result of groundwater abstraction and discharge for the Mesa J Hub.
- Ensure that groundwater abstraction and surplus dewater discharge, does not cause long term impacts to the Aboriginal heritage values linked to the physical and/or biological surroundings of the Robe River or Jimmawurrada Creek.

Riparian Vegetation

The outcomes for riparian vegetation were selected as it is acknowledged that the Mesa J Hub may have an impact on riparian vegetation communities, particularly in Jimmawurrada Creek 'Zone 3' (Table 1-3), however potential impacts are not expected to be permanent as they will be limited in spatial extent and/or will occur over a limited time period and changes are considered unlikely to be so great that they result in permanent changes in the composition of riparian vegetation.

The selected trigger and threshold criteria are based on standard deviations in foliage cover of phreatophytic overstorey riparian tree species from the baseline period mean as measured by mean vegetation index. Mean vegetation index is a readily measurable indicator of the health of riparian vegetation for which reference sites can be established and regular monitoring undertaken. Measurement of mean vegetation index is also consistent with other riparian vegetation monitoring programs. The approach taken is analogous to the 'control chart' method (Morrison 2008) that has been applied to a wide range of environmental impact studies and monitoring programs. In line with this, a trigger criterion of ≥ 2 standard deviations from baseline mean vegetation index has been selected for the following reasons:

- Decline from a baseline mean in number of standard deviations aligns with commonly accepted convention for establishing trigger criteria to detect potential environmental impacts.
- Quantifying decline in number of standard deviations from the baseline mean takes into account the natural variability observed in the system. This is preferable to using a set value or percentage decline which does not take natural variability into account.
- In a normally distributed dataset, 2 standard deviations from the mean encompasses 95% of the observed values, that is, there is a 5% chance of measuring a value either higher or lower than 2 standard deviations from the mean prior to any disturbance being imposed. This is aligned with the convention of using a statistical significance level of p=0.05.

A threshold criterion of ≥ 2 standard deviations from baseline mean vegetation index over a period of two consecutive monitoring events has been selected. Mean vegetation index is a readily measurable indicator of the health of riparian vegetation and comparison with standard deviation from baseline values is consistent with other riparian vegetation monitoring programs conducted by the Proponent in the Pilbara region. Rainfall and streamflow can fluctuate, both seasonally and across multiple years, influencing the condition of phreatophytic vegetation. As such two years has been selected as a suitable timeframe to assess whether the condition of upper canopy vegetation is under threat of long term impacts from the Mesa J Hub, and to differentiate natural variation of the canopy from the potential impacts of groundwater abstraction and surplus water discharge. Following the completion of collection and analysis of baseline data, the trigger and threshold criteria will be reviewed and adjusted if deemed appropriate.

Trigger and threshold criteria for detection of new introduced species in the riparian zone of the Robe River were selected as an indicator of potential impacts from discharge of surplus water. Introduced species can be monitored regularly, have a baseline, and measurement of these parameters is consistent with other flora and vegetation monitoring programs.

Semi-permanent and permanent pools and aquatic fauna

The outcome for semi-permanent and permanent pools was selected based on the high cultural and environmental value of Robe River Pools.

The selected triggers and threshold criteria for semi-permanent and permanent pools of the Robe River are groundwater levels adjacent to select pools, pool depth, water quality and aquatic fauna (fish).

Installation of paired alluvial aquifer bores in the Robe River near targeted pools is proposed to monitor groundwater levels and hence potential impact to water levels in pools. Bores will be placed (subject to approvals) on the north and south side of the river. The south edge of the river receives water from the Mesa H CID / basement aquifers that has a northern groundwater flow direction, whilst the northern edge receives groundwater from the aquifer to the north that has a southern flow direction. The drawdown from Mesa H operations are likely to be observed earlier in the south edge of the river channel rather than in the north, hence if the predicted maximum drawdown (~0.5m) is observed in the proximal monitoring bores and not in the distal bores would be a clear indication the drawdown is higher than expected.

Trigger and threshold criteria have also been developed for Yeera Bluff (Gnieroora) Pool. A depth trigger of 2m and threshold of 1m was selected on the basis that is appears that it is a permanent pool. It is likely that if this pool is dry, others will be too and key environmental values will be compromised Surface water is directly associated with maintaining the cultural and aesthetic values.

A trigger criterion was developed for water quality in pools exceeding the rolling quarterly median measured against the operational guideline site specific trigger value (SSTV) equivalent to the 95th percentile value of baseline or the ANZECC/ARMCANZ (2000) default trigger value for toxicants for protection of 95% of species, whichever is higher (except for pH).

An additional threshold criteria for semi-permanent and permanent pools of the Robe River is fish species richness. A threshold criterion of three or less species of fish recorded in Robe River Pools was selected on the basis of approximately 27 years of sampling of Robe River pools (Streamtec 2017, WRM 2017). The total number of species recorded is 11 species with a range in species richness of 4 to 11 in any sampling event. To date, species richness has been highly correlated with pool depth and volume and hence climate. A threshold has been developed of three (or less) species recorded across all sampling sites indicating that pool levels may have dropped beyond the range of natural variability.

b) Terrestrial Fauna

Ghost Bat

Outcome-based and management-based provisions have been adopted for the Ghost Bat on the basis that objective measurement and reporting is possible for some parts of the environment and some of the potential impacts but not for others.

The environmental outcome adopted for the Ghost Bat is:

- No irreversible impact as a result of the Project to retained escarpments of Mesa H which are high value habitat for the Ghost Bat.

No irreversible impact to the retained escarpments is defined as not resulting in 'significant damage'. Significant damage is considered to be damage that negatively impacts the structural integrity and microclimate of the cave such that future Ghost Bat use of the site is prevented.

This outcome has been selected as the escarpments of Mesa H represent potential roosting and foraging habitat. Habitat loss through disturbance to roost caves, specifically caves that play a role in breeding activities (maternal roosts) and nearby areas is seen as a key risk to this species conservation status. The Mesa H Project has been designed to retain the mesa escarpment, except where cuts are required to access the top of the mesa, and to avoid direct disturbance to diurnal/potential maternal roosts and known nocturnal roosts on Mesa H particularly those associated with or in close proximity to the diurnal / potential maternal roosts.

Vibration levels and direct disturbance near the potential diurnal/maternal roosts have been selected as triggers as both can be directly targeted to the highest value habitat, are readily measurable, can be monitored regularly and are consistent with other Ghost Bat monitoring programs. Ensuring the vibration levels at the potential diurnal/maternal roosts remain below a peak particle velocity determined for each cave reduces the risk that vibrations compromise the structural integrity of the roosts.

Temperature and humidity monitoring of the two diurnal/potential maternal caves on Mesa H (MH16-34 and AC4) have been selected on the basis of ensuring that the roost cave is viable for Ghost Bats not only from a physical perspective, but also from a cave microclimate perspective. The approach is readily measurable and will enable verification that blasting and mine pit development within adjacent pits does not inadvertently open up new cavities or openings at the back of the potential diurnal/maternal roost caves which may change the cave microclimate.

The management objective adopted for the Ghost Bat is:

- Improve knowledge of the Ghost Bat population and utilisation of high value habitat in the Robe Valley in order to assist in maintaining biological diversity and ecological integrity.

This management objective has been selected as it relates to the EPA objective for Terrestrial Fauna and is specific to the Project. One of the limitations noted during the Environmental Impact Assessment is the lack of long-term data that would provide an estimate of natural Ghost Bat population variability and an indication of how the Ghost Bat utilises caves within the central part of the Robe Valley. The proposed management action to undertake a five-year study of Ghost Bat

utilisation of high value habitat in the Robe Valley has been selected to start to address this limitation.

Northern Quoll

Northern Quoll population numbers fluctuate on both annual and inter-annual cycles. This variability is driven by both the reproductive biology of individuals (males usually die-off after one year) and longer-term cycles in response to regional stochastic processes such as rainfall, fire and related changes of prey populations (How et al. 2009). This natural variability makes threshold criteria based on population dynamics inappropriate for compliance at this stage. Protection of high value habitat for the Northern Quoll is, therefore, the most appropriate strategy to protect this conservation significant fauna within the Development Envelope.

The environmental outcome adopted for the Northern Quoll is:

- No irreversible impact as a result of the Project to Breakaways and Gullies habitat retained in the escarpment of Mesa H.

This outcome has been selected as the escarpment of Mesa H contains high value denning and foraging habit. The Mesa H Project has been designed to retain the mesa escarpment, except where cuts are required to access the top of the mesa, and to avoid the highest value sections of mesa escarpment (Astron 2017a).

A trigger and threshold have been developed for direct disturbance to the breakaway and gullies habitat of the retained escarpment. Direct disturbance to these breakaway and gorge habitats in the retained escarpment is readily measurable and can be monitored regularly. Ensuring direct disturbance to the breakaway and gullies habitat of the mesa escarpment is minimised reduces the risk that Northern Quoll denning habitat is disturbed or degraded.

Note that the proposed triggers and thresholds relate to the Northern Quoll habitat within the *retained* sections of the escarpments (MEZs) which already account for the approved disturbance (escarpment cuts and waste dump). i.e. the triggers and thresholds are impacts over and above the proposed / approved impacts to the MEZ.

c) Subterranean Fauna

Outcome-based and management-based provisions have been adopted for subterranean fauna on the basis that objective measurement and reporting is possible for some parts of the environment but not for others.

