RioTinto

Environmental Management Plan

Mesa H Proposal (Revision to the Mesa J Iron Ore Development)

July 2024

RTIO-HSE-0349253

Robe River Mining Co. Pty. Ltd.

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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) as the authorised manager and agent for the participants in the Robe River Iron Associates Joint Venture, specifically for the Mesa J Hub Revised Proposal. Neither the document nor its contents may be referred to without the express approval of Rio Tinto unless the document has been approved for implementation under Ministerial Statement 1141.

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	March 2019	EPA Services	March 2019
4	Rio Tinto	Rio Tinto HSES	January 2021	EPA Services	8 January 2021
5	Rio Tinto	Rio Tinto HSES	July 2021	EPA Services	8 July 2021
6	Rio Tinto	Rio Tinto HSES	December 2021	EPA Services	24 December 2021
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8	Rio Tinto	Rio Tinto HSES	January 2023	EPA Services	-
9	Rio Tinto	Rio Tinto HSEC	July 2024	EPA services	

SUMMARY

This Environmental Management Plan (EMP) has been prepared by Rio Tinto on behalf of Robe River Mining Co. Pty. Ltd. (the Proponent) as the authorised manager and agent for the participants in the Robe River Iron Associates Joint Venture for the Mesa H Proposal (Revision to the Mesa J Iron Ore Development) (herein referred to as the **Mesa J Hub**) in accordance with Conditions 5 – 8 of Ministerial Statement 1141 (MS 1141), and to meet relevant requirements of Conditions 2 – 6 of EPBC Act Approval 2017/8017.

This EMP incorporates the Blind Cave Eel Action Management Plan (required under Condition 6 of EPBC Decision Notice 2017/8017), due to the overlap and duplicative monitoring and management requirements of the State and Commonwealth approvals relating to water management (groundwater levels and water quality) and subterranean fauna management.

This EMP provides for monitoring and management of the following environmental factors:

- Inland Waters / Vegetation - Pool Ecosystems and riparian vegetation.
- Terrestrial Fauna - MNES species: Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python.
- Subterranean Fauna - Troglofauna and Stygofauna (including the Blind Cave Eel).

Summary Table 1 below presents the environmental outcomes and objectives for the environmental factors to be met through implementation of this EMP, as well as the environmental criteria and management targets to measure achievement of the associated environmental outcomes and objectives, in accordance with the conditions of MS1141 and Decision Notice 2017/8017.

Summary Table 1: Environmental criteria and targets to measure achievement of environmental outcomes and objectives under MS1141 and for the Blind Cave Eel under EPBC 2017/8017.

<table>
<tr><td colspan="2">Proposal title</td><td>Mesa H Proposal (Revision to the Mesa J Iron Ore Development)</td></tr>
<tr><td colspan="2">Proponent</td><td>Robe River Mining Co. Pty. Ltd.</td></tr>
<tr><td colspan="2">Purpose of this EMP</td><td>This EMP fulfills the requirements of Conditions 5-1, 5-2 and 5-3 of MS 1141 in relation to management of environmental factors and in turn meets the requirements of Conditions 2 - 5 of EPBC Act approval 2017/8017.</td></tr>
<tr><td colspan="3">Inland Waters – Vegetation – Robe River
(Groundwater abstraction / discharge and riparian vegetation of the Robe River)
EPA Objective:
To maintain the hydrological regimes and quality 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.</td></tr>
<tr><td rowspan="3">Outcome based provisions</td><td>Condition Environmental outcome</td><td>MS Condition 6-1 (1): Ensure no irreversible impact to the health of the Robe River and Jimmawurrada Creek ecosystems, including associated riparian vegetation, as a result of groundwater abstraction for the Revised Proposal.
MS Condition 6-1 (2): Ensure no irreversible impact to the health of the Robe River and Jimmawurrada Creek ecosystems, including associated riparian vegetation, as a result of discharge of surplus water for the Revised Proposal.</td></tr>
<tr><td>Early response criteria</td><td>1. Robe River groundwater (alluvial aquifer) level trends adjacent to the Mesa J and H deposits (Zone 1) show significantly different abstraction related trends compared with the broader locality or reference sites.
OR
2. Greater proportion of phreatophytic overstorey stands in the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2) with declining trend in MSAVI since baseline and/or greater average decline (more negative slope) in comparison to reference areas.</td></tr>
<tr><td>Trigger criteria</td><td>1. The area of phreatophytic overstorey canopy decline since baseline (below the MSAVI baseline 5th percentile) is 20% greater in the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2) than in reference areas and a demonstrated causal link to the Project.
OR
2. Over 20% of Robe River Zone 1 or Zone 2 monitoring quadrats record significant structural or compositional change, in comparison to baseline and reference sites.</td></tr>
</table>

	Threshold criteria	1. The area of phreatophytic overstorey canopy decline since baseline (below the baseline MSAVI 5th percentile) is over 50% of the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2); trend continues over two or more consecutive dry season monitoring events; with no evidence of seasonal recovery; and outside of historical baseline or seasonal variation, in comparison to reference sites with demonstrated causal link to Project. OR 2. Over 50% of Robe River Zone 1 or Zone 2 monitoring quadrats record significant structural or compositional change in comparison to baseline and reference sites, with demonstrated causal link to Project.
Inland Waters – Vegetation – Jimmawurrada Creek **(Groundwater abstraction / discharge and riparian vegetation of Jimmawurrada Creek)** **EPA Objective:** *To maintain the hydrological regimes and quality 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.*		
Outcome based provisions	**Condition Environmental outcome**	MS Condition 6-1 (1): Ensure no irreversible impact to the health of the Robe River and **Jimmawurrada Creek** ecosystems, including associated riparian vegetation, as a result of **groundwater abstraction** for the Revised Proposal. MS Condition 6-1 (2): Ensure no irreversible impact to the health of the Robe River and **Jimmawurrada Creek** ecosystems, including associated riparian vegetation, as a result of **discharge of surplus water** for the Revised Proposal.
	Early response criterion	**1.** Within any one management zone, groundwater level monitoring indicates drawdown in the Jimmawurrada Creek alluvial aquifer (at locations as per Appendix 6) exceeds 5 metres in depth (below the minimum recorded seasonal groundwater level).
	Trigger criteria	**1.** The area of phreatophytic overstorey canopy decline since baseline (below the baseline MSAVI 5th percentile) is 20% greater within Jimmawurrada Creek Zone 3 or Zone 4 than in reference areas with demonstrated causal link to the Project. OR **2.** Over 20% of Jimmawurrada Creek Zone 3 or Zone 4 monitoring quadrats record significant structural or compositional change, in comparison to baseline (and reference sites where available). OR: **3.** Establishment of new high priority weed species within Jimmawurrada Creek Zone 3 monitoring quadrats or downstream of the discharge extent, previously not detected within the Development Envelope.

	Threshold criteria	1. The area of phreatophytic canopy decline since baseline (below the baseline MSAVI 5th percentile) is over 50% of the Jimmawurrada Creek potential impact area (Zone 3 and Zone 4); trend continues over two or more consecutive dry season monitoring events; with no evidence of seasonal recovery; and outside of historical baseline or seasonal variation, in comparison to reference sites with demonstrated causal link to Project. OR 2. Over 50% of Jimmawurrada Creek Zone 3 or Zone 4 monitoring quadrats record significant structural or compositional change in comparison to baseline (and reference sites where available), with demonstrated causal link to Project. OR 3. Increased extent and persistence of high priority weed species within Jimmawurrada Creek Zone 3 monitoring quadrats or downstream of the discharge extent, relative to baseline (and reference data where applicable) with demonstrated causal link to the Project.
Inland Waters – Pools of the Robe River **(Groundwater abstraction / discharge and pools of the Robe River)** **EPA Objective:** *To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.* **EPBC Objective:** *Protection of the habitat for the Blind Cave Eel.*		
Outcome based provisions	**Condition Environmental outcome**	MS Condition 6-1 (3): Ensure no irreversible impact to the health of the **pools** of the Robe River, as a result of **groundwater abstraction** and/or **discharge of surplus water** for the Revised Proposal.
	Early response criterion	**1.** Water quality in any key pool exceeds Tier 1 SSGV.
	Trigger criteria	**1.** Pool surface water levels at Yeera Bluff (Gnieraoora) Pool fall below historically recorded natural low of 114.5m AHD. OR **2.** Water quality in any key pool exceeds Tier 2 SSGV.
	Threshold criteria	1. Pool surface water levels at Yeera Bluff (Gnieraoora) Pool fall below 113.5mAHD. OR 2. Ecological Effects Assessment shows a declining trend in aquatic fauna diversity or change to assemblage structure with demonstrated causal relationship to the Project and effects persist for 2 or more years.

Terrestrial Fauna Habitat – Conservation Significant Fauna Species; Ghost Bat (*Macroderma gigas*) and Northern Quoll (*Dasyurus hallucatus*) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia* – Pilbara form) **EPA Objective:** *To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.*		
Outcome based provisions	**Condition** **Environmental outcome**	MS Condition 8-1 (1): No irreversible impact, as a result of the Revised Proposal, to Breakaways and Gullies habitat retained within the Mesa H MEZ, other than existing and authorised disturbance.
	Early response criterion	**1.** Disturbance, other than existing and authorised clearing, within 50 m of the recorded back of the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6.
	Trigger criteria	**1.** Vibration levels exceed 50 millimeters (mm/s) peak particle velocity at the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6. OR **2.** Disturbance of ≥ 5% of potential Northern Quoll denning habitat (comprising Breakaways and Gullies habitat) in the MEZ of Mesa H, excluding existing disturbance (prior to MS1141).
	Threshold criteria	1. Permanent structural damage to diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6, with demonstrated causal link to Project. OR 2. Disturbance, other than existing and authorised clearing, within 40 m of the recorded back of the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6, with demonstrated causal link to Project. OR 3. Disturbance of ≥ 10% of potential Northern Quoll denning habitat (comprising Breakaways and Gullies habitat) in the MEZ of Mesa H, excluding existing disturbance, with demonstrated causal link to Project.
Subterranean Fauna - Troglofauna **EPA Objective:** *To protect subterranean fauna so that biological diversity and ecological integrity are maintained.*		
Outcome based provisions	**Environmental outcome**	MS Condition 7-1 (1): A minimum of fifty (50) percent by volume of pre-mining troglofauna habitat shall be retained at Mesa H through the implementation of a Mining Exclusion Zone (MEZ) as delineated in Figure 1 of Schedule 1.
	Trigger criterion	1. Operational error during mining resulting in removal of greater than 0.05% by volume annually of the Mesa H MEZ.
	Threshold criterion	1. Net loss of the MEZ at Mesa H such that the retained habitat represents less than 50% by volume of pre-mining habitat.

Management based provisions	**Environmental objective**	MS Condition 7-2 (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.
	Management target	1. Total clearing of native vegetation across the surface of the Mesa H MEZ is not greater than 132 ha excluding clearing prior to MS1141. 2. Troglofauna specimen capture rate is not below the baseline minimum for three consecutive sampling events at Mesa H.
Subterranean Fauna - Stygofauna **EPA Objective:** *To protect subterranean fauna so that biological diversity and ecological integrity are maintained.* **EPBC Objective:** Protection of the habitat for the Blind Cave Eel.		
Management based provisions	**Condition Environmental objective**	MS Condition 7-2 (2): The proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages of the local aquifers by minimising impacts as far as practicable.
	Management target	**1.** Groundwater quality is maintained to support stygofauna. **2.** Stygofauna specimen capture rate is not below the baseline minimum for three or more consecutive sampling events.
EPBC 2017 / 8017 – Action Management Plan		
EPBC AMP Provisions	**Condition Environmental Objective**	EPBC 2017/8017 Condition 5: To minimise impacts to the Blind Cave Eel and its habitat the approval holder must ensure that, as a result of the action: a) There is no significant change to groundwater quality detrimental to the Blind Cave Eel within its known habitat; b) Groundwater drawdown in the known pre-mining saturated Blind Cave Eel habitat within the Jimmawurrada Creek alluvial aquifer must not exceed 10 metres in depth below the minimum recorded wet season groundwater level.
	Early response criterion	**1.** Water quality in any key Robe River surface pool exceeds Tier 1 SSGV (Appendix 8). OR **2.** Groundwater physicochemical quality in Jimmawurrada Bores exceeds Tier 1 SSGV (Appendix 6) OR **3.** Groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 8 metres in depth below the minimum recorded wet season groundwater level with a causal relationship to the Proposal in four groundwater bores for two consecutive monitoring events.

	Trigger criteria	**1.** Water quality in any key Robe River surface water pool exceeds Tier 2 SSGV (Appendix 8). OR **2.** Groundwater physicochemical quality in Jimmawurrada Bores exceeds groundwater Tier 2 SSGV (Appendix 6) OR **3.** Groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 9.0 metres in depth below the minimum recorded wet season groundwater level with a causal relationship to the Proposal in any one groundwater bore (Appendix 6) for two consecutive monitoring events. OR **4.** Modelling predicts groundwater drawdown in Jimmawurrada Creek will exceed 10 metres in depth below the minimum recorded wet season groundwater level in any one monitored groundwater bore (Appendix 6).
	Threshold Criteria	**1.** Ecological Effects Assessment shows a declining trend in aquatic and stygofauna diversity or change to assemblage structure and absence of Blind Cave Eel records (specimen or eDNA) with a causal relationship to the Proposal and effects persisting for a three (3) year rolling window. AND **2.** Water quality in any two or more compliance groundwater bores or 2 key Robe River surface water pool exceeds Tier 2 SSGV for two consecutive sampling events with a causal relationship to the Proposal. OR **3.** Groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 10 metres in depth below the minimum recorded wet season groundwater level with a causal relationship to the Proposal in two or more monitored groundwater bores for a single monitoring event.

Corporate endorsement

I hereby certify that to the best of my knowledge, the provisions within this Mesa A Hub Revised Proposal Environmental Management Plan are true and correct.

Name: Julie Fowden

Signed:

Designation: General Manager, Robe Valley Operations

Date: Wednesday, 31 July 2024

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Abbreviations

Abbreviation/Term	Description
ACAR	Annual Compliance Assessment Report
AC04	Astron Cave 4, also known as CRMH-01
AHD	Australian Height Datum
AWT	Above water table
BC Act	*Biodiversity Conservation Act 2016*
BWT	Below water table
CEO	The Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the *Environmental Protection Act 1986*, or their delegate
CID	Channel Iron Deposit
Commonwealth Department	The Australian Government agency responsible for administration of the *Environment Protection and Biodiversity Conservation Act 1999*
DAWE	Department of Agriculture, Water and the Environment (Cwth)
Development Envelope	The Development Envelope as defined by Ministerial Statement 1141 that applies to the Revised Proposal and contains the indicative Revised Proposal footprint of the mine and associated infrastructure.
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
ERD	Environmental Review Document
Established (introduced weed species)	An introduced (weed) species that has grown to maturity and reproduced, producing a viable second generation of individual plants signifying persistence at a given location
Framework for EMPs	Rio Tinto Framework for development of EMPs as described in Appendix 1.
GIS	Geographical Information System
GL	Giga litre

High priority (introduced weed species)	Introduced (weed) species as defined by: • Any plant declared under section 22(2) of the *Biosecurity and Agriculture Management Act 2007* • Any plant listed as a Weed of National Significance http://www.environment.gov.au/biodiversity/invasive/weeds/weeds/lists/ • Any plant listed as "rapid invasiveness" and "high ecological impact" in Department of Parks and Wildlife (2013), *Ecological impact and invasiveness ratings from the Department of Parks and Wildlife Pilbara region species prioritisation process 2014* spreadsheet and its updates, while taking into account feasibility of control, will be rated high priority for control. https://www.dpaw.wa.gov.au/plants-and-animals/plants/weeds/156-how-do-we-manage-weeds
Irreversible impact	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)
m	Metre
mm/s	Millimetres per second
Management level	Level of management appropriate for an environmental value, as determined by assessment described in the Framework for the Development of Rio Tinto Environmental Management Plans
Mesa J Hub EMP	Mesa J and Mesa H collectively termed 'Mesa J Hub' for the EMP required to satisfy Mesa J and H conditions of MS1141 and Mesa H conditions of EPBC Decision Notice 2017/8017
MEZ	Mining Exclusion Zone
MNES	Matters of National Environmental Significance
MSAVI	Modified Soil Adjusted Vegetation Index
Permanent structural damage to a Ghost Bat roost cave	Damage that negatively impacts the integrity of the cave and microclimate such that future Ghost Bat use of the site is prevented
Proponent	Robe River Mining Co. Pty. Ltd.
Project	Mesa H Proposal (Revision to the Mesa J Iron Ore Development)
SPR	A '*causal pathway conceptual model*' (Pressure, Stressor, Receptor) approach for potential impacts due to project (refer to Appendix 1).
SSGVs	Site Specific Guideline Values

1. Context, Scope and Rationale

This Environmental Management Plan (EMP) has been prepared by Rio Tinto on behalf of Robe River Mining Co. Pty. Ltd. (the Proponent) as the authorised manager and agent for the participants in the Robe River Iron Associates Joint Venture for the Mesa H Proposal (Revision to the Mesa J Iron Ore Development) (the Project – herein referred to as the Mesa J Hub). This EMP has been developed to meet the conditions of approval of Ministerial Statement (MS) 1141; and *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) Decision Notice 2017/8017.

This EMP was developed according to the Conceptual Framework for the Development of Rio Tinto EMPs (internal guidance described in Appendix 1). This framework provides a standardised approach to environmental management at Rio Tinto's Pilbara Iron Ore Operations, in accordance with Western Australian (WA) and Commonwealth Policy and Guidance, including:

- *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2016* (EPA 2016);
- Environment Protection Authority's (EPA) *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA 2018a);
- *Environmental Impact Assessment (Divisions 1 and 2) Procedures Manual* (EPA 2018b); and
- *Environmental Management Plan Guidelines* (Australian Government 2014).

This EMP will be implemented subject to approval by the Chief Executive Officer (CEO).

Note that the content of the EMP that relates solely to Decision Notice 2017/8017 is not subject to approval by the Chief Executive Officer of DWER.

1.1 Mesa H and J Project (Mesa J Hub)

The Proponent manages and operates the Robe Valley mining operations, which includes iron ore mines at Mesa J and H as approved by MS 1141 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 (Figure1-1) and consists of the following:

- Mine Pits:
    - Mesa J – open cut above and below water table pits; 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 (WFSF's).
- 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 (including Jimmawurrada Creek and West Creek).
    - 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, and 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 12.

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

400,000mE 500,000mE 600,000mE 700,000mE 800,000mE

7,700,000mN 7,600,000mN 7,500,000mN 7,400,000mN

Port Hedland
Murujuga National Park
Cape Lambert
Dampier
Wickham
Karratha
Roebourne
North West Coastal Highway
Great Northern Highway
Millstream-Chichester National Park
Pannawonica
Mesa A
See Inset
Mesa J
Mesa H
Silvergrass
Nammuldi
Brockman 2
Brockman 4
Western Turner Syncline
Tom Price
Mount Tom Price
Marandoo
Karijini National Park
Paraburdoo
Paraburdoo
Eastern Range
Channar
West Angelas
Fortescue Marsh
Gudai-Darri
Yandicoogina
Hope Downs 1
Hope Downs 4
Newman

Inset
Mesa H
Mesa J
0 2.5 5 km

Legend

- Development Envelope
- National Park
- Fortescue Marsh
- Mesa H
- Rio Tinto Mine
- Rio Tinto Port
- Town
- Rio Tinto Railway
- Highway
- Major Road

Drawn: A.D.
Plan: RTIO-1056649v1
Date: July 2024

Checked by: A.Coulson
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

Karratha PILBARA AUSTRALIA Perth

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Figure 1-1: Regional Location

0 10 20 30 40 50 kilometres

N

Scale: 1:1,500,000 @A3

415,000mE 420,000mE 425,000mE

7,600,000mN 7,595,000mN 7,590,000mN

Escarpment Cut

Mesa H

Escarpment Cut

Mesa J

Robe River

Diversion Drain

Southern Cutback Borefield

Jimmawurrada Creek

0

Legend

- Development Envelope (MS1141)
- Mesa H Development Envelope (EBBC 2017/2018)
- Mining Exclusion Zone

Conceptual Mine Layout

- Mine Pit (Indicative)
- Waste Dump/Stockpile
- Waste Fines Storage Facility
- Powerline
- Haul Road
- Diversion Drain
- Discharge Point

- Rio Tinto Railway
- Powerline
- Site Access Road
- Major Creek

Drawn: A.D.
Plan: RTIO-1056650v1
Date: July 2024

Checked by:
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

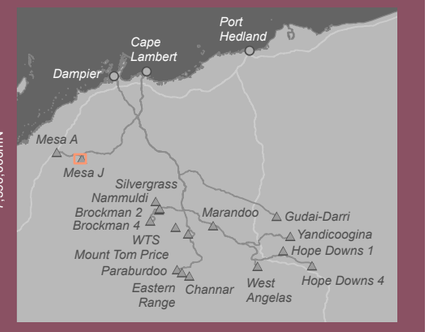

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Figure 1-2: Development Envelope and Conceptual Footprint

0 0.5 1 1.5 2
kilometres
Scale: 1:50,000 @A3

N

1.2 Key Environmental Factors

The key environmental factors relevant to the Mesa J Hub as identified in Ministerial Statement 1141 and addressed in this EMP, are described in Table 1-1.

Table 1-1: Key environmental factors associated environmental values, and potential impacts from the Project as addressed in this EMP (as per the SPR model0F[1]).

Environmental value (receptor)	Predicted impacts		Potential impacts Not predicted to occur	
	Direct (stressor, pressure)	Indirect (stressor, pressure)	Direct (stressor, pressure)	Indirect (stressor, pressure)
Inland Waters Riparian Vegetation	**Robe River**	**Robe River (Riparian GDE communities Zone 1 and Zone 2)**	**Robe River**	**Robe River (GDE Communities Zone 1)**
	• None identified.	**Groundwater Abstraction / Drawdown** • Zone 1 and 2: Drawdown <1m. • Reduction in water availability due to mine pit dewatering may cause limited / minor decline in the health of riparian (Groundwater Dependent Ecosystem) communities.	• None identified.	**Surplus Water Discharge** • Periodic availability of surplus water may result in augmentation of riparian vegetation. • Decline in health of *Eucalyptus victrix* due to waterlogging. • Ingress of weed species.
	Jimmawurrada Creek	**Jimmawurrada Creek Riparian Communities (Zones 3 and 4)**	**Jimmawurrada Creek**	**Jimmawurrada Creek (Zones 3 and 4)**
	• None identified.	**Groundwater Abstraction / Drawdown** • Drawdown between 4 - 9m Reduction in water availability due to abstraction / mine pit dewatering may cause decline in the health of riparian (Groundwater Dependent Ecosystem) communities. **Surplus Water Discharge**	• None identified.	**Surplus Water Discharge** • Decline in health of *Eucalyptus victrix* due to waterlogging.

[1] A '*causal pathway conceptual model*' (Stressor, Pressure, Receptor [SPR]) approach for potential impacts due to the Mesa J Hub (Appendix 1).

Environmental value (receptor)	Predicted impacts		Potential impacts Not predicted to occur	
	Direct (stressor, pressure)	Indirect (stressor, pressure)	Direct (stressor, pressure)	Indirect (stressor, pressure)
		• Periodic availability of surplus water resulting in augmentation of riparian vegetation. • Ingress of weed species.		
Inland Waters Pool Ecosystems	**Robe River**	**Robe River**	**Robe River**	**Robe River**
	Groundwater Drawdown • Zones 1 – 2 (Figure 1): Drawdown <1m. • Yeera Bluff (Gnieraoora) Permanent Pool water level may temporarily reduce. • Shallow intermittent – semi permanent pools (i.e. <1m deep) may periodically dry out.	**Surplus Water Discharge** • Temporary, localised degradation of aquatic fauna habitats due to changes in water chemistry as a result of discharge of surplus abstracted groundwater. • Temporary changes in health of aquatic fauna communities due to changes in water chemistry as a result of discharge of surplus abstracted groundwater. • Ingress of weed species as a result of discharge of surplus abstracted groundwater.	**Groundwater Abstraction / Drawdown** • Yeera Bluff (Gnieraoora) Permanent Pool becoming dry. • All semi-permanent pools become dry.	• None identified.
Terrestrial Fauna Conservation Significant Species (Northern Quoll, Ghost Bat, and Pilbara Leaf-nosed Bat)	**Northern Quoll (*Dasyurus hallucatus*)**	**Northern Quoll (*Dasyurus hallucatus*)**	**Northern Quoll (*Dasyurus hallucatus*)**	**Northern Quoll (*Dasyurus hallucatus*)**
	Clearing • Reduction of habitat, including breeding, foraging and dispersal habitat. • Loss of individuals from increased vehicle strikes, and construction activities.	**Hydrogeology / Hydrology** • Alteration of fauna foraging habitat due to groundwater abstraction / drawdown and increased periodic / temporary availability of surface water from discharge of surplus water.	**Mining activities** • fragmentation of habitat, including breeding, foraging and dispersal habitat..	**Mining activities** • Degradation of habitat due to altered fire regime, introduction or spread of weeds; and changes to feral animal populations.

Environmental value (receptor)	Predicted impacts		Potential impacts Not predicted to occur	
	Direct (stressor, pressure)	**Indirect (stressor, pressure)**	**Direct (stressor, pressure)**	**Indirect (stressor, pressure)**
	Ghost Bat (*Macroderma gigas*)	**Ghost Bat (*Macroderma gigas*)**	**Ghost Bat (*Macroderma gigas*)**	**Ghost Bat (*Macroderma gigas*)**
	Clearing • Reduction or fragmentation of habitat, including breeding, foraging and dispersal habitat **Mining activities** • Loss of individuals from increased vehicle strikes, collisions with fencing and construction activities.	**Hydrogeology / Hydrology** • Alteration of fauna foraging habitat due to groundwater abstraction / drawdown and increased periodic / temporary availability of surface water from discharge of surplus water.	• None identified.	**Vibration** • Blasting may cause structural damage to roost caves that are to be retained in the Development Envelope. • Blasting and/or mine pit development may inadvertently generate new openings at the back of roost caves resulting in changes to the microclimate (i.e. temperature and humidity). **Mining Activities** • Degradation of habitat due to dust and light emissions; • Degradation of habitat due to altered fire regime, introduction or spread of weeds; and changes to feral animal populations.
Terrestrial Fauna Conservation Significant Species (Northern Quoll, Ghost Bat, and Pilbara Leaf-nosed Bat)	**Pilbara Leaf-Nosed Bat**			
	Clearing • Reduction or fragmentation of habitat, including foraging and dispersal habitat **Mining activities** • Loss of individuals from increased vehicle strikes, collisions with fencing and construction activities.	**Hydrogeology / Hydrology** • Alteration of fauna foraging habitat due to groundwater abstraction / drawdown and increased periodic / temporary availability of surface water from discharge of surplus water.	• None identified.	**Mining activities** • Degradation of habitat due to light emissions • Degradation of habitat due to altered fire regime, introduction or spread of weeds; and changes to feral animal populations.

Environmental value (receptor)	Predicted impacts		Potential impacts Not predicted to occur	
	Direct (stressor, pressure)	Indirect (stressor, pressure)	Direct (stressor, pressure)	Indirect (stressor, pressure)
	Pilbara Olive Python			
	Clearing • Reduction or fragmentation of habitat, including breeding, foraging and dispersal habitat **Mining activities** • Loss of individuals from increased vehicle strikes and construction activities.	**Hydrogeology / Hydrology** • Alteration of fauna foraging habitat due to groundwater abstraction / drawdown and increased periodic / temporary availability of surface water from discharge of surplus water.	• None identified.	**Mining activities** • Degradation of habitat due to altered fire regime, introduction or spread of weeds; and changes to feral animal populations.
Subterranean Fauna Troglofauna	**Mesa H CID**	**Mesa H CID**	**Mesa H CID**	**Mesa H CID**
	Mine pit excavation • Loss of individuals due to mine pit development • Removal of 50% by volume of habitat	**Vegetation Clearing** • Reduction in organic inputs into the subterranean environment. **Mining activities** • Blasting may result in changes to voids and mesocaverns within the remnant mesa formations.	• None identified.	**Mining activities** • Exposure of pit faces may cause changes to the biophysical parameters in the subterranean environment • Population decline due to loss of habitat • Hydrocarbon and wastewater spills may result in localised reduction in the quality of troglofauna habitat.
Subterranean Fauna Stygofauna.[2]	**CID and alluvial aquifers**	**CID and alluvial aquifers**	**CID and alluvial aquifers**	**CID and alluvial aquifers**
	Mine Pit excavation • Loss of individuals in the Mesa H CID	**Surplus Water Discharge** • Temporary changes in stygofauna habitat quality due to temporary changes to surface water chemistry in	• None identified.	**Mining activities** • Hydrocarbon and wastewater spills; and seepage from tailings may

[2] Includes the Blind Cave Eel (*Ophisternon candidum*)

Environmental value (receptor)	Predicted impacts		Potential impacts Not predicted to occur	
	Direct (stressor, pressure)	Indirect (stressor, pressure)	Direct (stressor, pressure)	Indirect (stressor, pressure)
	Groundwater Drawdown • Reduction in habitat availability in the Mesa H CID; and the Robe River and Jimmawurrada Creek alluvial aquifers	the Robe River and pools and Jimmawurrada Creek. • Periodic changes to discharge flow regime may result in the temporary displacement of stygofauna (hyporheic, stygobionts and/or stygoxenes to surface waters • Temporary changes in stygofauna numbers / assemblages		result in a reduction in the quality of stygofauna habitat.

1.3 Condition Requirements

The Project was assessed and approved under Ministerial Statement 1141 and EPBC Decision Notice 2017/8017. Conditions relevant to this EMP are identified in Table 1-2 and Table 1-3 respectively.

This EMP proposes environmental management and monitoring to ensure environmental outcomes and objectives are achieved.

Table 1-2: MS 1141 conditions for the Project relevant to this EMP

Condition		Section in EMP
5	**Condition Environmental Management Plan(s)**	
5-1	Within six (6) months of issue of this Statement (or otherwise agreed in writing by the CEO) the proponent shall prepare and submit a Condition Environmental Management Plan(s) to the satisfaction of the CEO to demonstrate that the environmental outcomes specified in conditions 6-1, 7-1 and 8-1, and the environmental objectives specified in condition 7-2, will be met.	N/A
5-2	For outcome based provisions, the Condition Environmental Management Plan(s) shall: (1) specify the environmental outcomes to be achieved, as specified in condition 5-1; (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.	Table 2-1 through Table 2-6
5-3	For management based provisions, the Condition Environmental Management Plan(s) shall: (1) specify the environmental objectives to be achieved, as specified in condition 5-1; (2) specify management actions to meet the environmental objective; (3) specify management targets; (4) specify monitoring to determine if management targets are being met; (5) 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.	Table 2-5 and Table 2-6

	Condition	Section in EMP
	(6) specify a process for revision of management actions and changes to Revised Proposal activities, in the event that the management targets are not achieved. The process shall include an investigation to determine the cause of the management target(s) not being achieved.	
5-4	The proponent shall continue to implement Environmental Management Plan RTIO-HSE-0175388 until the CEO has confirmed by notice in writing that the Condition Environmental Management Plan(s) satisfies the requirements of conditions 5-1, 5-2 and 5-3.	N/A
5-5	After receiving notice in writing from the CEO that the Condition Environmental Management Plan(s) satisfies the requirements of conditions 5-1, 5-2 and 5-3, the proponent shall: (1) implement the Condition Environmental Management Plan(s), or any subsequently approved versions; and (2) continue to implement the Condition Environmental Management Plan(s) until the CEO has confirmed by notice in writing that the proponent has demonstrated the outcomes and objectives specified in condition 5-1 have been met.	This EMP
5-6	In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria specified in the Condition Environmental Management Plan, 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 Plan 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 investigations required by condition 5-6(3) and 5-6(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.	Section 2.2

Condition		Section in EMP
5-7	The proponent: (1) may review and revise the Condition Environmental Management Plan(s), or (2) shall review and revise the Condition Environmental Management Plan(s) as and when directed by the CEO.	This EMP
5-8	The proponent shall implement the latest revision of the Condition Environmental Management Plan(s) which the CEO has confirmed by notice in writing satisfies the requirements of conditions 5-1, 5-2 and 5-3.	This EMP
6	**Inland Waters and Vegetation**	
6-1	The proponent shall manage the implementation of the Revised Proposal to meet the following environmental outcomes: (1) ensure no irreversible impact to the health of the Robe River and Jimmawurrada Creek ecosystems, including associated riparian vegetation, as a result of groundwater abstraction for the Revised Proposal; (2) ensure no irreversible impact to the health of the Robe River and Jimmawurrada Creek ecosystems, including associated riparian vegetation, as a result of discharge of surplus water for the Revised Proposal; and (3) ensure no irreversible impact to the health of the pools of the Robe River, as a result of groundwater abstraction and/or discharge of surplus water for the Revised Proposal.	Table 2-1; Table 2-2; and Table 2-3
7	**Subterranean Fauna**	
7-1	The proponent shall manage the implementation of the Revised Proposal to meet the following environmental outcomes: (1) A minimum of fifty (50) per cent by volume of pre-mining troglofauna habitat shall be retained at Mesa H through the implementation of a Mining Exclusion Zone (MEZ) as delineated in Figure 1 of Schedule 1.	Table 2-5
7-2	The proponent shall manage the implementation of the Revised Proposal to meet the following environmental objectives: (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. (2) The proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages of the local aquifers by minimising impacts as far as practicable.	Table 2-5 and Table 2-6
8	**Terrestrial Fauna Habitat - Conservation Significant Fauna Species: Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-Nosed Bat (*Rhinonicteris aurantia* - Pilbara form)**	
8-1	The proponent shall manage the implementation of the Revised Proposal to meet the following environmental outcome: (1) no irreversible impact, as a result of the Revised Proposal, to Breakaways and Gullies habitat retained within the Mesa H MEZ, other than existing and authorised disturbance.	Table 2-4

Table 1-3: EPBC Act Approval 2017/8017 conditions for the Project relevant to this EMP

	Condition	Section in EMP
2	To minimise impacts to the **Blind Cave Eel**, **Ghost Bat**, **Northern Quoll**, **Olive Python** and **Pilbara leaf-nosed bat**, the approval holder must comply with all specifications of the following conditions of the **EPA Report and Recommendations** that are consequential for these species: (a) Condition 5 (Condition Environmental Management Plan(s)), (b) Condition 6 (Inland Waters and Vegetation), (c) Condition 8 (Terrestrial Fauna Habitat – Conservation Significant Fauna Species: Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigas*) and Pilbara Leaf-Nosed Bat (*Rhinonicteris aurantia* - Pilbara form)).	This EMP
3	To minimise impacts to the **Blind Cave Eel**, **Ghost Bat**, **Northern Quoll**, **Olive Python** and **Pilbara leaf-nosed bat**, the Condition Environmental Management Plan(s) specified under Condition 5 of the **EPA Report and Recommendations**, must (where relevant to **Blind Cave Eel**, **Ghost Bat**, **Northern Quoll**, **Olive Python** and **Pilbara leaf-nosed bat**) specify environmental outcomes or objectives related to the mitigation and management of the following key threatening processes: (a) fire (b) vehicle and machinery movements (c) fauna encounters/sightings (d) weed management (e) feral animal control (f) noise and vibration (g) dust and light For 3.(f) noise and vibration, the Condition Environmental Management Plan(s) must include monitoring of the **Ghost Bat** (*Macroderma gigas*) and include a management target(s) to ensure that the approved action does not result in a significant long-term decline in the Ghost Bat population.	Table 3-1
4	To minimise impacts to **Ghost Bat**, the approval holder must implement a Mining Exclusion Zone and blast management to minimise potential impacts to Ghost Bat roosts from noise and vibration associated with mining activities. The Condition Environmental Management Plan(s) specified under Condition 5 of the EPA Report and Recommendations must include and justify appropriate management, avoidance and mitigation measures and may specify different measures for diurnal / potential maternal and nocturnal Ghost Bat roosts. If the action results in permanent significant structural damage to a Ghost Bat roost which cannot be remedied, or a failure to meet the management targets required under Condition 3, the proponent must submit a plan in writing within two months of the occurrence to the Minister for approval. This plan must justify and specify how the impact will be rectified or offset.	Table 3-2

	Condition	Section in EMP
5	To minimise impacts to the **Blind Cave Eel** and its habitat the approval holder must ensure that, as a result of the action: (a) there is no significant change to groundwater quality detrimental to the Blind Cave Eel within its known habitat; and (b) groundwater drawdown in the known pre-mining saturated Blind Cave Eel habitat within the Jimmawurrada Creek alluvial aquifer must not exceed 10 metres in depth below the **minimum recorded wet season groundwater level**.	Table 3-3;

	Condition	Section in EMP
6	The approval holder must submit an Action Management Plan that specifies how the approval holder will achieve the outcomes specified in Condition 5 for approval by the **Minister**. The approval holder must not commence **abstraction** activities that are part of the action unless the **Minister** has approved the Action Management Plan in writing. The approved Action Management Plan must be implemented. The Action Management Plan must: (a) justify and specify the definition of significant change to groundwater quality detrimental to the **Blind Cave Eel habitat**. (b) provide detail of the method(s) to be used with appropriate justification and relevant case studies (noting that method(s) may include but need not be restricted to managed aquifer recharge); (c) specify threshold criteria exceedance of which presents a risk of breaching condition 5 and commit to not exceeding those criteria; (d) specify trigger criteria that provide an early warning that the threshold criteria could be exceeded; (e) specify monitoring capable of determining if trigger criteria and threshold criteria are exceeded; (f) include an **isopach map** illustrating the alluvial thickness in the known **pre-mining** saturated **Blind Cave Eel habitat** within the Jimmawurrada Creek alluvial aquifer. The **isopach map** must: I. show the location of the groundwater monitoring bore(s) for which the **minimum recorded wet season groundwater level** has been measured; II. show the extent of the saturated alluvial thickness which does not exceed 10 metres in depth below the **minimum recorded wet season groundwater level**; III. identify which bores will be used for compliance monitoring to ensure that the 10 metres in depth below the **minimum recorded wet season groundwater level** does not occur; IV. include the approval holder's commitment to reporting significant damage or loss of any bore(s) used for compliance monitoring in writing to the **Department** within seven (7) days of becoming aware of the damage, and the replacement of any bore used for compliance monitoring within three (3) months of the damage occurring, or another period as agreed in writing by the **Minister**. (g) specify actions to be implemented in the event that the trigger criteria have been exceeded; (h) specify threshold contingency actions to be implemented in the event that the threshold criteria are exceeded (these may include but need not be limited to ceasing groundwater **abstraction**); and (i) provide the format and timing for the reporting of monitoring results against trigger criteria and threshold criteria to demonstrate that Condition 5 is being met.	6 (a), (b) Table 1-4 6 (c) (d) (e) (g) (h) Table 2-3; Table 2-6 6 (f) - i. Figure 3-2 6 (f) – ii. Figure 3-3 6 (i) Table 3-3; Table 3-4

1.4 Approach

This EMP was drafted in accordance with the *Conceptual Framework for the Development of Rio Tinto Environmental Management Plans* (internal guidance described in Appendix 1). This conceptual approach to management considers the conservation significance of the environmental value (receptor) based on conservation status at local, state, and regional levels. Management level (low, moderate, or high) is assigned to achieve the environmental objective and / or outcome according to the conservation significance of the environmental value and the significance of impact/s predicted over spatial and temporal scales. Assessment of the pathways over which impacts may occur provides the rationale for choice of provisions and choice of appropriate indicators to measure against the environmental outcome and/or objective.

