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Ghost Bat Management Plan

West Angelas Revised Proposal

Ministerial Statement 1251

Decision Notice 2021/8923

April 2026

RTIO-1131427

Robe River Mining Co. Pty. Ltd.
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Disclaimer and Limitation

This Ghost Bat Management Plan (GBMP) has been prepared by Rio Tinto on behalf of Robe River Mining Co. Pty Ltd (the Proponent) for the West Angelas Revised Proposal (the Proposal). Neither the document nor its content may be referred to without the express approval of Rio Tinto unless Rio Tinto has submitted the document to the relevant government regulator for assessment in connection with the Proposal.

Document Status					
Rev	Author	Reviewer/s	Date	Approved for Issue	
				To Whom	Date
0	JBS&G / Rio Tinto	RTIO	October 2025	DWER	2025
1	JBS&G / Rio Tinto	RTIO	February 2026	DWER	2026
2	JBS&G / Rio Tinto	RTIO	April 2026	DWER	2026

EXECUTIVE SUMMARY

This Ghost Bat Management Plan (GBMP; Management Plan) has been prepared by Rio Tinto on behalf of Robe River Mining Co Pty Ltd (the Proponent) for the West Angelas Revised Proposal (the Proposal). The GBMP specifically addresses the requirements of conditions B2-7, C4 and C5 of Ministerial Statement (MS) 1251 and includes monitoring and management strategies to achieve the environmental outcomes and objectives required by conditions B2-7, B2-1(1)(c), B2-1(2), B2-1(3), B2-1(4), B2-1(5), B2-1(6) and B2-4. This GBMP also addresses the requirements of conditions 6, 24, 25 and 26 of Decision Notice 2021/8923.

ES Table 1 outlines the relevant approval, the purpose of this GBMP, and the environmental outcomes and objectives for the ghost bat (*Macroderma gigas*) to be met through implementation of this Management Plan, as well as the environmental criteria and management targets to measure the achievement of the associated environmental outcomes.

ES Table 1: Summary of GBMP management provisions for the Proposal.

Project title	West Angelas Revised Proposal	
Proponent name	Robe River Mining Co. Pty Ltd	
Ministerial Statement number	MS 1251	
Decision Notice Number	DN 2021/8923	
Purpose of this GBMP	This EMP provides management for environmental values with the potential to be impacted by the (Proposal) and fulfils the requirements of condition B2-7 MS 1251 and condition 23 DN 2021/8923.	
Key Environmental Factor and Value: Terrestrial Fauna – Ghost bat; Pilbara leaf-nosed bat **Condition Clauses:** Relevant condition clauses are included in Table 1-3. **Proposed Construction Date:** October 2025 **Environmental Management Plan (EMP) required Pre-construction:** Yes (for ground disturbing activities within 350 m of critical caves (as defined in MS 1251). **Environmental Protection Authority (EPA) Objective**: 'To protect terrestrial fauna so that biological diversity and ecological integrity are maintained' (EPA, 2016a). **Department of Climate Change, Energy, the Environment and Water's (DCCEEW) Objective:** Manage threatening processes associated with implementation of the Proposal, where relevant to minimising impacts to EPBC Act listed threatened species.		
Outcome based provisions	**Trigger criteria**	More than 113 ha (90% of threshold) of fauna habitat identified as gorge/gully is disturbed within the Significant Amendment. and/or More than 3,357 ha (90% of threshold) of fauna habitat identified as hillcrest/hillslope is disturbed within the Significant Amendment.

		Mining activities attributable to the Significant Amendment encroaches within 10 m of MEZ 1A, MEZ1B or MEZ 2 or Over 4% of MEZ 1A, MEZ 1B or MEZ 2 disturbed for low impact activities attributed to the Significant Amendment. or Low impact activities attributed to the Significant Amendment come within 10m of cave within MEZ 1A, MEZ 1B or MEZ 2.
		Vibration levels at critical caves exceed design parameters of: 75 mm/s PPV limit for critical caves with a low geotechnical sensitivity (Blast vibration category II) and/or 50 mm/s PPV limit for critical caves with a medium geotechnical sensitivity (Blast vibration category III) and/or 25 mm/s PPV limit for critical caves with a high geotechnical sensitivity (Blast vibration category IV)
	Threshold criteria	More than 126 ha of fauna habitat identified as gorge/gully is disturbed for the Significant Amendment. and/or More than 3,731 ha of fauna habitat identified as hillcrest/hillslope is disturbed for the Significant Amendment.
		Disturbance of more than four Pilbara leaf-nosed bat (category 4) caves or Disturbance of more than five ghost bat (category 4) caves or Ground disturbing activities (except for low impact activities) occur in MEZ 1A, MEZ 1B or MEZ 2. or Low impact activities exceed 5% disturbance within MEZ A1, MEZ 1B or MEZ 2. or Low impact activities impact a cave within MEZ 1A, MEZ 1B or MEZ 2.
		Trigger exceedance. and A change to the structural integrity of a critical cave that is confirmed by a suitably qualified expert that it will significantly reduce its capacity to support ghost bat usage.