Subterranean fauna surveys in general have low capture rates per survey effort meaning the abundance and diversity of specimens recorded during surveys are highly variable (Halse and Pearson 2014). These sampling artefacts mean that threshold criteria based on abundance or diversity would be inappropriate at this stage. Protection of high value habitat for subterranean fauna is, therefore, considered the most appropriate strategy to protect subterranean fauna so that biological diversity and ecological integrity are maintained. The following environmental outcomes have been adopted:

- Troglofauna: The Proponent shall ensure there is no irreversible impact as a result of the Project to the troglofauna habitat retained within the Mesa H MEZ.
- Stygofauna: The Proponent shall ensure there is no irreversible impact, as a result of the Proponents water management activities, to stygofauna habitat within the CID aquifer and stygofauna and Blind Cave Eel habitat within the alluvial aquifer habitat of Jimmawurrada Creek and the Robe River shown in Figure 1-6.

Mesa H comprises iron-rich Robe Pisolite which is considered to be the geological unit that provides primary habitat for troglofauna. As the Robe Pisolite is also the target ore body, a key part of the Mesa H Project design is to ensure retention of a significant volume of Robe Pisolite habitat in the

form of a MEZ. The environmental outcome has been selected to reflect this key part of the Mesa H Project design.

Trigger and threshold criteria have been developed to limit the direct removal, through operational error, of troglofauna habitat to be retained in the MEZ. Blasting and excavation carried out as part of the mining process have a degree of operational error associated with them. The trigger and threshold criteria, while recognising the practical limits to operational precision, have been structured to ensure that significant volumes of troglofauna habitat are not lost from the MEZ over the life of the mine. Volume excavated is readily measurable and is part of the causal relationship between mining and impacts on troglofauna.

The amount, quality and distribution of stygofauna habitat within the Development Envelope may be influenced by dewatering as well as pit excavation. The below water table extent of the Robe Pisolite, alluvium and Wittenoom aquifer are considered to be the geological units that provide primary habitat for stygofauna. Trigger and threshold criteria have been developed around the amount and quality of water drawdown at key locations in the CID and alluvial aquifer habitat of Jimmawurrada Creek and the Robe River. The ongoing persistence of connected stygofauna habitat in the Development Envelope was a key consideration when defining these criteria and thus doubles as trigger and threshold criteria for stygofauna and Blind Cave Eel habitat. Trigger and threshold values criteria also been developed around the ongoing persistence of a diverse stygofauna community, including the Blind Cave Eel, within the available stygofauna habitat.

The management objectives adopted for subterranean fauna are:

- Troglofauna: The Proponent shall protect the biological diversity and ecological integrity of the troglofauna assemblage at Mesa H by minimising impacts as far as practicable.
- Stygofauna: The Proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages within the CID and Alluvial aquifer habitats shown in Figure 1-6 by minimising impacts as far as practicable.

These management objectives have been selected as they relate to the EPA objective for Subterranean Fauna and are specific to a key part of the Mesa H Project. Six management targets (three for troglofauna and three for stygofauna) have been selected to assess whether the management actions are effective in meeting the environmental objective. Management targets relate to:

- clearing of native vegetation in the MEZs to limit the potential for degradation of retained troglofauna habitat as a result of diminished organic nutrient inputs;
- troglofauna specimen capture rate to assess whether the Mesa H Project has an impact on troglofauna utilization of retained habitat in the MEZs; and
- further research to understand the distribution of key stygofauna species and allow refinement of the proposed outcome and management based provisions.

Management actions and targets have been selected to address potential impacts of the Mesa H Project as well as to build upon existing data.

2. EMP PROVISIONS

This section of the EMP identifies the legal provisions that the Proponent will implement to ensure that the environmental outcomes of conditions 6, 7, 8 and 9 are met during implementation of the Mesa J Hub.

Outcome and management based provisions are provided in Section 2.1. Monitoring and reporting are detailed in Section 2.4 and Section 2.5 respectively.

Table 2-6 to Table 2-10 detail for all provisions within this EMP.

2.1 Outcome and Management Based Provisions

The following outcome based provisions are included in this EMP:

Mesa H and J: Inland waters, Vegetation and Aquatic Fauna

- No irreversible impact, as a result of the proponent's water abstraction, to groundwater dependent vegetation within the Robe River.
- No irreversible impact, as a result of the proponent's water abstraction, to riparian vegetation communities within Jimmawurrada Creek.
- No irreversible impact, as a result of the Proponent's discharge of surplus water, to the health of riparian vegetation of Jimmawurrada Creek and the Robe River.
- No irreversible impact, as a result of the Proponent's drawdown and discharge, to the pool ecosystems of the Robe River.

Mesa H: Terrestrial Fauna – Ghost Bat and Northern Quoll

- No irreversible impact, as a result of the proponent's activities, to Breakaways and Gullies habitat (and associated Ghost bat Roosts) retained in the escarpments of Mesa H.

Mesa H: Subterranean Fauna – Troglofauna and Stygofauna

- No irreversible impact, as a result of the proponent's activities, to the troglofauna habitat retained within the Mesa H MEZ.
- No irreversible impact, as a result of the proponent's water management activities, to stygofauna habitat within the CID aquifer and stygofauna and Blind Cave Eel habitat within the alluvial aquifer habitat of Jimmawurrada Creek and the Robe River.

The following management based provisions are included in this EMP:

Mesa H: Terrestrial Fauna – Ghost Bat

- The Proponent shall improve knowledge of the Ghost Bat population and utilisation of high value habitat in the Robe Valley in order to assist in maintaining biological diversity and ecological integrity.

Mesa H: Subterranean Fauna – Troglofauna and Stygofauna

- The Proponent shall protect the biological diversity and ecological integrity of the troglofauna assemblages of Mesa H by minimising impacts as far as practicable.
- The Proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages within the CID and Alluvial aquifer habitat by minimising impacts as far as practicable.

2.2 Performance Indicators (environmental criteria)

2.2.1 Trigger level criteria

Trigger criteria measures are set at a conservative level to ensure management actions are implemented well in advance of the environmental objective being compromised. Thus, trigger criteria are set at a level below the threshold criteria to signal the need to focus and investigate and where applicable, mitigate the impact further or increase the level of protection or rehabilitation.

Mesa H and J: Inland waters, Vegetation and Aquatic Fauna

1. The mean vegetation index for riparian overstorey taxa (E. victrix, E. camaldulensis and M. argentea) of Zones 1 & 2 of Jimmawurrada Creek and the Robe River changes by ≥ 2 standard deviations.
2. A statistically significant decline from baseline ($p<0.05$) in the number and/or cover of native perennial species of Zones 1 & 2 of Jimmawurrada Creek and the Robe River.
3. Detection of new introduced species at a potential impact site, previously not detected within the Development Envelope.
4. Decline of >0.5m between paired Alluvial Aquifer bores in the Robe River near targeted pools.
5. Yeera Bluff (Gnieroora) Pool drops below 2m depth.
6. Water quality in pools exceeds rolling quarterly median measured against the operational guideline SSTV equivalent of 95%ile value of baseline or the ANZECC/ARMCANZ (2000) default TV for toxicants for protection of 95% of species, whichever is higher (except for pH).

Mesa H: Terrestrial Fauna – Ghost Bat

1. Vibration levels exceed 50mm/s peak particle velocity at the potential diurnal/maternal Ghost Bat roost caves.
2. Disturbance, other than approved clearing, within 50m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves.

Mesa H: Terrestrial Fauna – Northern Quoll

1. Disturbance of >5% of potential Northern Quoll denning habitat on the retained escarpment of Mesa H.

Mesa H: Subterranean Fauna – Troglofauna

1. Operational error during mining resulting in removal of greater than 0.01% by volume annually of the MEZ at Mesa H.

Mesa H: Subterranean Fauna – Stygofauna

1. Groundwater levels drop three (3) m below predicted water table heights in the Jimmawurrada Creek alluvial aquifer.
2. Diversity of stygofauna Orders collected during annual survey events reduced to three (3) or less.

2.2.2 Threshold level criteria

Mesa H and J: Inland waters, Vegetation and Aquatic Fauna

3. The mean vegetation index for the riparian upper canopy (*E. victrix, E. camaldulensis* and *M. argentea*) of Zones 1 & 2 of Jimmawurrada Creek and the Robe River declines by ≥ 2 standard deviations from baseline over two consecutive monitoring events.

4. A statistically significant decline from baseline ($p<0.05$) in the number and/or cover of native perennial species over two consecutive monitoring events.
5. Detection of new introduced species rated high or very high management priority (by the Department of Biodiversity, Conservation and Attractions) at a potential impact site, previously not detected within the Development Envelope and a significant increase in cover or abundance over successive monitoring events.
6. Decline of ≥1 m between paired Alluvial Aquifer bores in the Robe River near targeted pools.
7. Yeera Bluff (Gnieroora) Pool drops below 1m depth.
8. Three (3) or less species of fish recorded during a sampling event.

Mesa H: Terrestrial Fauna – Ghost Bat

1. Significant damage to diurnal/maternal Ghost Bat roost caves.
2. Disturbance, other than approved than approved clearing, within 40m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves.