This EMP provides provisions for potential impacts to environmental values specific to the Project. The significance of all potential threats to environmental values present within the Development Envelope, including threatening processes to MNES fauna (that is: presence of weed species and fauna, vibration, dust, light, noise, fire and fauna interactions), are considered during the conceptual framework assessment to ensure appropriate provisions.

1.5 Management Rationale

This EMP adopts a combination of outcome and objective-based provisions, in order to achieve the proposed environmental outcomes.

Outcome-based provisions are applied where a sufficient level of information exists to establish objective and measurable criteria (EPA 2018a). Environmental criteria are defined to assess performance against the environmental outcome. These criteria are:

Early Response Provide information on changes that are precursors to an environmental impact, used to initiate early response actions before or at the onset of environmental impacts.

Trigger Measures set at a conservative level to forewarn the approach of threshold criteria and ensure trigger level actions are implemented well in advance of the environmental outcome being compromised.

Threshold Framed to represent the limit of acceptable impact beyond which there is likely to be a significant effect on the environment. This indicates there is risk that the environmental outcome will not be met.

Objective-based provisions are applied where a level of uncertainty exists that prevents setting objective and measurable criteria. In this case, management targets are established to measure success of management actions in achieving the environmental objective.

Additional supporting monitoring may also be included to improve baseline knowledge for a factor where information is limited.

Table 1-4: Rationale for choice of provisions

Current knowledge and description of impacts	Key assumptions and uncertainties	Rationale for choice of provision
Inland Waters: Riparian Vegetation of the Robe River		
Level of Management[3] : High		
Key Surveys and Studies: 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, intermittent and some semi-permanent pools can periodically dry out (as observed during the period prior to cyclone Damien in February 2020). Key features of the vegetation associated with the Robe River and Robe River pools 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 (GDE) including vegetation communities dominated by obligate phreatophytic vegetation which includes *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. Within the Development Envelope, Astron (2016b) mapped two riparian communities which they identified as potential GDE's: MaEcCv (representing the obligate phreatophytic vegetation (OPV) or generally "high risk" type communities mapped by Rio Tinto (2017a); and EcEvAtrApyPITw) (representing the facultative phreatophytic vegetation (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. Riparian vegetation of the Robe River differs from Jimmawurrada Creek due to the dominance of obligate phreatophytic species, which are considered groundwater dependent. Dry seasonal conditions were experienced from 2018 to the end of 2019 with total rainfall significantly lower than long-term average (386mm) across both years (-88mm and -220mm respectively; SILO 2023). In addition, fire affected a significant proportion of the Robe River adjacent to Mesa J and H in February of 2019, resulting in a decrease riparian vegetation health (as seen in annual remote sensing and on-ground analysis). Post-fire recovery within the fire affected zone (Mesa J and H Drawdown and Discharge Zone 1), was reported in the recent remote sensing and on-ground monitoring report (Astron 2023a, 2023b), however the evidence of fire is still apparent. 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 by <1m. Qualitative annual monitoring of the riparian vegetation cover within the Robe River by Streamtec since the early 1990's supports that dewatering from the existing Mesa	**Assumptions:** • The groundwater levels in the Mesa H CID aquifer will be lowered by up to ~30 m over approximately 16 years from groundwater abstraction for the Mesa H deposit – there is limited hydrological connection between the Mesa H CID aquifer and the Robe River alluvial aquifer. • This Robe River alluvial aquifer will be periodically recharged during high rainfall events. • Groundwater levels are expected to recover following cessation of dewatering. • All surplus water is proposed to be used on site and for ore processing, however there may be periods after large rainfall events where storage capacity is exceeded and surplus water is required to be discharged. On these occasions, surplus water is discharged via tributaries of the Robe River (Jimmawurrada Creek / West Creek), however discharge is not expected to present as a saturated surface water flow once it reaches the Robe River due to infiltration into the coarse gravels of the alluvial aquifer and significant storage capacity of the Robe River. This is supported by the fate of the current Mesa J discharges into the Robe River where flows are not observed downstream in the low flow channels. Additionally, discharge volumes are expected to decrease from the current Mesa J rates with the development of Mesa H (Rio Tinto 2019). **Uncertainties:** • The hydrogeological modelling of groundwater abstraction from the CID aquifers provide estimates of the extent and depth of groundwater drawdown, however may not capture the full range of climatic variability 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	The outcome-based provision under MS1141 is to ensure no irreversible impact to the health of the Robe River ecosystem, including riparian vegetation, acknowledging the high value of this feature and that significant detrimental impacts from the Project are not expected. **Groundwater drawdown and discharge** Due to the relatively high conservation value of the Robe River and as the Project is not anticipated to have significant detrimental impacts to the riparian vegetation in the Robe River due to limited maximum modelled groundwater drawdown (<1m), two early response criteria have been included in the provisions. A sensitive trigger criterion, utilising both on-ground and remote sensing analysis, has been included for the Robe River. This will prompt earlier investigation and action if decline is seen in the riparian vegetation of the Robe River well in advance of the threshold criterion. Based on refined mapping and likely sensitivity of the riparian vegetation units to changes in groundwater levels (Figure 1-4), combined with predicted extent and depth of groundwater drawdown, a 'zone' of impact has been defined along the Robe River as shown in Figure 1-5. Groundwater levels, in combination with assessment of change to the groundwater dependent riparian vegetation, is included in the early response criteria for the Robe River as described below, given that limited decline in the groundwater levels in the Robe River adjacent to Mesa J and H as a result of dewatering is predicted. In addition, criteria and management response actions have been included to maintain the surface water levels of indicator pools of the Robe River. This will ensure that the hydrological regime will be maintained to support the riparian vegetation of the Robe River. Selected early response, trigger and threshold criteria for the upper canopy of Robe River are based on an index of vegetation health derived from high spatial resolution satellite imagery (remote sensing). Currently modified soil adjusted vegetation index (MSAVI) is used but an alternative index may be used in the future subject to adaptive management. MSAVI is a readily measurable indicator of the health of riparian vegetation for which reference sites can be established and regular monitoring undertaken. Measurement of MSAVI is also consistent with other Rio Tinto riparian vegetation monitoring programs implemented across the Pilbara. A time series of MSAVI values from the baseline period to the latest date is used to monitor the condition of riparian (phreatophytic) tree canopy over time. The early response criterion measures the trend in MSAVI over time with frequently captured satellite imagery (Landsat and/or Sentinel), comparing the number of phreatophytic canopy stands (groups of trees) that show a negative trend in the Robe River relative to reference areas, as well as comparing the average slope of the trend. Areas that show exceedance of the early response or trigger criteria will be reviewed in terms of risk to impact from decreased groundwater levels. If obligate phreatophytes, i.e. *Melaleuca argentea* dominated or co-dominated communities, are showing decline, this could be an early indicator of groundwater level drawdown and would require further investigation. The trigger and threshold criteria will be informed by baseline statistics (5th percentile) of MSAVI. Statistically based criteria aim to determine the limits of natural variation (Morrison 2008); a decrease below the 5th percentile of baseline represents change below the lower end (one-tailed) of a normally distributed data set and may indicate that canopy health has decreased beyond established patterns of variation. As the baseline period for the Robe River and Jimmawurrada Creek is limited (currently 2016 to 2020 for Jimmawurrada Creek and 2016 to current for Robe River) and is insufficient to cover typical levels of seasonal and longer term (decadal) variability experienced in the Pilbara, the 5th percentile of baseline data will be used to inform initial criteria, which will be refined as site-specific knowledge develops in accordance with adaptive management principles. . Any changes evident in the annual dry season remote sensing capture will be investigated with more frequent remotely sensed imagery (e.g. Sentinel), a longer term record (e.g. Landsat), and including ground-truthing of any observed declines, to help distinguish potential mining related impacts from seasonal variation and regional trends (although some of these data are captured at coarser spatial resolution and may reflect both understorey and overstorey vegetation cover and health). In addition to the high-resolution satellite imagery, light detection and ranging (LiDAR) or similar elevation derived data, will be captured every three years, or when required, to generate a canopy height model (CHM) to validate current canopy extents to baseline extents. A greater than 20% increase since baseline in the proportion of phreatophytic canopy area that falls below the baseline 5th percentile in comparison to the reference areas has been designated as the trigger criterion for the Robe River. A 20% margin above reference is considered reasonable in order to detect a decline in canopy condition that may be beyond natural variation and reflect a potential impact from dewatering or discharge, while also taking into account differences in satellite acquisition properties. For the Robe River, this will be applied to phreatophytic vegetation in proximity to the Mesa J and H deposits. A threshold criterion has been selected to prevent irreversible impact to the riparian vegetation of the Robe River to meet the environmental outcome of MS1141, acknowledging that dewatering and discharge are expected to result in some temporary compositional and structural changes to vegetation; however, this is not expected to affect the long-term functioning of the community. Decline over two consecutive dry season monitoring events is chosen for the threshold criterion as condition of the upper canopy is best measured from remote sensing in the dry season when there is less influence from the understorey, and two years has been selected as a suitable timeframe to differentiate from natural variability and assess whether the condition of upper canopy vegetation is under threat of long-term impact. Assessment of seasonal variation in comparison to long term and regional trends, including ground-truthing of any observed decline, is also considered in the threshold criterion. Following the completion of collection and analysis of baseline data, the trigger and threshold criteria for overstorey canopy will be reviewed and adjusted if deemed appropriate. Remote sensing of vegetation is an evolving technology, so methods will be reviewed and revised as improvements become available and in accordance with adaptive management principles, in consultation with DWER and other stakeholders. On ground monitoring of understorey and overstorey vegetation (including weeds) will also be undertaken to detect any change in composition and structure riparian vegetation. Species foliage cover and abundance data determined from on-ground surveys is analysed on a 'quadrat by zone' basis due to the limited number of potential impact and reference transects for 'transect by zone' analysis. Two floristic measurements are used to assess compliance with the riparian vegetation criteria: vegetation structure and composition, whereby a trigger exceedance equates to 20% or more of Zone 1 or Zone 2 quadrats and the threshold equates to 50% or more of the Zone 1 or Zone 2 quadrats in comparison to Robe River reference sites. Significant compositional change is defined as a 'loss of dominance' for any dominant native perennial taxa that were present at baseline (refer to Appendix 4). Given baseline riparian vegetation monitoring of the Robe River adjacent to Mesa J and H has shown significant variation in the foliage cover of native species

[3] Includes the Blind Cave Eel (*Ophisternon candidum*) d management zone provided in Appendix 2, as per the conceptual framework for development of Rio Tinto's EMPS (Appendix 1).

J operations has not indicated noticeable trends of impact on riparian vegetation cover when compared to seasonal and climatic variation.	vegetation and stygofauna may be required. • Riparian vegetation monitoring data since 1991 has been qualitative rather than quantitative until new baseline riparian monitoring commenced in 2016. Commencement of monitoring was following a period of above average rainfall then significant below average. There is limited knowledge of the long-term variability of vegetation health in the Robe River.	and presence within quadrats (both increases and decreases in numbers) between monitoring events (Astron 2020a), key taxon demonstrating persistence over time were chosen to track change of ecological significance. Loss of dominance is determined if a quadrat containing one of the key taxa listed, no longer records the highest overall foliage cover due to its own cover reduction or an increase in another species' cover. Change in species dominance in relation to baseline, looks at replacement of key riparian species by other native or non-native species which may indicate changes to the overall community composition as a result of dewatering or discharge activities. A certain level of impact from dewatering and discharge on the riparian vegetation of the Robe River is expected, therefore management would only be implemented if this impact (including potential augmentation of vegetation from surplus water discharge) caused a significant change in composition or structure of native species across 20% of quadrats within the same management zone. The threshold criterion describes structural shift or loss of dominant species across 50% of potential impact quadrats within any one zone, which could occur in any part of the creek habitat (channel, terrace, banks, or floodplain), beyond which there is the potential for irreversible impacts to occur. The threshold criterion aims to detect a major change to vegetation outside of natural variation and beyond the expected effects of dewatering and discharge that may indicate potential for an irreversible change.
Inland Waters: Riparian Vegetation of Jimmawurrada Creek		
Level of Management[4] : Moderate		
Key Surveys and Studies: Jimmawurrada Creek is an ephemeral system with minor 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, and the Coastal Water Supply borefields; and mine dewatering discharge through existing licensed discharge points[5]. Key features of the vegetation associated with Jimmawurrada Creek in the Development Envelope and within the extent of the modelled groundwater drawdown include (Astron, 2016b): • No TECs or PECs and no Threatened flora. • No permanent and semi-permanent pools. • Vegetation is dominated by facultative phreatophytic vegetation: *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. Groundwater abstraction for water supply (predominantly for wet ore processing) is sourced from the Southern Cutback Borefield. Abstraction from the bores is not expected to increase during the development of Mesa H pits but the steady abstraction will result in further lowering of the groundwater table around the borefield. Combined with the existing Mesa J / H abstraction and the Coastal Water Supply, cumulatively, this is modelled to result in groundwater drawdown of 1 – 9 m (14mbgl) along a 12 km section of Jimmawurrada Creek, of which the most substantial drawdown of 9 m is expected along a 6.5 km stretch ('Zone 3' as depicted in Figure 1). If an extended dry period occurs, the water table could vary by up to 14 m from pre-mining conditions. Localised changes to riparian vegetation health are expected along this 12 km stretch, particularly during extended dry periods, with the most significant impact predicted across Zone 3. Groundwater drawdown from abstraction is expected to result in some compositional and structural change due to decreased water availability in the creek channel, terrace, banks, and floodplain. Risk of impact from drawdown was determined based on detailed mapping of composition of vegetation in Jimmawurrada Creek and knowledge of the degree of groundwater dependency of species present (Rio Tinto 2017). Recent 2023 monitoring results from both on-ground and remote sensing programs, indicate a reduction in canopy cover within Zone 3 and 4, which is likely linked to both a reduction in average monthly rainfall and cumulative impacts from the Southern Cut Bore field and Coastal Water Supply. Further on-ground investigations, through digital canopy photography analysis, are being undertaken to examine the possible casual links to the decline (Astron 2023a). No significant	**Assumptions:** • 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 variability 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 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. **Uncertainties:** • Limited hydrogeological data for the Jimmawurrada Alluvial Aquifer to inform estimates of the hydraulic connectivity between the CID and alluvial aquifers and hence potential impacts to 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 Jimmawurrada Creek to predict the groundwater dependence of riparian vegetation. • Riparian vegetation monitoring data since 1991 focussed on the Robe River and limited riparian monitoring information is available for the lower reaches of Jimmawurrada Creek until new baseline riparian monitoring commenced in 2016.	The outcome-based provision under MS1141 is to ensure no irreversible impact to the health of the Jimmawurrada Creek ecosystem, including riparian vegetation. The riparian vegetation communities of Jimmawurrada Creek is classified as moderate conservation value, and both the ERD and the EPA's Report 1668 acknowledged that the Project may have an impact on these riparian vegetation communities along a 12.5 km stretch, particularly a 6.5 km stretch: 'Zone 3' (Figure 1-5); where cumulative drawdown impacts from both the Southern Cutback Borefield (Mesa J & H water supply) and the Coastal Water Supply borefield are modelled to be the most pronounced. 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 irreversible changes in the composition of riparian vegetation. To further monitor the potential drawdown impacts, three digital canopy photography sites were installed in 2020 within the cumulative impact area in Jimmawurrada Creek. The purpose of this monitoring is to inform and investigate internally any seasonal changes in overstorey phreatophytic canopy and further validate the annual and seasonal remote sensing analysis. For Jimmawurrada Creek, an early response criterion has been selected based on changes to groundwater level (Appendix 6), to ensure groundwater drawdown, and therefore potential impact to groundwater dependent riparian vegetation associated with Jimmawurrada Creek, is no greater than was predicted in the ERD. Similar to the Robe River, selected trigger, and threshold criteria for the upper canopy of Jimmawurrada Creek is based on an index of vegetation health derived from high spatial resolution satellite imagery, as well as on-ground monitoring of the composition and structure of riparian vegetation. Additional data sources, such as LiDAR and high temporal satellite imagery (Landsat and Sentinel-2) will be analysed as required to provide additional information on phreatophytic canopy area and regional, seasonal trends. The trigger criterion using remote sensing has been specified as a 20% increase since baseline in the proportion of phreatophytic canopy area that falls below the baseline 5th percentile, in any one zone (Zone 3 or Zone 4; Figure 2-1) relative to reference areas, as a certain level of impact to the groundwater dependent vegetation of Jimmawurrada Creek from dewatering is expected. On-ground monitoring transects were established along Jimmawurrada Creek in 2016 and are monitored on an ongoing biannual basis. To analyse riparian vegetation health trends, current floristic data is compared to the first six survey events from 2016 to 2020. For Jimmawurrada Creek, these monitoring events constitute the baseline period, as per EPBC decision notice 2017/ 2018. A second trigger criterion uses on-ground riparian vegetation monitoring data to assess significant structural and compositional change across quadrats. The trigger is exceeded if more than 20% of Zone 3 or 4 quadrats experience measurement of change. Significant compositional change is defined as a 'loss of dominance' for any dominant native perennial taxa that were present at baseline (refer to Appendix 4). Significant structural change in vegetation is assessed by comparing the structural classes in the Level IV vegetation descriptions by stratum and by quadrat between baseline and 2023. Significant structural change within a quadrat was considered to have occurred when two or more strata recorded a change since the baseline period across two or more structural classes (Appendix 5) due to a change in cover. Assessment of the change considers the full variation across the baseline period. The threshold criterion describes structural shift or loss of dominant species across 50% of the monitored potential impact area, which could occur in any part of the creek habitat (channel, terrace, banks, or floodplain), beyond which there is the potential for irreversible impacts to occur. The threshold criterion aims to detect a major change to vegetation outside of natural variation and beyond the expected effects of dewatering and discharge from the Project that may indicate potential for an irreversible change. Discharge will predominantly occur during post wet season flows where on-site storage capacity is exceeded. Due to the intermittent and low volume and generally post-wet timeframe for discharge, discharge is rarely expected to result in lengthy periods of saturation of sections of the low flow channel base, but may temporarily increase saturation of alluvial sediments throughout the low flow channel, within the surface discharge extent within Jimmawurrada Creek / West Creek. This intermittent augmentation over confined sections of the creek could lead to either an increase or decline in presence or cover of some native species and introduced species. Less significant changes may occur in the remaining areas of the creek channel, terrace and banks due to increased water availability. Intermittent discharge of surplus water may also potentially reduce the impacts associated with groundwater drawdown. A trigger criterion for detection of new high priority weed species within the potential impact zone and downstream of the discharge extent in Jimmawurrada Creek was selected as an indicator of potential impacts from discharge of surplus water. A threshold criterion has been selected to capture an increase in extent or persistence of high priority weed species within Jimmawurrada Creek Zone 3 riparian vegetation monitoring quadrats or downstream of the discharge extent. The threshold is exceeded if over 20% of quadrats across the zone with records of a high priority weed species for over three or more years. Weed species can be monitored regularly via the riparian vegetation monitoring transects; have a baseline; and measurement of these parameters is consistent with other flora and vegetation monitoring programs. Dewatering and discharge may result in some minor temporary compositional and structural changes to the riparian vegetation; however, this is not expected to affect the long-term functioning of the community.

[4] Summary of assessment for determination of required level of management provided in Appendix 2, as per the conceptual framework for development of Rio Tinto's EMPS (Appendix 1).

[5] For the purpose of monitoring compliance against MS 1141 Condition 6-1, **and to ensure consistency between State and Commonwealth approvals groundwater level compliance baselines (April 2020 - lowest recorded wet season low, as per EPBC decision notice 2017/8017)**, baseline riparian vegetation monitoring across Jimmawurrada Creek **is measured prior to this date** (April 2020).

declining trends in native species composition were reported in 2023, however an increase (though not significant) in weed species abundance was reported (Astron 2023b). While a proportion of the creek is expected to be impacted (most likely significant changes in the base of the primary channel (or low flow) and banks), broad scale maintenance of species composition and structure in the remaining proportion (i.e. secondary channels (high flow), terrace and floodplain zones) would allow recolonization once dewatering or discharge ceases, thus preventing an irreversible impact.	Commencement of monitoring was following a period of above average rainfall. • There is limited knowledge of the long-term variability of vegetation health in Jimmawurrada Creek.	For the threshold criteria, the management approach acknowledges that impacts to groundwater levels have already occurred across sections of Jimmawurrada Creek and are predicted to continue, 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. Similar to Robe River, threshold criteria have been selected based on both remote sensing of the upper canopy, and the composition and structure of both understorey and overstorey species (including weed species), determined from on-ground survey. Groundwater abstraction and discharge activities are expected to result in some temporary compositional and structural changes to the riparian vegetation; however, this is not expected to affect the long-term functioning of the community (Rio Tinto 2019).
Inland Waters: Pool Ecosystems of the Robe River		
Level of Management[6] : High		
Key Surveys and Studies: **Pool hydrogeological regime** The Robe River is predominantly an ephemeral river which carries a significant base-flow in its alluvial bed. Permanent and semi-permanent pools exist along the Robe River (a number of which are contained within the Development Envelope) due to the significant subsurface groundwater flow in the coarse channel gravels of the Robe River alluvial aquifer. Adjacent CID aquifers at Mesa H and J are in partial connection to the baseflow of the alluvial aquifer in the Robe River. 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 becomes the only contributor to sustaining pool water volumes. Ephemeral pools eventually become disconnected from intermittent pools and as surface water evaporates, these pools reduce in size or disappear. The range in seasonal groundwater variability of up to 3m, has been recorded in alluvial bores of the Robe River. Drought conditions and declining groundwater levels result in shallower pool depths and semi-permanent pools becoming disconnected from the groundwater. Deeper, permanent pools have longer-term connectivity to the groundwater and are expected to be maintained by natural groundwater expression during drought periods. The permanent pool at Yeera Bluff is the only permanent pool along the Robe River within the Development Envelope and has important Aboriginal heritage and social value, in addition to its environmental value. **Pool Ecosystems** The 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 (Astron 2016a). The pools within the Robe River have been sampled annually since 1991 (prior to the commissioning and mining of the Mesa J Iron Ore Development) by Streamtec Pty Ltd. This monitoring has provided an integrated long-term dataset on water chemistry, channel and pool morphology, aquatic macroinvertebrates and fish, together with qualitative analysis of riparian and bank condition, weeds and water flow, however there are limitations with this data including that these are more qualitative assessments rather than quantitative and variation in annual monitoring which has been undertaken during different seasons. Subsequent more consistent and quantitative analyses have been undertaken by WRM since 2016. The monitoring for nearly 30 years has captured some recurring extreme natural events such as cyclones and prolonged dry periods, as well as comparison of pre and post mining / impact and non-impact sites. Seasonal and annual variation in rainfall and subsequent river flows with extreme natural events are the main drivers of pool diversity and ecosystems, with deeper pools generally showing higher levels of biodiversity due to water chemistry being more stable; and shallower pools showing greater fluctuations in water temperature and dissolved oxygen, including to levels unsuitable for local fauna (Dobbs and Davies 2009). Large rainfall events such as from cyclones can change the overall morphology of both the river channel and the pools, whereby the biodiversity and predictability of biodiversity can be significantly changed and effectively ‘reset’ by these events.	Assumptions: • Baseline data collected for riparian vegetation and aquatic fauna provide representative species inventories and reflect sampling over variable seasonal conditions. However, the data may not necessarily capture the full range of climatic variability experienced in an arid environment (which may vary on a decadal-scale). • 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 in depth) have the potential to dry out as a result. Uncertainties: • Limited hydrogeological data for the Robe River alluvial aquifers, to inform estimates of the hydraulic connectivity between the CID and alluvial aquifers and hence potential impacts to pools and vegetation. • Limited ability to separate natural seasonal and climate variability with the proposed limited groundwater drawdown in the CID. • Inherent difficulty in determining water quality changes due to natural seasonal variability as the pool chemistry changes with pool volume, compared to potential chemistry changes as a result of the Project, and limited baseline data for some parameters of interest. • Limited (chlorophyll a) to no (phytoplankton) baseline data available	The outcome-based provision under MS1141 for semi-permanent and permanent pools is based on the high cultural and environmental value of the Robe River Pools. The selected early response, trigger and threshold criteria for semi-permanent and permanent pools of the Robe River include: pool water level (mAHD) (surface water depth); water quality; and aquatic fauna (macroinvertebrates and hyporheic fauna) monitoring. **Pool Water Levels** Establishing reference pool levels have been difficult due to differences in pool morphology, depth and overstorey cover (which impacts evaporation rates). Installation of paired alluvial aquifer bores in the Robe River near targeted pools are proposed to monitor groundwater levels and hence measure potential impact to water levels in pools as a result of mining. Once installed, the paired bores, on the northern and southern side of the Robe River, will enable detection of changes to water table levels in the Robe River proximal to the mining operations at Mesa J and H, and particularly when mine pit dewatering commences at Mesa H, relative to each other. The bores will be monitored continuously via data loggers which will be downloaded regularly.This is considered the most accurate way to determine a mine dewatering related change to groundwater table levels in the pools as compared to natural seasonal pool water table fluctuations.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. Mesa H operations is modelled to have negligible groundwater drawdown on the Robe River however, upon installation of the monitoring bores, any drawdown impacts will be picked up by the wells on the southern edge. Drilling of these bores is currently awaiting Heritage approvals (subject to formal s18 approvals under the *Aboriginal Heritage Act 1972*) and ongoing consultation with the RRK People, and therefore have not yet been able to be drilled. Hence for the purposes of this plan, the bores have not been included to measure trigger and threshold groundwater levels (within the alluvial gravels of the Robe River), however will be used as correlative bores to verify groundwater triggers and thresholds once approved to be drilled. Consequently, trigger and threshold criteria have been developed for surface water levels in Yeera Bluff (Gnieraoora) Pool which was selected on the basis that it is the only known permanent pool within the Development Envelope, and represents a significant ecological refuge, particularly during periods of extended drought. Japanese pool, a semi-permanent pool upstream of Mesa H, has been identified to provide additional spatial coverage of potential drawdown impacts. Being semi-permanent, surface water levels at Japanese pool can provide an indicator of potential impacts to pools that may be less resilient to groundwater drawdown. However, noting that Japanese Pool is a gravel pool and so may be subject to post streamflow modifications (change in shape and depth) and thus differing water table levels, hence the more dynamic nature of this pool will need to be considered in interpretation of the trigger criterion. Yeera Bluff and Japanese Pool have been sampled on a quarterly basis since 2017 using a comprehensive water chemistry suite (Appendix 7) and prior to that via various annual aquatic fauna surveys. Water depths were recorded in a discontinuous manner using transducers and water levels were surveyed by a certified surveyor several times. The 2018-2019 period saw wet season rainfall within the 5 driest in the 50-year period 1970-2020. During this period many of the gravel pools in the Robe River dried and bore water levels within the adjacent Mesa formations (Mesa J, K and H) were some of the lowest recorded to date. However significant water remained in both Yeera Bluff pool and the reference rock pool at SW16MEH0003 (RRD6). Hydrology monitoring during December 2019 and January 2020 resulted in photographs of the monitoring pools at their lowest levels. Yeera Bluff pool was recorded down to a level of approximately 114.8 mAHD (see Figure 1-4A). At this level, the three Yeera Bluff pools remained connected and it was estimated that there was ~2-3m of water left in the deepest pool sections. The visual amenity was deemed to be at the limit of what would likely be acceptable to the traditional owners, the general public and the Proponent. Of note is that this status occurred under natural conditions with no active mining present in this location. The natural decline of pools at low levels does not tend to be rapid and it is expected to take months to fall a further 0.5m. A depth trigger of 114.5m AHD and threshold of 113.5 mAHD in Yeera Bluff Pool have been set based on observations of natural fluctuations in pool level depths and current observed pool water levels (See Figure 1-4B). The enduring nature of the surface water in Yeera Bluff pool is also directly associated with maintaining the ecological, cultural, and aesthetic values of the area. Whilst other pools will be monitored as reference sites, their permanence in the landscape, morphology and vegetation cover mean that the pools cannot be directly compared, however, these can provide an indication of climatic and groundwater response related trends. Based on this, the nearest analogous reference rock pool which is proposed for water level monitoring is SW16MEH0003 (RRD6), which is approximately 3.5 km downstream of Yeera Bluff (Gnieraoora) Pool. Upstream pools are mostly large reach pools, scoured into the gravel (e.g. SW16MEH005, Medawandy (Regatta Pool)), and thus can be used to make inferences on overall alluvial aquifer groundwater trends, but are not considered to be permanent due to their susceptibility to modification following flow events in the Robe River. This can result in variable rates of water level fluctuation and an absence of long-term consistency, as illustrated in Figure 1-4B.

[6] Summary of assessment for determination of required level of management provided in Appendix 2, as per the conceptual framework for development of Rio Tinto’s EMPS (Appendix 1).

The history of isolation of river systems of the Pilbara has resulted in a low biodiversity of freshwater fish being recorded (12 species) (Allen et al. 2002 cited in Streamtec 2017).

In-depth multivariate data analysis by Golder (2020) using Streamtec and WRM datasets confirmed shifts in fish and macroinvertebrate community assemblages between certain sites, seasons, and years. Results from the data analysis suggest that many of the changes in community structure are attributed to multiple and complex environmental pressures and ecological interactions. Factors that can influence the resilience in the system includes groundwater seepage, discharge from groundwater abstraction, elevated nutrient concentrations (from mine related activities as well as from livestock), variations to rainfall and associated river flows (seasonal and multi-year), and movements and behaviour of fish and macroinvertebrate species. On top of these factors, confounding factors including changes in sampling techniques and experimental design over the period can influence the quality of the data and the subsequent interpretation of the observations made during monitoring events.

Pool water quality

Surface water chemistry data has been monitored and collected on a quarterly basis since 1992. The monitoring encompasses quarterly monitoring of discharge outlets along Jimmawurrada Creek and West Creek (when intermittently discharging), and annual monitoring of the semi-permanent and permanent pools of the Robe River (as described above). Further detailed sampling of surface water was undertaken biannually post wet and post dry season from 2016 to the present as part of the baseline aquatic fauna surveys undertaken for the Mesa H Project (WRM 2020).

A major determining factor of variability in surface water quality is pool morphology and permanence, together with cyclonic rainfall and associated stream flow events (Streamtec 2017). Hence the surface water chemistry in the semi-permanent and permanent pools can be highly variable, ranging from fresh (592 µS/cm EC) to brackish (1,700 µS/cm EC), with circum-neutral to mildly alkaline pH values (6.9 – 7.9) and dissolved oxygen from hypoxic (14.5%) to supersaturated (134.9%) (WRM 2017). There is a naturally occurring increasing salinity gradient in the Robe River from upstream to downstream, which was evident pre-mining and is also observed at reaches upstream of mining activities (Golder 2020).

Chemistry and isotope data have supported the conceptual understanding that the primary contributor of water within the pools and alluvial gravels adjacent to Mesa J and Mesa H is local runoff-recharge and river flows with a secondary contribution from persistent (months) post-rainfall gravel baseflows that are sustained by seepage from upstream catchment alluvial aquifers. Water balance analysis suggests the basement aquifer contribution is less than 10%.

A hazard analysis (or screening assessment) of site-specific information to identify potential stressors associated with the Project and the development of Site-Specific Guideline Values (SSGVs) based on historical water quality data was undertaken by Golder (2020). The aim of the study was to select key stressors for monitoring impacts to ecosystem health from both the Mesa J and H mining operations.

The information considered in the hazard analysis included interpretative reports and raw data relating to characterisation, monitoring and assessment of stressors in a variety of media including: waste rock; tailings solids; tailings leachate; process and contact waters; groundwater across Mesa J and Mesa H; discharge water quality from Mesa J discharge points along Jimmawurrada Creek and West Creek; and surface water quality from the Robe River.

The development of the SSGVs included comparison with ‘reference sites’; default water quality guidelines (physical and chemical stressors, and toxicants) and ecotoxicological literature.

The screening of water quality entailed comparison to national aquatic ecosystems screening levels, namely the Australian and New Zealand Guidelines for Fresh and Marine Water Quality (formerly ANZECC and ARMCANZ 2000, now ANZG 2018).

Groundwater and discharge surface waters were screened separately to identify stressors for SSGV development. Consideration was given to information on potential stressors and their capacity to be mobilised from sources. Where a stressor was identified with the potential to be readily mobilised, the stressor was retained for SSGV development. Conversely, parameters that were identified through the groundwater screening process, but which were indicated to pose a low risk of mobilising from leachate or contact waters, were excluded from the

Figure 1-4A Yeera Bluff lower pool 08/01/2020 at 114.8 mAHD

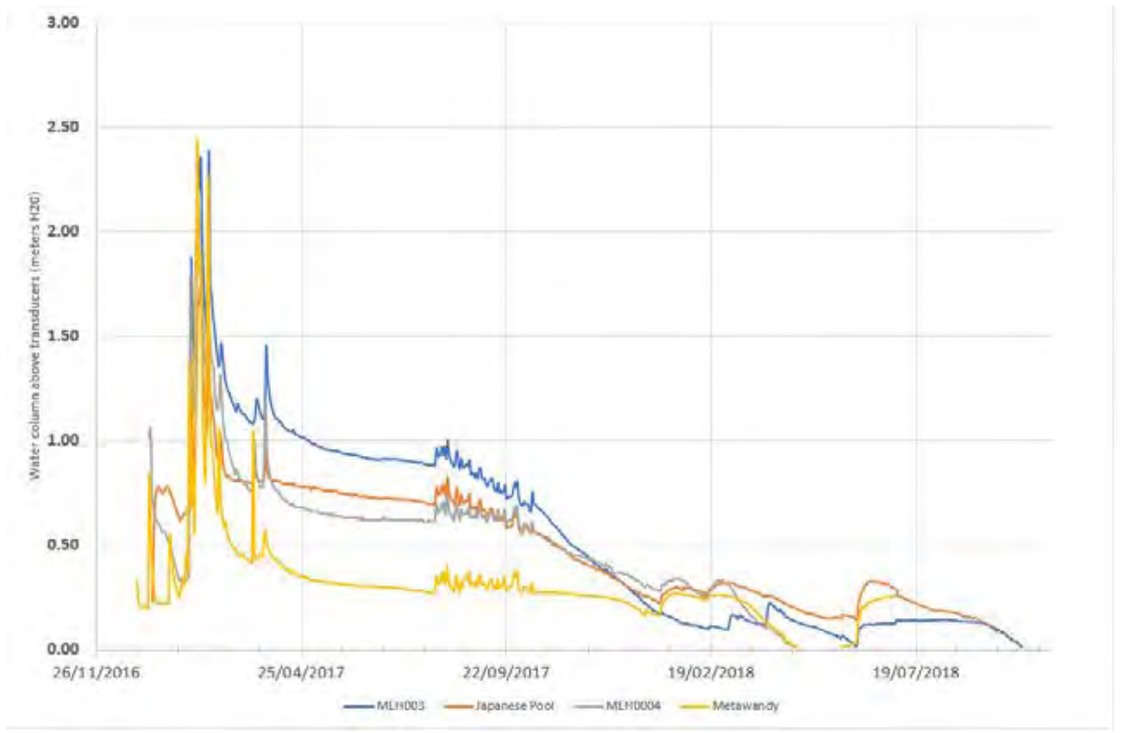

Figure 1-4B. Hydrographs indicating similar groundwater level trends in Robe River Pools, but variable rates of decline between pools as a response to climatic / seasonal influences.

If declining groundwater levels are due to seasonal or climatic drivers, then the pool level monitoring compared to reference sites and local climate data will support differentiation of potential mining related impacts from natural climatic variation.

SSGV development, but a comprehensive analysis suite was retained to support the recommended monitoring activities.