Corporate endorsement

I hereby certify that to the best of my knowledge, the provisions within this West Angelas Revised Proposal GBMP are true and correct.

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Abbreviations and Glossary

Abbreviation	Description
ACAR	Annual Compliance Assessment Report
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 the CEO's delegate.
Conceptual Footprint	Refers to the current indicative layout of the direct disturbance footprint of the Proposal, which includes key elements such as mine pits and waste rock landforms, as well as infrastructure.
Critical cave – group A	Caves CWAN-04, CWAN-01, CWAN-02, CWAN-03, CWAN-06 and CWAN-07
Critical cave – group B	Caves AA1, WA-13, WA-21 and WA-23
Critical habitat	Fauna habitat types, such as gorge/gully habitat and hillcrest/hillslope habitat for bats as described in the West Angelas Revised Proposal Environmental Review Document (Rio Tinto, 2023)
DoE	Department of the Environment
Development Envelope	Area in which the new mine and existing areas and associated facilities of the proposal are located. All direct impacts associated with the proposal will be contained within the development envelope
Direct Impact	Direct impact refers to direct disturbance and/or clearing of a value.
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986*
EPA	Western Australian Environmental Protection Authority
ERD	Environmental Review Document
Existing Operations	The West Angelas Iron Ore Project implemented under Ministerial Statement 1113.
GBMP	Ghost Bat Management Plan
HSEC	Health, Safety, Environment and Compliance
Indirect Impact	Indirect impacts are secondary impacts that may result from direct impacts (e.g. noise, dust etc.)
km	Kilometres
m	Metre
Management level	Level of management appropriate for an environmental value, as determined by assessment described in the Rio Tinto Framework for EMPs
MEZ	Mining Exclusion Zone - Refers to an area within the development envelope where no direct disturbance is permitted, unless in response to a contingency action associated with monitoring and management.
mm/s	Millimetres per second
MS	Ministerial Statement
PPV	Peak Particle Velocity

Abbreviation	Description
Proponent	Robe River Mining Co. Pty Ltd
Proposal	The West Angelas Revised Proposal; The Proposal incorporates both the Existing Operations and the Significant Amendment.
Responsible	Indicative team within the Proponent's organisation responsible for implementing monitoring and management actions to demonstrate compliance with criterion. A responsible team is provided to facilitate internal Proponent management only; the identified responsible team is subject to amendment without resubmission of the EMP in line with adaptive management processes.
Significant Amendment	The Significant Amendment includes the extension and development of new above and below water table deposits and associated activities to extend the life of the Existing Operations.
Viability	Where there is evidence of breeding and juveniles and the population numbers remain within natural variation.
WA	Western Australia
WRL	Waste Rock Landform

1. CONTEXT, SCOPE AND RATIONALE

This Ghost Bat Management Plan (GBMP; Management Plan) has been prepared by Rio Tinto on behalf of Robe River Mining Co. Pty Ltd (the Proponent) for the West Angelas Revised Proposal (the Proposal), to address Ministerial Statement (MS) 1251 and Decision Notice 2021/8923 approval conditions under the Western Australian (WA) *Environmental Protection Act 1986* (EP Act) and the Commonwealth *Environmental Protection and Biodiversity Conservation Act 1999* (EPBC Act), respectively.

This GBMP describes the environmental management of key environmental factor: Terrestrial Fauna (specifically ghost bat, *Macroderma gigas* and Pilbara leaf-nosed bat *Rhinonicteris aurantia*) for the Proposal and as a relevant Matter of National Environmental Significance (MNES) under the EPBC Act. The GBMP has been and was developed in accordance with relevant policy and guidance, including:

- Environmental Protection Authority's (EPA) *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA, 2024a)
- EPA's *Interim Guidance for Environmental outcomes and outcomes-based conditions* (EPA, 2021a).
- Department of Climate Change, Energy, the Environment and Water's (DCCEEW) *Environmental Management Plan Guidelines* (DCCEEW, 2024)

The sections of the GBMP that address the EPA and DCCEEW Environmental Management Plan (EMP) requirements are provided in Table 1-1.