Mesa H: Terrestrial Fauna – Northern Quoll

1. Disturbance of >10% of potential Northern Quoll denning habitat on the retained escarpment of Mesa H.

Mesa H: Subterranean Fauna – Troglofauna

1. Net loss of the MEZ at Mesa H, at the completion of mining.

Mesa H: Subterranean Fauna – Stygofauna

1. Alluvial aquifer in Jimmawurrada is dry for two (2) consecutive years.
2. Absence of Blind Cave Eel recorded for two (2) consecutive annual sampling events.
3. Absence of stygofauna specimens for two (2) consecutive annual sampling events.

2.2.3 Management Targets

Mesa H: Terrestrial Fauna – Ghost Bat

1. Estimate the local population of Ghost Bats in the central part of the Robe Valley.
2. Indicate how Ghost Bats use caves within the central part of the Robe Valley (e.g. diurnal versus maternal), including the degree of utilisation of caves by pregnant females.

Mesa H: Subterranean Fauna – Troglofauna

1. Total clearing of native vegetation across the surface of the MEZ is less than 30% of the MEZ surface area.
2. Troglofauna specimen capture rate is not below the baseline minimum for three (3) consecutive sampling events at Mesa H.

Mesa H: Subterranean Fauna – Stygofauna

1. Understand the distribution and ecology of key stygofauna taxa within the Robe Valley area.

2.3 Response Actions

The Proponent has developed a number of trigger level actions that would be implemented if the associated trigger criterion signals the need to increase mitigation or protection (Table 2-6 to Table 2-10). These trigger level actions will be implemented by the Proponent to mitigate and manage impacts so they once again will meet trigger and safeguard the threshold criteria.

The Proponent has developed a number of threshold contingency actions that would be implemented if the associated threshold criterion signals that the environmental outcome is exceeded (Table 2-6 to Table 2-10). The threshold contingency actions will be implemented to manage aspects of the proposal and achieve the condition environmental outcome and manage the impact to below threshold and trigger criteria again and hence bring the Proponent back into compliance.

2.4 Monitoring

Monitoring will be undertaken to measure performance against the environmental outcomes and to assess the effectiveness of management actions in meeting management-based objectives. Monitoring will inform, through the environmental criteria, when trigger or threshold contingency actions will be implemented.

2.4.1 Inland Waters

The Proponent will monitor the health of riparian vegetation of the Robe River and Jimmawurrada Creek both within the potential groundwater drawdown and surplus water discharge impact zones and at reference sites.

The effects of groundwater drawdown on facultative and obligate phreatophytes are dependent upon both the baseline groundwater level and the rate of groundwater drawdown. For example, trees accessing shallow groundwater may be more sensitive to groundwater drawdown than trees growing above a groundwater table at greater depth. While it is inherently difficult to interpolate local groundwater table elevation from limited data and hence predict groundwater dependence of local phreatophytes, monitoring the cover of the upper canopy provides an indicator of stress either due to groundwater drawdown or due to surplus water discharge. The health of phreatophytic species along the Robe River and Jimmawurrada Creek will, therefore, be monitored utilizing remote sensing with supporting field-based surveys. Due to the difficulty of distinguishing phreatophytic riparian trees using remote sensing, the phreatophytic assemblages of the Robe River and Jimmawurrada Creek will be treated as a functional group 'riparian overstorey' for trigger and threshold criteria.

The Proponent will monitor the health of obligate and facultative vegetation of the Robe River and Jimmawurrada Creek using remote sensing to ensure there are no significant changes to health beyond natural variation. Annual remote sensing will provide an indication of vegetation condition over the riparian zones. The foliage cover of the upper canopy will be assessed as a time series, to compare against both baseline conditions and also alongside correlative parameters including rainfall, water levels and fire. The large coverage of canopy captured in remote sensing will accommodate assessment of potential relationships between dewatering and vegetation condition across the entire riparian zone, overcoming some of the limitations of field-based assessment. The monitoring to be undertaken is summarised in Table 2-1.

Baseline data from potential impact and reference sites will be collected prior to operations commencing to quantify natural variation in foliage cover (and health). The mean of all measurements made during the baseline period will be calculated for each reach (or system). Changes over time at these reaches (or zones) will be compared back to the baseline and to reference sites to assess any potential impacts from the Project.

A decline in vegetation index of ≥ 2 standard deviations from the baseline for upper canopy vegetation has been selected as the trigger (trigger criterion 1) to prompt causal investigation and if necessary, remedial actions. Applying criteria to the results of one image with no temporal replication does not adequately accommodate investigation into causation, and comparison with vegetation health at reference sites, and hence is not appropriate as a pass/fail compliance measure. However, a shift of ≥ 2 standard deviations from a sample of adequate size (through spatial coverage) does warrant investigation, including time series assessment of vegetation condition in conjunction with correlative environmental parameters and monitoring results from reference sites. The outcomes of investigation will inform the proponent whether dewatering

operations pose a risk of irreversible impact to the riparian vegetation of the Robe River and Jimmawurrada Creek.

A decline in vegetation index of ≥ 2 standard deviations from the baseline for upper canopy vegetation over a period of two consecutive sampling events has been selected as the threshold criterion (threshold criterion 1) for the Robe River and Zones 1 and 2 in Jimmawurrada Creek. In the absence of data to support that obligate and facultative phreatophytic species can recover or re-establish following periods of stress, a decline of ≥ 2 standard deviations from baseline has been selected as a pass/fail criterion. In the event this criterion is exceeded, the Proponent will conduct additional assessments of the impacted riparian vegetation, and liaise with the EPA Services on both the appropriateness of a decline of ≥ 2 standard deviations as a compliance threshold, and also the remedial actions required to prevent the impacts becoming irreversible.

The species richness and cover of both native and introduced species will be recorded during field-based, post-wet season, annual monitoring surveys in selected transects established during baseline surveys. Monitoring of the understorey vegetation will provide data about the structure, cover and health of both native and introduced species to assist in investigation of any trends that may occur as a result of changed hydrological regime and measured against management criteria. Trends in the presence of native species will be analysed in parallel with the presence of introduced species, to detect any threats which introduced species may pose to native vegetation. The presence of introduced species will be monitored in isolation as an early warning indicator, though the threshold criterion take into account the balance of all species, to ensure that the potential increased productivity as a result discharge is not misinterpreted as a negative impact to the health of riparian vegetation.

Due to the difficulty in establishing reference pool levels due to differences in pool morphology, depth and overstorey cover (which impacts evaporations rates), paired bores (on the north/south sides of the Robe River) once installed will be monitored continuously via data loggers and downloaded quarterly. The paired bores on either side of the Robe River will enable early detection of changes to water table levels in the Robe River proximal to the Mesa J Project when mine pit dewatering commences, relative to its paired alluvial bore on the other side of the Robe River. This is considered the most accurate way to determine a mine dewatering related change to water table levels in the pools as compared to natural seasonal pool water table fluctuations.

Pool depth at Yeera Bluff will be determined by bathymetry measurements, field morphology measurements or remotely via drone. Water quality will be sampled quarterly in five (5) key pools in the Robe River to determine adherence to the SSTV or ANZECC/ARMCANZ values.

Fish species richness will be recorded during biannual surveys of selected Robe River pools through direct observation. Water levels and quality will be assessed through the use of paired bores, bathymetry and direct sampling (of fish and water).

Table 2-1: Monitoring required to evaluate performance against the environmental outcomes for hydrological processes and riparian vegetation

Monitoring action	Location	Frequency and timing	Data collection method and analysis	Responsible
Capture and analysis of remote sensing images (criterion 1)	Selected potential impact sites and reference sites established during baseline monitoring	Annual during operational mine life[1]	Remote sensing images Calculation of vegetation index and analysis of changes to vegetation index	Operations Environment team
Annual field survey (criterion 2)	Selected transects established during baseline monitoring	Annual during operational mine life Post wet season	Understorey riparian taxa: condition, cover and health Introduced species: number and locations	Operations Environment team
Paired Alluvial Aquifer bores[2] in the Robe River near targeted pools (criterion 3).	3 sets of paired bores, on the Mesa H side of the Robe River, paired with a bore on the opposite side of the River	Quarterly downloads (of daily data)	Bore data loggers Automated triggers in database	Mesa H and J Hydrogeology team
Yeera Bluff (Gnieroora) Pool depth (criterion 4)	Yeera Bluff (Gnieroora) Pool	Biannual	Bathymetry measurements Field morphology monitoring of impact and reference pools or remote assessment via drone	Mesa H and J Hydrogeology team Operations Environment Team
Water quality (criterion 5)	5 Key pools on the Robe River; Japanese, Yeera Bluff (Gnieroora), Medawandy, Yarramudda, Martangkuna	Quarterly	Monitoring of impact and reference pools	Operations Environment team
Monitoring of aquatic fauna (fish) (criterion 6)	13 pools on the Robe River; Mussel Pool – Yeera Bluff (Gnieroora) Pool (established in 1991)	Bi-annual	Fish – direct observation at selected pools	Operations Environment team

[1] Locations may not always be available due to accessibility, weather conditions, safety considerations etc.

[2] Alluvial Bore locations subject to approval from the Kuruma Marthadunera People.

2.4.2 Terrestrial fauna (Ghost Bat)

Protection of high value habitat for the Ghost Bat is the most appropriate strategy to protect this conservation significant fauna within the Development Envelope. High value habitat for the Ghost Bat includes the escarpment and cave structures associated with mesa formations in the Robe Valley. Trigger and threshold criteria have been applied to potential diurnal/maternal roosts, as diurnal/maternal roosts are recognised as geographically restricted and ecologically critical. These trigger and threshold criteria have been designed to ensure no 'significant damage' to critical Ghost Bat roosts, where 'significant damage' is defined as 'damage that negatively impacts the structural integrity and microclimate of the cave such that future Ghost Bat use of the site is prevented'.