Water quality monitoring of the Robe River pools indicate that the pool water is generally very hard much like the groundwater at Mesa H. Between seasons, the temperature of Robe River pools ranges from 7-37°C with an average of 28°C. Therefore, a site adapted nitrate toxicity guideline value has been incorporated based on work by van Dam *et. al.* (2022), which analysed the ecotoxicological literature on effects of nitrate on aquatic species tested in harder and warmer water (i.e. akin to the Pilbara) and ecotoxicological data tested with local Pilbara species. Given that the current recommended ANZG (2018) DGV for nitrate (2.4 mg/L nitrate-nitrogen, NO_3_N) in freshwater for Australia are based on toxicity data generated under a wide range of test water quality conditions (e.g. hardness, temperature, pH), this is not applicable to Pilbara waters receiving surplus discharge water and/or in receiving waters that generally exhibit high water hardness (as $CaCO_3$). van Dam (2020) examined extensive field and laboratory data undertaken by RTIO quantifying the effects on nitrate on local aquatic ecosystem, also taking into account non-local species (tested under similar water conditions) to enable the derivation of a Pilbara site adapted guideline value, using the preferred species sensitivity distribution (SSD) method (Warne et al. 2018). The Pilbara specific hardness adapted values for nitrate as nitrogen of 7.6 mg/L (99% Species Protection Level (SPL)), 15 mg/L (95% SPL), 23 mg/L (90% SPL) and 39 mg/L (80% SPL) was published in van Dam *et. al.* (2022). In May 2024, The Australian and New Zealand Governments Guidelines for Fresh and Marine Water Quality (ANZG, 2024) published draft, hardness adapted nitrate values which indicate the following DGVs (as mg/L NO_3^-_N) for 99%, 95%, 90% and 80% species protection levels (SPL) (respectively):

- Soft waters (< 30 mg/L as $CaCO_3$) – 0.64 mg/L. 1.1 mg/L, 1.5 mg/L and 2.3 mg/L;
- Moderately hard waters (30 – 150 mg/L as $CaCO_3$) – 1.0 mg/L, 2.6 mg/L, 4.2 mg/L and 7.1 mg/L;
- Hard waters (>150 mg/L as $CaCO_3$) – 18 mg/L, 29 mg/L, 38 mg/L and 56 mg/L.

Given that the hardness of the waters in the Robe River is naturally above 150 mg/L, 29 mg/L (NO_3^-_N for 95% SPL) would be sufficient to protect the health of the Robe River based on the draft ANZG (2024) DGV. However, RTIO would prefer to take a conservative approach and adopt van Dam *et. al's* (2022) values of 15 mg/L (NO_3^-_N for 95% SPL) as the trigger value given that the ANZG (2024) values for nitrate are still in draft.

Managed Aquifer Recharge has been trialled in 2017 in the Robe River, however, no groundwater response was observed from sustained injection of mine water into the upper horizon of the unconfined Robe River alluvial aquifer containing shingle size material. The Robe River in this area is approximately 400 m wide and has very high transmissivity. The volume and injection rate for generating groundwater mounding in such a high storage aquifer are considered to be unlikely to be successfully achieved. A key mitigation measure proposed to protect both the pools and riparian vegetation is the cessation of the dewatering activities in relevant pits at Mesa H which may have potential to impact the pool and alluvial aquifer water levels (Table 2-3).

Yeera Bluff Pool, in particular, can receive inflows from a local 80km^2 creek to the north which responds more readily to rainfall.116 mAHD has been identified as the levels at which the pools are over filled with flows primarily influenced by local geomorphology, local creek contributions and baseflows within the Robe River gravels. Below 116 m AHD, the pools are predominantly expressions of the gravel aquifer with further declines potentially reflecting the status of the local aquifer. Notwithstanding, any trigger that is reached indicating declining groundwater levels in the pools (whether mining related or seasonal / climatic prior to dewatering), will trigger the operation to postpone or avoid dewatering of pits 7 & 8 which are the closest pits within Mesa H likely to influence recharge of groundwater levels in Yeera Bluff (Gnieraoora) Pool (Figure 1-4C).

The 113.5 mAHD threshold criterion would leave the pools at a functional 'survival' level for trees and aquatic fauna (including fish) however, diminished in terms of water volume. Current resource evaluation and hydrogeological data suggest it is unlikely that mining would require the groundwater level to be lowered to 113.5 mAHD. Review of the pool bathymetry suggests that the Yeera Bluff Pool regularly drops to 115 mAHD during most dry periods and hence these levels would be regularly triggered from normal cycles of filling and drying. Therefore, a level of 113.5 mAHD is considered appropriate for the threshold to distinguish between inherent variability and a potential mining related impact. Natural seasonal variations and longer-term drier climatic influences can confound pool surface water levels and should be considered when determining the cause of groundwater decline in line with the trigger or threshold conditions.

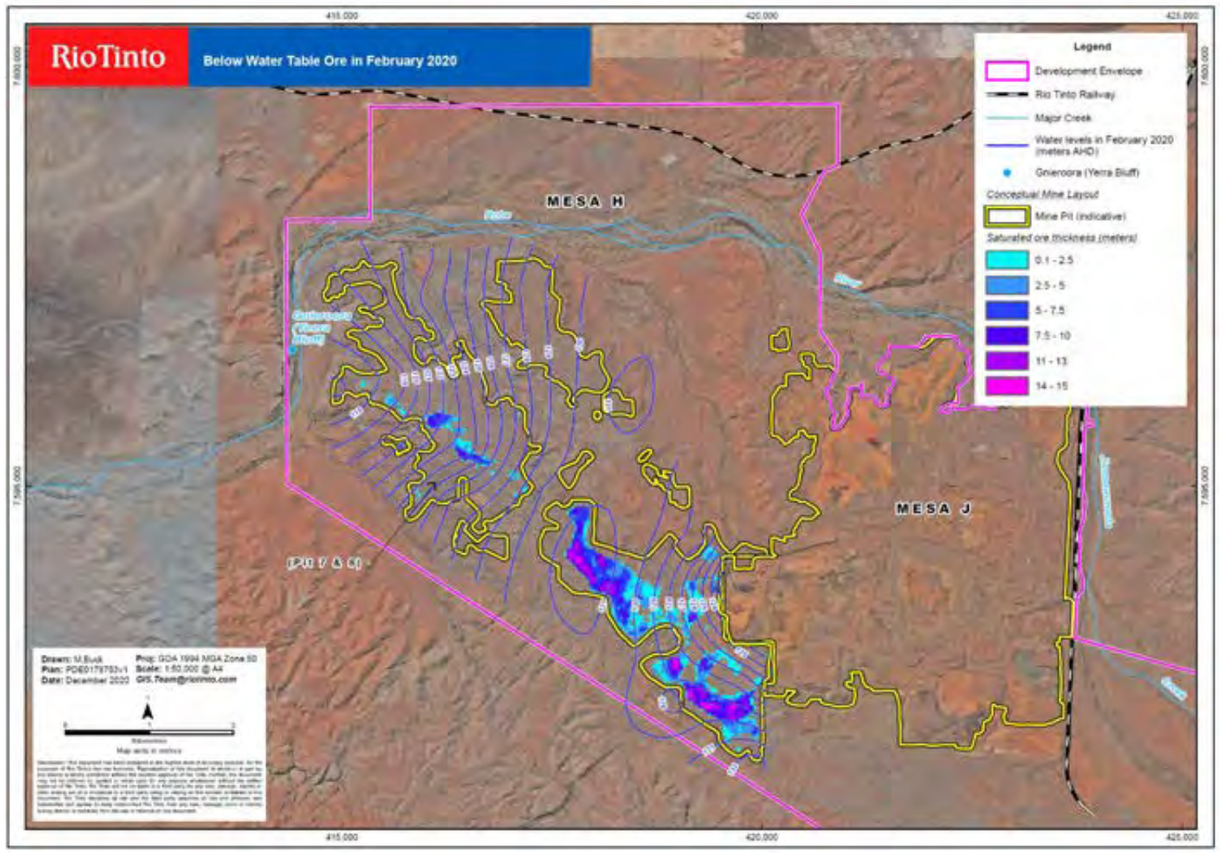

Figure 1-4C – Mesa H pit 7 and 8 groundwater levels (requiring dewatering)

Water Quality

Two levels of SSGV were developed for most parameters.[7] identified during the hazard analysis (Golder 2020), which have been incorporated into the early response and trigger criteria for water quality in the Robe River pools. Key pools (Figure 2-2) have been designated for assessing water quality changes according to the criteria described below, subject to surface water being present and accessibility constraints, with supporting monitoring undertaken in additional pools as appropriate.

Tier 1 SSGVs were chosen to provide an early indication for potentially deteriorating water quality in Robe River pools before ecological effects are anticipated and represent the early response criteria. For nitrate, the Tier 1 SSGV was based on the recently observed (last 2 years to represent 'current' conditions prior to implementation of Mesa H) benchmark maximum for each key pool, noting that pools vary in hydrological characteristics and nutrient inputs; some pools already have elevated nitrate concentrations and the Tier 1 SSGV aims to prevent any further increase for any particular pool as a result of the Project. If during ongoing monitoring, the 2-year average nitrate concentrations decreases by 25% or more from the current benchmark (Appendix 7), the benchmark will be revised down accordingly as per the adaptive management strategy. The Tier 1 SSGV for nitrate also includes biological indicators for assessment of potential eutrophication effects associated with nutrient enrichment (nitrate releases); chlorophyll a. Chlorophyll a is widely regarded as a reliable and accessible indicator of algal biomass (ANZECC and ARMCANZ, 2000). The chlorophyll a guideline is derived from Table 3.3.4 and 3.3.5 in ANZECC/ ARMCANZ 2000 for regional stressor levels

[7] Note that for nitrate (toxicant) Tier 1 value is based on the average of the 2 year most recent data to represent current conditions, and also to align with Tier 2 values which are adapted from the van Dam *et. al.* (2022) proposed nitrate guideline values for Pilbara waters with high hardness.

		indicated for Northern Tropical Australia (which includes north-western Western Australia) . This criteria for eutrophication will be applied to all pools, regardless of current nitrate concentration For other parameters, depending on the availability of baseline data, the Tier 1 SSGV is based on the 80th percentile of baseline data across the Robe River, for either the ANZG (2018) DGV at the 99% species protection level (adjusted for water hardness at the time of monitoring for zinc) or the ANZECC and ARMCANZ (2000) regional physio-chemical stressor values (pH). The 80th percentile of baseline data for EC is calculated across creek reaches to take into account the naturally occurring salinity gradient in the Robe River (Appendix 7) Tier 2 SSGVs were selected to provide an indicator of deteriorating water quality in the Robe River pools at a level which may indicate the potential for detrimental ecological effects and comprise the trigger criterion for water quality in key Robe River pools. The Tier 2 SSGV for potential toxic impacts from nitrate is the site adapted guideline value suitable for the protection of aquatic organisms in Pilbara Creek lines (van Dam 2020) that exhibit high water hardness.[8] (200 – 500 mg/L as $CaCO_3$). The Tier 2 SSGV for nitrate also includes biological indicators for assessment of potential eutrophication effects associated with nutrient enrichment (nitrate releases); phytoplankton composition and abundance. Phytoplankton composition and abundance is proposed for assessment of the presence of harmful algal blooms and risks to human and ecological receptors. This will be included as part of the biannual aquatic fauna monitoring as a line of evidence additional to water chemistry. The phytoplankton assessment will also assist with the detection of potential eutrophication impacts. The framework for assessment of phytoplankton will follow the guidance provided in the Australian National Health and Medical Research Council Guidelines for Managing Risks in Recreational Waters. The appropriateness of this framework will be evaluated during ongoing future monitoring and revised as necessary according to adaptive management principles, in consultation with DWER. In addition, routine monitoring of aquatic fauna diversity and composition will be ongoing in conjunction with water quality monitoring and provide further indicators of any potential deleterious impact of water quality changes. The Tier 2 SSGVs for other parameters is based on either the 95th percentile of baseline data across the Robe River or the ANZG (2018) DGV at the 95% species protection level (hardness adjusted for zinc). The 95th percentile of baseline data for EC and pH is calculated across creek reaches to account for naturally occurring gradients (Appendix 7) In addition to the parameters of potential concern identified during the hazard analysis, a comprehensive water quality suite will be monitored for supporting information and compared to ANZG (2018) default guidelines as appropriate. The threshold criterion for water quality in Robe River pools is based on ecological effects observed on aquatic fauna diversity or assemblage composition, as a result of water quality changes attributable to Mesa J hub operations. Routine biannual monitoring will assess aquatic macroinvertebrates (including hyporheic fauna) composition and diversity, fish composition, diversity, size class distribution and abundance in key pools, and further effects assessment in addition to the routine biannual monitoring will be undertaken as warranted. Two years for the threshold criteria is considered a suitable time-frame to distinguish a potential impact from mining operations from the inherent natural variability in aquatic fauna diversity.
MNES: Ghost Bats and Roosts		
Level of Management[9] : High		
Key Surveys and Studies: **Population:** The Ghost bat is listed as Vulnerable pursuant to the EBPC Act and the BC Act, and is a matter of National Environmental Significance (MNES). Assessments of caves in the Mesa H Survey Area and Development Envelope (Astron 2015; Bat Call 2017a) have collectively identified evidence of Ghost bats from twelve caves: • two diurnal roosts (with maternal roost potential); and • ten nocturnal feeding roosts (two were part of the one system) (Figure 1-6) An assessment of the conservation value of these caves 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 (potential for maternal breeding) (Bat Call 2017a). The Ghost Bats at Mesa H likely originate from Buckland Hills to the south, Yeera Bluff Pool (Gnieraoora pool) between Mesas G and H or the Three Peak hills to the north-west of the Development Envelope (Bat Call 2017b). **High value habitat: roosts** Roost sites used permanently by Ghost Bats are generally deep natural caves with a relatively stable temperature of 23-28ºC 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 1-6); 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. The Project will not result in the direct removal of any of the 12 recorded Ghost bat roosts occurring within the Development Envelope.	**Assumptions:** • Retention and protection of high value Breakaways and Gullies habitats via the MEZ will support the persistence of MNES fauna within the Development Envelope. • Protection of roosts will enable the persistence of Ghost bats within the Development Envelope. **Uncertainties:** • Limited data on the sensitivity of the Ghost bat to noise and vibration. • Limited regional population studies data to assist in understanding the long-term natural population variability and movements of these species. • Limited understanding of the long-term behaviour of Ghost bats in relation to use of roosts and movement between, or abandonment of roosts. • Limited understanding of the geotechnical stability of nocturnal roosts.	Outcome-based and management-based provisions for the Ghost Bat are prescribed under MS1141 and EPBC Act Approval 2017/8017 respectively. The outcome-based provisions (Table 2-) address condition 8 of MS 1141 while management-based provisions (Table 3-1) addresses conditions 2, 3 and 4 of EPBC Act approval 2017/8017 The **environmental outcome** conditioned in MS1141 for the Ghost Bat high value habitat is: • No irreversible impact as a result of the Revised Proposal to Breakaways and Gullies habitat retained within the Mesa H MEZ of Mesa H other than existing or authorised disturbance. 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. The Proponent's key strategy to ensure no irreversible impacts to the breakaways and gullies habitats and to the Ghost Bat roost caves is *Avoidance* via protection of these habitats within a Mining Exclusion Zone (MEZ). i.e. mine pit excavation is not permitted within the MEZ. Some allowance for clearing activities within the MEZ has been assessed and approved as part of the Mesa H Revised Proposal, and hence the approach in this EMP focusses on the management of the clearing aspect. Targets for limiting clearing in these habitats within the MEZ have been translated into measurable triggers and thresholds in Table 2-4 to meet the condition outcome. This outcome recognises that 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 all diurnal / potential maternal roosts and all known nocturnal roosts on Mesa H. Specifically, the Project will avoid all recorded Ghost Bat roosts at Mesa H (Figure 1-6): • 2 diurnal / potential maternal roosts (AC04 (CRMH-01) & MH16-34 (CRMH-02)) • 10 nocturnal roosts (two are part of the one system) The EMP has been developed with a conservative assumption that caves with multiple records of Ghost Bat presence during the day and/or suitable dimensions and/or suitable configurations have potential to be diurnal / potential maternal roosts and therefore warrant management. 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. Direct disturbance near the diurnal/ potential maternal roosts has been selected as early warning, trigger, and threshold criteria as disturbance is readily measurable and targeted to the highest value Ghost Bat habitat. The threshold value for direct disturbance aligns with the commitment made in the ERD that mine

[8] The site adapted guideline value for nitrate will only be used for pools in the Robe River that meet the hardness criteria.

[9] Summary of assessment for determination of required management zone provided in Appendix 2, as per the conceptual framework for development of Rio Tinto's EMPS (Appendix 1).

Many of the nocturnal Ghost bat roosts occur within 100 m of the conceptual mine pit, however only one diurnal / potential maternal roost is located within 100m of the proposed mine pits. The mine design incorporates mining exclusion zones (MEZ) to avoid direct disturbance, minimise the impact of blasting and associated vibration on the structure and quality of roosts and protect the integrity of the habitat values of these caves. A Blast Management Plan will be implemented to manage vibration from blasting to ensure the structural integrity of significant caves is maintained throughout the life of the mining. Some disturbance from mining operations (i.e. material spillage, fly rock and venting from drill and blast activities) may extend into the MEZ, however, the MEZ will remain intact. Mitigation of indirect impacts from general activities, (including the potential for increased presence of introduced flora and fauna, noise, dust and light), are provided in Table 3-1. Considering impacts to Ghost Bat caves and the mitigation strategies employed, the Project is not expected to cause a reduction in the area of occupancy, a decline in, or interfere with the recovery of this species (Rio Tinto 2019).		pits would be set back a minimum of 40 m from the lateral extent (recorded back) of the diurnal / potential maternal Ghost Bat roost caves. This commitment was based on geotechnical assessment of the roost caves and geotechnical analysis of the mesa formations in the Robe Valley. Geotechnical assessment of the diurnal/ potential maternal roost caves AC04 & MH16-34 concluded the caves have a 'Low' geotechnical sensitivity to structural instability, with none of the caves displaying rock fractures or other features that would increase the geotechnical sensitivity (Rio Tinto 2017c). Geotechnical analysis of mesa formations in the Robe Valley concluded that a minimum of 30 m is adequate to maintain geotechnical stability at an open face within the Channel Iron Deposit (CID). Given no features were noted that would increase the geotechnical sensitivity, the proposed threshold criterion of 40 m from the recorded back of the diurnal/maternal roosts is considered satisfactory to meet the geotechnical stability criterion for the roost caves. Vibration levels near the diurnal/ potential maternal roosts have been selected as trigger criteria as vibration levels are relevant to protection of the roosts; are readily measurable; can be monitored regularly; and are consistent with other Pilbara Ghost Bat monitoring programs. Ensuring the vibration levels at the diurnal/ potential maternal roosts remain below a peak particle velocity determined for each cave reduces the risk that vibrations potentially compromise the structural integrity of the roosts. Designation of the peak particle velocity limit for each diurnal / potential maternal Ghost Bat roost cave is based on AS 2187-2006 'Explosives – Storage and use – Use of Explosives' in combination with a risk assessment of the geotechnical sensitivity, the environmental significance of each cave and the Proponent's vibration control experience. The environmental significance of each diurnal / potential maternal roost cave was assessed as 'High'. Geotechnical assessment of diurnal / potential maternal Ghost Bat roost caves includes assessment of the rock fractures, bedding planes and degree of cementation. The geotechnical sensitivity for structural instability at all assessed sites, including diurnal / potential maternal roost caves AC04 & MH16-34, was assessed as 'Low'. AS 2187.2 (Appendix J) recommends: • a ground vibration limit of 100 mm/s peak particle velocity to control damage to structures of reinforced concrete; and • a transient vibration limit of 50 mm/s peak particle velocity for prevention of cosmetic damage to reinforced or framed structures, industrial and heavy commercial buildings. The Proponent regularly uses vibration control to protect sensitive sites such as rock shelters with high cultural significance, high pressure gas pipelines, communications towers and the mesa escarpment at the nearby operations at Mesa A. From the Proponent's experience in vibration control, it is known that fracturing of intact rock typically occurs at 250 – 1000 mm/s peak particle velocity. Based on environmental sensitivity, geotechnical assessment and AS 2187.2, the trigger criterion for vibrations at the diurnal / potential maternal Ghost Bat roost caves has been set at 50 mm/s peak particle velocity. This is below typical vibration levels associated with rock fracture and meets the AS 2187.2 recommendation for prevention of cosmetic damage for heavy commercial buildings. Blast vibration monitoring will be conducted for blasts within 300 m of the diurnal / potential maternal Ghost Bat roosts. Based on blast vibration monitoring at West Angelas, significant damage is considered unlikely for blasts beyond 300 m as no monitored standard blasts have exceeded peak particle velocity of 50 mm/s outside the 300 m radius. At 300 m, using AS2187.2 scaled distance vibration prediction method and constants, an approximate +80% safety margin for maximum instantaneous charge is allowed for in blast execution and design. Temperature and humidity monitoring of the two diurnal/potential maternal caves on Mesa H (MH16-34 and AC04) 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. Temperature and humidity will be monitored on a continuous basis and calibrated with ambient temperature and humidity. 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 diurnal / potential maternal roost caves which may result in a change to the cave microclimate. The **management objective** for the Ghost Bat to address condition 3 of EPBC Act approval 2017/8017 is: • Improve knowledge of the Ghost Bat population in the Robe Valley, including its movements, use of high value habitat and effects of noise and vibration, in order to assist in maintaining biological diversity and ecological integrity. This management objective has been selected as it provides an appropriate objective for the management target required under condition 3 of EPBC Act approval 2017/8017. One of the limitations noted during the Environmental Impact Assessment for the Mesa H Project 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 eastern part of the Robe Valley. The proposed management action to monitor Ghost Bat utilisation of high value habitat in the Robe Valley has been selected to start to address this limitation as well as to improve knowledge of the effects of noise and vibration on Ghost Bat utilisation of habitat. The trigger, threshold and monitoring actions included in Table 2- of the EMP (to meet Condition 8-1 of MS1141), also meet the above requirement of EPBC 2017/8017.
MNES: Northern Quoll		
Level of Management[10] : High		
Key Surveys and Studies: In the Pilbara, the Northern Quoll favours rocky gorges/gullies, 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) however 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.	**Assumptions:** • Retention and protection of high value Breakaways and Gullies habitats via the MEZ will support the persistence of MNES fauna within the Development Envelope. **Uncertainties:** • Limited regional population studies data to assist in understanding habitat utilisation	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** required under MS 1141 for the Northern Quoll is: • No irreversible impact as a result of the Revised Proposal to Breakaways and Gullies habitat retained within the Mesa H MEZ other than existing and authorised disturbance.

[10] Summary of assessment for determination of required level of management provided in Appendix 2, as per the conceptual framework for development of Rio Tinto's EMPS (Appendix 1).

The Northern Quoll was recorded in the Development Envelope, with the majority of records occurring in Breakaway habitat with some in Riverine and Gorge/Gullies habitat types; however, the species is also likely to utilise Rocky Hills habitat (Astron 2015). 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 include the Breakaway and Gullies habitat (Figure 1-6), which contains 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 2015). The Riverine habitats, especially adjacent to Breakaway and Gullies habits provide microhabitats (e.g. crevices and cracks) for foraging (Astron 2015). There are no 'Rocky habitats' mapped separately at Mesa J and H.

and the long-term natural population variability and movements of these species.

High value denning and foraging habitat is potentially present within the mapped Breakaways and Gullies habitat in the MEZ of Mesa H. The Project has been designed to retain potential high value denning and foraging habitat in the Mesa H MEZ and the locations of escarpment cuts (i.e. removal of small sections of the mesa escarpments) were selected to avoid the highest value fauna habitat on each mesa escarpment (Astron 2017).

Limited clearing in the MEZ is authorised by Schedule 1 of MS 1141 as follows: no more than 132 ha (excluding existing and authorised clearing).

The clearing limits in Schedule 1 of MS 1141 apply to the habitat types in the entire Mesa H MEZ. Note that Mesa J is an existing mining operation however the area of Mesa J containing the highest value breakaway habitat adjacent to the Robe River occurs *outside* of the Development Envelope.

To meet the environmental outcome required by Condition 8 of MS 1141, trigger and threshold criteria have been developed specifically to further limit disturbance to potential Northern Quoll denning habitat in the Mesa H MEZ. i.e. the management approach is conservatively applied to *all* of the breakaways and gullies habitat in the MEZ. The trigger and threshold criteria will ensure the maximum clearing in potential Northern Quoll denning habitat will remain well below the clearing authorised by Schedule 1 of MS 1141.

Direct disturbance to potential Northern Quoll denning habitat is readily measurable and can be regularly monitored as disturbance to Breakaways and Gullies habitat in the Mesa H MEZ. Ensuring direct disturbance to the Breakaways and Gullies habitat in the MEZ is minimised reduces the risk that potential Northern Quoll denning habitat is disturbed or degraded.

The trigger criterion of disturbance to 5% of the potential Northern Quoll denning habitat in the MEZ of Mesa H equates to approximately 26 ha of new disturbance in the MEZ, well under the MEZ disturbance provided for in Schedule 1 of MS 1141. The proposed trigger and threshold will thus provide additional protection to the Breakaways and Gullies Habitat in the MEZ and ensure the outcome required by Condition 8 of MS 1141 is met.

The threshold criterion of disturbance to 10% of potential denning habitat in the Mesa H MEZ (approximately 52 ha) was selected based on consideration of Northern Quoll use of partially intact mesa escarpments in historical mining areas in the Robe Valley. Historical mining in the Robe Valley did not include retention of mesa escarpments; escarpments were either completely or partially removed, or waste rock was tipped over the escarpments resulting in loss of the original breakaway cliff line and denning/shelter features. Survey work in historically mined areas in the Robe Valley has recorded Northern Quoll use of historical mining areas near partially intact mesa escarpments as shown in Table 1-5.

Table 1-5 Historically mined mesas in the Robe Valley with nearby records of Northern Quoll

Mesa name	Estimated percentage of intact escarpment
Mesa K	45%
Mesa L	22%
Mesa 2400E	42%
Mesa 2401A	44%
Mesa 2403ABC	22%
Mesa 2403D	93%

The above data indicate that Northern Quoll use of habitat at Mesa H would be expected to continue even if the selected threshold of disturbance to 10% of potential Northern Quoll denning habitat (~52 ha) in the Mesa H MEZ was reached. The trigger and threshold have been set conservatively (i.e. well below disturbance levels in historical mining areas) to ensure disturbance associated with the Project is minimised and does not result in an irreversible impact to high value Northern Quoll habitat in the Mesa H MEZ.

Supporting monitoring to confirm ongoing presence of Northern Quolls in the Project area will be conducted by remote camera monitoring, including spot pattern analysis of individuals to determine relative abundance. Previous northern quoll monitoring activities have been completed within and surrounding the Robe Valley by the Department of Biodiversity, Conservation and Attractions (DBCA) in partnership with Rio Tinto during 2015 - 2019, as part of the Threatened Species Offset Plan (TSOP). Camera monitoring has been selected as it will provide longer term observations than shorter term cage trapping giving greater insight into habitat utilisation and associated seasonal variation. It will also record incidental observations of feral predators. Seven long-term camera monitoring sites will be established in the eastern part of the Robe Valley (nominally in the vicinity of Mesa H, Mesa J, Mesa K, and Middle Robe), which compliments the Mesa A Hub monitoring program which spans the Western portion of the Robe Valley, and thus provides a program which in its entirety, covers the span of the broader Robe Valley. The program will utilise two top-down cameras at each site as this will provide stronger presence/absence data than would be achieved through deployment of a single camera at each site. The EPBC Act referral guideline for the Northern Quoll (DotE 2016) states that baiting cameras for more than five consecutive nights may impact animal behaviour. Due to the ethics requirements, use of baited camera traps is not included in the Northern Quoll monitoring program. However, non-consumable baits or alternate attracting methods may be used if considered appropriate and animal ethics approval has been granted as required.

Camera sites will be primarily located in the Breakaways and Gullies habitat type (as this is considered to be the preferred habitat type for the Northern Quoll). However, sites will also be located in the Mesa Plateau, Hills, and Plains habitat types to contribute to a broader understanding of Northern Quoll habitat utilisation.

Camera monitoring will be undertaken annually for four months in the period April to September. This timing has been selected to match the ecology of the species and to minimise equipment failure due to high temperatures and cyclonic events. A subset of camera monitoring data (one month per year) will use spot pattern identification to provide relative abundance data for Northern Quoll.

The camera monitoring program has been designed be consistent with the latest DBCA Northern Quoll research (Dunlop *et al.* 2018; Moore *et al.* 2023), as far as practicable, and is also consistent with the approved Gudai-Darri Northern Quoll Management Plan (Rio Tinto 2022) and the revised Mesa A Hub Environmental Management plan (awaiting approval). Trapping and camera monitoring programs will be reviewed biennially. However, the Proponent reserves the right to align with current methodologies as appropriate, and in consultation with external experts and/or regulators (i.e., DBCA).

<table>
<tr><th colspan="3">Subterranean Fauna: Troglofauna</th></tr>
<tr><td colspan="3">Level of Management[11] : Moderate</td></tr>
<tr>
<td>Key Surveys and Studies:

Troglofauna were first recorded in the Robe Valley 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 1-8.

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.</td>
<td>Assumptions:

• Retention and protection of 50% of CID habitat via the MEZ will enable the persistence of troglofauna within the Development Envelope.

Uncertainties:

• Inherent limitations in troglofauna 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 distribution patterns, ecological requirements, and resilience.</td>
<td>Environmental criteria have been developed based on consideration of:

• Threatening processes and risks associated with troglofauna;
• The current state of knowledge for troglofauna; and
• The availability of suitable monitoring methods.

The specific trigger and threshold criteria, management targets and actions have been chosen as they provide a basis for detecting and avoiding or otherwise managing potential impacts, such that the condition environmental outcomes and objectives stated in condition 7 of MS1141 can be achieved.

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 condition environmental outcome as per Condition 7-1 of MS1141 applies:

• Troglofauna: A minimum of 50% by volume of pre-mining troglofauna habitat shall be retained at Mesa H through the implementation of the Mining Exclusion Zone (MEZ) as delineated in Figure 1 of Schedule 1.

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.

Long term monitoring of downhole biophysical parameters (temperature / relative humidity) is undertaken across the broader Robe Valley including at the adjacent Mesa K site (since ~2007). Downhole biophysical monitoring and analysis to date (Astron 2020b) has not indicated discernible changes in the subterranean environment during mining and hence downhole biophysical monitoring is not proposed at Mesa H.

The trigger criterion has been set at a conservative level by:

1. Estimating the volume of habitat that would be retained if the mine plan were implemented without operational error;
2. Using the estimate from (1) to calculate the percentage habitat volume retained that would be in excess of the required 50% retention if the mine plan were implemented without operational error; and
3. Annualising the excess volume calculated in (2).

Minor exceedance of the annualised excess volume (0.05%) would need to occur every year for the life of mine in order to reach the threshold criterion. This conservative trigger selection will allow trigger level actions to be implemented well in advance of the threshold criterion being reached.

The management objective outlined in MS1141 for troglofauna is:

• The Proponent shall protect the biological diversity and ecological integrity of the troglofauna assemblages of Mesa H by minimising impacts as far as practicable.

Two management targets 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 trapping capture rate to assess whether the Mesa H Project has an impact on troglofauna utilization of retained habitat in the MEZ (Note 1: Coordinates are approximate locations as the pool locations may change after major flow events.
• Appendix).

Management actions and targets have been selected to address potential impacts of the Mesa H Project as well as to build upon existing data. Additional data collected from newer methodologies will be used to support the proposed metrics when enough information is available to support the statistical power of the data sets, for example troglofauna scraping data (Note 1: Coordinates are approximate locations as the pool locations may change after major flow events.

Appendix).</td>
</tr>
<tr><th colspan="3">Subterranean Fauna: Stygofauna (including the Blind Cave Eel)</th></tr>
<tr><td colspan="3">Level of Management[12] : High</td></tr>
<tr>
<td>Key Surveys and Studies:

Key Surveys and Studies:

At the Mesa J Hub, baseline stygofauna surveys were conducted over five phases between 2015 and 2017. A total of 104 samples were collected from 53 bores, of</td>
<td>Assumptions:

• Retention of connected alluvial aquifer and CID habitats will support the persistence of</td>
<td>The extent, connectivity, and quality 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.

Management criteria have been developed around the extent and depth of drawdown and the quality of groundwater at available groundwater bore locations in the alluvial aquifer habitat of Jimmawurrada Creek and pools within the Robe River (given the absence of groundwater bores in the Robe River). The ongoing</td>
</tr>
</table>

[11] Summary of assessment for determination of required level of management provided in Appendix 2, as per the conceptual framework for development of Rio Tinto's EMPS (Appendix 1).

[12] Summary of assessment for determination of required level of management provided in Appendix 2, as per the conceptual framework for development of Rio Tinto's EMPS (Appendix 1).

which 39 bores were sampled more than twice. Other nearby survey work within the Mesa J drawdown extent recorded one species of conservation significance - the Blind Cave Eel, a stygofaunal vertebrate, which is known from three distinct populations in Western Australia: Cape Range, Barrow Island and across the Robe River catchment in the Pilbara.

The Blind Cave Eel is a subterranean fish that has been recorded within and over 100 km beyond the Mesa J Hub area. However, despite growing up to 40 cm in length, is rarely collected or observed. The first known record was from Jimmawurrada-Bungaroo area in 2009. The species was not detected again until 2016, and then again in 2017, despite ongoing stygofauna monitoring. Subsequent aquatic fauna monitoring surveys for the Mesa J Hub have recoded the Blind Cave Eel free swimming in the adjacent semi-permanent and permanent pools of the Robe River.

Environmental DNA (eDNA) studies were commissioned by Rio Tinto to improve detection of this elusive species and for the first-time in 2019, Blind Cave Eel eDNA was successfully detected from field samples. Subsequent, annual sampling targeting the Blind Cave Eel using eDNA (2020-2024) have collected approx. 751 water samples from 58 sites (38 bores and 20 surface water pools) throughout the Robe River catchment, including locations with the Mesa J drawdown extent. The methodology involves filtration of water to collect trace amounts of Blind Cave Eel DNA present in the water (sources of DNA are generally excrement, skin cells and saliva). A species-specific eDNA assay has been developed to improve detection rates (draft publication submitted July 2024).

Compilation of all stygofauna sampling to date has recorded:

- 76 stygofauna species from the Development Envelope and immediate vicinity of Mesa J Hub (Biologic 2023).
- 16 potential SRE stygofauna species from within the Mesa J Hub potential drawdown impact area, including 9 widespread species; 7 potential SRE species, including the following threatened listed species (including 2 currently under revision and potential reclassification):
    - *Nedsia mcraeae*,
    - *Nedsia robensis* [King et al 2021])
    - *Ophisternon candidum* (Blind Cave Eel) – Vulnerable; Schedule 3;

One Priority 1 PEC (Stygofaunal Community of the Bungaroo Aquifer) overlaps with the Development Envelope.

The Pilbara population of the Blind Cave Eel (specimens and eDNA) has been recorded throughout the Robe River Catchment with a linear range of 120 km that includes the Robe River (upstream and downstream of Mesa J Hub), Jimmawurrada Creek (Upstream) and Kumina Creek (upstream). The majority of the records have been recorded in the Robe River, with Kumina Creek and Jimmawurrada creek being upstream tributaries into the Robe River. In addition, a single positive detection was recorded from the Fortescue River in 2023, extending its distribution to the lower Fortescue River catchment. These records are consistent with the mechanism of distribution hypotheses of Moore et al. (2018).

The saturated alluvium of the major Robe Valley creek systems, predominantly the Robe River, is understood to be the core habitat for the Pilbara population of this species (i.e. habitat critical to the survival of the species), noting that additional work is needed to incorporate the recent Fortescue River records into this understanding. This Robe River habitat is expected to remain largely unaffected by the groundwater drawdown associated with the Mesa H project.

Stygofauna habitat and the modelled extent of groundwater drawdown is shown in Figure 1-9.

stygofauna (and the Blind Cave Eel) within the Development Envelope.

- Maintaining water quality to current baseline levels will support the ongoing persistence of stygofauna (and the Blind Cave Eel) within the Development Envelope.

Uncertainties:

- Inherent limitations in stygofauna (including Blind Cave Eel) 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; sampling bias towards orebodies or their associated aquifer; difficulty in determining the specific geological strata / aquifer that specimens originate from therefore limiting predictive ability of habitat modelling.
- Inherent limitations in sampling methodology that limit Blind Cave Eel detection. Limitations include limited access to the subterranean environment (via drill holes only); general limitation associated with construction of drill/sample holes and size of Blind Cave Eel; general low density of Blind Cave Eel within the environment; likely short-term persistence of eDNA in the environment.
- Lack of taxonomic framework, taxonomic constraints (shared data/specimens) limiting species alignments, identification constraints (juvenile, damaged, wrong sex for species-level IDs) and specialist expertise to identify and determine conservation significance of many groups of subterranean fauna.
- Limited knowledge of stygofauna distribution patterns, ecological requirements, and resilience.

persistence of connected stygofauna habitat in the Development Envelope was a key consideration when defining these criteria and thus supports criteria for stygofauna and Blind Cave Eel habitat. Management criteria have also been developed around the ongoing persistence of a diverse stygofauna community, including the Blind Cave Eel, within the available stygofauna habitat.

The management objective outlined in MS1141 for stygofauna is:

- The Proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages of the local aquifers by minimising impacts as far as practicable.

Key management targets that have been selected to assess whether the management actions are effective in meeting the environmental objective:

- Preservation of stygofauna habitat and habitat integrity via:
    - monitoring of groundwater levels (captured in the Blind Cave Eel EPBC Action Management Plan – Section 3.3); and
    - monitoring of groundwater quality
- Biological indicators – i.e. to verify if changes to stygofauna habitat as a result of the Project result in changes to stygofauna numbers and diversity.