Baseline monitoring of the two potential diurnal/maternal caves on Mesa H (MH16-34 and AC4), MH16-34 will continue to be undertaken prior to commencement of mining. Additional data from longer term monitoring of these caves may indicate that a different status, and potentially a different level of management, may be appropriate for these caves; this may require revision of the EMP.

Vibration levels will be measured at the potential diurnal/maternal Ghost Bat roost caves at Mesa H for all blasts within 300 m of the potential diurnal/maternal roosts. Ensuring the vibration levels at the potential diurnal/maternal roosts remain below a peak particle velocity determined for each cave reduces the risk that vibrations compromise the structural integrity of the roosts. Annual land clearing reconciliation using GIS disturbance layers will also be undertaken to monitor disturbance close to the potential diurnal/maternal roost caves. Annual assessment of Ghost Bat roost utilisation across the broader Robe Valley will also be completed as supporting monitoring to provide context to any potential impacts from blasting or ground disturbance in the vicinity of the potential diurnal/maternal roosts.

Temperature and humidity of the two potential diurnal/maternal caves on Mesa H (MH16-34 and AC4) will be monitored on a continuous basis, and calibrated with ambient temperature and humidity. The approach is to support the above described monitoring actions to verify that blasting and mine pit development within adjacent pits does not inadvertently open up new cavities or openings at the back of the potential diurnal/maternal roost caves which may change the cave microclimate.

The Proponent has identified that there is a lack of regional population studies for the Ghost Bat to assist in understanding the long-term natural population variability and movements of this species. The EMP includes a management objective to improve knowledge of the Ghost Bat population and utilisation of high value habitat in the Robe Valley. The associated monitoring includes bi-annual collection of scats from Ghost Bat roost caves across the broader Robe Valley where safety and heritage considerations allow. Analysis of scat samples will include genetic and hormone analysis to provide information on utilisation of caves by individuals including pregnant females.

Table 2-2 summarises the monitoring required to measure performance against the environmental outcome and to assess the effectiveness of management actions in meeting the management-based objective.

Table 2-2: Monitoring required to evaluate performance against the environmental outcome and to assess the effectiveness of management actions for the Ghost Bat

Monitoring action	Location	Frequency and timing	Data collection method and analysis	Responsible
Vibration levels (criterion 1)	Caves MH16-34 and AC4 (Figure 1-4)	For all blasts within 300m of caves MH16-34 and AC4	Modelling of peak particle velocity prior to blast. Vibration monitoring of actual peak particle velocity. Analysis of modelled versus actual peak particle velocity.	Drill and Blast team

Land clearing reconciliation (criterion 2)	Caves MH16-34 and associated cave complexes, and AC4 (Figure 1-4)	Annual during operational mine life	GIS avoidance and disturbance layers. Internal approvals request process.	Operations Environment team
Temperature and Humidity	Caves MH16-34 and AC4 (Figure 1-4)	Ongoing (continuous) during operational mine life	Temperature and humidity logging and data analysis correlated against ambient temperature; and timing of mine pit development / blasting data in adjacent pits.	Operations Environment team
Scat collection and analysis (management target)	Caves across the broader Robe Valley*	Bi-annual for 5 years	Scat collection from Ghost Bat roost caves. Genetic and hormone analysis.	Operations Environment team

* Access subject to safety and heritage assessments of caves

2.4.3 Terrestrial fauna (Northern Quoll)

Protection of high value habitat for the Northern Quoll is the most appropriate strategy to protect this conservation significant fauna within the Mine Development Envelope. High value habitat for the Northern Quoll in the Robe Valley includes the Breakaways and Gullies habitat contained within the mesa escarpments which provides denning habitat. Trigger and threshold criteria for disturbance to Northern Quoll denning habitat on the retained escarpments of Mesa H will be applied.

An annual field survey of Northern Quoll will be undertaken as supporting monitoring.

Offset actions, including Northern Quoll monitoring, are currently being undertaken on parts of Yarraloola Station as part of the approved Yandicoogina Threatened Species Offset Plan (TSOP). Yarraloola Pastoral Station underlies and surrounds the Development Envelope. Camera monitoring and trap monitoring protocols for the annual field survey will be based on the protocols established as part of the TSOP so that data from the two programs are comparable. Forty cameras will be utilised at eight mesas across the Robe Valley (nominally Mesa A, Mesa B, Mesa C, Mesa F, Mesa G, Mesa H, Mesa 2402D and Mesa 2403E).

Four trap sites will be established within the Robe Valley and designed in two categories ‘impact’ or ‘reference’ sites. Impact sites will be located at Mesa B (TSOP Site Q) and Mesa H (TSOP Site L) and reference sites will be located at Mesa G (TSOP Site K) and Mesa F (TSOP Site B). Each site will consist of 20 cage traps spaced at 50 m intervals and will be set up, where possible, in preferred habitat for this species in the Robe Valley. The preferred habitat is seen as the rocky escarpments abutting a major drainage system (i.e. Robe River), however additional habitats including the Plains habitat will be included in the monitoring design to enable a full picture of extent of habitat utilisation to be understood.

Table 2-3 summarises the monitoring required to measure performance against the environmental outcome and the supporting field monitoring that will be undertaken.

Table 2-3: Monitoring required to evaluate performance against the environmental outcome for the Northern Quoll

Monitoring action	Location	Frequency and timing	Data collection method and analysis	Responsible
Land clearing reconciliation (criterion 1)	Escarpment of Mesa H	Annual during the operational mine life	GIS avoidance and disturbance layers. Internal approvals request process.	Operations Environment team
Annual field survey (supporting monitoring)	Escarpments of mesas across the broader Robe Valley and other targeted habitats (e.g. Plains) 40 camera monitoring sites spread over Mesa A, Mesa B, Mesa C, Mesa F, Mesa G, Mesa H, Mesa 2402D and Mesa 2403E 4 trap monitoring sites located at Mesa B, Mesa H, Mesa G and Mesa F	Annual (May–September) during operational mine life	Camera monitoring Trapping	Operations Environment team

2.4.4 Subterranean fauna (troglofauna)

Protection of high value habitat for troglofauna is the most appropriate strategy to protect troglofauna so that biological diversity and ecological integrity are maintained. High value habitat in the Development Envelope includes the CID comprising Mesa H. The Proponent will ensure that at least 50% by volume of pre-mining troglofauna habitat will be retained through delineation of a MEZ.

Monitoring of the retained volume of troglofauna habitat in the MEZ will require regular on-ground surveying of the actual pit shell for comparison with the planned pit shell.

A biennial field survey for troglofauna specimens will also be conducted (Table 2-4). This will be the primary source of monitoring data with which to evaluate progress against management targets. As a minimum, the survey will include trapping and scraping from 25 drill holes in the Mesa H MEZ. Previously sampled sites will be used wherever possible to ensure results from each survey are readily comparable. All specimens will be identified to species level and aligned with existing taxa/specimens where possible. Molecular identification will be used where morphological identification is not possible or is less efficient. All specimens with troglomorphic characteristics will be included in the analysis and reporting as 'potentially troglobitic' until shown otherwise.

Following biennial sampling, troglofauna capture rate will be calculated as the number of troglobitic specimens collected per 100 trapping sites, per survey. Appendix 1 shows baseline values for capture rates at Mesa H. Capture rate has naturally high variability with survey timing, location and rainfall potentially influencing the capture rate. Specimens collected via scraping will be excluded from capture rate calculations to ensure pre-mining data are comparable with data collected during mining.

Table 2-4: Monitoring required to evaluate performance against the environmental outcome and to assess the effectiveness of management actions for troglofauna

Monitoring action	Location	Frequency and timing	Data collection method and analysis	Responsible
Pit shell reconciliation (criterion 1)	Mine pits at Mesa H	Annual during operational mine life	High accuracy differential GPS. 3-dimensional coordinates of the mine pit shell in the area of active mining. Reconcile actual and planned 3-dimensional pit shell.	Mine Planning team
Land clearing reconciliation (management target)	MEZ at Mesas H	Annual during operation mine life	GIS avoidance and disturbance layers. Internal approvals request process.	Operations Environment team
Troglofauna field survey (management target)	Minimum 25 sites	Biennial during operational mine life Post- wet season	Trapping and scraping. Morphological and molecular species level identifications. Analysis to evaluate capture rate trends	Operations Environment team

2.4.5 Subterranean fauna (stygofauna)

Protection of high value habitat for stygofauna is the most appropriate strategy to protect stygofauna so that biological diversity and ecological integrity are maintained. High value habitat in the Mine Development Envelope includes the alluvial aquifer, and the CID aquifer (BWT Robe Pisolite).

Monitoring of the retained stygofauna habitat will be completed by monthly monitoring of groundwater levels in groundwater bores (Table 2-5). These bores will intercept the alluvial aquifer of the Robe River and Jimmawurrada Creek and be strategically located to assess cumulative impacts from mine dewatering. Trigger and threshold criteria have been chosen on the modelled extent of drawdown in relation to the thickness of the alluvial aquifer.