Management targets relate to preserving stygofauna habitat and habitat integrity, and in addition, are consistent with the requirements of Condition 5 of EPBC 2017/8017 relating to the subterranean fish – *Ophisternon candidum* (Blind Cave Eel):

- Monitoring of groundwater levels within the Jimmawurrada Creek and Robe River alluvial aquifers.

  As there are no bores located within the Robe River (for cultural heritage reasons and issues with the ability to retain bores within a river subject to high flows during flood events), the monitoring metric relates to monitoring surface water pool levels (Refer to Inland waters – pools of the Robe River); and in Jimmawurrada Creek - with a limit not to exceed 10 metres of drawdown below the minimum recorded wet season groundwater level to ensure connected habitat is retained. This ensures that >40% of saturated alluvial aquifer habitat is maintained between the Robe River and Jimmawurrada Creek, within the extent of groundwater drawdown associated with the Mesa J Hub (Appendix 5). The metric for drawdown in Jimmawurrada Creek is captured in the requirements for the Blind Cave Eel EPBC Action Management Plan – Section 3.3). The threshold is set based on two or more of the compliance monitoring bores (Appendix 5) reaching the 10m threshold. The rationale for using two bores rather than just a single bore is due to the limited available groundwater bores in Jimmawurrada creek to monitor the groundwater levels (Heritage approval to drill further bores remains pending after several years). These bores are predominantly situated on the margins of the alluvial aquifer rather than along the thalweg, and therefore may be more susceptible and sensitive to variability in water levels (and therefore provide a conservative measure). A second bore measurement is to validate that a threshold level has been exceeded, given some of the uncertainties with the bores along the periphery of the alluvial aquifer.
- Development of Site-Specific Water Quality Trigger Values to ensure no significant change to groundwater quality which may be detrimental to stygofauna and particularly the Blind Cave Eel (Appendix 8). These site-specific Water Quality Values are derived from existing baseline water quality values and published guidance. Refer to Inland Waters – Pools of the Robe River SSTV's (Table 2-6) for further rationale.
- Monitoring of Stygofauna (including specifically for the Blind Cave Eel) to ensure stygofauna assemblages are not significantly impacted as a result of the Project via measurement of stygofauna and Blind Cave Eel specimen capture rate (Appendix 10), 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 simple presence / absence species data would not be a suitable metric and threshold criteria based on abundance or diversity would be inappropriate at this stage. The stygofauna specimen capture rate provides for supporting evidence of any change in trends. Given the extremely low detection rates for the Blind Cave Eel, in order to verify that the outcome of protecting this species is met, monitoring of the available habitat (chemistry and groundwater levels) is proposed, which will be validated by the persistence of this species, based on current detection rates. Current detection rates support a 3 year rolling window for detection of the Blind Cave Eel in the groundwater drawdown areas.

Blind Cave Eel eDNA detection rates

Year	Positive			Samples collected	Supplier	In-field handling of water/filters	Sites only within Mesa H GWDD Zone
	Impact samples	Ref samples	Sites				
2017	42%	13%	22%	36	Helix/eDNA-F	Frozen	2/4 positive
2019	11%	7%	16%	69	helix	Frozen	0/3 positive
2020	14%	29%	21%	28	helix	Frozen	0/6 positive
2021	9%	29%	28%	162	eDNA-F	Frozen	0/5 positive
2022	14%	21%	50%	150	eDNA-F	Frozen	0/5 positive
2023	42%	43%	63%	170	eDNA-F	Most straight in buffer	2/6 positive
2024	44%	35%	52%	165	eDNA-F	Most straight in buffer	1/6 positive

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.

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

415,000mE
420,000mE
425,000mE
7,600,000mN
7,595,000mN
7,590,000mN

Gnieroora (Yeera Bluff)
MESA H
MESA J
Robe River
Jimmawurrada Creek

Legend

Development Envelope

Conceptual Mine Layout
- Mine Pit (indicative)
- Waste Dump / Stockpile

Locally Significant Riparian Vegetation
- C1AA / C1A - OPV-A or OPV-B - MA dominated Open-forest/Closed-forest OR MA and EC dominated Woodlands

Riverine
- C1b - OPV-C - MA and Eucalypt spp. Co-dominated Woodland/Low-woodland
- C2A-EC - FPV-A EC Dominated Open-forest/Woodland
- C2B - FPV-B - EC & EV Co-dominated Open-Forest / Woodland
- C2C/C3 - FPV-C EV dominated Woodland to Low-open-woodland
- C4/C5 - Vadophytic - Gravel Bed or Low-flow channel shrublands
- C6/C7/F - Vadophytic/Xerophytic - Floodplain/Terrace/High-flow Channel Shrublands
- Fringing Hill slope - Colluvial zone vegetation
- HD - Heavily Disturbed - Minimal Vegetation
- PO - POOLS - High Risk GDE - Macrophyte/Sedgelands - Minimal Vegetation

Vegetation
- Drainage Line

- Pool
- Permanent Pool
- Rio Tinto Railway
- Site Access Road
- Major Creek

Drawn: A.D.
Plan: RTIO-1056651v1
Date: July 2024

Checked by: A.Coulson
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

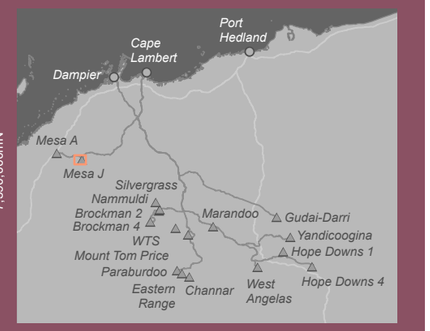

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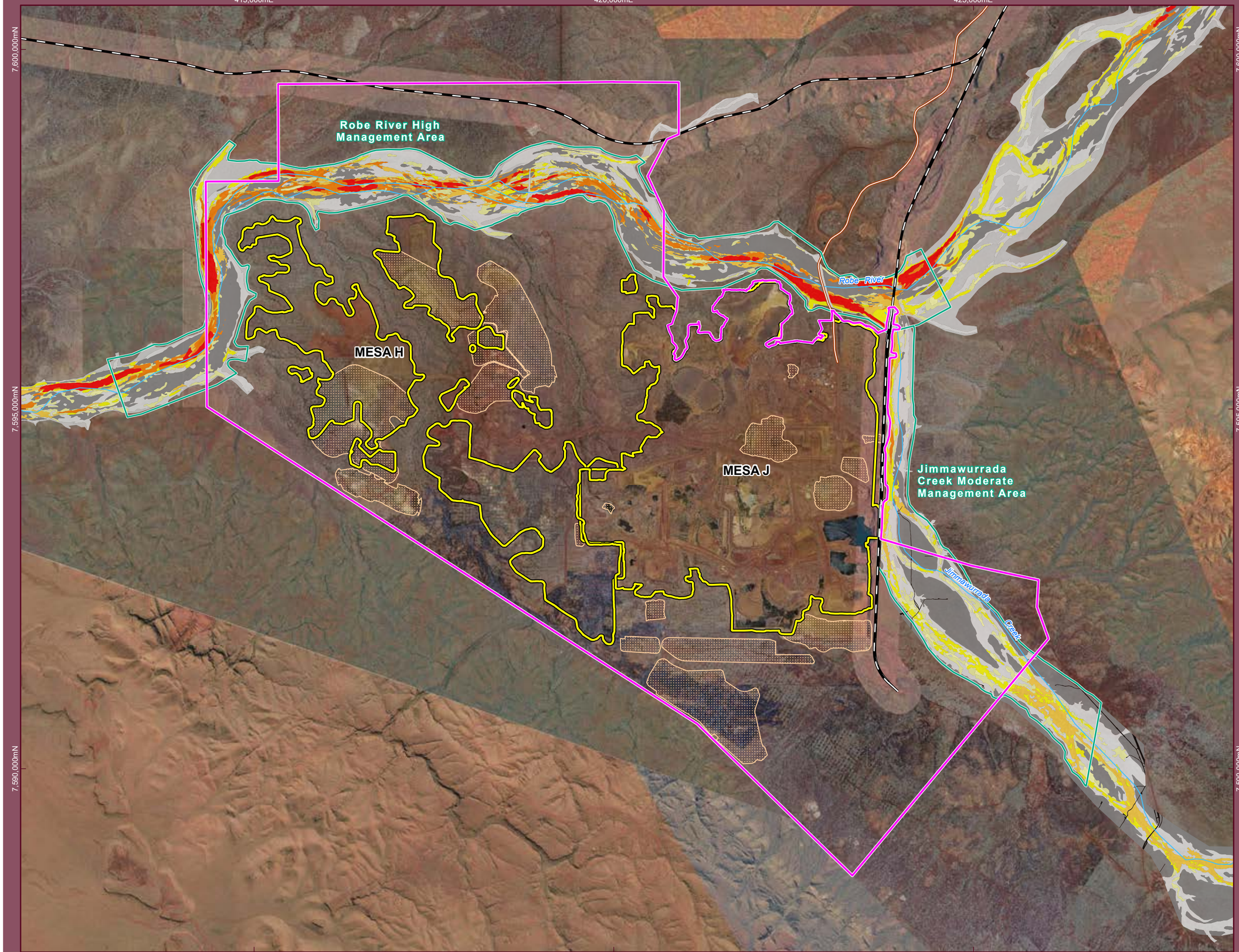
Figure 1-3: Pools and Riparian Vegetation of the Robe River and Jimmawurrada Creek

0 0.5 1 1.5 2
kilometres
Scale: 1:50,000 @A3

N



Legend

- Development Envelope
- Management Area
- Mine Pit (Indicative)
- Waste Dump / Stockpile

Interpreted Risk Rating (Sensitivity)

- Very High
- High
- Moderate-High
- Moderate (+)
- Moderate
- Low-Moderate
- Low
- Very Low
- Negligible
- N/A

- Rio Tinto Railway
- Site Access Road
- Major Creek

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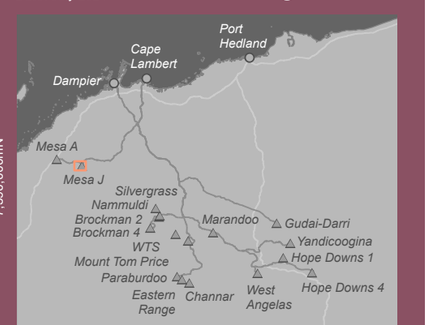

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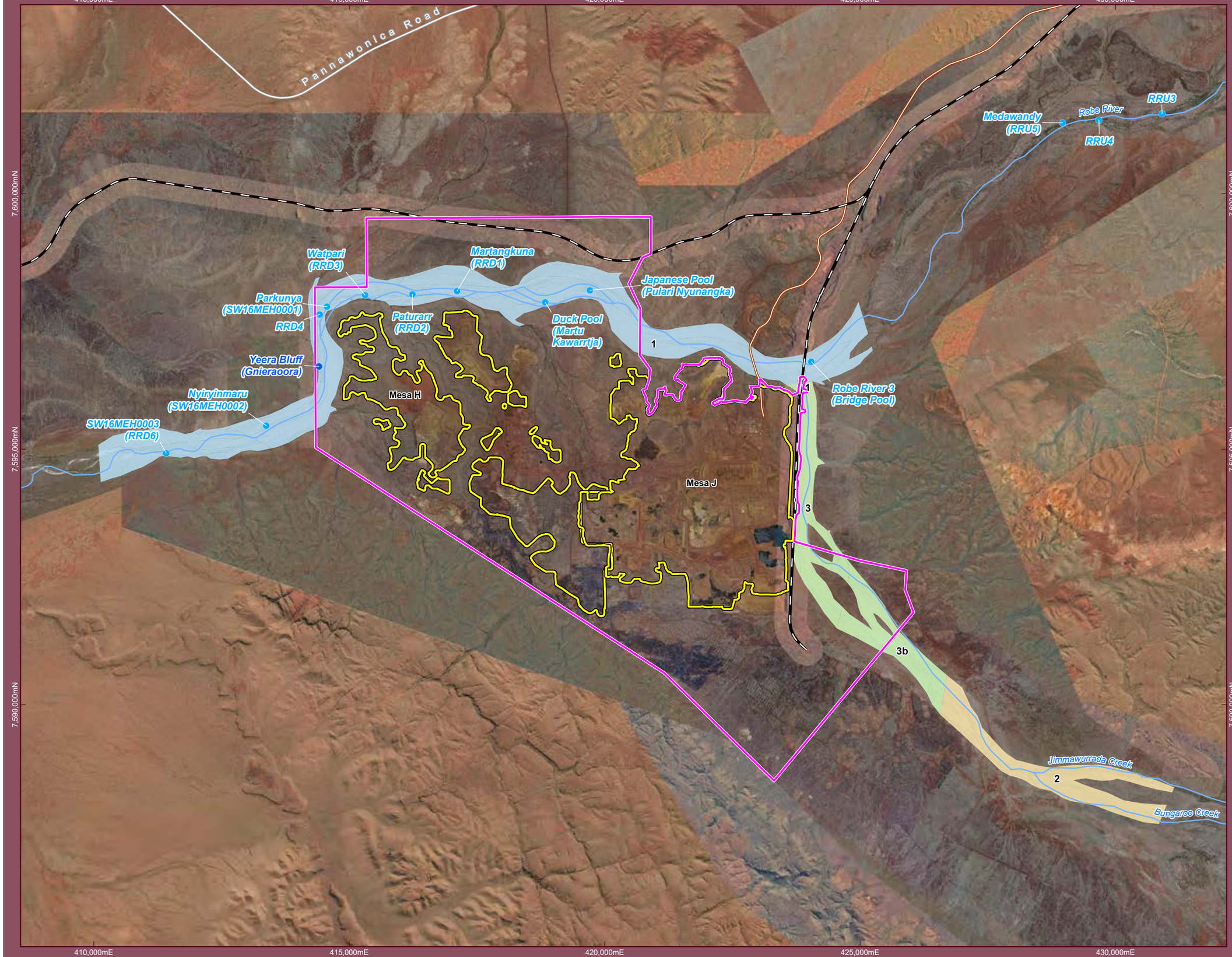
Figure 1-4: Inferred Hydrological Sensitivity of Riparian Vegetation in the Robe River and Jimmawurrada Creek

0 0.5 1 1.5 2
kilometres
Scale: 1:50,000 @A3

N



Legend

- Development Envelope

Conceptual Mine Layout

- Mine Pit (Indicative)

Drawdown Zones

Robe River

- 1 - < 1m

Jimmawurrada Creek

- 3 - 4-9m
- 2 - 4-8m

Pool

- Pool
- Gnieraoora (Yeera Bluff)

- Rio Tinto Railway
- Major Road
- Site Access Road
- Major Creek

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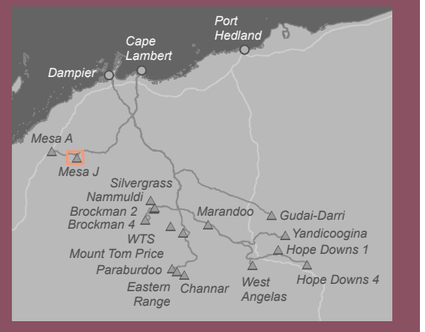

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Figure 1-5: Extent of Groundwater Impact Zones on Riparian Vegetation and Pools

0 0.5 1 1.5 2 2.5
kilometres
Scale: 1:70,000 @A3

N

415,000mE
420,000mE
425,000mE
7,600,000mN
7,595,000mN
7,590,000mN

Robe River
Mesa H
See Inset A
MH16-34
AC04
See Inset B
Mesa J
Jimmawurrada Creek

Inset A
MH16-34
0 100 200 m

Inset B
AC04
0 100 200 m

Legend

- Development Envelope
- Mining Exclusion Zone
- 50m Disturbance Buffer
- 350m Blast Management Buffer

Conceptual Mine Layout

- Mine Pit (Indicative)
- Waste Dump/Stockpile
- Haul Road

Fauna Habitat

- Breakaway
- Disturbed
- Drainage
- Gorge
- Loamy/Stony Plain
- Low Hills and Slopes
- Riverine
- Rocky Hills

- Diurnal/Potential Maternal Ghost Bat Roost
- Nocturnal Ghost Bat Roost
- Rio Tinto Railway
- Site Access Road
- Major Creek

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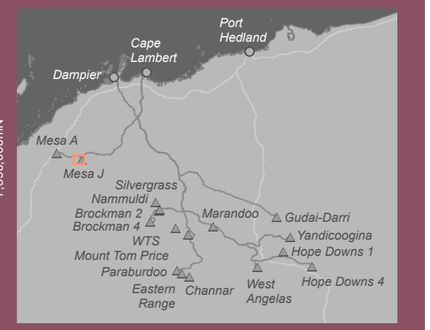

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Figure 1-6: Ghost Bat Habitat and Roosts and Northern Quoll Habitat in the Development Envelope

0 0.5 1 1.5 2 kilometres
N
Scale: 1:50,000 @A3

415,000mE
420,000mE
425,000mE
7,600,000mN
7,595,000mN
7,590,000mN

Mesa H
Mesa J
Robe River
Jimmawurrada Creek

Legend

- Development Envelope
- Mining Exclusion Zone

Conceptual Mine Layout

- Mine Pit (Indicative)
- Waste Dump/Stockpile

Fauna Habitat

- Breakaway
- Disturbed
- Drainage
- Gorge
- Loamy/Stony Plain
- Low Hills and Slopes
- Riverine
- Rocky Hills

Conservation Listed Fauna

- Ghost Bat (Macroderma gigas)
- Northern Quoll (Dasyurus hallucatus)
- Pilbara Leaf-nosed Bat (Rhinonicteris aurantia)
- Pilbara Olive Python (Liasis olivaceus barroni)

- Rio Tinto Railway
- Major Road
- Site Access Road
- Major Creek

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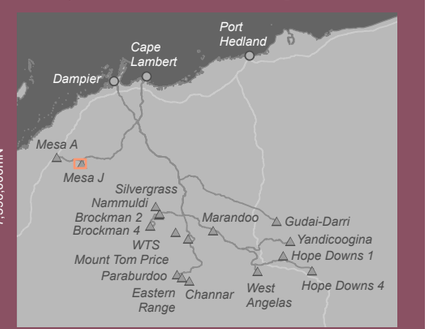

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Figure 1-7: Location of MNES Terrestrial Fauna Recorded in or Near the Development Envelope

0 0.5 1 1.5 2
kilometres
Scale: 1:50,000 @A3

N

415,000mE
420,000mE
425,000mE
7,600,000mN
7,595,000mN
7,590,000mN

Mesa H
Mesa J
Robe River
Jimmawurrada Creek

Legend

- Development Envelope
- Mining Exclusion Zone

Conceptual Mine Layout

- Mine Pit (Indicative)
- Disturbed

Habitat Prospectivity (High Confidence)

- Habitat Prospectivity : High
- Habitat Prospectivity : Medium
- Habitat Prospectivity : Low
- Limit of High Confidence Habitat Modelling

- Rio Tinto Railway
- Site Access Road
- Major Creek

Drawn: A.D.
Plan: RTIO-1056656v1
Date: July 2024

Checked by: M.Jacob
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

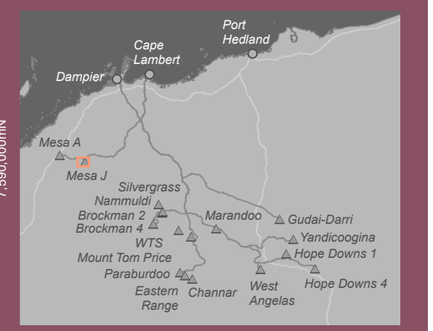

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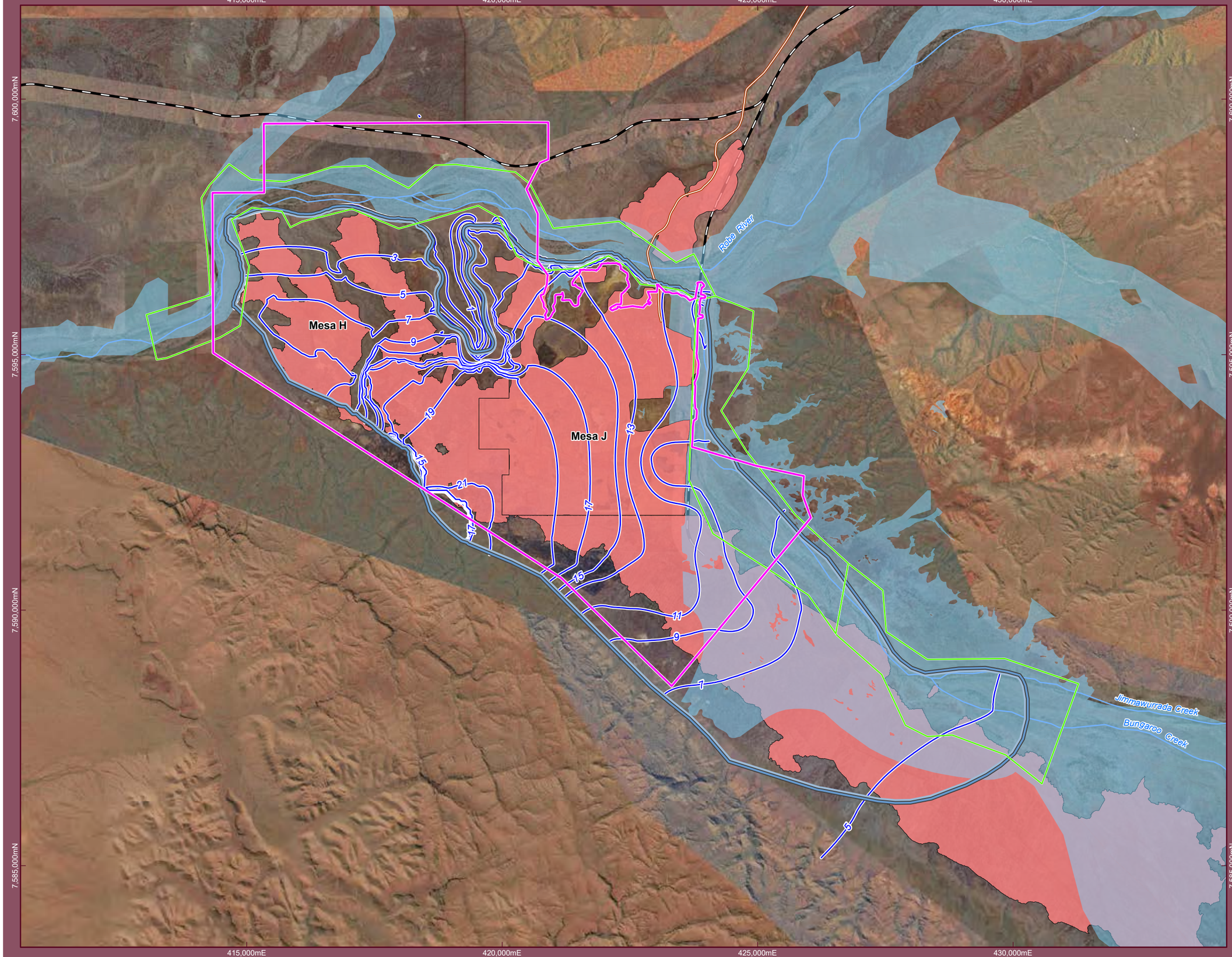
Figure 1-8: Troglofauna Habitat

0 0.5 1 1.5 2
kilometres
Scale: 1:50,000 @A3
N



Legend

- Development Envelope
- Management Area
- Modelled Groundwater Drawdown Extent Attributable to the Proposal

Potential Stygofauna Habitat

- Alluvials
- CID

- Drawdown Contour
- Rio Tinto Railway
- Site Access Road
- Major Creek

Drawn: A.D.
Plan: RTIO-1056657v1
Date: July 2024

Checked by: M.Jacob
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

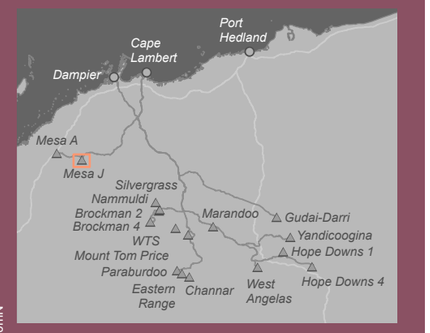


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Figure 1-9: Stygofauna Habitat and Management Area

0 1 2
kilometres
Scale: 1:70,000 @A3

N

2. Requirements under MS 1141

This section of the EMP identifies the provisions the Proponent will implement to ensure that the environmental outcomes and objectives of MS 1141 conditions 6, 7, 8 are met during implementation of the Project. Outcome and objective-based provisions are provided in Section 2.1, and monitoring and reporting are detailed in Table 2-1 to Table 3-27.

Section 3 identifies the provisions the Proponent will implement to meet relevant requirements of EPBC Act Approval 2017/8017.

2.1 Outcome-based and objective-based provisions

The environmental outcomes, environmental criteria (early response, trigger and threshold) and response actions (early response, trigger level and threshold level) are provided in Table 2-1 to Table 2-, for each environmental value that is to be managed using outcome-based provisions. Objective based provisions, management actions and management targets are provided in Table 2- and Table 2-6.

Table 2-1: EMP Provisions: Inland Waters - Vegetation (Robe River)

Rationale: The outcome to ensure no irreversible impact to the health of riparian vegetation of the Robe River acknowledges the high conservation value of the Robe River and hence additional early response criteria has been applied. The criteria applied also reflects that impacts from the Project on the Robe River are expected to be limited (<1m drawdown) and are not expected to be permanent as they will be limited in spatial extent and/or will occur over a limited time period.

EPA Factor: Inland Waters – Groundwater abstraction / discharge and riparian vegetation of the **Robe River**

EPA objectives: *To maintain the hydrological regimes and quality 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.*

Key environmental values: Riparian vegetation of the **Robe River**

Key impacts and risks: Potential adverse impacts on riparian vegetation as a result of groundwater abstraction or surplus water discharge from the Mesa J and H deposits.

Outcome-based provisions

High Level of Management (Figure 1)

Condition 6-1: Ensure no irreversible impact to the health of the **Robe River** and Jimmawurrada Creek ecosystems, including associated riparian vegetation, as a result of groundwater abstraction and surplus water discharge for the Revised Proposal.

Environmental criteria Indicators	Response Actions	Monitoring	Timing/Frequency	Responsible	Reporting
Early response criteria: 1. Robe River groundwater (alluvial aquifer) level trends adjacent to the Mesa J and H deposits (Zone 1) show significantly different abstraction related trends compared with the broader locality or reference sites OR 2. Greater proportion of phreatophytic overstorey stands in the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2[13]) with declining trend in MSAVI since baseline, and/or greater average decline (more negative slope) in comparison to reference areas.[14] **Trigger criteria:** 1. The area of phreatophytic overstorey canopy decline since baseline)below the MSAVI baseline 5th percentile.[15]) is 20% greater in the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2) than in reference areas and a demonstrated casual link to the Project. OR 2. Over 20% of Robe River Zone 1 or Zone 2 monitoring quadrats.[16] record significant structural.[17] or compositional.[18] change, in comparison to baseline and reference sites.	**Early response and trigger criteria action:** **Investigate potential cause of exceedance by review of:** • Review local/regional reference and baseline data with regard to groundwater levels, including surface water levels of Robe River groundwater level monitoring pools and/or alluvial monitoring bores (once installed) and climatic information to assess if groundwater changes are due to natural variation. • Review groundwater abstraction rate, bore location and pumping biases in relation to extent of the cone of depression and the drawdown at potential impact sites compared to predicted impacts on riparian vegetation. • Review results of Robe River pool level monitoring and response actions as per Table 2-3 • Review local and regional reference data, including rainfall, temperature, flooding and fire regime, and weed species to assess if changes to vegetation are due to natural variation. If warranted for early response criterion 2 and trigger criterion 1: • Undertake visual census of remote sensing imagery and triennial CHM data, and review on-ground monitoring to confirm areas of exceedance. If areas coincide with vegetation at greatest risk of impact from groundwater level change (i.e. obligate phreatophytic vegetation), undertake additional on-ground investigation to determine extent of change.	1. **Groundwater level (alluvial aquifer) monitoring** in the Robe River while dewatering of the Mesa J and H deposits is occurring.[19]; upstream and downstream of Mesa J/H and adjacent to Mesa J/H: • Pool level monitoring in the Robe River at key impact and reference pools as per Table 2-3 & Figure 2-2. 2. **Remote Sensing Assessment of overstorey canopy condition** and cover using satellite imagery of the Robe River adjacent to Mesa J and H and upstream and downstream reference areas in the Robe River until dewatering of the Mesa J and H deposits and discharge cease. • Remote sensing images of management zones and analysis of changes (Figure 2-1) • Triennial phreatophytic canopy cover validation through LiDAR or appropriate elevation data set. 3. **On-ground Field Monitoring of composition, condition, and cover** of riparian vegetation (overstorey and understorey, including weed species)	1. **Groundwater level**: Monthly while groundwater abstraction and/or dewatering is occurring. 2. **Remote Sensing:** • Annual (dry season); or biannual as triggered (wet and dry season); and until groundwater abstraction ceases (or as triggered) • Triennial LiDAR or equivalent elevation dataset acquisition; or as triggered; until groundwater abstraction ceases. 3. **On-ground Field Monitoring:** Annual (wet season); or biannual as triggered (wet and dry season); until groundwater abstraction ceases (or as triggered)	1. Hydrogeology team 2. Operations Environment team 3. Operations Environment team	**Early Response Criteria** • If the trigger or threshold criterion was exceeded during the reporting period, the ACAR will include review of early response criteria and actions, if relevant to the exceedance. **Trigger Criteria** • The environmental outcome will be reported against the trigger criterion for each calendar year by 30 April in the ACAR for MS1141. • If any 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.

[13] Zone 1 and Zone 2 refer to the hydrological management zones specified in Figure 1-4 and within riparian remote sensing zone, Mesa J and H Drawdown and Discharge Zone 1.

[14] The number of stands (e.g. groups of at least 20 trees) that show a negative slope in trend of MSAVI with time that is significantly different (α=0.05) from the baseline trend, compared to reference areas. The Proponent will update this criterion as knowledge develops based on empirical observations of tree health and/or improvements in monitoring methodology. MSAVI is the current index used, an alternative index may be used in the future subject to advances in remote sensing. Canopy decline evident from satellite imagery will be confirmed and further investigated with ground truthing via internal on-ground monitoring or un-manned aerial vehicle (UAV) capture.

[15] The criteria is based on current understanding of the system and data. The Proponent will review the criteria after baseline monitoring is complete, and as knowledge develops based on empirical observations of tree health and/or improvements in monitoring methodology. MSAVI is the current index used, an alternative index may be used in the future subject to advances in remote sensing. Canopy decline evident from satellite imagery will be confirmed and further investigated with ground-truthing or analysis of additional remote sensing data (i.e., UAV or LiDAR).

[16] Calculated as the proportion of quadrats meeting the criteria, against the total number of quadrats surveyed within the same zone.

[17] Significant structural change within a quadrat occurs if two or more stratum (upper, mid, or lower) records a shift in two or more structural formation classes applied to National Vegetation Information System Level IV sub-formation classes (ESCAVI 2003) due to a ±1 change in cover class (Table A4. 1).

[18] Significant compositional change within a quadrat occurs if a dominant native perennial species (listed in Table A4. 2) experiences a loss of dominance.

[19] Installation of groundwater bores to enable monitoring is subject to Traditional Owner and formal heritage approval.

EPA Factor: Inland Waters – Groundwater abstraction / discharge and riparian vegetation of the **Robe River** **EPA objectives:** *To maintain the hydrological regimes and quality 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.* **Key environmental values:** Riparian vegetation of the **Robe River** **Key impacts and risks:** Potential adverse impacts on riparian vegetation as a result of groundwater abstraction or surplus water discharge from the Mesa J and H deposits.					

	• If above step confirms exceedance, assess seasonal trends (e.g. with Sentinel imagery) and/or long term and regional trends (e.g. with Landsat imagery)
	• Review current trigger levels according to result of above investigation if necessary.
	If investigations and on-ground survey (if applicable) indicate that trigger exceedance is due to the Project, implement trigger level response actions, for example:
	• Revise the hydrogeological conceptualisation in relation to the hydraulic connection between the Mesa J and H CID aquifer and the Robe River alluvial aquifer.
	• Re-consider potential environmental impacts in relation to any change in the hydrogeological conceptualisation and/or predicted groundwater abstraction.
	If warranted for trigger criterion 2:
	• Additional / increased frequency of weed management if change in vegetation is due to increased weed abundance, including spraying at high risk / key locations including discharge outlets and river / creek crossings.
	If warranted for all criteria:
	• Increase frequency of and/or extent of on-ground monitoring of condition, cover and health of riparian vegetation (overstorey and understorey, including weed species) and remote sensing analysis (if suitable).
	If warranted for all trigger criteria, if investigations indicate that trigger exceedance is due to the Project and may continue to be exceeded with no indication of recovery:
	• Review and modify contingency actions/strategy as warranted; monitor success as appropriate for the relevant strategy; for example, review groundwater levels and next round of vegetation monitoring against baseline and reference sites to ensure no significant adverse impact to riparian vegetation as a result of groundwater abstraction or surface discharge.
	• Consider mitigation options, for example:
	  • Change rate of dewatering
	  • Change timing of dewatering
	  • Use variable speed dewatering bores if relevant
	  • Re-optimise dewatering bore/sumping and trenching configuration/locations
	  • Other options as agreed with relevant stakeholders
	Consult with the DWER if investigation indicates threshold criteria are likely to be exceeded.
		within selected[20], established monitoring areas in the Robe River adjacent to Mesa J and H and upstream and downstream reference areas until dewatering of the Mesa J and H deposits cease (Figure 2-1).
		• Understorey and overstorey riparian taxa: composition, condition, cover and health
		• Weed species, including number and locations.			

[20] The Proponent will determine 'selected' areas from established monitoring sites based on factors such as trigger outcome from annual survey and/or dewatering extent and volume. Locations may not always be available due to accessibility, weather, or safety considerations.

EPA Factor: Inland Waters – Groundwater abstraction / discharge and riparian vegetation of the **Robe River** **EPA objectives:** *To maintain the hydrological regimes and quality 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.* **Key environmental values:** Riparian vegetation of the **Robe River** **Key impacts and risks:** Potential adverse impacts on riparian vegetation as a result of groundwater abstraction or surplus water discharge from the Mesa J and H deposits.					
Threshold Criterion: 1. The area of phreatophytic overstorey canopy decline since baseline (below the baseline MSAVI 5th percentile) is over 50% of the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2)[21]; trend continues over two or more consecutive dry season monitoring events; with no evidence of seasonal recovery; and outside of historical baseline or seasonal variation, in comparison to reference sites with demonstrated causal link to Project. OR 2. Over 50% of Robe River Zone 1 or Zone 2 monitoring quadrats[16] record significant structural[17] or compositional[18] change, in comparison to baseline and reference sites, with demonstrated causal link to Project.	**Threshold contingency action:** **If exceedance of the threshold criteria are considered likely to be attributable to the Project implement action/s as agreed during prior consultation with DWER, for example**: • Change rate of dewatering • Change timing of dewatering • Use variable speed dewatering bores if relevant. • Re-optimise dewatering bore/sumping and trenching configuration/locations. • Increase frequency and/or extent and/or duration of monitoring as appropriate. • Monitor to ensure contingency actions are successful and review procedures, if appropriate Monitor to validate success of threshold contingency actions.	1. Monitoring as per trigger level monitoring # 2 and 3 (or for a longer period as triggered)[22]	1. Monitoring frequency as per trigger level monitoring (or more frequently and/or for a longer period as triggered)	1. As per trigger level responsibilities	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the CEO within seven (7) days of the exceedance being identified. • The Proponent will provide a report to the CEO within twenty-one (21) days of the exceedance being reported. • 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.

[21] MSAVI is the current index used, an alternative index may be used in the future subject to advances in remote sensing. Canopy decline evident from satellite imagery will be confirmed and further investigated with ground-truthing and an investigation into regional trends.

[22] Installation of groundwater bores to enable monitoring is subject to Traditional Owner and formal heritage approval

Table 2-2: EMP Provisions: Inland Waters – Vegetation (Jimmawurrada Creek)

Rationale: The outcomes for riparian vegetation of **Jimmawurrada Creek** acknowledge that the Project may have an impact on riparian vegetation over a 12.5 km stretch, with the most significant impacts predicted across a 6.5 km stretch 'Zone 3' where cumulative drawdown impacts from both the Southern Cutback Borefield (Mesa J & H water supply) and the Coastal Water Supply borefield are modelled to be the most pronounced. 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[23].

EPA Factor: Inland Waters - Groundwater abstraction / discharge and riparian vegetation of **Jimmawurrada Creek**

EPA objective: To maintain the hydrological regimes and quality 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

Key environmental values: Jimmawurrada Creek including groundwater dependent riparian vegetation

Key impacts and risks: Potential adverse impacts on riparian vegetation as a result of groundwater abstraction or surplus water discharge from the Mesa J and H deposits

Outcome-based provisions

Moderate Level of Management (Figure 1)

Condition 6-1: Ensure no irreversible impact to the health of the Robe River and **Jimmawurrada Creek** ecosystems, including associated riparian vegetation, as a result of groundwater abstraction and surplus water discharge for the Revised Proposal.