An annual field survey for stygofauna specimens will also be conducted. Previously sampled sites will be used wherever possible to ensure results from each survey are readily comparable. Reference sites will also be sampled to provide context to the results. All specimens will be identified to species level and aligned with existing taxa/specimens where possible. Molecular identification will be used where morphological identification is not possible or is less efficient. All specimens with stygobitic characteristics will be included in the analysis and reporting as 'potentially stygobitic' until shown otherwise. Results will also be compared with those from monitoring conducted for the Bungaroo CWP to improve understanding of the regional context of the stygofauna community at Mesa H.

Following annual sampling, the number of stygobitic Orders collected will be calculated as a measure of diversity. Order level comparison has been chosen as species level identifications are not always possible. Surveys where three or less Orders are collected will be considered a breach of trigger criteria and stimulate management intervention.

Environmental DNA (eDNA) survey will be conducted annually in the dewatering impact footprint to detect the persistence of the Blind Cave Eel. Representative reference sites from the wider Robe Valley will be included to provide regional context and further understanding of the distribution and ecology of the species. An inability to detect the Blind Cave Eel in the dewatering impact footprint for two consecutive years - via either eDNA or direct collection - is regarded as a breach of threshold

criteria. Monitoring for eels using eDNA has been piloted by industry leading researchers during the environmental approvals process and shows great potential for efficient and effective detection (Biota 2018).

Further research focussing on understanding the distribution and ecology of stygofauna will be supported. Key subjects are the Blind Cave Eel, *Nedsia sculptilis* and *Nedsia hurlberti*, as well as the PEC entitled '*Stygofaunal Community of the Bungaroo Aquifer*'. Currently, Rio Tinto is proposing to support an Australian Research Council Linkage project entitled 'Transforming assessment of subterranean ecosystems using environmental DNA'. This project aims to develop eDNA methods for more effective and efficient monitoring of stygobitic communities and, if successful, could be incorporated into this EMP through adaptive management.

Table 2-5: Monitoring required to evaluate performance against the environmental outcome and to assess the effectiveness of management actions for stygofauna

Monitoring action	Location	Frequency and timing	Data collection method and analysis	Responsible
Groundwater levels (criterion 1)	Strategically located bores intercepting the alluvial aquifer.	Monthly	Groundwater monitoring Bore network (as per the Groundwater Operating Strategy (GWOS)).	Hydrogeologists
Stygofauna field survey (criterion 2)	• Minimum 25 sites within the dewatering extent. • Minimum 10 reference sites within the wider Robe Valley.	Annually	Haul net sampling Morphological and molecular species identifications Comparison with Bungaroo CWP results. Calculate number of stygobitic Orders present.	Operations Environment team
Blind Cave Eel eDNA field survey (criterion 3)	• Minimum five sites within the dewatering extent. • Minimum 10 reference sites within the wider Robe Valley.	Annually	eDNA water sample methods and analysis as per Biota (2018).	Operations Environment team

Table 2-6: EMP Provisions – Inland Waters and Flora and Vegetation

Outcome based provisions – Inland Waters and Flora and Vegetation			
EPA objectives: – To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected. – To protect flora and vegetation so that biological diversity and ecological integrity are maintained. **Outcomes relating to Condition xx:** – No irreversible[3] impacts to the semi-permanent and permanent Pools (water quality / integrity) and aquatic fauna of the Robe River and health of riparian[4] vegetation of the Robe River and Jimmawurrada Creek as a result of groundwater abstraction and discharge for the Project. **Key environmental values:** Groundwater Dependant Ecosystems: Semi-permanent and Permanent Pools (water quality / integrity) and aquatic fauna of the Robe River and riparian[5] vegetation of the Robe River and Jimmawurrada Creek. **Key impacts and risks:** Potential adverse impacts to the semi-permanent and permanent Pools (water quality / integrity) and aquatic fauna of the Robe River and health of riparian[6] vegetation of the Robe River and Jimmawurrada Creek as a result of groundwater abstraction and discharge for the Mesa J Hub.			
Environmental criteria	**Response actions**	**Monitoring**	**Reporting**
Trigger criterion: 1. The mean vegetation index for riparian overstorey[7] taxa (*E. victrix, E. camaldulensis and M. argentea*) of Zones 1 & 2[8] of Jimmawurrada Creek and the Robe River declines by ≥ 2 standard deviations from baseline.	• Review discharge regime, frequency, extent and timing in relation to predicted impacts on riparian vegetation. • Review supporting water quality data for surplus discharge (conducted under the Groundwater Operating Strategy) and supporting field-based overstorey and understorey vegetation monitoring data at selected sites • Review local/regional reference data. • Increase frequency and/or extent of on-ground assessments as appropriate.	• Capture and analysis of remote sensing images within selected[9], established monitoring areas, as appropriate[10]. • Annual condition, cover and health of riparian vegetation (understorey) within selected established monitoring areas.	The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx. If the trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions.

[3] Where 'irreversible impact' is defined as, 'an impact resulting in a permanent loss of environmental value(s); or where intensive, and/or un-proven management intervention, potentially over a long timeframe, would be required to restore the environmental value(s)'.

[4] See Section b) for more information regarding composition of riparian vegetation within the Robe River and Jimmawurrada Creek systems.

[5] See Section b) for more information regarding composition of riparian vegetation within the Robe River and Jimmawurrada Creek systems.

[6] See Section b) for more information regarding composition of riparian vegetation within the Robe River and Jimmawurrada Creek systems.

[7] Due to the difficulty in distinguishing *E. victrix* and *E. camaldulensis* (reliance on seed capsules that are not always present), the overstorey riparian vegetation will be represented as a functional group for the trigger and threshold criteria. Should any exceedance occur around these species specific on-ground investigations may be appropriate.

[8] Impacts are predicted in Zone 3 of Jimmawurrada creek which may exceed this trigger periodically during initial dewatering and later in the mine life (estimated to be 2030)

[9] The Proponent will determine "selected" transects from the established transects based on factors such as trigger and threshold outcome from H2 survey, discharge and/or dewatering extent and volume.

[10] Locations may not always be available due to accessibility, weather conditions, safety considerations etc.

2. A statistically significant decline from baseline ($p<0.05$) in the number and/or cover of native perennial species	• Review contingency actions/strategy, including potential modification to surplus water management and discharge regime. • Implement remedial or management actions as appropriate. • Consult with DWER if investigation indicates threshold criterion is likely to be exceeded.		
3. Detection of a new introduced species at a potential impact site, previously not detected within the Development Envelope			
4. Decline of >0.5m between paired Alluvial Aquifer bores[11] in the Robe River near targeted pools.	• Review dewatering regime, in relation to predicted drawdown. • Review local/regional reference data. • Increase frequency and/or extent of on-ground assessments as appropriate. • Review contingency actions/strategy, including potential modification to drawdown management and discharge regime. • Implement remedial or management actions as appropriate. • Consult with DWER if investigation indicates threshold criterion is likely to be exceeded.	• Monitoring bores (subject to installation approval). • Quarterly download of daily data.	
5. Yeera Bluff (Gnieroora) Pool drops below 2 m depth[12].	• Review dewatering regime, in relation to predicted drawdown. • Review local/regional reference data. • Increase frequency and/or extent of on-ground assessments as appropriate. • Review contingency actions/strategy, including potential modification to surplus water management and discharge regime.	• Pool morphology and bathymetry via Biannual (post wet and dry) monitoring. • Direct visualization or remote assessment via drone.	The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx. If the trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions

[11] Alluvial Bore locations subject to approval from the Kurama Marthadunera People.

[12] Except where a cyclonic event changes pool morphology

	• Implement remedial or management actions as appropriate. • Consult with DWER if investigation indicates threshold criterion is likely to be exceeded. • Compare to alluvial bore water depths to ascertain if mining and / or climatic related.		
6. Exceedance of rolling quarterly median measured against the operational guideline SSTV equivalent of 95%ile value of baseline or the ANZECC/ARMCANZ (2000) default TV for toxicants for protection of 95% of species, whichever is higher (except for pH).	• Review discharge regime, frequency, extent and timing in relation to predicted impacts on water quality. • Review local/regional reference data. • Increase frequency and/or extent of on-ground assessments as appropriate. • Review contingency actions/strategy, including potential modification to surplus water management and discharge regime. • Implement remedial or management actions as appropriate.	Quarterly pool water sampling	The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx. If the trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions
Threshold criterion: 1. The mean vegetation index for riparian vegetation overstorey[13] taxa (*E. victrix, E. camaldulensis and M. argentea*) of Zones 1 & 2[14] of Jimmawurrada Creek and the Robe River changes by ≥ 2 standard deviations from baseline values over two (2) consecutive sampling events.	As for trigger level actions with the addition of: • If exceedance of threshold criterion is considered likely to be attributable to the Project, submit a report including proposed contingency actions to the DWER. • Implement contingency action/s as agreed with the DWER. • Monitor to ensure contingency actions are successful and review procedures, if appropriate.	As for trigger level monitoring with the addition of monitoring of the effectiveness of contingency actions	• Notify the DWER within 7 days of the non-compliance being known and provide a report within 21 days of the non-compliance being known. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • If the threshold criterion was exceeded during the reporting period, the ACAR will include a description of the effectiveness of threshold contingency action/s that have been implemented to manage the potential impact. • Submit a report within 12 months after notification to the DWER of the non-compliance detailing the:

[13] Due to the difficulty in distinguishing *E. victrix* and *E. camaldulensis* (reliance on seed capsules that are not always present), the overstorey riparian vegetation will be represented as a functional group for the trigger and threshold criteria. Should any exceedance occur around these species specific on-ground investigations may be appropriate.

[14] Impacts are predicted in Zone 3 of Jimmawurrada creek which may exceed this trigger periodically during initial dewatering and later in the mine life (estimated to be 2030)

2. A statistically significant decline from baseline (P<0.05) in the number and/or cover of native perennial species over two successive monitoring events			○ effectiveness of contingency actions ○ analysis of trends of riparian tree health ○ schedule for ongoing reporting.
3. Detection of new introduced species rated high or very high management priority (by DBCA) at a potential impact site, previously not detected within the Development Envelope and a significant cover or abundance over successive monitoring events.			
4. Yeera Bluff (Gnieroora) Pool drops below 1m depth[15]	As for trigger level actions with the addition of: • If exceedance of threshold criterion is considered likely to be attributable to the Project, submit a report including proposed contingency actions to the DWER. • Implement contingency action/s including either: ○ Cease dewatering below the 120 mRL in Pit 7 of Mesa H. ○ Option for supplementary water direct to Yeera Bluff Pool ○ Or actions as agreed with the DWER. • Monitor to ensure contingency actions are successful and review procedures, if appropriate.	As for trigger level monitoring with the addition of monitoring of the effectiveness of contingency actions.	• Notify the DWER within 7 days of the non-compliance being known and provide a report within 21 days of the non-compliance being known. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • If the threshold criterion was exceeded during the reporting period, the ACAR will include a description of the effectiveness of threshold contingency action/s that have been implemented to manage the potential impact.

[15] Except where a cyclonic event changes pool morphology

5. Three (3) or less species of fish recorded in Robe River Pools.	• If exceedance of threshold criterion is considered likely to be attributable to the Project, submit a report including proposed contingency actions to the DWER. • Implement contingency action/s as agreed with the DWER. • Monitor to ensure contingency actions are successful and review procedures, if appropriate.	Bi-annual (pre and post wet) survey of semi-permanent and permanent pools	• Submit a report within 12 months after notification to the DWER of the non-compliance detailing the: ○ effectiveness of contingency actions. ○ schedule for ongoing reporting.

Environmental criteria	Response actions	Monitoring	Reporting
Supporting[16] riparian and aquatic fauna monitoring parameters for the trigger and threshold criteria			
Riparian overstorey taxa (*E. victrix, E. camaldulensis*)	N/A	• Annual post-wet season survey in selected[17], established transects, as appropriate[18]	N/A
Riparian understorey taxa (native and introduced)	N/A		
Aquatic ecosystems	N/A	• Continue biophysical/ecological survey established in 1991: aquatic fauna (macroinvertebrates and fish), channel/pool morphology, riparian/bank condition, weeds, water flows and water quality.	

[16] Parameters collected during annual surveys will assist in the interpretation of trigger and threshold criteria should an exceedance or trend be noted.

[17] The Proponent will determine "selected" transects from the established transects based on factors such as trigger and threshold outcome from H2 survey, discharge and/ or dewatering extent and volume.

[18] Locations may not always be available due to accessibility, weather conditions, safety concerns etc.

Table 2-7: EMP Provisions – Terrestrial Fauna (Ghost Bat)

Terrestrial fauna – Ghost Bat			
EPA objectives: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained **Key environmental values:** Conservation significant fauna species – Ghost Bat **Key impacts and risks:** Potential loss or degradation of high value (roosting) habitat as a result of implementation of the Project			
Outcome-based provisions			
Outcome: No irreversible[19] impact, as a result of the Project, to Breakaways and Gullies habitat retained in the escarpments of Mesas H			
Environmental criteria	**Response Actions**	**Monitoring**	**Reporting**
Trigger criterion: 1. Vibration levels exceed 50 mm/s peak particle velocity at the potential diurnal/maternal Ghost Bat roost caves as shown in Figure 1-4.	• Complete in-field inspection of the area. • Review blast vibration predictions and blast vibration monitoring data. • Update vibration model if appropriate. • Review supporting Ghost Bat monitoring data.	Blast vibration monitoring for all blasts within 300 m of the potential diurnal/maternal Ghost Bat roosts. Temperature and humidity monitoring in Diurnal Roost caves.	• The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx. • If the trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions in controlling vibration levels at the potential diurnal/maternal Ghost Bat roost caves.
Threshold criterion: 1. Significant damage[20] to diurnal/maternal Ghost Bat roost caves.	As for trigger level actions with the addition of: • Conduct geotechnical assessment of the site to assess structural stability of the roost. • Review temperature and humidity monitoring data to determine if the roost cave microclimate has been compromised. Remediate any noticeable new cave openings exposed pit-side. • If structural stability of the roost is considered to be compromised as a result of the Project, submit a report including proposed contingency actions to the DWER. • Implement contingency action/s as agreed with the DWER.	As for trigger level monitoring with the addition of monitoring of the effectiveness of contingency actions	• Notify the DWER within 7 days of the non-compliance being known and provide a report within 21 days of the non-compliance being known. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • If the threshold criterion was exceeded during the reporting period, the ACAR will include a description of the effectiveness of threshold contingency action/s that have been implemented to manage the potential impact. • Submit a report within 12 months after notification to the DWER of the non-compliance detailing the: o effectiveness of contingency actions o schedule for ongoing reporting.

[19] Where 'irreversible impact' is defined as, 'an impact resulting in a permanent loss of environmental value(s); or where intensive, and/or un-proven management intervention, potentially over a long timeframe, would be required to restore the environmental value(s)'.

[20] Where 'significant damage' is defined as, 'damage that negatively impacts the structural integrity and microclimate of the cave such that future Ghost Bat use of the site is prevented'.

	• Monitor to ensure contingency actions are successful and review procedures, if appropriate.		
Environmental criteria	**Response Actions**	**Monitoring**	**Reporting**
Trigger criterion: 2. Disturbance, other than approved clearing, within 50 m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves	• Complete in-field inspection of the area. • Review site specific observations; clearing extent; blast vibration predictions / blast vibration monitoring levels; and other natural factors (i.e. seasonal rainfall data etc.) to determine if disturbance is attributable to implementation of the Project. • Review supporting Ghost Bat monitoring data • Investigate potential remediation strategies (such as review of land clearing procedure or modified blast management strategy).	Annual land clearing reconciliation against potential diurnal/maternal Ghost Bat roost caves.	• The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx. • If the trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions in managing disturbance near the potential diurnal/maternal Ghost Bat roost caves.
Threshold criterion: 2. Disturbance, other than approved clearing, within 40 m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves	As for trigger level actions with the addition of: • Conduct geotechnical assessment of the site to assess structural stability of the roost. • If exceedance of threshold criterion is considered likely to be attributable to the Project, submit a report including proposed contingency actions to the DWER. • Implement contingency action/s as agreed with the DWER. • Monitor to ensure contingency actions are successful and review procedures, if appropriate.	As for trigger level monitoring with the addition of monitoring of the effectiveness of contingency actions.	• Notify the DWER within 7 days of the non-compliance being known and provide a report within 21 days of the non-compliance being known. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • If the threshold criterion was exceeded during the reporting period, the ACAR will include a description of the effectiveness of threshold contingency action/s that have been implemented to manage the potential impact. • Submit a report within 12 months after notification to the DWER of the non-compliance detailing the: ○ effectiveness of contingency actions

			○ schedule for ongoing reporting.
Supporting[21] Ghost Bat monitoring parameters for the trigger and threshold criteria			
Ghost Bat monitoring	N/A	• Annual assessment of evidence of Ghost Bat use in potential diurnal/ maternal roost caves in the broader Robe Valley	N/A

[21] Parameters collected during annual surveys will assist in the interpretation of trigger and threshold criteria should an exceedance or trend be noted.

Management-based provisions			
Management objective: Improve knowledge of the Ghost Bat population and utilisation of high value habitat in the Robe Valley in order to assist in maintaining biological diversity and ecological integrity			
Management Actions	**Management Targets**	**Monitoring**	**Reporting**
Undertake a five year study of Ghost Bat utilisation of high value habitat.	• Estimate[22] the local population of Ghost Bats in the central part of the Robe Valley. • Indicate how Ghost Bats use caves within the central part of the Robe Valley (e.g. diurnal versus maternal), including the degree of utilisation of caves by pregnant females[23].	Bi-annual collection and analysis (genetic and hormone) of scat samples from across the broader Robe Valley[24].	• The environmental outcome will be reported against the management target for each calendar year by 30 April in the ACAR for MS xxxx. • If a management target was not met during the reporting period, the annual report will include discussion of the effectiveness of the management actions and whether revision of the management actions is required.

[22] Preliminary estimate of the local population based on the data collected during the five year study period

[23] Preliminary indication of utilisation based on the data collected during the five year study period

[24] Access subject to safety and heritage assessments of caves

Table 2-8: EMP Provisions – Terrestrial Fauna (Northern Quoll)

Terrestrial fauna – Northern Quoll			
EPA objectives: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained **Key environmental values:** Conservation significant fauna species – Northern Quoll **Key impacts and risks:** Potential loss or degradation of high value (denning) habitat as a result of implementation of the Project			
Outcome-based provisions			
Outcome: No irreversible[25] impact, as a result of the Project, to Breakaways and Gullies habitat retained in the escarpments of Mesas H			
Environmental criteria	**Response Actions**	**Monitoring**	**Reporting**
Trigger criterion: 1. Disturbance of ≥ 5% of potential Northern Quoll denning habitat on the retained escarpments[26] (MEZs) of Mesa H	• Complete in-field inspection of the area. • Review site specific observations such as clearing extent and natural factors (e.g. seasonal rainfall data) to determine if disturbance is attributable to implementation of the Project. • Review supporting Northern Quoll monitoring data. • Review local/regional reference data. • Increase frequency and/or extent of on-ground assessments as appropriate. • Investigate potential remediation strategies, including rehabilitation.	Annual land clearing reconciliation against escarpments of Mesas H.	The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx If the trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions in managing disturbance of the mesa escarpments.