Environmental Criteria Indicators	Response Actions	Monitoring	Timing/Frequency	Responsible	Reporting
Early response criterion: 1. Within any one management zone, groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 5 metres in depth (below the minimum recorded seasonal groundwater level). **Trigger criteria:** 1. The area of phreatophytic overstorey canopy decline[24] since baseline (below the baseline MSAVI 5th percentile) is 20% greater within Jimmawurrada Creek Zone 3 or Zone 4 than in reference areas and demonstrated causal link to the Project. OR 2. Over 20% of Jimmawurrada Creek Zone 3 or Zone 4 monitoring quadrats[25] record significant structural[26] or compositional[27] change, in comparison to baseline (and reference sites where available). OR 3. Establishment[28] of new high priority weed species within Jimmawurrada Creek Zone 3 monitoring quadrats, or downstream of the discharge extent, previously not detected within the Development Envelope.	**Early response and trigger criteria action**: • Review local/regional reference data with regard to surface water quality, groundwater quality, groundwater levels (aligning with trends for Table 2-6 [trigger criteria] for wet season groundwater levels), trend in baseline groundwater levels and climatic information, to assess if groundwater changes are due to natural variation • Review groundwater abstraction rate, bore location and pumping biases in relation to extent of the cone of depression and the drawdown at potential impact sites compared to predicted impacts on riparian vegetation • Review discharge rates, duration, and discharge outfall location • Review annual remote sensing, on-ground riparian and quarterly tree health monitoring data (DCP) to risk assess potential impact. • Review local and regional reference data, including rainfall, temperature, flooding and fire regime, and weed species to assess if changes to vegetation are due to natural variation. **If warranted for trigger criterion 1:** • Undertake visual census of remote sensing imagery and triennial CHM data and review on-ground monitoring to confirm areas of exceedance • If above step confirms exceedance, assess seasonal trends (e.g. with Sentinel imagery) and/or longer term and regional trends (e.g. with Landsat imagery) • Review current trigger levels according to result of above investigation if necessary **If warranted for trigger criterion 3:** • Additional / increased frequency of weed management including spraying at high risk / key locations including discharge outlets and river / creek crossings	1. **Groundwater level monitoring** in Jimmawurrada Creek while dewatering of the Mesa J deposit and / or abstraction from the Southern Cutback borefield are occurring[29]; adjacent to and upstream of Mesa J / Southern Cutback Borefield: • Groundwater levels measured via selected boreholes (Figure 2-2 / Appendix). 2. **Remote Sensing Assessment of overstorey canopy condition and cover** using satellite imagery of Jimmawurrada Creek adjacent to Mesa J and the Southern Cutback Borefield and upstream and downstream reference areas until dewatering / groundwater abstraction for the Mesa J and H operations cease. • Remote sensing images and analysis of changes (Figure 2-1). • Triennial phreatophytic canopy cover validation through LiDAR or appropriate elevation data set. 3. **On-ground Field Monitoring of composition, condition, and cover of riparian vegetation** (overstorey	1. **Groundwater level monitoring:** Monthly while groundwater abstraction and/or dewatering is occurring abstraction ceases (or as triggered). 2. **Remote Sensing Assessment:** • Annual (dry season); or biannual as triggered (wet and dry season); until groundwater abstraction ceases (or as triggered). • Triennial LiDAR or equivalent elevation dataset acquisition; or as triggered; until groundwater abstraction ceases. 3. **On-ground field monitoring: Bi-annual** (Wet and Dry season) monitoring; and rapid on-ground assessments when triggered; until groundwater abstraction ceases.	1. Hydrogeology team 2. Operations Environment team **3.** Operations Environment team	**Early Response Criteria** • If the trigger or threshold criterion was exceeded during the reporting period, the ACAR will include review of early response criteria and actions, if relevant to the exceedance. **Trigger Criteria:** • The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR. • If any 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.

[23] For the purpose of monitoring compliance against MS 1141 Condition 6-1, **and to ensure consistency between State and Commonwealth approvals groundwater level compliance baselines (April 2020 - lowest recorded wet season low, as per EPBC decision notice 2017/8017)**, baseline riparian vegetation monitoring across Jimmawurrada Creek **is measured prior to this date** (April 2020).

[24] The Proponent will update this criterion as knowledge develops based on empirical observations of tree health and/or improvements in monitoring methodology. MSAVI is the current index used, an alternative index may be used in the future subject to advances in remote sensing. Canopy decline evident from satellite imagery will be confirmed and further investigated with ground-truthing.

[25] Calculated as the proportion of quadrats meeting the criteria against the total number of quadrats surveyed within the same zone.

[26] Significant structural change within a quadrat occurs if two or more stratum (upper, mid, or lower) records a shift in two or more structural formation classes applied to National Vegetation Information System Level IV sub-formation classes (ESCAVI 2003) due to a ±1 change in cover class (refer to Table A4. 1).

[27] Significant compositional change within a quadrat occurs if a dominant native perennial species (listed in Table A4. 2) experiences a loss of dominance.

[28] Establishment occurs if new high priority weed species (not listed in Table A-3) has grown into maturity and reproduced, producing a viable second generation of individual plants.

[29] Installation of groundwater bores to enable monitoring is subject to Traditional Owner and formal heritage approval

	If warranted for all criteria:
	• Increase frequency of and/or extent of on-ground monitoring of condition, cover and health of riparian vegetation (overstorey and understorey, including weeds).
	
	If investigations indicate that trigger exceedance is due to the Project and may continue to be exceeded with no indication of recovery:
	• Review contingency actions/strategy
	• Consider mitigation options, for example:
	  • Change rate of abstraction
	  • Re-optimise the pumping operating strategy away from the impacted areas
	  • Optimise surplus water discharge outlet location to support recovery/reduce impact to high value stands of vegetation
	  • Managed Aquifer Recharge
	  • Other options as agreed with relevant stakeholders
	Consult with the DWER if investigation indicates threshold criteria are likely to be exceeded
		and understorey, including weed species) within selected[30], established monitoring areas in Jimmawurrada Creek downstream of discharge points until dewatering of the Mesa J and H deposits cease (Figure 2-1).
		• Understorey and overstorey riparian taxa: composition, condition, cover and health
		• Weed species: number and locations			

Threshold criteria: 1. The area of phreatophytic canopy decline since baseline (below the baseline MSAVI 5th percentile) is over 50% of the Jimmawurrada Creek potential impact area (Zone 3 and Zone 4)[31]; trend continues over two or more consecutive dry season monitoring events; with no evidence of seasonal recovery; and outside of historical baseline or seasonal variation, in comparison to reference sites with demonstrated causal link to Project OR 2. Over 50% of Jimmawurrada Creek Zone 3 or Zone 4 monitoring quadrats[25] record significant structural[26] or compositional[27] change in comparison to baseline (and reference sites where available) with demonstrated causal link to Project. OR 3. Increased extent and persistence[32] of high priority weed species within Jimmawurrada Creek Zone 3 monitoring quadrats or downstream of the discharge extent, relative to baseline (and reference data where applicable) with demonstrated causal link to the Project.	**If exceedance of threshold criterion is considered likely to be attributable to the Project implement contingency action/s as agreed during prior consultation with the DWER, for example**: • Change rate of abstraction • Re-optimise the pumping operating strategy away from the impacted areas • Provide temporary supplementary irrigation to high value stands of vegetation • Optimise surplus water discharge outlet location to support recovery/reduce impact to high value stands of vegetation • Managed Aquifer Recharge • Increase frequency and/or extent of monitoring as appropriate Monitor to ensure contingency actions are successful and review procedures, if appropriate.	1. Monitoring as per trigger level monitoring # 2 and 3 (or for a longer period as triggered)	1. Monitoring frequency as per trigger level monitoring (or more frequently and/or for a longer period as triggered)	• Operations Environmental team	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the CEO within seven (7) days of the exceedance being identified. • The Proponent will provide a report to the CEO within twenty-one (21) days of the exceedance being reported. • 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.

[30] The Proponent will determine 'selected' areas from established monitoring sites based on factors such as trigger outcome from annual survey and/or dewatering extent and volume. Locations may not always be available due to accessibility, weather, or safety considerations.

[31] The Proponent will update the criteria as knowledge develops based on empirical observations of tree health and/or improvements in monitoring methodology. MSAVI is the current index used, an alternative index may be used in the future subject to advances in remote sensing. Canopy decline evident from satellite imagery will be confirmed and further investigated with ground-truthing.

[32] Over 20% of quadrats across the zone with records of a high priority weed species for over three or more years.

Table 2-3: EMP Provisions: Inland Waters – Pools of the Robe River

Rationale: Groundwater abstraction for pit dewatering may result in a temporary reduction of water levels in the Robe River alluvial aquifer and the Robe River semi-permanent and permanent pools up to 1m. Shallow intermittent and semi-permanent pools (<1m depth) have the potential to dry out more quickly during extended dry periods, however the effects would be seasonal / temporary, and the deeper pools and permanent pool at Yeera Bluff are expected to continue to persist without active management. The footprint of the periodic surplus water discharge may intermittently (although unlikely) extend up to 8km from the discharge outlets on Jimmawurrada Creek and / or West Creek, however the wetting footprint is currently observed to dissipate once it reaches the gravel alluvial aquifer of the Robe River due to the storage capacity / high transmissivity. Changes to surface water quality from discharge activities may potentially indirectly impact the health of the local aquatic fauna population. The risk to aquatic fauna is the highest during extended drought or no-flow events when dilution is at its lowest. However, the intermittent, temporary and localised (<8km) nature of the discharge, is unlikely to impact the broader aquatic fauna population, which survives in an environment with a naturally high variability in surface water quality due to wet season rainfall patterns and concentration from evaporation during dry periods.

EPA Factor: Inland Waters - Groundwater abstraction / discharge and **Pools of the Robe River**

EPA objective: To maintain the hydrological regimes and quality 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.

Key environmental values: Pool ecosystems of the Robe River

Key impacts and risks: Potential adverse impacts on semi-permanent – permanent pools of the Robe River as a result of groundwater abstraction or surplus water discharge from the Mesa J and H deposits

Outcome-based provisions

High Level of Management (Figure 1-3)

Condition 6-1 (3): Ensure no irreversible impact to the health of the **pools** of the Robe River, as a result of groundwater abstraction and/or discharge of surplus water for the Revised Proposal.

Environmental Criteria Indicators	Response Actions	Monitoring	Timing/Frequency	Responsible	Reporting
Early response criterion: 1. Water quality in any key pool exceeds Tier 1 SSGV. **Trigger criteria:** 1. Pool surface water levels at Yeera Bluff (Gnieraoora) fall below historically recorded natural low of 114.5m AHD. OR 2. Water quality in any key pool exceeds Tier 2 SSGV[33].	**Early response actions**: • Confirm water quality exceedance with resampling as soon as practicable. • Review baseline, local and regional reference data, including discharge volumes and water quality , weather conditions (i.e. rainfall and temperature), and flooding, to assess if changes to water quality are due to natural variation. • Review routine (biannual) aquatic fauna monitoring for evidence of impact of water quality change on diversity or composition of aquatic invertebrates or fish. **In addition to early warning actions**: • Review local/regional reference data with regard to groundwater levels, trend in baseline groundwater levels and climatic information, to assess if groundwater changes / pool level changes are due to natural variation. • Assess predicted impacts on pool levels by review of groundwater abstraction rates, bore locations and pumping biases in relation to extent of the cone of depression and the drawdown at potential impact sites. • Review and revise (if appropriate) the hydrogeological conceptualisation in relation to the hydraulic connection between the Mesa J and H CID aquifer and the Robe River alluvial aquifer. • Undertake visual census (e.g. aerial imagery review, on-ground monitoring, drone, etc.) of semi-permanent pools as per supporting monitoring (Figure 2-2). • If visual census confirms exceedance attributable to mining activities, assess seasonal trends (e.g. with using site aerial imagery and available satellite imagery) and/or longer term and regional trends (e.g. with applicable band/resolution satellite imagery) • Review current trigger levels according to result of above investigation if necessary. **If warranted for trigger criterion 3**: • Review local and regional reference data, including discharge and water quality sources, rainfall, temperature, and flooding, to assess if changes to the pool water quality is due to natural variation. • Review of discharge water quality and sediment quality analysis as indicators of potential for water quality impacts in Robe River pools and to trigger response action(s) prior to impact.	1. Pool surface water level monitoring (mAHD) in pools while dewatering of the Mesa J and H deposits is Figure); • Yeera Bluff (Gnieraoora) • Japanese Pool (Pulari Nyunangka) • Robe River 3 (Bridge Pool) • SW16MEH0003 (RRD6) • RRD4 • Medawandy (RRU5) 2. Water quality monitoring of selected analytes as listed in Appendix 6 in key pools of the Robe River (Figure 2-2).	1. Monthly 2. Quarterly	1. Operations Environment Team 2. Operations Environment Team	**Early Response Criteria** • If the trigger or threshold criterion was exceeded during the reporting period, the ACAR will include review of early response criteria and actions, if relevant to the exceedance. **Trigger Criteria** • The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR. • If any 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 and will include review of early response criteria, if relevant to the exceedance.

[33] Exceedance of the Tier 2 SSGV water quality criteria will be assessed as is described in Appendix 6.

	• Review routine (biannual) aquatic fauna monitoring for evidence of impact of water quality change on diversity or composition aquatic invertebrates or fish. • Notify ALGALWATCH if there is evidence of a harmful algae bloom and undertake additional monitoring as advised by ALGALWATCH. • If warranted, undertake an ecological effects assessment to investigate ecological effects associated with Mesa H in one or more ecological groups (for example this may include ecotoxicological assessment and/or tissue analysis). **If investigations indicate that trigger exceedance is due to the Project and may continue to be exceeded with no indication of recovery**: • Review contingency actions/strategy and options as agreed with relevant stakeholders. Consider mitigation options, for example: • **Criteria 1 and 2** • Change rate of abstraction • Cease dewatering below 116m AHD in Mesa H Pit 7 and Pit 8 until significant rainfall recharge has occurred. • Re-optimise the pumping operating strategy away from the impacted areas. • **Criteria 3** • Should the Ecological Effects Assessment or other investigations indicate potential significant impact to aquatic fauna undertake corrective action (e.g. amend discharge regime) in consultation with the DWER. Consult with the DWER if investigation indicates threshold criteria are likely to be exceeded				
Threshold criteria: 1. Pool surface water levels at Yeera Bluff (Gnieraoora) Pool fall below 113.5m AHD.[34]; OR 2. Ecological Effects Assessment shows a declining trend in aquatic fauna diversity.[35] or change to assemblage structure with demonstrated causal relationship to the Project and effects persisting for 2 or more years.	**If exceedance of threshold criterion is considered likely to be attributable to the Project implement contingency action/s as agreed during prior consultation with the DWER, for example:** • Change rate of abstraction • Maintain no dewatering below 116m AHD in Mesa H Pit 7 & 8 until significant rainfall recharge has occurred. • Re-optimise the pumping operating strategy away from the impacted areas. • Increase frequency and/or extent of monitoring as appropriate. • Undertake water quality Ecological Effects Assessment • Should the ecological effects assessment show that there is a potential for irreversible impact to the health of the Robe River Pool ecosystems (e.g. aquatic fauna), the Proponent will consider Whole Effluent Testing (WET), including an ecotoxicological assessment if warranted. Monitor to ensure contingency actions are successful and review procedures, if appropriate	1. Pool surface water level monitoring (mAHD) in pools while dewatering of the Mesa J and H deposits is occurring (Figure 2-2); • Yeera Bluff (Gnieraoora) • Japanese Pool (Pulari Nyunangka) • Robe River 3 (Bridge Pool) • SW16MEH0003 (RRD6): reference / background pool • RRD4 • Medawandy (RRU5) 2. Aquatic invertebrates (including hyporheic fauna) composition, phytoplankton and fish composition, size class distribution and abundance, in selected upstream / downstream reference and key pools of the Robe River31F.[36] (Figure 2-2).	1. Monthly 2. Bi-annual (or more frequently as triggered).	1. Operations Environment team 2. Operations Environment team	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the CEO within seven (7) days of the exceedance being identified. • The Proponent will provide a report to the CEO within twenty-one (21) days of the exceedance being reported. • 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.
• **Supporting monitoring parameters for the pool ecosystems of the Robe River**					
1. Pool level monitoring 2. Water quality 3. Sediment quality	Supporting parameters, review of trends to inform the trigger and threshold criteria.	1. Paired alluvial bores (when available). 2. Discharge points and other potential sources where applicable. 3. In selected key pools and/or other potential impact areas, where applicable.	1. Monthly 2. Quarterly from discharge points when discharging 3. Biennial (or as triggered)	1. Hydrogeology team 2. Operations Environment team 3. Operations Environment team	• If the trigger or threshold criterion was exceeded during the reporting period, the ACAR will include relevant supporting monitoring results, if relevant to the exceedance.

[34] Drop of 1m below December 2019 wet-season low

[35] Macroinvertebrates and hyporheic fauna. Note that sampling includes other variables (e.g habitat, water quality) for supporting assessment.

[36] The Proponent will determine 'selected' areas from established monitoring sites based on factors such as trigger outcome from routine surveys. Locations may not always be available due to accessibility, weather or safety considerations

415,000mE 420,000mE 425,000mE 430,000mE

7,600,000mN 7,595,000mN 7,590,000mN 7,585,000mN

Mesa J and H Drawdown and Discharge Zone 1

MESA H

MESA J

Robe River

MesaJ SCB Drawdown Zone 3

Mesa J SCB Drawdown Zone 2

Jimmawurrada Creek

Bungaroo Creek

Legend

- Development Envelope

Conceptual Mine Layout

- Mine Pit (indicative)
- Waste Dump / Stockpile

Management Zones

- Zone 1 (drawdown < 0.5m)
- Zone 2 (drawdown < 1m)
- Zone 3 (drawdown 4-9m)
- Zone 4 (drawdown 4-8m)

Management Areas

- Potential Impact
- Reference

Riparian Monitoring Transects

- Potential Impact
- Reference

- Rio Tinto Railway
- Site Access Road
- Drawdown Contour
- Major Creek

Drawn: GIS Team
Plan: RTIO-1056658v2
Date: July 2024

Checked by: M.Jacob
Proj: GDA 1994 MGA Zone 50
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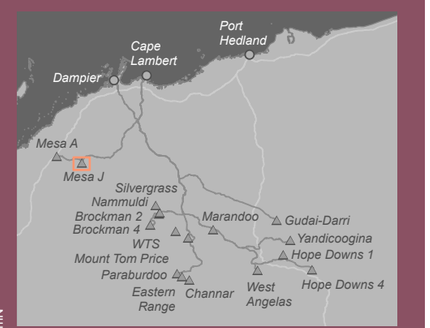

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Figure 2-1: Indicative Riparian Vegetation Monitoring Locations and Remote Sensing Management Zones for the Robe River and Jimmawurrada Creek

0 0.5 1 1.5 2
kilometres
Scale: 1:70,000 @A3

N

415,000mE 420,000mE 425,000mE 430,000mE 435,000mE

7,605,000mN 7,600,000mN 7,595,000mN 7,590,000mN 7,585,000mN

Pannawonica Road

Watpari (RRD3)
Paturarr (RRD2)
Martangkuna (RRD1)
Parkunya (SW16MEH0001)
RRD4
Japanese Pool (Pulari Nyunangka)
Duck Pool (Martu Kawarrtja)
Yeera Bluff (Gnieraoora)
Nyityinmaru (SW16MEH0002)
SW16MEH0003 (RRD6)
MESA H
MESA J
PFF1
PZ09MEJ004
Robe River 3 (Bridge Pool)
Medawandy (RRU5)
RRU4
RRU3
RRU1
Robe River
JWO29
JWO21
JWO23
PZ10BUN041
Jimmawurrada Creek
Bungaroo Creek

Legend

- Development Envelope
- Key Water Quality Monitoring Pool
- Pool Level Measurement Location
- Aquatic Fauna Monitoring Pool
- Groundwater Monitoring Bore
- Proposed Paired Alluvial Bore

Conceptual Mine Layout

- Mine Pit (indicative)

Management Zones

- Zone 1 (drawdown < 0.5m)
- Zone 2 (drawdown < 1m)
- Zone 3 (drawdown 4-9m)
- Zone 4 (drawdown 4-8m)

- Rio Tinto Railway
- Major Road
- Minor Road
- Site Access Road
- Major Creek

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Plan: RTIO-1056659v2
Date: July 2024

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Proj: GDA 1994 MGA Zone 50
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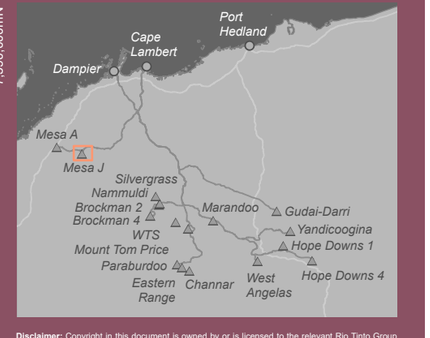

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Figure 2-2: Indicative Hydrological Monitoring areas for the Robe River, Jimmawurrada Creek and Pools

0 0.5 1 1.5 2
kilometres
Scale: 1:80,000 @A3

N

Table 2-4: EMP Provisions: Terrestrial Fauna habitat (Ghost Bat, Northern Quoll and Pilbara Leaf-nosed Bat)

Rationale: Protection of high value habitat for the Ghost Bat, Northern Quoll and Pilbara Leaf-nosed Bat is the most appropriate strategy to protect these conservation significant fauna species within the Development Envelope (Figure 1-7). High value habitat for the Ghost Bat and Pilbara Leaf-nosed Bat includes the escarpment and cave structures associated with mesa facades in the Robe Valley (noting that Mesa H's prominent facades generally only occur along the north-west and central gully areas), which have been protected from mine excavation by delineation of a MEZ (Figure 1-7). Similarly, the mesa escarpments and their rocky slopes (comprising breakaway and gullies habitats) also support foraging habitat potential Northern Quoll denning habitat. Early response, trigger and threshold criteria have been applied to diurnal / potential maternal Ghost Bat roosts, as these roosts are recognised as geographically restricted and ecologically critical for this species. No Pilbara Leaf-nosed bat roosts have been recorded at Mesa H. 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'. Trigger and threshold criteria have been applied to ensure preservation of high value habitat (breakaways and gullies) which is potential Northern Quoll denning habitat within the MEZ, and additionally also supports preservation of foraging habitat for all three species.

EPA Factor: Terrestrial Fauna – Ghost Bat, Northern Quoll and Pilbara Leaf-nosed Bat

EPA objective: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

Key environmental values: Conservation significant fauna species – Ghost Bat, Northern Quoll and Pilbara Leaf-nosed Bat

Key impacts and risks: Potential reduction or degradation of high value Ghost Bat roosting, Northern Quoll denning and Pilbara Leaf-nosed Bat foraging habitat as a result of implementation of the Project

Outcome-based provisions

High Level of Management (Figure 1-6 & Figure 1-7)

Condition 8: No irreversible impact, as a result of the Revised Proposal, to Breakaways and Gullies habitat retained within the Mesa H MEZ, other than existing and authorised disturbance

Environmental Criteria Indicators	Response Actions	Monitoring	Timing/Frequency	Responsible	Reporting
Early response criterion: 1. Disturbance, other than existing and authorised clearing[37], within 50 m of the recorded back of the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6	**Early response action:** **Investigate potential cause of exceedance by review of:** Review clearing extent, blast vibration predictions, blast vibration monitoring levels and other natural factors (e.g. seasonal rainfall data) to determine if disturbance is as expected. • Review land clearing procedure, vibration model and/or blast management controls as appropriate	1. **Blast vibration monitoring** for all blasts within 300 m of the diurnal / potential maternal Ghost Bat roosts (AC04 (CRMH-01) & MH16-34 (CRMH-02)) as shown in Figure 1-6 • Modelling of peak particle velocity prior to blast. • Vibration monitoring of actual peak particle velocity. • Analysis of modelled versus actual peak particle velocity. 2. **Land clearing reconciliation** against diurnal / potential maternal Ghost Bat roost cave buffers. • Land clearing reconciliation (against GIS avoidance layers and disturbance layers) to ensure the Mining Exclusion Zones are not impacted or entered without authorisation. • Aerial image capture (satellite or Remotely Piloted Aircraft). • Internal approvals request process	1. All blasts within 300m of diurnal / potential maternal roosts 2. Annual, or as triggered clearing reconciliation	1. Operations Drill and Blast Team 2. Operations Environment team	• If the trigger or threshold criterion was exceeded during the reporting period, the ACAR will include review of early warning criterion, if relevant to the exceedance and will include review of early response criteria, if relevant to the exceedance.
Trigger criteria: 1. Vibration levels exceed 50 mm/s peak particle velocity at the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6 OR 2. Disturbance of ≥ 5% of potential Northern Quoll denning habitat (comprising Breakaways and Gullies habitat) in the MEZ of Mesa H, excluding existing disturbance (prior to MS1141)	**Trigger criterion action 1:** **Investigate potential cause of exceedance by:** • Review mine plan, blast vibration predictions and blast vibration monitoring data. • Update vibration model and/or modify blast management controls as appropriate. • Conduct geotechnical assessment of the site to assess structural stability of the roost. • Review supporting Ghost Bat monitoring data. **Trigger criterion action 2:** **Investigate potential cause of exceedance by:** • Review clearing extent, blast vibration predictions, blast vibration monitoring levels and other natural factors (e.g. seasonal rainfall data) to determine if disturbance is as expected. • Conduct on-ground assessments as appropriate. If investigations indicate that trigger exceedance is associated with the Project, implement trigger level response actions, for example: • Investigate potential MEZ remediation strategies, as agreed with relevant stakeholders. • Consult with the DWER if investigation indicates threshold criteria are likely to be exceeded and where relevant, agreed response actions could include temporary cessation of some activities.	1. **Blast vibration monitoring** for all blasts within 300 m of the diurnal / potential maternal Ghost Bat roosts (AC04 (CRMH-01) & MH16-34 (CRMH-02)) as shown in Figure 1-6 • As per early warning monitoring 2. **Land clearing reconciliation** against potential Northern Quoll denning habitat in the MEZ of Mesa H. • As per early warning monitoring 3. **Temperature and humidity monitoring** in diurnal/potential maternal Ghost Bat roosts AC04 (CRMH-01) & MH16-34 (CRMH-02) as shown in Figure 3-1 • Temperature and humidity logging and data analysis correlated against reference sites and ambient temperature; and • timing of mine pit development / blasting data in adjacent pits as appropriate.	1. All blasts within 300m of diurnal / potential maternal roosts 2. Annual, or as triggered clearing reconciliation. 3. Ongoing (continuous[38]) during operational mine life	1. Operations Drill and Blast Team 2. Operations Environment team 3. Operations Environment team	• The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR for MS1141. • If any 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.

[37] Authorised clearing is as authorised in Table 2 of Schedule 1 of MS 1141

[38] Continuous monitoring except where downtime is experienced e.g. due to periodic maintenance or equipment failure

Threshold criteria: 1. Permanent structural damage to diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6 with demonstrated causal link to Project. OR 2. Disturbance, other than existing and authorised clearing[3], within 40 m of the recorded back of the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6 with demonstrated causal link to Project. OR 3. Disturbance of ≥ 10% of potential Northern Quoll denning habitat (comprising Breakaways and Gullies habitat) in the MEZ of Mesa H, excluding existing disturbance with demonstrated causal link to Project	**Threshold criterion action 1:** • Review temperature and humidity monitoring data to determine if the roost cave microclimate has been compromised. • If the roost cave microclimate has been compromised from structural damage, remediate any noticeable new cave openings exposed pit-side. **Threshold criterion action 2:** • Implement threshold contingency actions as agreed during prior consultation with DWER, for example: o remediate disturbance within 40 m of the recorded back of the diurnal/ potential maternal Ghost Bat roost caves. **Threshold criterion action 3:** • Remediate disturbance to the MEZ. Implement measures as agreed by relevant stakeholders. Monitor the threshold contingency actions to validate success of mitigation strategy.	1. **Blast vibration monitoring** for all blasts within 300 m of the diurnal / potential maternal Ghost Bat roosts AC04 (CRMH-01) & MH16-34 (CRMH-02) as shown in Figure 1-6 • As per early warning monitoring 2. **Land clearing reconciliation** against potential Northern Quoll denning habitat in the MEZ of Mesa H. • As per early warning monitoring 3. **Temperature and humidity monitoring** in diurnal/potential maternal Ghost Bat roosts AC04 (CRMH-01) & MH16-34 (CRMH-02) as shown in Figure 3-1 • Temperature and humidity logging and data analysis correlated against reference sites and ambient temperature; and • timing of mine pit development / blasting data in adjacent pits as appropriate.	1. All blasts within 300m of diurnal / potential maternal roosts 2. Annual, or as triggered clearing reconciliation. 3. Ongoing (continuous[38]) during operational mine life	1. Operations Drill and Blast Team 2. Operations Environment team 3. Operations Environment team	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the CEO within seven (7) days of the exceedance being identified. • The Proponent will provide a report to the CEO within twenty-one (21) days of the exceedance being reported. • The environmental outcome will be reported against the threshold criterion for each calendar year by 30 April in the ACAR • If a 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
• **Supporting[39] Northern Quoll monitoring parameters for the trigger and threshold criteria**					
Northern Quoll monitoring (Figure 2-3)	N/A	• Annual camera monitoring including spot pattern analysis of individuals	Annual	• Operations Environment team	• N/A

[39] Parameters collected during annual surveys will assist in the interpretation of trigger and threshold criteria should an exceedance or trend be noted. The monitoring locations will be subject to a 3-yearly review, based on outcomes of the monitoring program to support an adaptive management approach.

410,000mE 420,000mE 430,000mE 440,000mE 450,000mE

7,610,000mN

7,600,000mN

7,590,000mN

Inset A 0 200 400 m

Inset B 0 100 200 m

Inset C 0 100 200 m

Inset D 0 200 400 m

Inset E 0 100 200 m

Pannawonica Road

East Deepdale

Mesa K

Mesa G

Mesa H

Mesa J

Pit

Middle Robe

Robe River

Gnieroora (Yeera Bluff)

See Inset A

See Inset B

See Inset C

See Inset D

See Inset E

Burgaroo Creek

Jimmawurrada Creek

Legend

- Development Envelope

Conceptual Mine Layout

- Mine Pit (indicative)

MNES Habitat

- Breakaways and Gullies
- Hills
- Mesa Plateau
- Plain
- River

Indicative Northern Quoll Monitoring Location

- Motion Camera

Pool

- Gnieraoora (Yeera Bluff)

- Rio Tinto Railway
- Major Road
- Minor Road
- Site Access Road
- Major Creek

Drawn: A.D.
Plan: RTIO-1056660v2
Date: July 2024

Checked by: DvH
Proj: GDA 1994 MGA Zone 50
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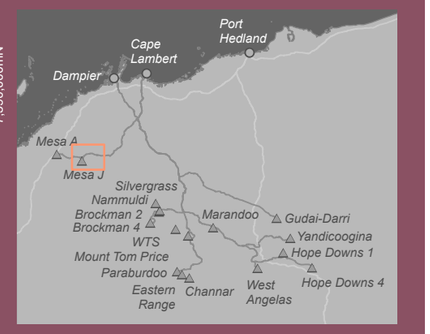

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Figure 2-3: Indicative Camera Locations for Northern Quoll Monitoring

0 1 2 3 4 5 kilometres

Scale: 1:140,000 @A3

N

Table 2-5: EMP Provisions: Subterranean Fauna (Troglofauna)

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

EPA Factor: Subterranean Fauna - Troglofauna

EPA objective: To protect subterranean fauna so that biological diversity and ecological integrity are maintained.

Key environmental values: Subterranean fauna - troglofauna

Key impacts and risks: Reduction of habitat from mining as a result of implementation of the Project

Outcome-based provisions

Moderate Management zone (Figure 1-8)

Condition 7-1 (1): A minimum of fifty (50) percent by volume of pre-mining troglofauna habitat shall be retained at Mesa H through the implementation of a Mining Exclusion Zone (MEZ) as delineated in Figure 1 of Schedule 1

Environmental Criteria Indicators	Response Actions	Monitoring	Timing/Frequency	Responsible	Reporting
Trigger criterion: 1. Operational error during mining resulting in removal of greater than 0.05% by volume annually of the Mesa H MEZ.	• Review 3-dimensional pit shell and adjust to ensure no predicted net loss of the Mesa H MEZ (i.e. amend mine plan to ensure retention of the same volume of habitat as approved under MS1141) • Assess the adequacy of work practices and propose changes if necessary to prevent future deviations from the planned 3-dimensional pit shell.	1. **Pit shell reconciliation** for Mesa H mine pit	1. Annual	1. Operations Environment team	• The environmental outcome will be reported against the trigger criteria for each calendar year by 30 April in the ACAR. • If any 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. Net loss of the Mesa H MEZ such that the retained habitat represents less than 50% by volume of pre-mining habitat.	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	1. **Monitor the effectiveness** of contingency actions	1. As required	1. Operations Environment team	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the CEO within seven (7) days of the exceedance being identified. • The Proponent will provide a report to the CEO within twenty-one (21) days of the exceedance being reported. 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. • schedule for ongoing monitoring and reporting

Management-based provisions					
Condition 7-2 (1): The proponent shall protect the biological diversity and ecological integrity of the troglofauna assemblages of Mesa H by minimizing impacts as far as practicable					
Management Targets	**Management Actions**	**Monitoring**	**Timing / Frequency**	**Responsible**	**Reporting**
1. Total clearing of native vegetation across the surface of the MEZ is not greater than: a. 132 ha within the Mesa H MEZ excluding existing clearing prior to MS1141. 2. Troglofauna specimen capture rate is not below the baseline minimum[40] for three consecutive sampling events at Mesa H.	• Maintain MEZ (significant troglofauna habitat). • Minimise ground disturbance and potential for degradation in the retained MEZ habitat. • Continue to improve understanding of troglofauna ecology	1. **Land clearing reconciliation** against Mesa H MEZ 2. **Troglofauna field survey.** <u>Monitoring:</u> • Nominal 20 holes within the MEZ (Figure 1-8) including trapping and scraping 3. **Rainfall** with daily total reporting.	1. Annual 2. Biennial 3. Continuous[38]	1. Operations Environment team 2. Operations Environment team 3. Operations Environment team	• The environmental outcome will be reported against the management target for each calendar year by 30 April in the ACAR for MS1141 • 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. The annual report will also include: • Capture rates calculated for sampling conducted using the scraping technique (calculated as number of specimens per 100 scraped holes) and comparison with previous capture rates for the scraping technique. Due to the limited baseline data for the scraping technique, these capture rates will be provided as additional contextual information and will not form part of the management target for capture rate.

Table 2-6: EMP Provisions: Subterranean Fauna (Stygofauna)

Rationale: Stygofauna surveys in general have low capture rates per survey effort meaning the abundance and diversity of stygofauna recorded during surveys are highly variable (Halse and Pearson 2014). These sampling artefacts mean that threshold criteria based on stygofauna abundance or diversity would be inappropriate at this stage. Protection and preservation of high prospectivity habitat and its quality for stygofauna is, therefore, considered the most appropriate strategy to protect stygofauna so that biological diversity and ecological integrity are maintained. In addition, this approach also supports the requirements of Condition 5 of EPBC 2017/8017 relating to the subterranean fish – *Ophisternon candidum* (Blind Cave Eel):

EPA Factor: Subterranean Fauna - Stygofauna

EPA objective: To protect subterranean fauna so that biological diversity and ecological integrity are maintained

Key environmental values: Subterranean fauna – stygofauna (including the Blind Cave Eel)

Key impacts and risks: Reduction of habitat and habitat quality from groundwater abstraction and discharge as a result of implementation of the Project

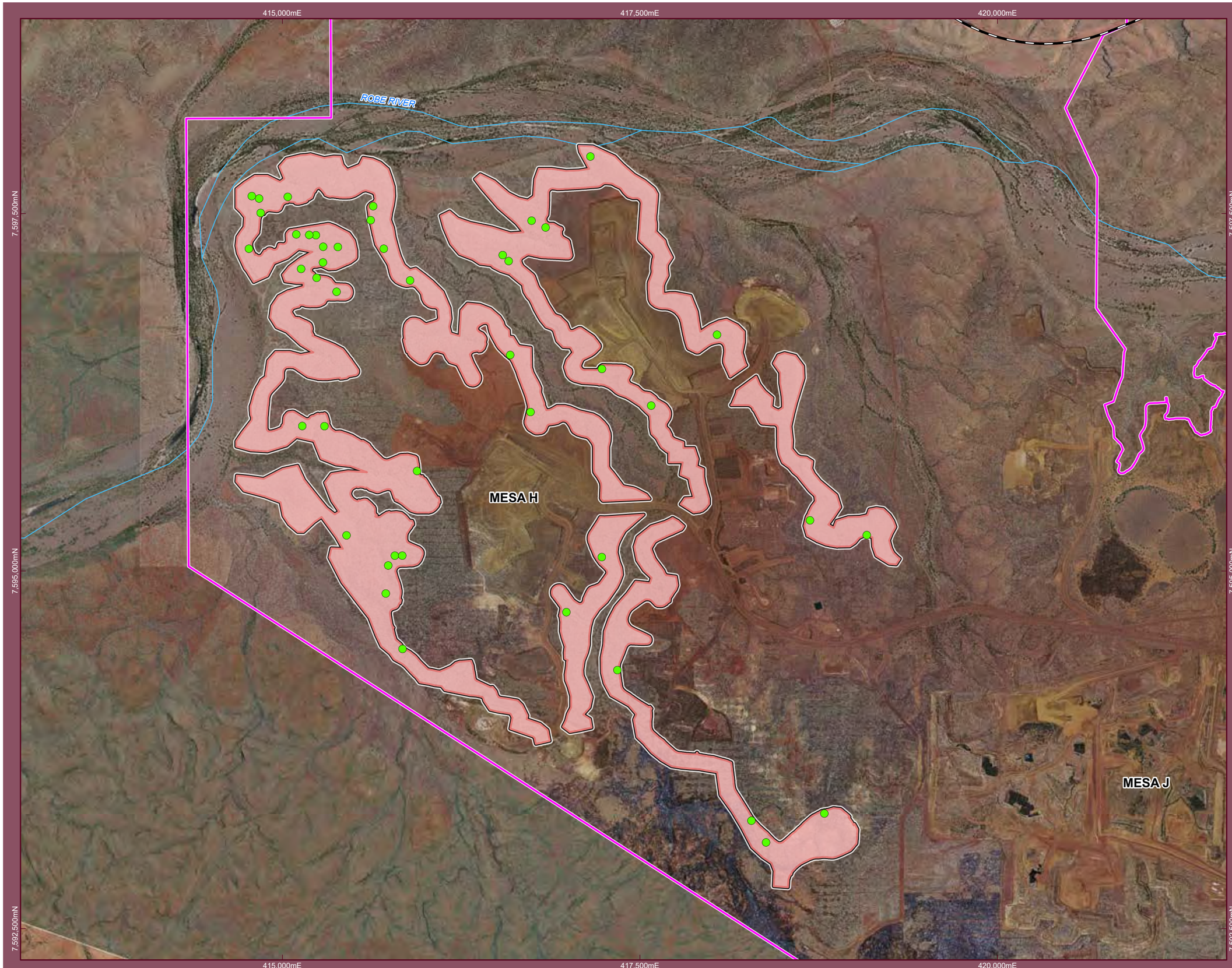
Management-based provisions					
Moderate Management zone (Figure 1-9) **Condition 7-2 (2):** The proponent shall protect the biological diversity and ecological integrity of the stygofauna assemblages of the local aquifers by minimizing impacts as far as practicable					
Management Targets	**Management Actions**	**Monitoring**	**Timing/Frequency**	**Responsible**	**Reporting**
Management target: 1. Groundwater quality is maintained to support stygofauna. 2. Stygofauna specimen capture rate is not below the baseline minimum for three or more consecutive sampling events.	• Maintain groundwater quality within Site Specific Guideline Values (SSGV's). • Continue to improve understanding of stygofauna ecology and assemblages via sampling.	1. **Water quality** • <u>Pool water quality:</u> o Key Robe River pools as outlined in the pool ecosystem monitoring (Table 2-3 and Figure 2-2) o Analyte suite and water quality SSGVs as provided in Appendix 2. **Stygofauna field survey** • Nominal 20 sites including conventional and eDNA[41] sampling for stygofauna including the Blind Cave Eel: o Aquifers and pools within the groundwater drawdown extent (minimum of 6 sites).[42] o Bores within Jimmawurrada Creek including water level bores where feasible (Appendix 5); and o reference sites (including sites upstream of Jimmawurrada groundwater drawdown).[43]	1. Quarterly 2. Bi-Annual (wet and dry)	3. Operations Environment team 4. Operations Environment team	• The environmental outcome will be reported against the management target for each calendar year by 30 April in the ACAR for MS1141 • 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.