[25] Where 'irreversible impact' is defined as, 'an impact resulting in a permanent loss of environmental value(s); or where intensive, and/or un-proven management intervention, potentially over a long timeframe, would be required to restore the environmental value(s)'.

[26] Where disturbance of 'retained escarpments" is disturbance over and above existing or approved disturbance

Environmental criteria	Response Actions	Monitoring	Reporting
Threshold criterion: 1. Disturbance of >10% of potential denning Northern Quoll habitat on the retained escarpments (MEZs) of Mesa H.	As for trigger level actions with the addition of: • If exceedance of threshold criterion is considered likely to be attributable to the Project, submit a report including proposed contingency actions to the DWER. • Implement contingency action/s as agreed with the DWER. • Monitor to ensure contingency actions are successful and review procedures, if appropriate.	As for trigger level monitoring with the addition of monitoring of the effectiveness of contingency actions.	• Notify the DWER within 7 days of the non-compliance being known and provide a report within 21 days of the non-compliance being known. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • If the threshold criterion was exceeded during the reporting period, the ACAR will include a description of the effectiveness of threshold contingency action/s that have been implemented to manage the potential impact. • Submit a report within 12 months after notification to the DWER of the non-compliance detailing the: o effectiveness of contingency actions o schedule for ongoing reporting.
Supporting[27] Northern Quoll monitoring parameters for the trigger and threshold criteria			
Northern Quoll monitoring	N/A	Annual field survey of Northern Quoll	N/A

[27] Parameters collected during annual surveys will assist in the interpretation of trigger and threshold criteria should an exceedance or trend be noted.

Table 2-9: EMP Provisions – Subterranean Fauna (Troglofauna)

Subterranean fauna – troglofauna			
EPA objectives: To protect subterranean fauna so that biological diversity and ecological integrity are maintained **Key environmental values:** Subterranean fauna - troglofauna **Key impacts and risks:** Loss of habitat from mining as a result of implementation of the Project			
Outcome-based provisions			
Outcome: No irreversible impact, as a result of the Project, to the troglofauna habitat retained within the Mesa H MEZ			
Environmental criteria	**Response Actions**	**Monitoring actions**	**Reporting**
Trigger criterion: 1. Operational error during mining resulting in removal of greater than 0.01% by volume annually per mesa of the MEZ at Mesas H.	• Review 3-dimensional pit shell and adjust to ensure no predicted net loss of the MEZ per individual mesa (i.e. amend mine plan to ensure retention of the same volume of habitat as approved under MS xxxx; or backfill; or attempt habitat recreation). • Assess the adequacy of work practices and propose changes if necessary to prevent future deviations from the planned 3-dimensional pit shell.	Annual pit shell reconciliation for mine pits at Mesa H	• The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx • If the trigger criterion was exceeded during the reporting period, the environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx. • If trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions to prevent removal of the MEZ.
Threshold criterion: 1. Net loss of the MEZ at Mesa H at the completion of mining.	As for trigger level actions with the addition of: • If exceedance of threshold criterion is considered likely to be attributable to the Project, submit a report including proposed contingency actions (e.g. backfill; attempt habitat recreation) to the DWER. • Implement contingency action/s as agreed with the DWER. • Monitor to ensure contingency actions are successful and review procedures, if appropriate.	Monitor the effectiveness of contingency actions	• Notify the DWER within 7 days of the non-compliance being known and provide a report within 21 days of the non-compliance being known. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • If the threshold criterion was exceeded during the reporting period, the ACAR will include a description of the adequacy of threshold contingency action/s that have been implemented to manage the potential impact. • Submit a report within 12 months after notification to the DWER of the non-compliance detailing the: ○ adequacy of contingency actions to re-instate the appropriate amount of lost habitat ○ schedule for ongoing monitoring and reporting.

Management-based provisions			
Management objective: To minimize impacts as far as practicable to protect the biological diversity and ecological integrity of the troglofauna assemblages of Mesa H			
Management actions	**Management targets**	**Monitoring**	**Reporting**
• Maintain MEZ (significant troglofauna habitat). • Minimise ground disturbance and potential for degradation in the retained MEZ habitat.	• Maintain MEZ (significant troglofauna habitat). • Total clearing of native vegetation across the surface of the MEZ is less than 30% of the MEZ surface area. • Troglofauna specimen capture rate is not below the baseline minimum for three consecutive sampling events for Mesa H.	• Annual land clearing reconciliation against escarpments of Mesa H. • Biennial troglofauna field survey.	• The environmental outcome will be reported against the management target for each calendar year by 30 April in the ACAR for MS xxxx. • If a management target was not met during the reporting period, the annual report will include discussion of the effectiveness of the management actions and whether revision of the management actions is required.
Supporting[28] Troglofauna monitoring parameters for the trigger and threshold criteria			
Troglofauna monitoring	N/A	Daily weather and climatic data	N/A

[28] Parameters collected during annual surveys will assist in the interpretation of trigger and threshold criteria should an exceedance or trend be noted.

Table 2-10: EMP Provisions – Subterranean Fauna (Stygofauna)

Subterranean fauna – stygofauna			
EPA objectives: To protect subterranean fauna so that biological diversity and ecological integrity are maintained **Key environmental values:** Subterranean fauna – stygofauna community and Blind Cave Eel **Key impacts and risks:** Loss of habitat from mining (groundwater management) as a result of implementation of the Project			
Outcome-based provisions			
Outcome: No irreversible impact, as a result of the Proponents water management activities, to the stygofauna habitat within the CID aquifer and stygofauna and Blind Cave Eel habitat within the alluvial aquifer habitat of Jimmawurrada Creek and the Robe River shown in Figure 1-6.			
Environmental criteria	**Response Actions**	**Monitoring actions**	**Reporting**
Trigger criterion: 1. Groundwater levels drop three (3) m below predicted water table heights in the Jimmawurrada Creek alluvial aquifer. 2. Diversity of stygofauna Orders collected during annual survey events reduced to 3 or less.	• Review site specific observations such as clearing extent and natural factors (e.g. seasonal rainfall data) to determine if exceedance is attributable to implementation of the Project. • Review trends in alluvial groundwater levels • Review stygofauna monitoring data. • Review local/regional reference data. • Increase frequency and/or extent of monitoring as appropriate. • Investigate potential remediation strategies.	• Monthly monitoring of groundwater levels in alluvial aquifer bores. • Annual stygofauna field survey.	• The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx • If the trigger criterion was exceeded during the reporting period, the environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS xxxx. • If trigger criterion was exceeded during the reporting period, the ACAR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions to prevent loss of habitat.
Threshold criterion: 1. Alluvial aquifer is dry for 2 consecutive years. 2. Absence of Blind Cave Eel recorded for two consecutive annual sampling events. 3. Absence of stygofauna specimens for two consecutive sampling events.	As for trigger level actions with the addition of: • If exceedance of threshold criterion is considered likely to be attributable to the Project, submit a report including proposed contingency actions (e.g. backfill; attempt habitat recreation) to the DWER. • Implement contingency action/s as agreed with the DWER. • Monitor to ensure contingency actions are successful and review procedures, if appropriate.	• Monthly monitoring of groundwater in alluvial aquifer bores. • Annual eDNA field survey targeting the Blind Cave Eel. • Annual stygofauna field survey.	• Notify the DWER within 7 days of the non-compliance being known and provide a report within 21 days of the non-compliance being known. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • If the threshold criterion was exceeded during the reporting period, the ACAR will include a description of the adequacy of threshold contingency action/s that have been implemented to manage the potential impact. • Submit a report within 12 months after notification to the DWER of the non-compliance detailing the: o adequacy of contingency actions to re-instate the appropriate amount of lost habitat o schedule for ongoing monitoring and reporting.

Management-based provisions			
Management objective: The Proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages within the CID and Alluvial aquifer habitat shown in Figure 1-6 by minimizing impacts as far as practicable.			
Management actions	**Management targets**	**Monitoring**	**Reporting**
• Continue to improve understanding of stygofauna distribution and ecology by supporting research. (e.g. ARC Linkage Project currently entitled 'Transforming assessment of subterranean ecosystems using environmental DNA'). • Retain significant connected stygofauna habitat.	Understand the distribution and ecology of key stygofauna taxa within the Robe Valley area.	• Annual stygofauna field survey results. • Annual eDNA field survey targeting the Blind Cave Eel.	• The environmental outcome will be reported against the management target for each calendar year by 30 April in the ACAR for MS xxxx. • If a management target was not met during the reporting period, the annual report will include discussion of the effectiveness of the management actions and whether revision of the management actions is required.

Supporting[29] Stygofauna monitoring parameters for the trigger and threshold criteria			
Meteorological monitoring	N/A	Daily weather and climatic data.	N/A
Water quality	N/A	Water quality parameters in alluvial aquifer bores.	