[40] Troglofauna specimen trapping capture rates to 2022 are provided in Appendix 9

[41] eDNA sampling must be undertaken on-site without freezing of water and filtering should take place as soon as possible following collection with filters placed directly into DNA buffer

[42] Can include aquatic fauna sampling in the hyporheic zone

[43] Where available / feasible, subject to the availability of boreholes which can be damaged due to flood events and may be subject to Traditional Owner consent, particularly if located in creeklines.



Legend

- Development Envelope
- Mining Exclusion Zone
- Indicative Troglofauna Monitoring Sites
- Rio Tinto Railway
- Major Creek

Drawn: A.D.
Plan: RTIO-1056661v1
Date: July 2024

Checked by: A.Coulson
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

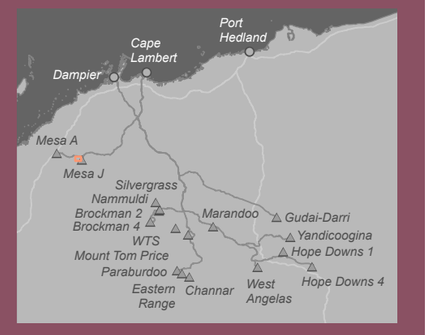


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Figure 2-4: Indicative Troglofauna Monitoring Sites

0 0.25 0.5 0.75 1
kilometres
Scale: 1:25,000 @A3

N

2.2 Reporting

For each calendar year, during the operational phase (refer to Section 2), the environmental outcomes and objectives will be reported against their associated trigger and threshold criteria and management targets in the Annual Compliance Assessment Report (ACAR) for the Project (Table 2-7).

In the event of a potential non-compliance with MS 1141, the DWER will be advised of the potential non-compliance within seven days of the non-compliance being known.

In the event that monitoring indicates exceedance of a threshold criteria, the DWER will be notified in writing of the exceedance or non-achievement within seven days of the exceedance or non-achievement being identified. A report containing details as required by Condition 5-6 (5) of MS 1141 for an exceedance will be provided to the DWER within twenty-one days of the exceedance being reported to the DWER.

The ACAR will report against the trigger and threshold criteria and the management targets for the for each calendar year. 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 were exceeded during the reporting period, the ACAR will include a description of the effectiveness of any management contingency actions that have been implemented to manage the impact.

Table 2-7 Mesa J Hub Environmental Management Plan Reporting Table

Key environmental factors: Inland Waters – Riparian Vegetation (Robe River)	
Environmental outcomes and objectives with associated criteria	**Reporting periods 1 January - 31 December**
Early response criteria	
1. Robe River groundwater (alluvial aquifer) level trends adjacent to the Mesa J and H deposits (Zone 1) show significantly different abstraction related trends compared with the broader locality or reference sites OR	
2. Greater proportion of phreatophytic overstorey stands in the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2) with declining trend in MSAVI since baseline and/or greater average decline (more negative slope) in comparison to reference areas	
Trigger criteria	**Status report:** Trigger criteria not exceeded Trigger criteria exceeded
1. The area of phreatophytic overstorey canopy decline since baseline (below the MSAVI baseline 5th percentile) is 20% greater in the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2) than in reference areas and a demonstrated causal link to the Project. OR	
2. Over 20% of Robe River Zone 1 or Zone 2 monitoring quadrats record significant structural or compositional change in comparison to baseline and reference sites.	
Threshold criteria:	**Status report:** Threshold criteria not exceeded Threshold criteria exceeded
1. The area of phreatophytic overstorey canopy decline since baseline (below the baseline MSAVI 5th percentile) is over 50% of the Robe River adjacent to the Mesa J and H deposits (Zone 1 and Zone 2); trend continues over two or more consecutive dry season monitoring events; with no evidence of seasonal recovery; and outside of historical baseline or seasonal variation, in comparison to reference sites with demonstrated causal link to Project.	

OR	
2. Over 50% of Robe River Zone 1 or Zone 2 monitoring quadrats record significant structural or compositional change in comparison to baseline and reference sites, demonstrated causal link to Project	
Key environmental factors: Inland Waters – Riparian Vegetation (Jimmawurrada Creek)	
Environmental outcomes and objectives with associated criteria	**Reporting periods 1 January - 31 December**
Early response criterion	
1. Within any one management zone, groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 5 metres in depth (below the minimum recorded seasonal groundwater level).	
Trigger criteria	**Status report:** Trigger criteria not exceeded Trigger criteria exceeded
1. The area of phreatophytic overstorey canopy decline since baseline (below the baseline MSAVI 5th percentile) is 20% greater within Jimmawurrada Creek Zone 3 or Zone 4 than in reference areas and a demonstrated causal link to the Project. OR	
2. Over 20% of Jimmawurrada Creek Zone 3 or Zone 4 monitoring quadrats record significant structural or compositional change, in comparison to baseline (and reference sites where available). OR	
3. Establishment of new high priority weed species within Jimmawurrada Creek Zone 3 monitoring quadrats or downstream of the discharge extent, previously not detected within the Development Envelope.	

Threshold criteria	**Status report:** Threshold criteria not exceeded Threshold criteria exceeded
1. The area of phreatophytic canopy decline since baseline below the baseline MSAVI 5th percentile is over 50% of the Jimmawurrada Creek potential impact area (Zone 3 and Zone 4); trend continues over two or more consecutive dry season monitoring events; with no evidence of seasonal recovery; and outside of historical baseline or seasonal variation, in comparison to reference sites with demonstrated causal link to Project. OR	
2. Over 50% of Jimmawurrada Creek Zone 3 or Zone 4 monitoring quadrats record significant structural or compositional change, in comparison to baseline (and reference sites where available), with demonstrated causal link to Project. OR	
3. Increased extent and persistence of high priority weed species within Jimmawurrada Creek Zone 3 monitoring quadrats or downstream of the discharge extent, relative to baseline (and reference data where applicable) with demonstrated causal link to the Project.	
Key environmental factors: Inland Waters – Pools of the Robe River	
Environmental outcomes and objectives with associated criteria	**Reporting periods 1 January - 31 December**
Early response criterion	
1. Water quality in any key pool exceeds Tier 1 SSGV	
Trigger criteria	**Status report:** Trigger criteria not exceeded Trigger criteria exceeded
1. Pool surface water levels at Yeera Bluff (Gnieraoora) Pool fall below historically recorded natural low of 114.5m AHD. OR	
2. Water quality in any key pool exceeds Tier 2 SSGV.	

Threshold criteria	**Status report:** Threshold criteria not exceeded Threshold criteria exceeded
1. Pool surface water levels at Yeera Bluff (Gnieraoora) Pool fall below 113.5m AHD[44]; OR	
2. Ecological Effects Assessment shows a declining trend in aquatic fauna diversity or change to assemblage structure with demonstrated causal relationship to the Project and effects persisting for 2 or more years	
Key environmental factors: Terrestrial Fauna Habitat	
Environmental outcomes and objectives with associated criteria	**Reporting periods 1 January - 31 December**
Early response criterion	
1. Disturbance, other than existing and authorised clearing within 50 m of the recorded back of the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6	
Trigger criteria	**Status report:** Trigger criteria not exceeded Trigger criteria exceeded
1. Vibration levels exceed 50 mm/s peak particle velocity at the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6; OR	
2. Disturbance of ≥ 5% of potential Northern Quoll denning habitat (comprising Breakaways and Gullies habitat) in the MEZ of Mesa H, excluding existing disturbance (prior to MS1141)	
Threshold criteria	**Status report:** Threshold criteria not exceeded Threshold criteria exceeded
1. Permanent structural damage to diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6 with demonstrated causal link to Project:	

[44] Drop of 1m below December 2019 wet-season low

OR	
2. Disturbance, other than existing and authorised clearing[3], within 40 m of the recorded back of the diurnal / potential maternal Ghost Bat roost caves as shown in Figure 1-6 with demonstrated causal link to Project: OR	
3. Disturbance of ≥ 10% of potential Northern Quoll denning habitat (comprising Breakaways and Gullies habitat) in the MEZ of Mesa H, excluding existing disturbance (prior to MS1141) with demonstrated causal link to Project:	
Key environmental factors: Subterranean Fauna – Troglofauna	
Environmental outcomes and objectives with associated criteria and management targets.	**Reporting periods 1 January - 31 December**
Trigger criterion	**Status report:** Trigger criteria not exceeded Trigger criteria exceeded
1. Operational error during mining resulting in removal of greater than 0.05% by volume annually of the Mesa H MEZ.	
Threshold criterion	**Status report:** Threshold criteria not exceeded Threshold criteria exceeded
1. Net loss of the Mesa H MEZ such that the retained habitat represents less than 50% by volume of pre-mining habitat.	
Management targets	**Status report:** Management target achieved Management actions implemented Management target not achieved Management actions not implemented
1. Total clearing of native vegetation across the surface of the MEZ is not greater than: o 132 ha within the Mesa H MEZ excluding existing clearing prior to MS1141	

2. Troglofauna specimen capture rate is not below the baseline minimum[45] for three consecutive sampling events at Mesa H.	
Key environmental factors: Subterranean Fauna – Stygofauna (including the Blind Cave Eel)	
Environmental objectives with associated management targets.	**Reporting periods 1 January - 31 December**
Management targets	**Status report:** Management target achieved Management actions implemented Management target not achieved Management actions not implemented
1. Groundwater quality is maintained to support stygofauna	
2. Stygofauna specimen capture rate is not below the baseline minimum for three or more consecutive sampling events.	

[45] Troglofauna specimen capture rates to September 2022 are provided in Note 1: Coordinates are approximate locations as the pool locations may change after major flow events.

3. Requirements under EPBC Act approval 2017/8017

This section of the EMP identifies the provisions the Proponent will implement to meet the requirements of EPBC Act approval 2017/8017. General provisions and monitoring in relation to threatening processes are provided in Section 3.1. Provisions and monitoring specific to the Ghost Bat are provided in Sections 3.2 and 3.2.1 respectively.

The Action Management Plan requirements for the Blind Cave Eel are embedded within the overarching provisions of this EMP due to the integral overlap with monitoring and management requirements of MS1141, including proposed management triggers and thresholds. To enable clarity, simplification, and alignment of the management approach, these provisions are included in:

- Table 1 (EPBC Act Approval conditions)
- Table 1-4 (Rationale for choice of provisions)
- Table 2-3 (Inland Waters – pools of the Robe River)
- Table 2-6 (Subterranean Fauna).

Additional management requirements specifically relevant to the Action Management Plan are provided below in Section 3.3.

Reporting for all provisions is detailed in Section 2.2.

3.1 General provisions and monitoring in relation to threatening processes

Management and mitigation of threatening processes resulting from the Action for the EPBC Act listed threatened species, Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and the Blind Cave Eel and their habitats, will assist in reducing impacts to these species. Threatening processes relevant to the Action include fire, vehicle and machinery movements, fauna encounters/sightings, weeds, feral animals, noise and vibration and dust and light. Table 3-1 provides an outcome and objective and specifies the management actions and targets to be implemented where relevant to EPBC Act listed threatened species in order to reduce risks from threatening processes associated with implementation of the Action (i.e. implementation of the Project).

Table 3-1: EMP Provisions: General provisions for EPBC Act listed threatened species

EPBC Act listed threatened species (Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Blind Cave Eel)					
Key environmental values: EPBC Act listed threatened species - Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Blind Cave Eel **Key impacts and risks:** Potential loss or degradation of high value habitat, or injury to MNES fauna, as a result of implementation of the Action **Outcome:** Minimise impacts to EPBC Act listed threatened species (Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Blind Cave Eel) associated with implementation of the Action					
Management-based provisions					
Objective: Manage threatening processes associated with implementation of the Action, where relevant to minimising impacts to EPBC Act listed threatened species (Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Blind Cave Eel*) * Note that the key threatening processes for the Blind Cave Eel as listed in DAWE (2008) are sedimentation from mining and construction; water abstraction; point source pollution from sewage, landfill, dumping and mining. The key threats relating to water abstraction and water quality are addressed under the Inland Waters Provisions of this EMP and in the Blind Cave Eel Action Management Plan required under EPBC 2017/8017 Condition 6.					
Management Targets	**Management Actions**	**Monitoring**			
		Method	**Location**	**Frequency and timing**	**Responsibility**
Threatening process: fire					
1. Provision and maintenance of fire fighting equipment in accordance with the relevant fire safety standards. 2. Fire fighting emergency response procedures are in place.	1. Appropriate fire fighting equipment is to be available to control localised outbreaks of fire. Regular inspection and maintenance of fire fighting equipment will be implemented to comply with relevant fire safety standards. 2. Emergency response (fire fighting) procedures are to be implemented to control fires arising as a result of implementation of the Project.	• Inspection of fire fighting equipment to ensure availability and compliance with fire safety standards. • Inspection of hazard/incident records.	Mesa H Development Envelope	Annual, or as appropriate, during the operational mine life.	Safety Representatives (item 1) Emergency Services team (item 2)
Threatening process: vehicle and machinery movements					
1. No incidents of vehicles being used off designated roads outside operational areas unless in the case of emergency or for necessary activities, that result in significant impacts to high value MNES habitat.	1. Vehicles and machinery to remain on designated roads unless in the case of emergency or for undertaking necessary activities.	• Inspection of incident records.	Mesa H Development Envelope	Annual, or as appropriate, during the operational mine life.	Operations Environment team

Threatening process: fauna encounters/sightings					
1. Induction material contains information relating to Blind Cave Eel, Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python. 2. Records of all EPBC Act listed threatened species observed are appropriately maintained. 3. Fauna handling is only undertaken by trained personnel, in accordance with Rio Tinto's Wildlife Interaction Guidelines. 4. No incidents of native fauna feeding, hunting, or keeping of firearms or pets on site. 5. Access to the MEZs (which potentially contain significant roost/den sites) is restricted to authorised personnel and there are no incidents of unauthorised access. 6. No use of barbed wire on site, except in the case of statutory requirements. 7. Where barbed wire is used in accordance with legislation, reflectors are installed.	1. All site personnel to be informed during their site induction of EPBC Act listed threatened species (Blind Cave Eel, Ghost Bat, Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python) that may occur on site. 2. Any EPBC Act listed threatened species encountered on site are to be recorded and records maintained for the Project. This will include locations, and animal status (alive/dead). 3. If EPBC Act listed threatened fauna species are required to be moved, fauna are to be handled and transported in accordance with Rio Tinto's Wildlife Interaction Guidelines. Handling and capture will be undertaken by trained personnel only. 4. Feeding of native fauna, hunting, keeping of firearms[46] or pets on site is prohibited. 5. The MEZ is to be demarcated and access restricted to authorised personnel. 6. Barbed wire use is to be avoided in the Development Envelope, except where there is a legislative requirement to do so. Where barbed wire is required by legislation, reflectors are to be installed on the barbed wire.	• Inspection of records, related to sightings, records, encounters and fauna removal. • Inspection of MEZ demarcation and procedures restricting access to the MEZs. • Inspections to assess whether any unauthorised barbed wire is being utilised on site. • Inspection of barbed wire installation to ensure reflectors are in place.	Mesa H Development Envelope	Annual, or as appropriate, during the operational mine life	Training Department (item 1) Operations Environment team
Threatening process: weed management					
1. Compliance with equipment hygiene procedures. 2. Weed control is undertaken in the Development Envelope each year	1. Weed management measures, including equipment hygiene procedures, are to be implemented to ensure weeds are recorded and controlled and equipment is cleaned to minimise the spread of weeds 2. Weeds within the Development Envelope are to be managed through a weed control program.	Weed monitoring is undertaken in specified transects during targeted vegetation monitoring	Mesa H Development Envelope	Annual, or as appropriate, during the operational mine life	Operations Environment team

[46] Excluding firearms for use in pastoral station activities

Threatening process: feral animal control					
Feral animal management actions are implemented	Feral animal presence is to be managed on site by: • prohibiting feeding animals • prohibiting keeping pets • appropriate waste disposal for food scraps and other wastes as per the Rio Tinto waste management guidelines	Inspection of waste disposal areas	Mesa J Hub Village and administration block	Bi-annual inspection during the operational mine life	Operations Environment team
Threatening process: noise and vibration					
1. No disturbance, other than existing and authorised clearing[47], in the Mesa H MEZ 2. Implementation of blast management controls where relevant to minimising potential impacts to roosting Ghost Bats[48]	1. Implement a Mining Exclusion Zone to ensure retention of potential high value MNES habitat 2. Implement blast management where relevant to minimise potential impacts to diurnal / potential maternal Ghost Bat roosts from noise and vibration associated with mining activities. 3. If the Action results in permanent significant structural damage to a Ghost Bat roost which cannot be remedied, or a failure to meet the management targets the proponent will submit a plan in writing within two months of the occurrence to the Minister for approval. This plan will justify and specify how the impact will be rectified or offset.	• Annual land clearing reconciliation against Mesa H MEZ • Noise and blast vibration monitoring for all blasts within 300 m of the diurnal / potential maternal Ghost Bat roosts shown in Figure 1-6	Mesa H Development Envelope	Annual land clearing reconciliation Noise and blast vibration monitoring – as required by distance from diurnal / potential maternal Ghost Bat roosts	Mine Operations team (item 1) Drill and Blast team (item 2)
Threatening process: dust and light					
1. No disturbance, other than existing and authorised clearing[32], in the Mesa H MEZ 2. Lighting and dust management actions are implemented	1. Delineate MEZ to ensure retention of potential high value MNES habitat in the Mesa H MEZ 2. Install lighting only where required, that is, mainly in-pit and operational areas 3. Direct lighting into the active pits to avoid the mesa escarpments 4. Manage dust emissions through:	• Annual land clearing reconciliation against Mesa H MEZ • Monitoring of wind direction for all blasts within 300 m of the diurnal / potential maternal Ghost Bat roosts shown in Figure 1-6	Mesa H Development Envelope	Land clearing reconciliation – annual Wind direction monitoring – as required by distance from diurnal / potential maternal Ghost Bat roosts	Mine Operations team

[47] Authorised clearing is as authorised in Table 2 of Schedule 1 of MS 1141

[48] No Pilbara Leaf-nosed Bat roosts have been recorded at Mesa H

	• application of dust suppression methods including water sprays, where applicable; and • Implementing blast management protocols where relevant to minimise potential impacts of dust to roosting Ghost Bats[48]				

3.2 Provisions specific to the Ghost Bat

Conditions 3 and 4 of EPBC Act approval 2017/8017 include requirements to minimise impacts to the Ghost Bat and to ensure no significant long-term decline in the Ghost Bat population attributable to implementation of the Action. Table 3-2 provides management-based provisions to meet these requirements. Table 2- provides details of management, avoidance, and mitigation of potential impacts to Ghost Bat roost caves.

Table 3-2: EMP Provisions: EPBC Act listed threatened species - Ghost Bat

EPBC Act listed threatened species – Ghost Bat (*Macroderma gigas*)					
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					
Management-based provisions					
Objective: Improve knowledge of the Ghost Bat population in the Robe Valley, including its use of high value habitat and effects of noise and vibration, in order to assist in maintaining biological diversity and ecological integrity					
Management Actions	**Management Targets**	**Monitoring**	**Timing / Frequency**	**Responsible**	**Reporting**
Undertake monitoring of Ghost Bats and indicate how Ghost Bats use caves within the eastern part of the Robe Valley (Figure 3-1) (Mesa H and east of Mesa H including Middle Robe) (e.g. diurnal versus maternal)	Ensure that the approved action does not result in significant long-term decline in the **Ghost Bat** population.	1. Visual inspection[49] of the structural integrity of Ghost Bat roosts (nocturnal and diurnal/ potential maternal) as shown in Figure 1-6 that were within 300 m of the active pits during the previous 12-month period (i.e. inspection of those roosts/caves with potential to have been impacted by noise/vibration in the 12 month reporting period) 2. Noise and blast vibration monitoring for all blasts within 300 m of the diurnal/ potential maternal Ghost Bat roosts as shown in Figure 1-6 3. Temperature and humidity monitoring in diurnal/potential maternal Ghost Bat roosts as shown in (Figure 3-1) to assess potential changes to the structural integrity of diurnal/ potential maternal Ghost Bat roosts • Caves AC04 (CRMH-01) & MH16-34 (CRMH-02) • Temperature and humidity logging and data analysis correlated against: reference sites and ambient temperature; and timing of mine pit development / blasting data in adjacent pits as appropriate. 4. Ghost Bat audio monitoring at known Ghost Bat roost locations (Figure 3-1): • Mesa H; • Mesa K; and • Middle Robe Mesas	1. Annual 2. All blasts within 300m of diurnal / potential maternal roost caves as shown in Figure 1-6 3. Continuous[50] monitoring during operational mine life. 4. Continuous[50] monitoring during operational mine life.	1. Operations Environment team 2. Drill and Blast team 3. Operations Environment team 4. Operations Environment team	If the Action results in permanent significant structural damage[51] to a Ghost Bat roost or a failure to meet the management targets required under Condition 3 of EPBC Act approval 2017/8017, submit a plan within two months of the occurrence detailing how the impact will be rectified or offset

[49] Visual inspection will be conducted either in-person from the base of the mesa or through the use of drones or other suitable method. The visual inspection is designed to verify that there has not been a loss of structural integrity which would be evident as significant collapse of the cave opening.

[50] Continuous monitoring except where downtime is experienced e.g. due to periodic maintenance or equipment failure

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

3.2.1 Monitoring specific to the Ghost Bat

Monitoring will be undertaken to assess the effectiveness of management actions in meeting the objective for the Ghost Bat. A missed monitoring event will not be treated as a non-compliance provided the Proponent can validate that the required management objective has still been achieved, for example through the use of alternative data.

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. In addition to blast management controls addressed in Section 2.1, visual assessment of the structural integrity of Ghost Bat roosts within 300 m of an active pit will be undertaken to confirm blasting in the vicinity of the roosts has not resulted in permanent significant structural damage[38] to the roosts. Temperature and humidity monitoring will also be undertaken in diurnal/potential maternal Ghost Bat roosts. Significant changes in temperature and humidity, in comparison to local weather conditions outside the cave, would indicate a potential loss of the structural integrity of the cave.

The EMP includes a management objective to improve knowledge of the Ghost Bat population in the Robe Valley, including its use of high value habitat and the effect of noise and vibration, and a management target to ensure no significant long-term decline in the Ghost Bat population attributable to the Action. Noise and blast vibration monitoring are to be conducted for all blasts within 300 m of diurnal/potential maternal Ghost Bat roosts and bat audio monitoring is to be conducted at Mesa H and Middle Robe Mesas to meet the management objective. Audio monitoring has been selected in preference to the previously proposed scat collection and analysis as audio monitoring is considered less invasive (ongoing repetitive cave entry is not required) and changes in the numbers of calls recorded over time provide information about bat utilisation of a roost over time. Successful audio monitoring programs are also currently being utilised for Ghost Bats at other Rio Tinto sites. Data from audio monitoring will provide information about the Ghost Bat population and its utilisation of caves in the eastern part of the Robe Valley. Audio monitoring will also indicate which caves are potentially in use as maternity roosts; a significant increase in calls near civil twilight during the maternity period (November to December) will indicate that the cave is likely in use as a maternity roost.

420,000mE 430,000mE 440,000mE 450,000mE

7,610,000mN 7,600,000mN 7,590,000mN

Pannawonica Road

East Deepdale

Robe River

Middle Robe

Mesa K

Mesa G

Mesa H

Mesa J

Gnieroora (Yeera Bluff)

MH16-34

Astron Cave 4

See Inset A

See Inset B

See Inset C

See Inset D

Bungaroo Creek

Jimmawurrada Creek

Inset A

MH16-34

0 100 200 m

Inset B

Robe River

0 100 200 m

Inset C

Astron Cave 4

0 100 200 m

Inset D

Robe River

0 100 200 m

Legend

Development Envelope

Conceptual Mine Layout

Mine Pit (indicative)

MNES Habitat

Breakaways and gullies

Hills

Mesa Plateau

Plain

River

Ghost Bat Monitoring

Temperature Humidity Monitoring

Audio Monitoring

Pool

Gnieroora (Yeera Bluff)

Rio Tinto Railway

Major Road

Minor Road

Site Access Road

Major Creek

Drawn: A.D.
Plan: RTIO-1056662v1
Date: July 2024

Checked by: A.Coulson
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

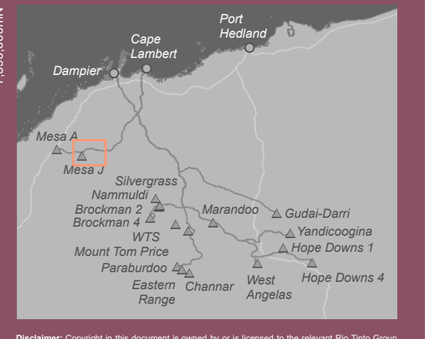

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Figure 3-1: Indicative Monitoring Locations for Ghost Bats

0 1 2 3 4 5
kilometres

Scale: 1:140,000 @A3

N

3.3 Action Management Plan for the Blind Cave Eel - Specific Requirements

Action Management Plan requirements for the Blind Cave Eel as per Condition 5 and Condition 6 are incorporated into the Inland Waters and Subterranean Fauna Management Provisions of this EMP, including:

- Justification and rationale for approach and methods, including groundwater quality defined as detrimental to the Blind Cave Eel habitat (Table 1-4, Table 2-6, Appendix 8)
- Proposed monitoring (Table 2-6; Table 3-3)
- Trigger and Threshold Criteria (Table 3-3)
- Trigger actions and Threshold contingency actions (Table 3-3)

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 monitoring only for the presence of Blind Cave Eel to demonstrate the effectiveness of the Action Management Plan would be an inappropriate metric at this stage. In particular, given the highly limited ability to sample the Blind Cave Eel via conventional methods in groundwater bores, namely due to the narrow slot openings (~2mm), or the bores casing which do not enable adult species to enter or pass through the bores in order to capture via conventional haul netting or trapping.

Stygofauna Community Assemblage:

Rather than rely solely on the detection of Blind Cave Eel given the low detection rates, it is proposed to use stygofauna community assemblage as a surrogate/indicator for Blind Cave Eel presence as a management target in combination with monitoring of water quality and water levels (Table 3-2; Appendix 10).

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 stygofauna is, therefore, considered the most appropriate strategy to protect subterranean fauna so that biological diversity and ecological integrity are maintained.

Blind Cave Eel Monitoring:

In addition to stygofauna community assemblage and water quality monitoring, ongoing monitoring for Blind Cave Eel will continue to be undertaken. This includes sampling using both eDNA and conventional stygofauna sampling methods targeting locations where the Blind Cave Eel have previously been detected, as well as areas of potential suitable habitat in the broader vicinity to further improve the known distribution of the species in the Robe Valley. The use of eDNA detection methods is also an important sampling methodology to support a monitoring protocol which does not have an impact to the species, which is a risk with conventional sampling methodologies.

Monitoring includes:

- Sampling of groundwater impact and reference sites

- Sampling of excavations into saturated alluvium in surface water pools with sieves and plankton nets with the target species being the Blind Cave Eel.

- Collection of a basic suite of groundwater parameters from each sampling site, particularly physiochemical properties including dissolved oxygen, total dissolved solids, pH, electrical conductivity and temperature.

- Collection, filtration and preservation of the provisional groundwater and surface pool water samples for eDNA analysis, including separate preservation of duplicate samples from every site sampled.

Sampling techniques for Blind Cave Eel are an evolving technology and hence methods will be reviewed and revised as technology improvements become available and in accordance with adaptive management principles, in consultation with DCCEEW and other relevant stakeholders.

Monitoring will be undertaken to assess the effectiveness of management actions in meeting the objective for the Blind Cave Eel. A missed monitoring event (for example due to safety reasons post a storm / cyclonic flood event, or due to requirement for Traditional Owner Consent) will not be treated as a non-compliance provided the Proponent can validate that the required management objective has still been achieved, for example through the use of alternative data.

Table 3-3: AMP Provisions: EPBC Act listed threatened species - Blind Cave Eel

Key environmental values: Jimmawurrada Creek alluvial aquifer and groundwater quality within the known habitat of Blind Cave Eel

Key impacts and risks: Potential loss or degradation of high value Blind Cave Eel habitat as a result of implementation of **the Action**

Habitat Quality Management Zone

EPBC Decision Notice 2017/8017 Condition 5a. *there is no significant change to groundwater quality detrimental to the Blind Cave Eel within its known habitat*.

Outcome: Ensure no significant change to groundwater quality detrimental to the Blind Cave Eel within its known habitat associated with implementation of the Action.

Environmental criteria	Response Actions	Monitoring	Timing/Frequency	Responsible	Reporting
Early response criteria: As per Table 2-4: 1. Water quality in any key Robe River surface water pool exceeds Tier 1 SSGV OR 2. Groundwater physicochemical quality in Jimmawurrada Bores exceeds Tier 1 SSGV	As per Table 2-4: • Confirm water quality exceedance with resampling as soon as practicable. • Review baseline, local and regional reference data, including discharge and other water quality sources, weather conditions (i.e. rainfall and temperature), and flooding, to assess if changes to water quality are due to natural variation. • Review routine (biannual) aquatic and subterranean fauna monitoring for evidence of impact of water quality change on diversity or composition of aquatic invertebrates or fish.	As per Table 2-4: 1. Water quality monitoring of selected analytes as listed in Appendix 7 in key pools of the Robe River (Figure 2-2). 2. Physiochemical water quality monitoring of Jimmawurrada Bores (Appendix 8) **Supporting Monitoring** o Subterranean fauna monitoring in the Robe River and Jimmawurrada Creek (as per Table 2-6 and Appendix 10	1. Quarterly 2. Quarterly	1. Operations Environment team 2. Hydrogeology team	• If the trigger or threshold criterion was exceeded during the reporting period, the Compliance Report will include review of early warning criterion, if relevant to the exceedance and will include review of early response criteria, if relevant to the exceedance.
Trigger criteria: As per Table 2-4: 1. Water quality in any key Robe River surface water pool exceeds Tier 2 SSGV OR 2. Groundwater physiochemical quality in Jimmawurrada Bores exceeds Tier 2 SSGV	**In addition to early warning actions**: • Review local and regional reference data, including discharge and water quality sources, rainfall, temperature, and flooding, to assess if changes to the water quality is due to natural variation **Criterion 1:** • Review of discharge water quality and sediment quality analysis as indicators of potential for water quality impacts in Robe River pools and to trigger response action(s) prior to impact. • Notify ALGALWATCH if there is evidence of a harmful algae bloom and undertake additional monitoring as advised by ALGALWATCH. **Criterion 1 and 2:** • Review routine (biannual) aquatic and subterranean fauna monitoring for evidence of impact of water quality change on diversity or composition aquatic invertebrates or fish. • If warranted, undertake an ecological effects assessment to investigate ecological effects associated with Mesa H in one or more ecological groups (for example this may include ecotoxicological assessment and/or tissue analysis). **If investigations indicate that trigger exceedance is due to the Project and may continue to be exceeded with no indication of recovery**: • Review contingency actions/strategy and options as agreed with relevant stakeholders Undertake mitigation options, for example: • Should the Ecological Effects Assessment or other investigations indicate potential significant impact to aquatic and subterranean fauna undertake corrective action (e.g. amend discharge regime) in consultation with DCCEEW Consult with the DCCEEW if investigation indicates threshold criteria are likely to be exceeded.	As per Table 2-4: **1.** Water quality monitoring of selected analytes as listed in Appendix 7 in key pools of the Robe River (Figure 2-2). 2. Physiochemical water quality monitoring of Jimmawurrada Bores (Appendix 8) **Supporting Monitoring** o Subterranean fauna monitoring in the Robe River and Jimmawurrada Creek, including for the Blind Cave Eel (as per Table 2-6 and Appendix 10	1. Quarterly (including dry and wet season); or more frequently in targeted locations as triggered 2. Quarterly (including dry and wet season); or more frequently in targeted locations as triggered	1. Operations Environment team 2. Hydrogeology team	• The environmental outcome will be reported against the trigger criterion for each calendar year by 30 April in the Compliance Report for EPBC Decision Notice 2017/8017. • If any trigger criterion was exceeded during the reporting period, the Compliance Report will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions and will include review of early response criteria, if relevant to the exceedance.

Key environmental values: Jimmawurrada Creek alluvial aquifer and groundwater quality within the known habitat of Blind Cave Eel **Key impacts and risks:** Potential loss or degradation of high value Blind Cave Eel habitat as a result of implementation of **the Action**					
Threshold criteria: **1.** Water quality in any two or more compliance groundwater bores or key Robe River surface water pool exceeds Tier 2 SSGV for two consecutive sampling events with a causal relationship to the Proposal AND **2.** Ecological Effects Assessment shows a declining trend in aquatic and stygofauna diversity or change to assemblage structure and absence of Blind Cave Eel records (specimen or eDNA) with a causal relationship to the Proposal and effects persisting for a three (3) year rolling window.	**If exceedance of threshold criterion is considered likely to be attributable to the Project implement contingency action/s as agreed during prior consultation with the DWER, for example:** • Change rate of abstraction • Maintain no dewatering below 116m AHD in Mesa H Pit 7 & 8 until significant rainfall recharge has occurred • Re-optimise the pumping operating strategy away from the impacted areas • Increase frequency and/or extent of monitoring as appropriate • Undertake water quality Ecological Effects Assessment • Should the ecological effects assessment show that there is a potential for irreversible impact to the health of the aquatic ecosystems (e.g. aquatic fauna), the Proponent will consider Whole Effluent Testing (WET), including an ecotoxicological assessment if warranted. Monitor to ensure contingency actions are successful and review procedures, if appropriate	1. Water quality monitoring of selected analytes as listed in Appendix 8 in key pools of the Robe River (Figure 2-2). 2. Physiochemical water quality monitoring of Jimmawurrada Bores (Appendix 5) Analysis 3. Aquatic invertebrates (including hyporheic fauna) composition, phytoplankton and fish composition, size class distribution and abundance, Blind Cave Eel records in selected upstream / downstream reference and key pools of the Robe River (Figure 2-2).	Monitoring frequency as per trigger level monitoring (or more frequently and/or for a longer period as triggered).	• As per trigger level responsibilities	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the Department within seven (7) days of the exceedance being identified. • The Proponent will provide a report to the Department within twenty-one (21) days of the exceedance being reported. • The environmental outcome will be reported against the threshold criterion for each calendar year in the Compliance Report. • If the threshold criterion was exceeded during the reporting period, the Compliance Report will include a description of the effectiveness of threshold contingency action/s that have been implemented to manage the potential impact.
Jimmawurrada Creek Alluvial Aquifer Drawdown Management Zone (Figure 1)					
EPBC Decision Notice 2017/8017 Condition 5b. *groundwater drawdown in the known pre-mining saturated Blind Cave Eel habitat within the Jimmawurrada Creek alluvial aquifer must not exceed 10 metres in depth below the minimum recorded wet season groundwater level*. **Outcome:** Ensure groundwater drawdown in the known pre-mining saturated Blind Cave Eel habitat within the Jimmawurrada Creek alluvial aquifer does not exceed 10 metres in depth below the minimum recorded wet season groundwater level.					
Environmental criteria	**Response Actions**	**Monitoring**	**Timing/Frequency**	**Responsible**	**Reporting**
Early response criteria: 1. Groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 8 metres in depth below the minimum recorded wet season groundwater level in four groundwater bores for two consecutive monitoring events.	**Early response and trigger criteria action:** **Investigate potential cause of exceedance by review of:** 1. Review local and regional reference data with regards to groundwater levels, trend in baseline groundwater levels and climatic information (including rainfall, temperature and flooding regime) to assess if groundwater changes are due to natural variation. Review groundwater abstraction rate, bore location and pumping biases in relation to extent of the cone of depression and the drawdown at monitoring bores compared to predicted (modelled) drawdown.	1. **Groundwater level monitoring** • Groundwater level monitoring in the Jimmawurrada Creek alluvial aquifer at locations as per Appendix 6. **Supporting Monitoring** • Groundwater levels in other reference groundwater bores (where available). • Subterranean fauna monitoring in the Robe River and Jimmawurrada Creek as per Table 2-6 and Appendix 10.	1. Quarterly (including dry and wet season); while groundwater abstraction is occurring	1. Hydrogeology team	• Report significant damage or loss of any bore(s) used for compliance monitoring in writing to the Department within seven (7) days of becoming aware of the damage, and the replacement of any bore used for compliance monitoring within three (3) months of the damage occurring, or another period as agreed in writing by the Minister
Trigger criteria: 1. Groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 9 metres in depth below the minimum recorded wet season groundwater level in any one groundwater bore for two consecutive monitoring events. OR	If warranted for trigger criterion 1: 1. Review groundwater abstraction rate, bore location and pumping biases in relation to extent of the cone of depression and the drawdown at monitoring bores compared to predicted (modelled) drawdown. 2. Review current trigger levels according to result of above investigation if necessary. If warranted for trigger criterion 2: 3. Review current trigger levels according to result of above investigation if necessary **If investigations and on-ground survey (if applicable) indicate that trigger exceedance is due to the Proposal, implement trigger level response actions, for example:**	1. **Groundwater level monitoring** • Groundwater level monitoring in the Jimmawurrada Creek alluvial aquifer at locations as per Appendix 6. **Supporting Monitoring** • Groundwater levels in other reference groundwater bores (where available). • Subterranean fauna monitoring in the Robe River and Jimmawurrada Creek (as per Table 2-6 and Appendix 10.	1. Quarterly (including dry and wet season); while groundwater abstraction is occurring; or monthly as triggered (until groundwater levels recover below the trigger levels) during	1. Hydrogeology team	• The environmental outcome will be reported against the trigger criterion for each calendar year by 30 April in the Compliance Report for EPBC Decision Notice 2017/8017. • If any trigger criterion was exceeded during the reporting period, the Compliance Report will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of trigger level actions and will include review of early response criteria, if relevant to the exceedance.

Key environmental values: Jimmawurrada Creek alluvial aquifer and groundwater quality within the known habitat of Blind Cave Eel **Key impacts and risks:** Potential loss or degradation of high value Blind Cave Eel habitat as a result of implementation of **the Action**					
2. Modelling predicts groundwater drawdown will exceed 10 metres in depth below the minimum recorded wet season groundwater level in any one monitored groundwater bore.	4. Revise the hydrogeological conceptualisation in relation to the hydraulic connection between the Mesa J and H CID aquifer and the Jimmawurrada Creek alluvial aquifer 5. Re-calibrate the numerical model based on the observed groundwater levels and generate revised groundwater drawdown predictions 6. Re-consider potential environmental impacts in relation to any change in the hydrogeological conceptualisation and/or predicted groundwater abstraction If warranted for all criteria: 7. Increase frequency of and/or extent of on-ground monitoring of groundwater levels. If warranted for all trigger criteria, if investigations indicate that trigger exceedance is due to the Proposal and may continue to be exceeded with no indication of recovery: 8. Review contingency actions/strategy 9. Implement mitigation options, for example: • Change rate of dewatering • Change timing of dewatering • Use variable speed dewatering bores if relevant • Re-optimise dewatering bore/sumping and trenching configuration/locations • Re-optimise the pumping operating strategy away from the impacted areas • Optimise surplus water discharge outlet location to support recovery/reduce impact to Jimmawurrada Creek alluvial aquifer • Managed aquifer recharge • Other options as agreed with relevant stakeholders. Consult with DCCEEW if investigation indicates threshold criteria are likely to be exceeded.		period of groundwater abstraction Groundwater management and monitoring must continue until the Minister agrees in writing that the outcomes specified at Condition 5 can be met without active management of groundwater levels by the approval holder.		• Report significant damage or loss of any bore(s) used for compliance monitoring in writing to the Department within seven (7) days of becoming aware of the damage, and the replacement of any bore used for compliance monitoring within three (3) months of the damage occurring, or another period as agreed in writing by the Minister
Threshold criteria: 1. Groundwater drawdown within the Jimmawurrada Creek alluvial aquifer exceeds 10 metres in depth below the minimum recorded wet season groundwater level with a causal relationship to the Proposal in two or more monitored groundwater bores for a single monitoring event. AND 2. Ecological Effects Assessment shows a declining trend in aquatic and stygofauna diversity or change to assemblage structure and absence of Blind Cave Eel records (specimen or eDNA) with a causal relationship to the Proposal and effects persisting for a three (3) year rolling window.	**Threshold contingency action:** **Implement as appropriate, previously determined threshold contingency actions, for example**: 1. Change rate of dewatering 2. Change timing of dewatering 3. Use variable speed dewatering bores if relevant 4. Re-optimise dewatering bore/sumping and trenching configuration/locations 5. Optimise surplus water discharge outlet location to support recovery/reduce impact to Jimmawurrada Creek alluvial aquifer 6. Managed aquifer recharge 7. Increase frequency and/or extent and/or duration of monitoring as appropriate 8. Monitor to ensure contingency actions are successful and review procedures, if appropriate Continue to implement threshold contingency actions until the CEO has confirmed by notice in writing that it has been demonstrated that the impact is below the threshold criteria. Monitor to validate success of threshold contingency actions and review procedures, if appropriate.	1. Monitoring as per trigger level monitoring	1. Monitoring frequency as per trigger level monitoring (or more frequently as triggered). Groundwater management and monitoring must continue until the Minister agrees in writing that the outcomes specified at Condition 5 can be met without active management of groundwater levels by the approval holder.	• As per trigger level responsibilities	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the Department within seven (7) days of the exceedance being identified. • The Proponent will provide a report to the Department within twenty-one (21) days of the exceedance being reported. • The environmental outcome will be reported against the threshold criterion for each calendar year in the Compliance Report. • If the threshold criterion was exceeded during the reporting period, the Compliance Report will include a description of the effectiveness of threshold contingency action/s that have been implemented to manage the potential impact. • Report significant damage or loss of any bore(s) used for compliance monitoring in writing to the Department within seven (7) days of becoming aware of the damage, and the replacement of any bore used for compliance monitoring within three (3) months of the damage occurring, or another period as agreed in writing by the Minister

3.4 Isopach Mapping (Condition 6(f))

Within the Robe Valley, the Blind Cave Eel has been recorded from the connected aquifers of the ephemeral Bungaroo / Jimmawurrada Creeks, Mungarathoona Creek and the Robe River. These records include from groundwater bores within the upstream Bungaroo / Jimmawurrada aquifer (a tributary of the Robe River); and from the shallow alluvial, surface habitats of the Robe River including the phreatic zone, which likely contributes to maintenance of gene flow and population connectivity within the species' overall range. The species recorded to date support the hypothesis by Moore et al. 2018) where the Robe River has provided a pathway for connectivity of habitat. The Jimmawurrada Creek Alluvial Aquifer consists of Quaternary alluvial sediments deposited along Jimmawurrada Creek, incised up to a maximum observed thickness of 40 m in the centre of the alluvial channel (thalweg).

To meet the environmental outcomes of maintaining connected habitat within the upstream extent of the Blind Cave Eel habitat in Jimmawurrada Creek, and drawdown not to exceed 10m below the minimum recorded wet season groundwater level (as per the requirements of Condition 5b), an isopach map has been developed (Figure 3-2) to show:

- The extent of saturated alluvial aquifer habitat baseline (lowest recorded wet season groundwater level) (Condition 6 (f) (i), Figure 3-2)
- The saturated alluvial aquifer with 10m drawdown from baseline; (Condition 6 (f) (ii), Figure 3-2); and
- Monitoring bores (Condition 6 (f) (iii), Figure 3-2, Appendix 5).

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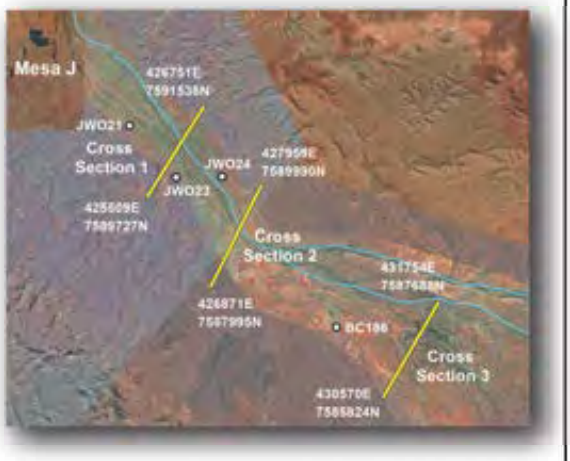
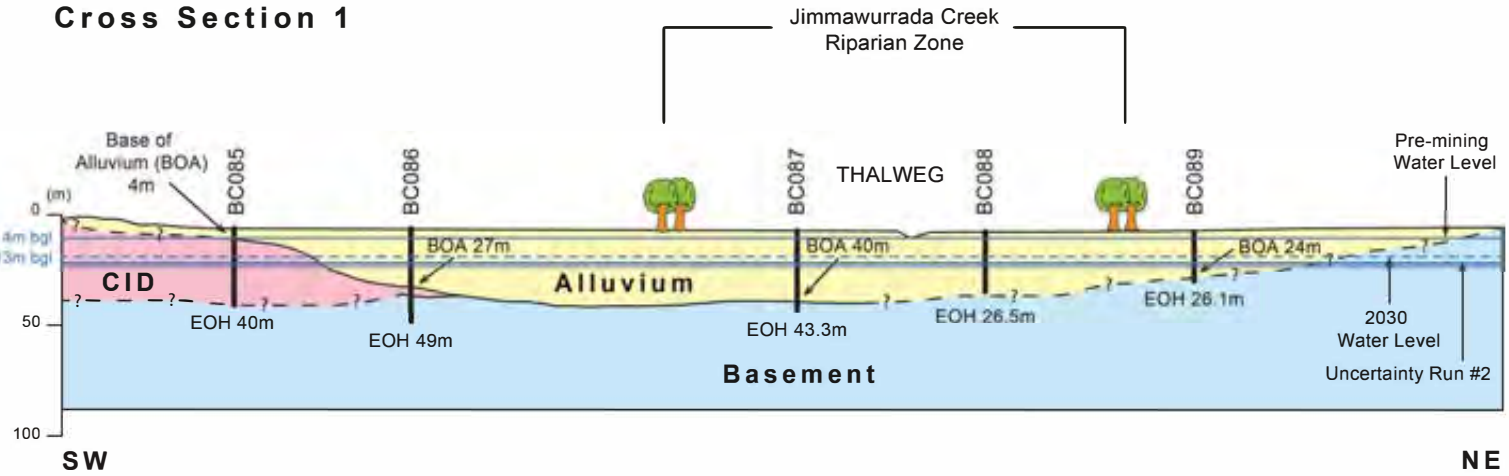
Figure 3-2: Jimmawurrada Creek cross sections (x2 vertical exaggeration)



Cross Section 1



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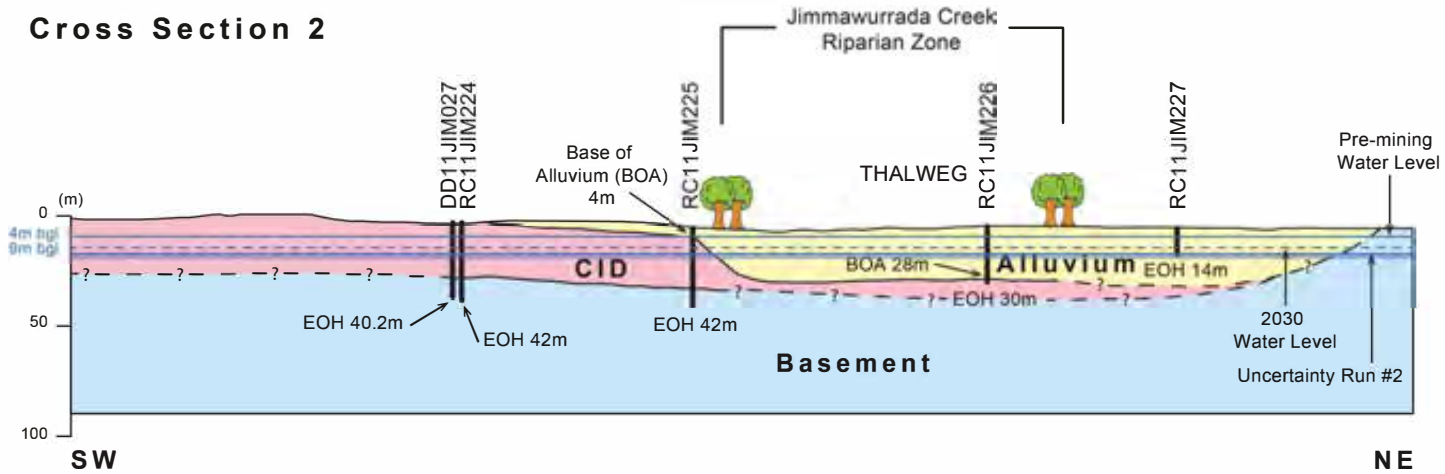

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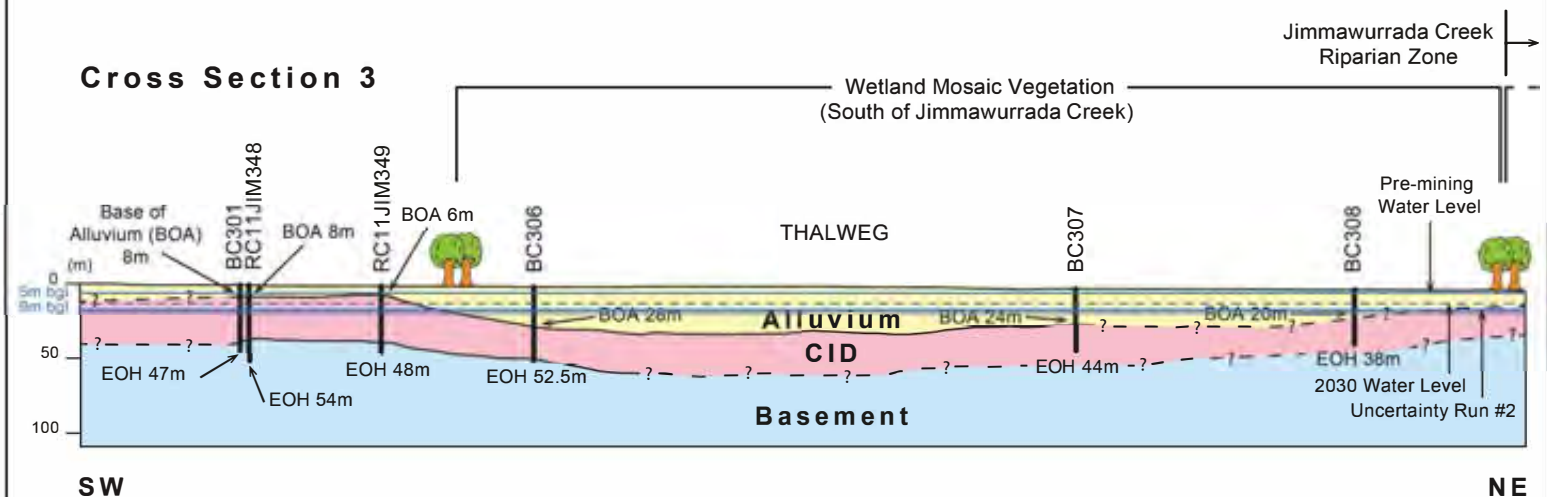

PDE0165476v4

415,000mE 420,000mE 425,000mE 430,000mE 435,000mE

7,600,000mN 7,595,000mN 7,590,000mN 7,585,000mN

Robe River

PZ09MEJ004

PFF1

JWO29

JWO21

JWO23

PZ10BUN041

Bungaroo Creek

Jimmawurrada Creek

Legend

- Mesa H EPBC Development Envelope

Contour Zone

- 0 - 10m
- 10 - 20m
- 20 - 30m
- 30 - 40m
- 40 - 50m

- Monitoring Bore
- Major Creek

10m Drawdown Limit Contour

- Known Saturated Alluvial Habitat of the Blind Cave Eel
- Inferred Saturated Alluvial Habitat

Other Contour

- Known Saturated Alluvial Habitat of the Blind Cave Eel
- Inferred Saturated Alluvial Habitat

- Rio Tinto Railway
- Major Road
- Minor Road
- Site Access Road

Drawn: A.D.
Plan: RTIO-1059174v1
Date: July 2024

Checked by: DvH
Proj: GDA 1994 MGA Zone 50
GIS.Team@riotinto.com

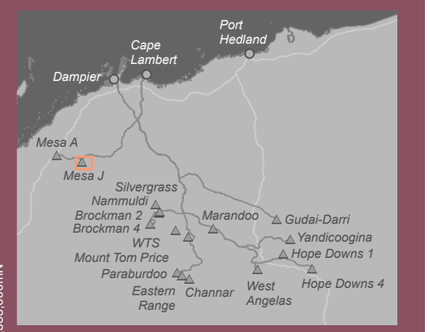

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Figure 3-3: Isopach map of Saturated Alluvium (Wet season low April 2020) and the 10m Drawdown as Measured in the Groundwater Bores (Appendix 5) within the Jimmarurrada Creek Alluvial Aquifer

0 0.5 1 1.5 2
kilometres
Scale: 1:70,000 @A3

N

3.5 Reporting

In the event of a non-compliance against the conditions of EPBC Act approval 2017/8017, the Commonwealth Department will be notified in writing as soon as practicable, and no later than seven (7) business days of the non-compliance being known. The Commonwealth Department will also be provided with details of the non-compliance as required by Condition 21 as soon as practicable, and no later than twenty-one (21) business days of the non-compliance being known.

Report significant damage or loss of any bore(s) used for compliance monitoring in writing to the Department within seven (7) days of becoming aware of the damage, and the replacement of any bore used for compliance monitoring within three (3) months of the damage occurring, or another period as agreed in writing by the Minister.

Compliance against the conditions of EPBC Act approval 2017/8017 will be reported annually as required by Condition 19. For conditions related to this EMP / AMP, the information to be reported as part of annual compliance reporting is shown in Table 3-4.

Table 3-4: Mesa H Environmental Management Plan reporting table for EPBC 2017/8017

Condition		Reporting period 1 January-31 December
2	To minimise impacts to the **Blind Cave Eel**, **Ghost Bat**, **Northern Quoll**, **Olive Python** and **Pilbara leaf-nosed bat**, the approval holder must comply with all specifications of the following conditions of the **EPA Report and Recommendations** that are consequential for these species: a. Condition 5 (Condition Environmental Management Plan(s)), b. Condition 6 (Inland Waters and Vegetation), c. Condition 8 (Terrestrial Fauna Habitat – Conservation Significant Fauna Species: Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma giga*) and Pilbara Leaf-Nosed Bat (*Rhinonicteris aurantia* - Pilbara form)).	Report status: Compliant Project implemented in accordance with conditions 5-1 to 5-8, 6-1 and 8-1 of MS 1141 where relevant to EPBC Act listed threatened species. OR Potentially non-compliant if the approval holder has not complied with Condition 5, Condition 6, and Condition 8 of the Western Australian approval where these conditions relate to EPBC Act listed threatened species.
3	To minimise impacts to the Blind Cave Eel, Ghost Bat, Northern Quoll, Olive Python and Pilbara leaf-nosed bat, the Condition Environmental Management Plan(s) specified under Condition 5 of the EPA Report and Recommendations, must (where relevant to Blind Cave Eel, Ghost Bat, Northern Quoll, Olive Python and Pilbara leaf-nosed bat) specify environmental outcomes or objectives related to the mitigation and management of the following key threatening processes: (a) fire; (b) vehicle and machinery movements; (c) fauna encounters/sightings; (d) weed management; (e) feral animal control; (f) noise and vibration; and (g) dust and light. For 3.f. noise and vibration, the Condition Environmental Management Plan(s) must include monitoring of the Ghost Bat and include a management target(s) to ensure that the approved action does not result in significant long term decline in the Ghost Bat population.	Report status: Compliant Condition Environmental Management Plan(s) includes: • environmental outcomes and objectives for the listed threatening processes where relevant to EPBC Act listed threatened species; • monitoring of Ghost Bat; and • a management target to ensure no significant long-term decline in the Ghost Bat population attributable to the Action OR Potentially non-compliant
4	To minimise impacts to Ghost Bat, the approval holder must implement a Mining Exclusion Zone and blast	Report status:

Condition		Reporting period 1 January-31 December
	management to minimise potential impacts to Ghost Bat roosts from noise and vibration associated with mining activities. The Condition Environmental Management Plan specified under Condition 5 of the EPA Report and Recommendations must include and justify appropriate management, avoidance and mitigation measures and may specify different measures for diurnal and nocturnal Ghost Bat roosts. If the action results in permanent significant structural damage to a Ghost Bat roost which cannot be remedied, or a failure to meet the management targets required under Condition 3, the proponent must submit a plan in writing within two months of the occurrence to the Minister for approval. This plan must justify and specify how the impact will be rectified or offset.	Compliant Where relevant to minimising potential impacts to roosting Ghost Bats, a Mining Exclusion Zone and blast management have been implemented. The Action has not resulted in: • permanent significant structural damage to a Ghost Bat roost; or • failure to meet the management targets established in Condition 3. If the Action has resulted in either a permanent significant structural damage to a Ghost Bat roost or a failure to meet the management targets established in Condition 3, BUT Conditions 20 and 21 have been complied with, and: • the damage can be remedied OR • an offset Project has been/will be submitted within two months. OR Potentially non-compliant
Action Management Plan		
5	To minimise impacts to the Blind Cave Eel and its habitat the approval holder must ensure that, as a result of the action: (a) there is no significant change to groundwater quality detrimental to the Blind Cave Eel within its known habitat; and (b) groundwater drawdown in the known pre-mining saturated Blind Cave Eel habitat within the Jimmawurrada Creek alluvial aquifer must not exceed 10 metres in depth below the minimum recorded wet season groundwater level	Report Status: Compliant Threshold criteria not exceeded OR Potentially non-compliant Threshold criteria exceeded
6	The approval holder must submit an Action Management Plan that specifies how the approval holder will achieve the outcomes specified in Condition 5 for approval by the Minister. The approval holder must not commence abstraction activities that are part of the action unless the Minister has approved the Action Management Plan in writing. The approved Action Management Plan must be implemented. The Action Management Plan must: (a) justify and specify the definition of significant change to groundwater quality detrimental to the Blind Cave Eel habitat. (b) provide detail of the method(s) to be used with appropriate justification and relevant case studies (noting that method(s) may include but need not be restricted to managed aquifer recharge); (c) specify threshold criteria exceedance of which presents a risk of breaching condition 5 and commit to not exceeding those criteria;	Compliant AMP includes: • definition of significant change to groundwater quality; • methods to achieve the outcomes of condition 5; • provision of early warning, trigger and threshold criteria and monitoring to demonstrate achievement of the outcome of Condition 5 • Isopach maps showing the depth of the saturated aquifer in Jimmawurrada creek and location of monitoring bores used for the minimum wet-season low and for compliance monitoring • Commitment to reporting (within 7 days) and replacement (within 3 months or as

Condition		Reporting period 1 January-31 December
	(d) specify trigger criteria that provide an early warning that the threshold criteria could be exceeded; (e) specify monitoring capable of determining if trigger criteria and threshold criteria are exceeded; (f) include an isopach map illustrating the alluvial thickness in the known pre-mining saturated Blind Cave Eel habitat within the Jimmawurrada Creek alluvial aquifer. The isopach map must: I. show the location of the groundwater monitoring bore(s) for which the minimum recorded wet season groundwater level has been measured; II. show the extent of the saturated alluvial thickness which does not exceed 10 metres in depth below the minimum recorded wet season groundwater level; III. identify which bores will be used for compliance monitoring to ensure that the 10 metres in depth below the minimum recorded wet season groundwater level does not occur; IV. include the approval holder's commitment to reporting significant damage or loss of any bore(s) used for compliance monitoring in writing to the Department within seven (7) days of becoming aware of the damage, and the replacement of any bore used for compliance monitoring within three (3) months of the damage occurring, or another period as agreed in writing by the Minister. (g) specify actions to be implemented in the event that the trigger criteria have been exceeded; (h) specify threshold contingency actions to be implemented in the event that the threshold criteria are exceeded (these may include but need not be limited to ceasing groundwater abstraction); and (i) provide the format and timing for the reporting of monitoring results against trigger criteria and threshold criteria to demonstrate that Condition 5 is being met.	otherwise agreed in writing) of compliance monitoring bores OR Potentially non-compliant

4. Adaptive Management and review of this EMP and AMP

The conceptual framework for the development of Rio Tinto EMPs provides details of the review and adaptive management process (Appendix 1). The approach will include evaluation of:

- Monitoring data and comparison to baseline and reference site data on a regular basis to verify responses to potential impacts.
- The effectiveness and relevance of trigger and threshold contingency actions against environmental objectives, on an annual basis, to determine if any changes to the criteria, monitoring or response actions are required.
- The effectiveness and relevance of management actions and targets against environmental objectives, on an annual basis, to determine if any changes to actions, targets or monitoring are required.
    - Based on the results of the review process the Proponent will update and adjust the management measures and strategies in consultation with DWER Table 5-1

5. Stakeholder Consultation

Stakeholder consultation for the Project, including environmental management of key environmental factors, was undertaken as part of the Environmental Impact Assessment for the Project as summarised in the *Mesa H Proposal (Revision to the Mesa J Iron Ore Development) Environmental Review Document* (Eco Logical Australia 2019).

To date, consultation, relevant to this EMP / AMP, has been undertaken in conjunction with key components of the consultation for the Project assessment and the Mesa A Hub (MS1112) EMP which are directly relevant for Mesa H (MS1141); and feedback from EMP reviews as indicated in Table 5-1.

Table 5-1: Stakeholder Consultation

Stakeholder	Date	Issues/topics raised	Proponent response/outcome
DWER	29 April 2019	The DWER requested changes to the Mesa A draft EMP: • Inclusion of groundwater level triggers and monitoring for the Robe River • Inclusion of multiple lines of evidence for potential impacts to riparian vegetation • Further details of methodology used for remote sensing monitoring or riparian vegetation	The Proponent completed additional analysis and has incorporated these into the draft Mesa H EMP.
DWER	26 September 2019	The analysis of Rio Tinto data to demonstrate the most suitable analysis method for detection of impacts to riparian vegetation was presented. The DWER requested, and were provided with, details of updated triggers and thresholds for review.	The Proponent has included the feedback from DWER on the riparian vegetation provisions for the Mesa A Hub, into the Mesa H EMP.

Stakeholder	Date	Issues/topics raised	Proponent response/outcome
DWER	10 March 2021	Water quality discussion on Nitrate SSGV's	Nitrate SSGV reference provided.
DWER	7 May 2021	EMP feedback	Updates made accordingly to this EMP.
DWER	20 January 2023	Robe River Pool water quality frequency	Robe River Pool water quality frequency updated accordingly
DWER	31 July 2024	RTIO requested update of EMP to ensure alignment with Mesa A and Mesa J Hub EMP's including: • Appropriateness of the current trigger and threshold criteria • Review and recommendations on establishment of additional on-ground monitoring transects across Mesa J Hub • Simplification of reporting requirements to address Environmental Management Plan criteria with best-practice methodology	Updates made accordingly to this EMP

Table 5-2: Changes to the Mesa J Hub EMP

Complexity of Changes	**Minor Revisions** ☐		**Moderate Revisions** ☐	**Major Revisions** ☐
Number of Key Environmental Factors	**One** ☐		**Two – Three** ☐	**> Three** ☐
Date Revision submitted to EPA: DD/MM/YYYY				
Proponent's Operational Requirement Timeframe for approval of revision **Reason for Timeframe:**	**< One Month** ☐	**< Six Months** ☐	**> Six Months** ☐	**None** ☐
Item No.	**EMP Section No.**	**EMP Page No.**	**Summary of Change**	**Reason for Change**
1.	3.2	Multiple cross references to monitoring parameters and rationale for parameters throughout.	Addition of detail of the EPBC 2017/8017 Action Management Requirements Note that the EPBC compliance metrics have been listed in separate tables and a separate section specifically for EPBC matters to differentiate between Ministerial Statement and Decision Notice requirements.	To satisfy EPBC 2017/8017 requirements for the Blind Cave Eel. The requirements have been included in this EMP due to the overlap / integral nature of the compliance metrics and associated and integrated monitoring requirements. The approach enables a single, comprehensive and integrated management plan which removes duplication of requirements, ensures consistency and transparency of management between State and Commonwealth requirements, and avoids misalignment between disparate plans (including any subsequent adaptive management updates over time).
2.	Key environmental factors		Key environmental factors: Subterranean Fauna – Stygofauna (including the Blind Cave Eel)	Management metrics amended: removal of Groundwater level metric as this is duplicative of the EPBC AMP groundwater level metrics

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7. Appendices

Appendix 1: Conceptual Framework for the Development of Rio Tinto Environmental Management Plans

For the development of Environmental Management Plans (EMPs), a conceptual framework model has been applied (Figure A 1). The framework ensures linkages between current understanding, potential impacts, outcomes, adaptive management, and consistent monitoring and management practices. The framework is a stepwise process that considers the environmental values as identified in the Proposal's Environmental Impact Assessment Documents, in order to implement appropriate management measures and actions to ensure the environmental objective can be achieved.

The first step of the framework examines in detail the current knowledge of the environmental value(s) associated with the Proposal. This is compiled from information provided in the EIA documents, any additional environmental surveys and examined with input from internal experts. Environmental values associated with the Proposal are evaluated based on their conservation status at local, state, and regional levels.

The second step of the framework is to define relevant indicators, level of management and type of provisions (outcome vs management-based) and associated criteria and/or targets.

A source-pathway receptor (SPR) conceptual modelling approach is used to inform the selection of indicators, as recommended by national and international guidance (DIIS 2016). The SPR conceptual model sets out the collective knowledge, experience, and perspective on the environmental value (system of interest) and illustrates assumptions about how the value (system) functions and what is believed to be the important or dominant processes and their linkages. This includes factors that are perceived to be driving changes in the value (system) and the consequences of changes in these factors. The conceptual model also includes factors such as spatial boundaries as well as temporal and seasonal variations.

The number and type of indicators selected to monitor and measure changes in individual environmental values will depend on several factors including; the conservation status of the environmental value; the level of management required; the environmental outcome or objectives; location; and the types of pressures and stressors identified.

The required level of management (Low, Moderate or High) is determined using an matrix assessment with four factors relating to predicted impacts from the Proposal including: likelihood; consequence; spatial extent; and temporal duration (Table A-1). The higher the level of management, the more lines of evidence may be deemed necessary to meet the environmental outcome or objective (that is more indicators and / or more frequent monitoring schedules).

Draft (interim) trigger and threshold criteria and/or draft management targets will be determined for each environmental value. Early response criteria (if appropriate) may be defined for indicators for the environmental value (e.g. groundwater depth) or the environmental value itself (e.g. vegetation status). Trigger and threshold criteria will directly relate to the environmental value and objective itself.

The number of trigger criteria, and the sensitivity of both trigger and threshold criteria, will be determined by the associated management level for the environmental value.

The third step of the framework is to undertake an evaluation of the baseline and/ or current data to assess against criteria and determine whether the environmental outcome or objectives are likely to be met with existing proposed indicators. This step should also occur as part of reporting requirements when criteria are exceeded. Where criteria are not being met the adaptive management process should be implemented.

The fourth step of the framework is to implement the EMP. To ensure successful implementation, relevant internal and external (regulatory) stakeholders are consulted to ensure the EMP meets management expectations and can be implemented for the associated Proposal.

The fifth, final step of the framework considers a revision of or alternatives of management objectives, indicators and/ or criteria. This step is considered where monitoring and assessment indicates objectives are not being met. Where data suggests that objectives cannot be met using current associated indicators and criteria, repeat the second to fifth step of the framework, with consideration of the additional information gained through monitoring.

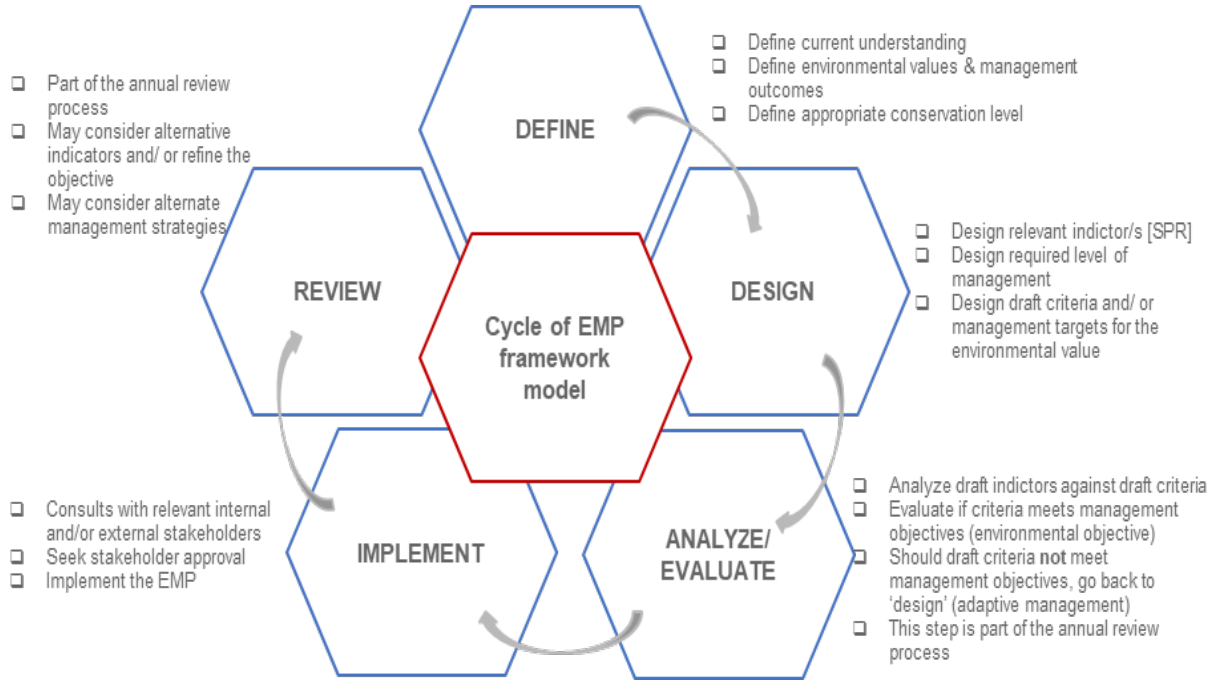

Figure A-1: Cycle of the conceptual Environmental Management Plan framework model

Table A-1: Management level assessment matrix

Factor	Level of required management (increasing to right)				
Likelihood	Rare	Unlikely	Possible	Likely	Almost Certain
Consequence	Minor Environmental values (species, communities /ecosystems) with no formal recognition for conservation purposes	Medium Environmental values (species, communities /ecosystems) with no formal recognition for conservation purposes but may hold local environmental significance	Serious Environmental values (species, communities /ecosystems) recognised as being of conservation interest	Major Environmental values (species, communities /ecosystems) directly protected under State and Commonwealth legislation	Catastrophic Environmental values (species, communities /ecosystems) directly protected under State and Commonwealth legislation (with potential severe consequence).
Extent	Immediate	Surrounds	Local	Catchment	Sub-regional
Duration	Days	Months	Years	Decades	Centuries

- The factors act independently of one another, and an increased risk of one factor will not necessarily result in other factors with higher risk.
- Level/s of management gives an indication of potential importance, however important to note that regulatory focus, cumulative impact, and heritage values may impact the way the environmental values are treated/ managed.

Reference

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Appendix 2: Summary of assessment for required management zone

The key environmental factors relevant to the Mesa J Hub as identified in Ministerial Statement 1141 and addressed in this EMP are described in Section 1.2. Each value was assigned a management zone based on matrix level assessment (Appendix 1, Step 2). A summary of the assessment for the Proposal, along with the resulting management zone for each environmental value relevant to this EMP is provided in Table A-2. Key Environmental Factors

The key environmental factors relevant to the Mesa J Hub as identified in Ministerial Statement 1141 and addressed in this EMP, are described in Table 1-1.

The assessment considers all impacts collectively (direct, indirect and including threatening processes) and assigns against the highest level of management zone.

Table A-2: Summary of assessment for assignment of management zone.