[29] Parameters collected during annual surveys will assist in the interpretation of trigger and threshold criteria should an exceedance or trend be noted.

2.5 Reporting

The management outcomes will be reported against the management target (Table 2-11) for each calendar year in the Annual Compliance Assessment Report (ACAR) for the Mesa J Hub against MS xxxx.

The annual report will also include a summary of the analysis of monitoring data to facilitate adaptive management.

In the event that trigger and threshold criteria are exceeded during the reporting period or management targets are not met, the annual report will include a description of the effectiveness of any management contingency actions that have been implemented to manage the impact. A stand-alone report will also be produced for the DWER within 21 days of any exceedance of the threshold criteria. A follow up report detailing the adequacy of the response actions will also be submitted to the DWER within 12 months of the initial notification.

Table 2-11: Mesa J Hub Environmental Management Plan Reporting Table

Key environmental factors: Inland waters, vegetation and aquatic fauna; terrestrial fauna (Ghost Bat and Northern Quoll); subterranean fauna (troglofauna and stygofauna).	
Condition environmental outcome, trigger and threshold criteria as per MS xxxx	**Reporting period** **1 January - 31 December**
Trigger criteria:	**Status report:** Environmental outcome achieved Environmental outcome not achieved
Inland waters, vegetation and aquatic fauna 1) The mean vegetation index for riparian overstorey[30] taxa (*E. victrix, E. camaldulensis and M. argentea*) of Zones 1 & 2[31] of Jimmawurrada Creek and the Robe River changes by ≥ 2 standard deviations. 2) A statistically significant decline from baseline ($p<0.05$) in the number and/or cover of native perennial species of Zones 1 & 2 of Jimmawurrada Creek 3) Detection of new introduced species at a potential impact site, not previously detected within the Development Envelope. [surplus water discharge] 4) Decline of >0.5m between paired Alluvial Aquifer bores[32] in the Robe River near targeted pools. 5) Yeera Bluff (Gnieroora) Pool drops below 2m depth. 6) Water quality in pools exceeds rolling quarterly median measured against the operational guideline SSTV equivalent of 95%ile value of baseline or the ANZECC/ARMCANZ (2000) default TV for toxicants for protection of 95% of species, whichever is higher (except for pH).	
Ghost bat 1) Vibration levels exceed 50mm/s peak particle velocity at the potential diurnal/maternal Ghost Bat roost caves. 2) Disturbance, other than approved clearing, within 50m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves.	
Northern Quoll 1) Disturbance of >5% of potential Northern Quoll denning habitat on the retained escarpment of Mesa H.	

[30] Due to the difficulty in distinguishing E. *victrix* and *E. camaldulensis* (reliance on seed capsules that are not always present), the overstorey riparian vegetation will be represented as a functional group for the trigger and threshold criteria. Should any exceedance occur around these species specific on-ground investigations may be appropriate.

[31] Impacts are predicted in Zone 3 of Jimmawurrada creek which may exceed this trigger periodically during initial dewatering and later in the mine life (estimated to be 2030)

[32] Alluvial Bore locations subject to approval from the Kurama Marthadunera People.

Key environmental factors: Inland waters, vegetation and aquatic fauna; terrestrial fauna (Ghost Bat and Northern Quoll); subterranean fauna (troglofauna and stygofauna).	
Condition environmental outcome, trigger and threshold criteria as per MS xxxx	**Reporting period** **1 January - 31 December**
Troglofauna 1) Operational error during mining resulting in removal of greater than 0.01% by volume annually of the MEZ at Mesa H.	
Stygofauna 1) Groundwater levels drop three (3) m below predicted water table heights in the Jimmawurrada Creek alluvial aquifer. 2) Diversity of stygofauna Orders collected during annual survey events reduced to three (3) or less	
Threshold criteria:	**Status report:** Environmental outcome achieved Environmental outcome not achieved
Inland waters, vegetation and aquatic fauna 1) The mean vegetation index for riparian vegetation overstorey (upper canopy) taxa (E. victrix, E. camaldulensis and M. argentea) of Zones 1 & 2 of Jimmawurrada Creek and the Robe River declines by ≥ 2 standard deviations from baseline values over two consecutive sampling events. 2) Statistically significant decline from baseline ($p<0.05$) in the number and/ or cover of native perennial species of Zones 1 & 2 of Jimmawurrada Creek and the Robe River. 3) Statistically significant decline from baseline ($p<0.05$) in the number and/or cover of native perennial species over two successive monitoring events. 4) Decline of ≥1 m between paired Alluvial Aquifer bores in the Robe River near targeted pools. 5) Yeera Bluff (Gnieroora) Pool drops below 1m depth[33]. 6) Three (3) or less species of fish recorded across all sampled Robe River Pools.	
Ghost bat 1) Significant damage to diurnal/maternal Ghost Bat roost caves. 2) Disturbance, other than approved clearing, within 40m of the recorded back of the potential diurnal/maternal Ghost Bat roost caves.	
Northern Quoll 1) Disturbance of >10% of potential denning Northern Quoll habitat on the retained escarpment of Mesa H.	

[33] Except where a cyclonic event changes pool morphology

Key environmental factors: Inland waters, vegetation and aquatic fauna; terrestrial fauna (Ghost Bat and Northern Quoll); subterranean fauna (troglofauna and stygofauna).	
Condition environmental outcome, trigger and threshold criteria as per MS xxxx	**Reporting period** **1 January - 31 December**
Troglofauna 1) Net loss of the MEZ at Mesa H, at the completion of mining.	
Stygofauna 1) Alluvial aquifer in Jimmawurrada is dry for two (2) consecutive years. 2) Absence of Blind Cave Eel recorded for two (2) consecutive annual sampling events. 3) Absence of stygofauna specimens for two (2) consecutive annual sampling events.	
Management-based targets:	**Status report:** Environmental target achieved Environmental target not achieved
Ghost bat 1) Estimate the local population of Ghost Bats in the central part of the Robe Valley. 2) Indicate how Ghost Bats use caves within the central part of the Robe Valley (e.g. diurnal versus maternal), including the degree of utilisation of caves by pregnant females.	
Troglofauna 1) Total clearing of native vegetation across the surface of the MEZ is less than 30% of the MEZ surface area. 2) Troglofauna specimen capture rate is not below the baseline minimum for three (3) consecutive sampling events at Mesa H.	
Stygofauna 1) Understand the distribution and ecology of key stygofauna taxa within the Robe Valley area.	

3. ADAPTIVE MANAGEMENT AND REVIEW OF THIS EMP

The Proponent will implement adaptive management to learn from the implementation of mitigation measures, monitoring and evaluation against trigger and threshold criteria, to more effectively meet the conditioned environmental outcome.

The following approach will apply:

- Monitoring data will be systematically evaluated and compared to baseline and reference site data on a regular basis in a process of adaptive management to verify whether riparian vegetation responses to the impact are the same or similar to predictions.
- The effectiveness and relevance of trigger level and threshold contingency actions will be evaluated on an annual basis to determine if any changes to management actions are required.
- The effectiveness and relevance of management actions will be evaluated on an annual basis to determine is any changes are required.

4. STAKEHOLDER CONSULTATION

Consultation specific to this EMP will be undertaken during the Environmental Impact Assessment process for the Mesa H Proposal. Consultation will be documented and any concerns will be addressed prior to finalisation of the EMP. Stakeholder consultation will include the Department of Biodiversity, Conservation and Attractions - Park and Wildlife Service and the Department of Water and Environmental Regulation – EPA Services and Compliance and Reporting (Water).

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6. APPENDIX

Appendix 1: Baseline Troglofauna 'hit rate' for Mesa H

Change in specimen capture rate over time for troglofauna recorded from the Mesa H landform.

Collection rate has been converted to a rate per 100 trapped holes. Data tracks changes over eight sampling events spanning 12 years including pre mining initiation. The variation in collection rate is naturally large (17 to 228.6). Larger collection rates are more likely influenced by rainfall prior to sampling rather than mining, however the required timing and size of the rainfall event is still uncertain from the current data. All troglobitic but indeterminate specimens are included in these calculations for completeness. Specimens collected via scraping have been omitted; this collection method was only employed in recent sampling events and is thus will not be comparable pre and post mining. Weather information was taken from Pannawonica BOM Station.

Mesa H	**Pre-mining**							
Sample collection date	**2005/2006 (21st Nov - 20th Jan)**	**2010 (21st Sep - 10th Nov)**	**2015 EIA P1 (29th Oct - 12th Dec)**	**2016 EIA P2 (12th Dec - 21st Jan)**	**2016 EIA P3 (7th May - 28th Jun)**	**2016 EIA P4 (14th Sep - 27th Oct)**	**2016 EIA P5 (27th Oct - 14th Dec)**	**2017 EIA P6 (14th Dec - 31st Jan)**
Rainfall during survey	5.8	0.0	40.4	3.8	13.6	0.4	37.8	151.0
Rainfall 3 months prior to collection date	13.0	23.8	40.4	9.0	171.8	2.4	38.2	187.8
Rainfall 12 months prior to collection date	530.4	219.2	422.0	354.2	312.8	348.6	360.0	448.4
Number of trapped holes	6	23	46	46	30	43	47	14
Number of specimens collected	0	24	23	20	8	34	8	32
Number of specimens per 100 trapped holes	n/a	104.3	50.0	43.5	26.7	79.1	17.0	228.6