Environmental Value	Predicted and potential impact/s	Assessment				Level of Management
		Likelihood	Consequence	Extent	Duration	
Inland Waters – Vegetation of the Robe River						
Riparian Vegetation	• Direct • Indirect	**Unlikely** The Proposal will limit clearing in the Robe River to ~2ha and is not expected to have a significant impact on groundwater levels in the Robe River (potential for <1m maximum drawdown); mitigation is proposed to avoid dewatering in Mesa H to ensure that Riparian values are protected.	**Serious** The Robe River hosts vegetation is classified as sub-regionally significant due to the presence of groundwater dependant, vegetation communities dominated by obligate phreatophytic vegetation including *Melaleuca argentea*; in addition to supporting pool ecosystems and associated riparian vegetation communities.	**Immediate** Groundwater drawdown is modelled to be minor (<1m) and generally confined to the Development Envelope.	**Years** Groundwater abstraction from the Mesa H Pits will be over a duration of years, however significant rainfall events immediately recharge the local Robe River alluvial aquifer	HIGH
Inland Waters – Vegetation of Jimmawurrada Creek						
Riparian Vegetation	• Direct • Indirect	**Almost Certain** The Proposal will limit clearing in Jimmawurrada Creek and will likely contribute to cumulative drawdown impacts between the Mesa J Hub and the Coastal Water Supply Project of up to 9m drawdown (~14mbgl), which may exacerbate seasonal / climatic stressors on lowering groundwater levels. Some level of impacts to riparian communities are expected,	**Medium** Jimmawurrada Creek hosts vegetation is classified as locally significant dominated by phreatophytic vegetation and is less sensitive to groundwater drawdown than the GDE vegetation of the Robe River. No pools occur in Jimmawurrada Creek in the vicinity of the Proposal.	**Surrounds** Proposal will likely contribute to cumulative drawdown impacts between the Mesa J Hub and the Coastal Water Supply Project of up to 9m drawdown over a ~12 km span.	**Years** Groundwater abstraction from the Mesa H Pits will be over a duration of years, however significant rainfall events immediately recharge the local Robe River alluvial aquifer	MODERATE

		however, the impacts are not expected to be irreversible.				
Inland Waters						
Pool Ecosystems of the Robe River	• Indirect	**Possible** The Proposal is not expected to have a significant impact on groundwater levels in the Robe River or associated pools (potential for <1m maximum drawdown); mitigation is proposed to avoid dewatering in Mesa H to ensure that Riparian and pool ecosystem values are protected. The Proposal has the potential to impact on pool water quality via discharge or potential for seepage.	**Major** The Robe River hosts GDE vegetation and supports 'Pool River Ecosystems', including permanent and semi-permanent pools which are important to ecosystems, including as critical habitat for MNES species, particularly in semi-arid environments and are classified as wetlands of importance. In addition, the pools also support cultural heritage and social values.	**Immediate** Groundwater drawdown is modelled to be minor (<1m) and generally confined to the Development Envelope. Potential changes to water quality are expected to be localised.	**Years** Groundwater abstraction from the Mesa H Pits will be over a duration of years, however significant rainfall events immediately recharge the local Robe River alluvial aquifer, and also flush the pools.	HIGH
Terrestrial Fauna - MNES						
Northern Quoll Ghost Bat Pilbara Leaf-nosed Bat Pilbara Olive Python	• Direct • Indirect • Threatening processes	**Almost Certain** The Proposal will result in clearing of areas of high value habitat, including (Gorge/Gully and Breakaway); Ghost Bat roosts will be exposed to indirect impacts associated with blasting). Blast management measures will be conducted for blasts within 300 m of the 2 diurnal / potential maternity Ghost Bat roosts). A Mining Exclusion Zone (MEZ) has been created to ensure retention of high value breakaway and gully habitats and ensure retention of all know Ghost Bat roosts.	**Major** MNES terrestrial fauna and their habitats have statutory protection under the Biodiversity Conservation Act 2016 and the EPBC Act as a Vulnerable species (Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python); and Endangered (Northern Quoll)	**Immediate** The Proposal has the potential to cause a reduction in the area of occupancy. However, given the retention of high value habitat locally (via the MEZ) and availability of habitat regionally, the Proposal is not expected to interfere with the recovery of these species or affect its conservation status. Therefore, potential impacts will be confined to the Development Envelope	**Years** The Proposal is not expected to cause a long term decrease in the size of populations of MNES species; as high value habitat will be retained and preserved via the MEZ, limited clearing in riverine habitats and all known Ghost Bat roost caves will be retained. Hence the assumption is that these will continue to provide suitable habitat after mining ceases.	HIGH
Subterranean Fauna						
Troglofauna	• Direct	**Almost Certain** Excavation for Mine Pit Development will remove up to 50% of known troglofauna habitat.	**Medium** Two Priority 1 Priority Ecological Communities occur in the Development Envelope: *Subterranean invertebrate communities of mesas in the Robe Valley Region*; and *Subterranean invertebrate community of pisolitic*	**Immediate** The Proposal has the potential to cause a reduction in the local mesa formation habitat (of which may troglofauna species are endemic). However, given the retention of 50% of	**Years** The Proposal is not expected to cause a long-term decrease in population size of MNES species; as a significant area of high value habitat will be retained and conserved via the MEZ the	MODERATE

			hills in the Pilbara. No listed troglofauna species occur within the Development Envelope	habitat locally (via the MEZ) the Proposal is not expected to affect its conservation status.	assumption is that this habitat will continue to provide sustaining habitat after mining ceases for Troglofaunal populations.	
Subterranean Fauna						
Stygofauna (including the Blind Cave Eel)	• Indirect • Threatening processes	**Likely** The Proposal will likely contribute to cumulative drawdown impacts between the Mesa J Hub and the Coastal Water Supply Project of up to 9m drawdown (~14mbgl), which may exacerbate seasonal / climatic stressors on lowering groundwater levels. Impacts to stygofauna through reduction in available habitat is not expected.	**Major** The Jimmawurrada / Bungaroo aquifers encompass the Priority 1 Ecological Community: *Stygofauna of the Bungaroo Aquifer.* In addition, the Blind Cave Eel are listed under the Biodiversity Conservation Act 2016 and the EPBC Act as a Vulnerable species.	**Surrounds** The Proposal will likely contribute to cumulative drawdown impacts between the Mesa J Hub and the Coastal Water Supply Project of up to 9m drawdown over a ~12 km span along Jimmawurrada Creek and the Jimmawurrada CID aquifer. Groundwater drawdown in the Robe River and associated pools is modelled to be minor (<1m) and generally confined to the Development Envelope.	**Years** Groundwater abstraction from the Mesa H Pits will be over a duration of years, however significant rainfall events immediately recharge and can reset groundwater levels in the local Jimmawurrada and Robe River alluvial aquifers and flush the water quality in the pools.	HIGH

Appendix 3: Weed species lists

A total of 24 introduced flora species have been recorded within the Revised Development Envelope as listed in Table A-3. One species, Tamarisk (Athel Pine) is listed as a Declared Pest and Weeds of National Significance. Tamarisk has been observed along a tributary to the Robe River, north of Mesa H, outside the Development Envelope by a Rio Tinto botanist (Rio Tinto 2019).

**Cenchrus ciliaris* (Buffel Grass) and **Cenchrus setiger* (Birdwood Grass) were the most abundant weed species occurring predominantly in disturbed areas, in major and minor drainages and on plains (Astron 2016b).

Table A-3: Weed species recorded in the Development Envelope to 2019

Family	Species	DBCA Ecological Rating	DBCA Invasiveness Rating
Amaranthaceae	*Aerva javanica* (Kapok Bush)	High	Rapid
Papaveraceae	*Argemone ochroleuca* (and subsp. *ochroleuca*) (Mexican Poppy)	Unknown	Rapid
Asteraceae	*Bidens bipinnata*	Unknown	Rapid
Poaceae	*Cenchrus ciliaris* (Buffel Grass)	High	Rapid
Poaceae	*Cenchrus setiger* (Birdwood Grass)	High	Rapid
Poaceae	*Chloris barbata* (Purpletop Chloris)	High	Rapid
Cucurbitaceae	*Citrullus colocynthis* (Colocynth)	Unknown	Moderate
Poaceae	*Cynodon dactylon* (Couch Grass)	High	Rapid
Solanaceae	*Datura leichhardtii*	Unknown	Unknown
Poaceae	*Echinochloa colona* (Awnless Barnyard Grass)	High	Rapid
Euphorbiaceae	*Euphorbia hirta* (Asthma Plant)	Low	Slow
Asteraceae	*Flaveria trinervia* (Speedy Weed)	-	-
Asteraceae	*Lactuca serriola* (Prickly Lettuce)	-	-
Malvaceae	*Malvastrum americanum* (Spiked Malvastrum)	High	Rapid
Lamiaceae	*Ocimum basilicum* (Basil)	-	-
Passifloraceae	*Passiflora foetida* (and var. *hispida*) (Stinking Passion Flower)	High	Rapid
Araceae	*Phoenix dactylifera* (Date Palm)	High	Rapid
Apocynaceae	*Rumex vesicarius* (Ruby Dock)	High	Rapid
Poaceae	*Setaria verticillate* (Whorled Pigeon Grass)	High	Rapid
Solanaceae	*Solanum nigrum*	Low	Rapid
Asteraceae	*Sonchus oleraceus* (Common Sowthistle)	Low	Rapid
Tamaricaceae	*Tamarix aphylla* (Athel Pine)	High	Rapid
Zygophyllaceae	*Tribulus terrestris* (Caltrop)	Unknown	Moderate
Fabaceae	*Vachellia farnesiana* (Mimosa Bush)	High	Rapid

Appendix : Floristic Data Analysis Methodology for Riparian Transect Monitoring

Bi-annual on-ground vegetation surveys is conducted post-wet season and post-dry season at representative locations as shown in Figure 2-2. Baseline monitoring for Robe River and Jimmawurrada Creek commenced in 2016 and the potential impact period for Jimmawurrada Creek began in 2021. The monitoring program will be used to assess the environmental criteria to indicate potential adverse changes from baseline, as well as supporting data that can be used to interpret, contextualise and investigate, in the event that any significant change is detected. The trigger and threshold criterion are designed to detect hydrological change that may affect overall riparian vegetation community structure and composition across the lower, mid and upper stratum.

A certain level of impact from dewatering and discharge on the riparian vegetation is expected, therefore management would only be implemented if this impact (including potential augmentation of vegetation from surplus water discharge) caused a significant change in composition or structure of native species across 20% of quadrats within the same management zone. The threshold criterion describes structural shift or loss of dominant species across 50% of potential impact quadrats within any one zone, which could occur in any part of the creek habitat (channel, terrace, banks, or floodplain), beyond which there is the potential for irreversible impacts to occur. The threshold criterion aims to detect a major change to vegetation outside of natural variation and beyond the expected effects of dewatering and discharge that may indicate potential for an irreversible change

Structural Change

Significant structural change in vegetation is assessed by comparing the structural classes in the Level IV vegetation descriptions by stratum (Table A4. 1) and by quadrat between baseline and the current survey event. Significant structural change within a quadrat is considered to have occurred when two or more strata recorded a change since the baseline period across two or more structural classes due to a change in cover.

Compositional Change (Loss of Species Dominance)

Significant compositional change is defined as a ‘loss of dominance’ for any dominant native perennial taxa that were present at baseline (as listed in Table A4.2 below). Loss of dominance is determined if a quadrat containing one of the key taxa listed no longer records the highest overall foliage cover due to its own cover reduction or an increase in another species’ cover. Replacement of key riparian species by other native or non-native species may indicate changes to the overall community composition as a result of dewatering or discharge activities.

Native perennial species were considered dominant for a stratum at baseline (upper, mid-, and lower storey) if a taxon had the highest mean cover within a quadrat and were present during at least three of six survey event from 2016 to 2020. An additional criterion of at least 2% mean total cover was imposed for this assessment, so that species with very low cover values were not classed as dominants. A maximum of three dominant species could occur within a quadrat: one per stratum. Conversely, quadrats may have no dominant species at baseline where vegetation cover across all strata was very low.

Table A4.1: NVIS level IV[52] Structural classes and integration with Aplin[53] structural classes, for assessment of Robe River and Jimmawurrada Creek riparian vegetation

Stratum		Canopy cover (%)				
NVIS level IV (Sub-association)	**Growth form**	**70-100%**	**30-70%**	**10-30%**	**2-10%**	**<2%**
Upper Stratum	Trees over 30 m	Tall closed forest	Tall open forest	Tall woodland	Tall open woodland	Scattered tall trees
	Trees 10-30 m	Closed forest	Open forest	Woodland	Open woodland	Scattered trees
	Trees under 10 m	Low closed forest	Low open forest	Low woodland	Low open woodland	Scattered low trees
Mid Stratum	Shrubs over 2 m	Tall closed shrub	Tall open shrub	Tall shrubland	Tall open shrubland	Scattered tall shrubs
	Shrubs 1-2 m	Closed heath	Open heath	Shrubland	Open shrubland	Scattered shrubs
	Shrubs under 1 m	Low closed heath	Low open heath	Low shrubland	Low open shrubland	Scattered low shrubs
Ground Stratum	Hummock grasses	Closed hummock grassland	Hummock grassland	Open hummock grassland	Very open hummock grassland	Scattered hummock grasses
	Grasses, Sedges, Herbs	Closed tussock grassland/ bunch grassland/ sedgeland/ herbland	Tussock grassland/ bunch grassland/ sedgeland/ herbland	Open tussock grassland/ bunch grassland/ sedgeland/ herbland	Very open tussock grassland/ bunch grassland/ sedgeland/ herbland	Scattered tussock grasses/ bunch grasses/ sedges/ herbs

[52] Executive Steering Committee for Australian Vegetation Information (ESCAVI) 2003, Australian Vegetation Attribute Manual: National Vegetation Information System, Version 6.0. Department of the Environment and Heritage, Canberra

[53] Aplin T.E.H 1979, The Flora. Chapter 3 In O'Brien, B.J (ed). Environment and Science. University of Western Australia Press

Table A4.2: Dominant native perennial species across stratum (upper, mid, and lower) within each quadrat and Management Zone (Potential Impact and Reference)

Zone	Quadrat	Stratum	Species name	Ecohydrological Rating
Potential Impact Management Zones				
1	MHT18-02	Mid	*Acacia trachycarpa*	None
	MHT18-03	Mid	*Acacia trachycarpa*	None
	MHT18-01	Mid	*Petalostylis labicheoides*	None
	MHT18-03	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT18-04	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT18-05	Upper	*Melaleuca argentea*	Very High Level
	MHT19-04	Upper	*Melaleuca argentea*	Very High Level
	MHT19-05	Upper	*Melaleuca argentea*	Very High Level
	MHT19-06	Upper	*Melaleuca argentea*	Very High Level
2	MHT08-01	Lower	*Tephrosia rosea* var. Fortescue creeks	None
	MHT10-01	Lower	*Stemodia grossa*	Low Level
	MHT10-04	Lower	*Stemodia grossa*	Low Level
	MHT08-02	Mid	*Acacia trachycarpa*	None
	MHT08-06	Mid	*Petalostylis labicheoides*	None
	MHT10-04	Mid	*Petalostylis labicheoides*	None
	MHT08-01	Upper	*Melaleuca argentea*	Very High Level
	MHT08-03	Upper	*Melaleuca argentea*	Very High Level
	MHT08-04	Upper	*Melaleuca argentea*	Very High Level
	MHT08-05	Upper	*Melaleuca argentea*	Very High Level
	MHT08-06	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT10-01	Upper	*Melaleuca argentea*	Very High Level
	MHT10-02	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT10-04	Upper	*Melaleuca argentea*	Very High Level
	MHT10-05	Upper	*Melaleuca argentea*	Very High Level
3	MHT29-05	Lower	*Triodia wiseana*	None
	MHT29-05	Mid	*Acacia pyrifolia var. pyrifolia*	None
	MHT20-03	Mid	*Acacia trachycarpa*	None
	MHT20-02	Mid	*Gossypium robinsonii*	None
	MHT20-01	Mid	*Petalostylis labicheoides*	None
	MHT20-04	Mid	*Petalostylis labicheoides*	None
	MHT20-05	Mid	*Petalostylis labicheoides*	None
	MHT20-06	Mid	*Petalostylis labicheoides*	None
	MHT20-01	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT20-02	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT20-04	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT20-05	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT20-06	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT21-02	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT21-04	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT21-05	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT21-06	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level

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	MHT23-01	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT23-03	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT24-06	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT29-01	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT29-02	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT29-03	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT29-04	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT21-03	Upper	*Eucalyptus victrix*	High Level
	MHT23-04	Upper	*Eucalyptus victrix*	High Level
	MHT23-05	Upper	*Eucalyptus victrix*	High Level
	MHT23-06	Upper	*Eucalyptus victrix*	High Level
	MHT24-02	Upper	*Eucalyptus victrix*	High Level
	MHT24-03	Upper	*Eucalyptus victrix*	High Level
	MHT24-04	Upper	*Eucalyptus victrix*	High Level
	MHT24-05	Upper	*Eucalyptus victrix*	High Level
	MHT29-05	Upper	*Eucalyptus victrix*	High Level
	MHT29-06	Upper	*Eucalyptus victrix*	High Level
	MHT21-01	Upper	*Melaleuca argentea*	Very High Level
4	MHT14-04	Lower	*Cyperus vaginatus*	Moderate Level
	MHT30-01	Lower	*Triodia wiseana*	None
	MHT30-02	Lower	*Triodia wiseana*	None
	MHT13-04	Mid	*Acacia trachycarpa*	None
	MHT13-06	Mid	*Acacia trachycarpa*	None
	MHT14-03	Mid	*Melaleuca glomerata*	Very High Level
	MHT30-02	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT30-03	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT13-04	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT14-03	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
	MHT14-04	Upper	*Eucalyptus camaldulensis subsp. refulgens*	Moderate - High Level
Reference Zones				
RR Reference	MHT25-01	Mid	*Acacia trachycarpa*	None
	MHT25-05	Mid	*Acacia trachycarpa*	None
	MHT26-04	Mid	*Acacia trachycarpa*	None
	MHT25-02	Mid	*Sesbania formosa*	High Level
	MHT25-06	Mid	*Sesbania formosa*	High Level
	MHT25-02	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT26-05	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT26-06	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT25-01	Upper	*Melaleuca argentea*	Very High Level
	MHT25-03	Upper	*Melaleuca argentea*	Very High Level
	MHT25-04	Upper	*Melaleuca argentea*	Very High Level
	MHT25-05	Upper	*Melaleuca argentea*	Very High Level
	MHT25-06	Upper	*Melaleuca argentea*	Very High Level
	MHT26-02	Upper	*Melaleuca argentea*	Very High Level
	MHT26-03	Upper	*Melaleuca argentea*	Very High Level
West creek	MHT03-04	Lower	*Cyperus vaginatus*	Moderate Level

	MHT01-01	Lower	*Triodia epactia*	None
	MHT01-05	Lower	*Triodia epactia*	None
	MHT01-06	Lower	*Triodia epactia*	None
	MHT03-01	Lower	*Triodia epactia*	None
	MHT03-02	Mid	*Acacia trachycarpa*	None
	MHT03-03	Mid	*Acacia trachycarpa*	None
	MHT01-03	Mid	*Petalostylis labicheoides*	None
	MHT01-01	Mid	*Stylobasium spathulatum*	Low Level
	MHT01-04	Mid	*Stylobasium spathulatum*	Low Level
	MHT03-06	Upper	*Corymbia hamersleyana*	None
	MHT01-02	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT01-03	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT01-04	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT03-03	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT03-05	Upper	*Eucalyptus camaldulensis* subsp. *refulgens*	Moderate - High Level
	MHT03-02	Upper	*Eucalyptus victrix*	High Level
	MHT03-04	Upper	*Eucalyptus victrix*	High Level

Appendix 4: Jimmawurrada Creek Monitoring Bore Groundwater Levels

Table A-5: Jimmawurrada Creek groundwater monitoring bore locations and response criteria

Monitoring Bore ID	Coordinates	Lowest wet season GW level measured as of April 2020 (mAHD)	Early Response Criteria 8m drop in GW Level (mAHD)	Trigger Criteria 9.0m drop in GW Level (mAHD)	Threshold Criteria 10m drop in GW Level (mAHD)
PZ09MEJ004	**50K 423728 7595885**	144.6	136.6	135.6	134.6
PFF1	**50K 423695 7594251**	141.8	133.8	132.8	131.8
JWO21	**50K 425134 7591152**	150.7	142.7	141.7	140.7
JWO23	**50K 426138 7590140**	156.0	148.0	147.0	146.0
JWO29	**50K 424029 7592152**	143.6	135.6	134.6	133.6
PZ10BUN041	**50K 430700 7587517**	173.6[54]	165.6	164.6	163.6

[54] Groundwater level used is an averaged water level from January 2020 and July 2020 due to Covid-19 travel restrictions during April 2020

Appendix 6: Jimmawurrada Creek Groundwater Bore Monitoring Schedule

Table A-6: Jimmawurrada Creek groundwater bore monitoring schedule

Monitoring Bore ID	Schedule	Parameters	Units
1. PZ09MEJ004 2. JWO21 3. JWO23 **4. JWO29**	**Quarterly[2]**	pH[1]	**pH unit**
		Temperature	**Degrees Celsius**
		Electrical Conductivity (EC)[1]	**µS/cm**
		Dissolved Oxygen	**mg/L and %**
		TDS TSS Silicon (SiO2) Total Alkalinity (CaCO3) Total Hardness (CaCO3) Dissolved Organic Carbon Major Ions – Na, K, Ca, Cl, Mg, and SO4 Dissolved metals - Al, As, Ba, Bo, Ca, Co, Cl, Cd, Cu, Cr, Fe, Pb, Mg, Mn, Hg, Mo, Na, Ni, Se, Sr, S, Zn, U, V Nitrate as N (NO3-N) Nitrite as N (NO2-N) Total Nitrogen **Total Phosphorus**	**mg/L**

Note 1: In-field and NATA accredited analysis required.
Note 2: Quarterly monitoring shall be undertaken at least 45 days apart.

Appendix 7: Inland Waters – Robe River Pools Monitoring Schedule

Table A-7: Robe River Pools monitoring schedule

Monitoring Site	Sampling Frequency[2,3]	Parameter	Unit	Monitoring Location
Robe River Pool Level Monitoring				
1. Robe River 3 (Bridge Pool) 2. Japanese Pool (Pulari Nyunangka) 3. Yeera Bluff (Gnieraoora) 4. SW16MEH0003 (RRD6) 5. Medawandy (RRU5) 6. RRD4	Monthly	Surface Water Level	mAHD	Figure 2-2
Paired alluvial bores (when installed)	Monthly	Groundwater Level	mAHD	
Robe River Pool Water and Sediment Quality				
1. RRU3 2. RRU4 3. Medawandy (RRU5) 4. Robe River 3 (Bridge Pool) 5. Japanese Pool (Pulari Nyunangka) 6. Martangkuna (RRD1) 7. Paturarr(RRD2) 8. Watpari (RRD3) 9. RRD4 10. Yeera Bluff (Gnieraoora) 11. Nyiryinmaru (SW16MEH0002) 12. SW16MEH0003 (RRD6)	Quarterly (water quality)	pH[1]	pH unit	Figure 2-2
		Temperature (field)	Degrees Celsius	
		Electrical Conductivity (EC)[1]	µS/cm	
		Dissolved oxygen (field)	% and mg/L	
		Turbidity[1]	NTU	
		Chlorophyll a TDS TSS Silicon (SiO2) Total Alkalinity (CaCO3) Total Hardness (CaCO3) Total Recoverable Hydrocarbons Dissolved Organic Carbon Major Ions – Na, K, Ca, Cl, Mg, and SO4 Total metals - As, Cr, Se Dissolved metals - Al, As, Ba, Bo, Ca, Co, Cl, Cd, Cu, Cr, Fe, Pb, Mg, Mn, Hg, Mo, Na, Ni, Se, Sr, S, Zn, U, V Nitrate as N (NO3-N) Nitrite as N (NO2-N) Ammonia Nitrogen (N-NH3) Total Nitrogen Total Phosphorus	mg/L	
	Biennial (sediment quality)	pH	pH unit	
		Electrical Conductivity	µS/cm	
		Silicon (SiO2)	mg/kg	

		Total Recoverable Hydrocarbons Total Organic Carbon Major Ions – Na, K, Ca, Cl, Mg, and SO4 Metals - Al, As, Ba, Bo, Ca, Co, Cl, Cd, Cu, Cr, Fe, Pb, Mg, Mn, Hg, Mo, Na, Ni, Se, Sr, S, Zn, U, V Nitrate as N (NO3-N) Nitrite as N (NO2-N) Ammonia Nitrogen (N-NH3) Total Nitrogen Total Phosphorus		
Aquatic Fauna Monitoring				
1. RRU1 2. RRU3 3. RRU4 4. Medawandy (RRU5) 5. Robe River 3 (Bridge Pool) 6. Japanese Pool (Pulari Nyunangka) 7. Duck Pool (Martu Kawarrja) 8. Martangkuna (RRD1) 9. Paturarr (RRD2) 10. Watpari (RRD3) 11. Parkunya (SW16MEH0001) 12. RRD4 13. Yeera Bluff (Gnieraoora) 14. Nyiryinmaru (SW16MEH0002) 15. SW16MEH0003 (RRD6)	Biannual (dry and wet season)	Aquatic invertebrates (including hyporheic fauna) composition, phytoplankton and fish composition, size class distribution and abundance, in selected upstream / downstream reference and key pools of the Robe River.	N/A	Figure 2-2

Note 1: In-field and NATA accredited analysis required.
Note 2: Monthly monitoring shall be undertaken at least 15 days apart.
Note 3: Quarterly monitoring shall be undertaken at least 45 days apart.

Appendix 8: Water Quality SSGV's

Table A-8-1: Summary of SSGVs for water quality and aquatic fauna provisions (Including the Blind Cave Eel)

Indicators	Early Response criteria (Tier 1) Level (Early indicator of potentially deteriorating water quality in Robe River)	Trigger criteria (Tier 2) Level (Indicator of deteriorating water quality in Robe River at a level which may indicate the potential for ecological effects)
Nitrate as N (NO3-N mg/L) **And** **Chlorophyll a**	**Single value in any key pool is above the nitrate Benchmark Maximum** (Appendix 8 – Table A-8-2) for that pool, for two or more monitoring events per annum. Or **>0.01mg/L** Chlorophyll a concentration is above ANZECC/ARMCANZ 2000 regional stressor level (0.01mg/L) in any key pool.	**Single value in any key pool is above 15 mg/L NO3_N** *(Site-adapted toxicant guideline value suitable for the protection of aquatic organisms in Pilbara Creek lines (van Dam 2020) that exhibit high water hardness[55] (200 – 500 mg/L as CaCO3)* *As of May 2024, ANZG has released draft national guideline values for nitrate as a toxicant in waters of varying hardness (as $CaCO_3$). Given that the hardness of the waters in the Robe River is naturally above 150 mg/L, 29 mg/L (NO_3^-_N for 95% SPL) would be sufficient to protect the health of the Robe River based on these draft ANZG (2024) DGV. However, RTIO would prefer to take a conservative approach and adopt van Dam et. al's (2022) values of 15 mg/L (NO_3^-_N for 95% SPL) as the trigger value given that the ANZG (2024) values for nitrate are still in draft.)*
pH (Field)	**<6.5 OR >8** Single value in any key pool exceeds the upper or lower stressor value. *(Upper stressor is based on the ANZECC/ARMCANZ 2000 default guidelines for Tropical Australia)* *(Lower stressor is based on Robertson-Bryan (2004), pH requirements of freshwater aquatic life)*	**<6 OR >8.4** Single value in any key pool exceeds the upper or lower stressor value for that pool for two monitoring events per annum. *(Upper stressor is based on the 95th percentile of baseline data for the relevant zone of Robe River (Appendix 8 – Table A-8-2))* *(Lower stressor is based on the ANZECC/ARMCANZ 2000 default guidelines for Tropical Australia)*
Electrical Conductivity (EC) (Field)	Single value in any key pool is above the EC 80th percentile of baseline for the relevant zone on Robe River (Appendix 8 – Table A-8-2), for two or more monitoring events per annum.	Single value in any key pool is above the EC 95^{h} percentile of baseline for the relevant zone of Robe River (Appendix 8 – Table A-8-2) for that pool, for two or more monitoring events per annum.

[55] The site adapted guideline value for nitrate will only be used for pools in the Robe River that meet the hardness criteria; the current ANZG 2018 recommended toxicant DGV for nitrate (2.4 mg/L NO_3_N; Hickey 2013) will be used for pools with lower hardness i.e. < 170 mg/L $CaCO_3$ at the time of sampling/analysis.

Indicators	Early Response criteria (Tier 1) Level (Early indicator of potentially deteriorating water quality in Robe River)	Trigger criteria (Tier 2) Level (Indicator of deteriorating water quality in Robe River at a level which may indicate the potential for ecological effects)
Barium (Total dissolved)	**0.0702 mg/L** *(80th percentile of upriver and downriver concentrations)* Single value in any key pool is above the Tier 1 criteria for two or more monitoring events per annum.	**0.0803 mg/L** *(95th percentile of upriver and downriver concentrations)* Single value in any key pool is above the Tier 2 criterion for two or more monitoring events per annum
Copper (Total dissolved)	**0.001 mg/L** *(99% species protection toxicant DGV)* Single value in any key pool is above the Tier 1 criteria for two or more monitoring events per annum	**0.0014 mg/L** *(95% species protection toxicant DGV)* Single value in any key pool is above the Tier 2 criterion for two or more monitoring events per annum.
Strontium (Total dissolved)	**1 mg/L** *(Inferred 99% species protection level based on the species sensitivity distribution used to calculate the FEQG (2020))* Single value in any key pool is above the Tier 1 criteria for two or more monitoring events per annum	**2.5 mg/L** *(FEQG (2020) for strontium 95% species protection level)* Single value in any key pool is above the Tier 2 criterion for two or more monitoring events per annum.
Zinc (Total dissolved)	**0.00248 mg/L** *(Based on ANZG 2018 99% species protection toxicant DGV and should be adjusted for water hardness at the time of sampling)* Single value in any key pool is above the Tier 1 criteria for two or more monitoring events per annum	**0.008 mg/L** *(Based on ANZG 2018 95% species protection toxicant DGV and should be adjusted for water hardness at the time of sampling)* Single value in any key pool is above the Tier 2 criterion for two or more monitoring events per annum.

Table A-8-2 Nitrate (mg/L NO_3_N) benchmarks for key Robe River pools, based on baseline data (2018-2020) and electrical conductivity (EC) and pH baseline percentiles for reaches of the Robe River.

Management Zone	Pool name	Coordinates[1]	Nitrate maximum (mg/L NO3_N)	EC 80th percentile (µs/cm)	EC 95th percentile (µs/cm)	pH 95th percentile
Downstream Reference/background	SW16MEH0003 (RRD6)	50K 411417 7594921	0.01	1400	1600	8.2
	Nyiryinmaru (SW16MEH0002)	50K 413373 7595460	0.16			
Potential Impact Downstream of Mesa J and Mesa H	Yeera Bluff (Gnieraoora)	50K 414407 7596617	0.27	1300	1500	8.2
	RRD4	50K 414421 7597635	1.60			
Potential Impact Downstream of Mesa J	Watpari (RRD3)	50K 415309 7598015	3.50	1100	1300	8.3
	Paturarr (RRD2)	50K 416237 7598031	2.80			
	Martangkuna (RRD1)	50K 417111 7598094	5.20			
	Japanese Pool (Pulari Nyunangka)	50K 419712 7598108	9.42			
Upstream Reference	Robe River 3 (Bridge Pool)	50K 424043 7596710	0.34	900	1000	8.4
	Medawandy(RRU5)	50K 428964 7601386	0.02			
	RRU4	50K 429675 7601437	0.03			
	RRU3	50K 430911 7601560	0.02			

Note 1: Coordinates are approximate locations as the pool locations may change after major flow events.

Appendix 9: Baseline Troglofauna Species Capture Rate for Mesa H

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

Table A8 shows the troglofauna capture rate per 100 trapped holes at Mesa H. Nine sampling events over a 12-year period are shown all of which are pre-mining. All troglobitic specimens (including indeterminate specimens) have been included for completeness in the calculations. The natural capture rate range varies between 0 and 34 specimens per 100 trapped holes. Scraping was not included in monitoring until the 2015 monitoring survey and thus collection rate pre- and post-mining cannot be directly compared. Specimens collected via scraping have been included for comparative reference only (but not for compliance monitoring). Higher capture rates are likely to be a result of rainfall prior to sampling. However, the required timing and size of the rainfall event required to produce a high capture rate has not yet been determined. Weather data to 2007 were taken from the Yarraloola Homestead Bureau of Meteorology (BOM) station, data post-2007 were taken from the Pannawonica BOM station.

Table A-9: Troglofauna baseline capture rates recorded at Mesa H

Mesa H Pre-mining (Baseline)												Mesa H Pit Development
Sample collection date	**2005/2006 (21 Nov - 20 Jan)**	**2010 (21 Sep - 10 Nov)**	**2015 EIA P1 (29 Oct - 12 Dec)**	**2016 EIA P2 (12 Dec - 21 Jan)**	**2016 EIA P3 (7 May - 28 Jun)**	**2016 EIA P4 (14 Sep - 27 Oct)**	**2016 EIA P5 (27 Oct - 14 Dec)**			**2017 EIA P6 (14 Dec - 31 Jan)**	**2019 P7 (3 Jul - 7 Sep)**	**2020 (31 Jul – 20 Oct)**	**2022 (15 Jul – 2 Sep)**
Rainfall during survey (mm)	5.8	0.0	40.4	3.8			13.6	0.4	37.8	151.0	5.6	34.4	243.2
Rainfall 3 months prior to collection date (mm)	13.0	23.8	40.4	9.0			171.8	2.4	38.2	187.8	64	87.8	160.8
Rainfall 12 months prior to collection date (mm)	530.4	219.2	422.0	354.2			312.8	348.6	360.0	448.4	133	168.0	324.8
Number of trapped holes	6	23	46	46			30	43	47	14	45	42	40
Number of specimens collected	0	24	23	20			8	34	8	32	30	78	4

Number of specimens per 100 trapped holes	n/a	104.3	50.0	43.5	26.7	79.1	17.0	228.6	66.6	185.7	10.0
Number of scraped holes	n/a	n/a	9	9	n/a	n/a	47	n/a	45	34	39
Number of specimens collected	n/a	n/a	0	1^	n/a	n/a	0	n/a	3	n/a	146
Number of specimens per 100 scraped holes	n/a	n/a	*	11.1	n/a	n/a	*	n/a	6.6	n/a	374.4

*denotes null specimens collected and capture rate n/a
^conservative estimation - record represents potential troglofauna

Appendix 10: Baseline Stygofauna and Blind Cave Eel Species Capture Rate

Table A-10: Change in specimen capture rate over time for stygofauna recorded from the Mesa J Hub

Baseline																	
Sample collection date	**2003**	**2004**	**2008**	**2009**	**2010**	**2011**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	18 Jun	22 Oct	09 Jun - 30 Sep	24 Jul - 05 Nov	21 Jun - 29 Nov	11 Apr - 20 Oct	01 Jul	26 May - 20 Oct	06 May - 25 Oct	19 Jan - 17 Sep	01 May - 13 Dec			01Jul – 30 Nov	01 Apr – 26 Sep	15 Mar – 18 Aug	17 Mar – 11 Aug
Rainfall during survey (mm)	No Data#	No Data#	46.7	No Data#	19.8^	108.2	0.0	8.0	52.2	281.6	2.2	79.4	69.2	34.4	149.6	243.2	31.4
Rainfall 3 months prior to collection date (mm)	No Data#	No Data#	213.6	No Data#	No Data#	357.0	147.4	78.4	246.8	36.8	262.0	144.2	67.2	87.8	275	160.8	295.6
Rainfall 12 months prior to collection date (mm)	No Data#	No Data#	213.6^	No Data#	No Data#	450.6^	338.0	303.0	328.0	355.6	601.4	150.0	148.4	168.0	430.8	324.8	539.0
Number of net-hauls (stygofauna)	1	1	4	7	10	7	4	7	19	65	12			16	36+2*	40+8*	37
Number of specimens collected	79	30	54	189	187	207	4	85	109	258	332			385	1912	4362	3452
Number of specimens per 100 net-hauled holes	7900	3000	1350	2700	1870	2957	100	1214	574	397	2767			2406	5032	9087	9330

^ Incomplete rainfall data from Mesa J weather station

* Sampled using the Karaman-Chappuis method.

No data from Mesa J weather station

Table A-11: Change in Blind Cave Eel specimen capture rate over time for stygofauna recorded from the Mesa J Hub

Baseline																	
Sample collection date	**2003**	**2004**	**2008**	**2009**	**2010**	**2011**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
	18 Jun	22 Oct	09 Jun - 30 Sep	24 Jul - 05 Nov	21 Jun - 29 Nov	11 Apr - 20 Oct	01 Jul	26 May - 20 Oct	06 May - 25 Oct	19 Jan - 17 Sep	01 May - 13 Dec			01Jul – 30 Nov	01 Apr – 26 Sep	15 Mar – 18 Aug	17 Mar – 11 Aug
Rainfall during survey (mm)	No Data#	No Data#	46.7	No Data#	19.8^	108.2	0.0	8.0	52.2	281.6	2.2	79.4	69.2	34.4	149.6	243.2	31.4
Rainfall 3 months prior to collection date (mm)	No Data#	No Data#	213.6	No Data#	No Data#	357.0	147.4	78.4	246.8	36.8	262.0	144.2	67.2	87.8	275	160.8	295.6
Rainfall 12 months prior to collection date (mm)	No Data#	No Data#	213.6^	No Data#	No Data#	450.6^	338.0	303.0	328.0	355.6	601.4	150.0	148.4	168.0	430.8	324.8	539.0
Number of physical records				1						1	1	3	1		1		2
Number of sites sampled for eDNA											32		37	28	32	30	32
Number of eDNA samples collected											36		69	28	162	150	170
Number of Sites with positive detection											7		6	6	9	15	20
Number of Samples with positive detection											8		6	6	33	27	72
Number of positive records only within Jimmawurrada Drawdown (positive sites / total sites)											2 / 4		0 / 3	0 / 6	0 / 5	0 / 5	2 / 6

^ Incomplete rainfall data from Mesa J weather station

* Sampled using the Karaman-Chappuis method.

No data from Mesa J weather station