Table 1-1: EMP Requirements within this GBMP

EMP Requirement	Section of this GBMP
EPA EMP Requirements	
Version control	Page ii
Executive summary	Page iii
Context, scope and rationale:	Section 1
Proposal description	Section 1.1
Key environmental factor	Section 1.2
Condition requirements	Section 1.3
Rationale and approach	Section 1.4
EMP components:	Section 2
Outcome-based conditions	Section 0
Objective-based conditions	Section 2.3
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Stakeholder Engagement	Section 4
DCCEEW EMP Requirements	
Version control	Page ii
Executive summary	Page iii
Conditions of the Approval reference table	Table 1-3
Project Description	Section 1.1
Objectives	Section 2
Roles and Responsibilities	HSEC Operational Delivery – PMO
Reporting	Section 2.3

EMP Requirement	Section of this GBMP
Training	Table 2-3 and Table 2-4
Potential Environmental Impacts and Risks	Section 1.2
Environmental Management Measures: • Environmental Management Activities • Performance Targets • Environmental Monitoring • Corrective Actions	Table 2-3 to Table 2-4
Maps and Diagrams	Figure 1-1 to Figure 1-6
Audit and Review	Section 3
Glossary	Page viii
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1.1 Proposal Description

The Proposal is located approximately 130 km northwest of Newman in the East Pilbara region of Western Australia (Figure 1-1) is an Existing Operation implemented under MS 1113. A significant amendment was recently approved to extend the life of the operation.

The Proposal includes:

- Development of Above Water Table (AWT) and Below Water Table (BWT) iron ore deposits
- Associated activities including, but not limited to, the following:
    - Mineral waste management: including Waste Rock Landforms, land bridges, low grade ore dumps, topsoil and sub-soil stockpiles, in-pit WRL and storage of waste fines;
    - Ore processing (including crushing) infrastructure;
    - Other facilities including workshops, hydrocarbon and Ammonium Nitrate Fuel Oil storage and laydown areas;
    - Linear infrastructure, including heavy and light vehicle access roads, rail and associated infrastructure, conveyors, utility corridors, pipelines and power (including sub-stations) and communications distribution networks;
    - Infrastructure for surface water management, including crossings, diversion drains, levees and culverts;
    - Groundwater abstraction and utilisation and associated infrastructure;
    - Dewatering to enable BWT mining and associated infrastructure (including bores and pipelines); and
    - Infrastructure for management and use of water from dewatering.
- Offices and accommodation villages; and
- Renewable energy including renewable energy generation, energy storage and associated ancillary infrastructure.

Figure 1-2 shows the key elements of the Proposal.

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Figure 1-1
Regional Location of the Proposal

Drawn: GIS Team
Plan: PDE0186383v5
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:1,250,000 @A3
GIS.Team@riotinto.com

Legend

- Rio Tinto Mine
- Rio Tinto Port
- Town
- Revised Development Envelope
- Approved Development Envelope
- National Park
- Fortescue Marsh
- Rio Tinto Railway
- Highway
- Major Road
- Major Creek

N

0 20 40 60
Kilometres

Map units in metres

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400,000 500,000 600,000 700,000

7,700,000 7,600,000 7,500,000

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

Enlargement

Great Northern Highway
Turee Creek East Branch
West Angelas

0 5 10
Kilometres

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Figure 1-2
Ghost Bat Records, Habitat and Caves within the Revised Development Envelope

Drawn: A.D.
Plan: RTIO-0970589v2
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

660,000 670,000 680,000 690,000

7,450,000 7,440,000 7,430,000

Karijini National Park

Great Northern Highway

Turee Creek East Branch

Spearhole Creek

CWAN-03 CWAN-02 CWAN-04 CWAN-01 CWAN-07 Western Hill CWAN-06 CWAN-30 CWAN-28 CWAN-33 CWAN-29 CWAN-05 CWAN-32 CWAN-27 CWAN-31 CWAN-26

CDHI-001 A2 L3 A1 L2 I1 CDHI-002 Deposit H Deposit B CWAN-09

WA-09 WA-10 WA-11 Deposit C WA-22 WA-23 WA-12 WA-20 WA-17 WA-13 WA-21 Deposit D

Deposit G

CMAR-02 CMAR-01 CMAR-04 CMAR-03

Deposit A West Deposit A Deposit F North Deposit F AA1 Deposit E

CWAN-34 CWAN-08 Mt Ella East CWAN-11

Legend

- Revised Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

- Pit
- Waste Landform

Caves

- Category 2 (Critical Habitat)
- Category 3
- Category 4

Significant Fauna

- Ghost Bat

Habitat Value

- Potential Critical Habitat
- Supporting Habitat
- National Park
- Rio Tinto Railway
- Highway
- Major Creek

N

0 1 2 3 4 5
Kilometres

Map units in metres

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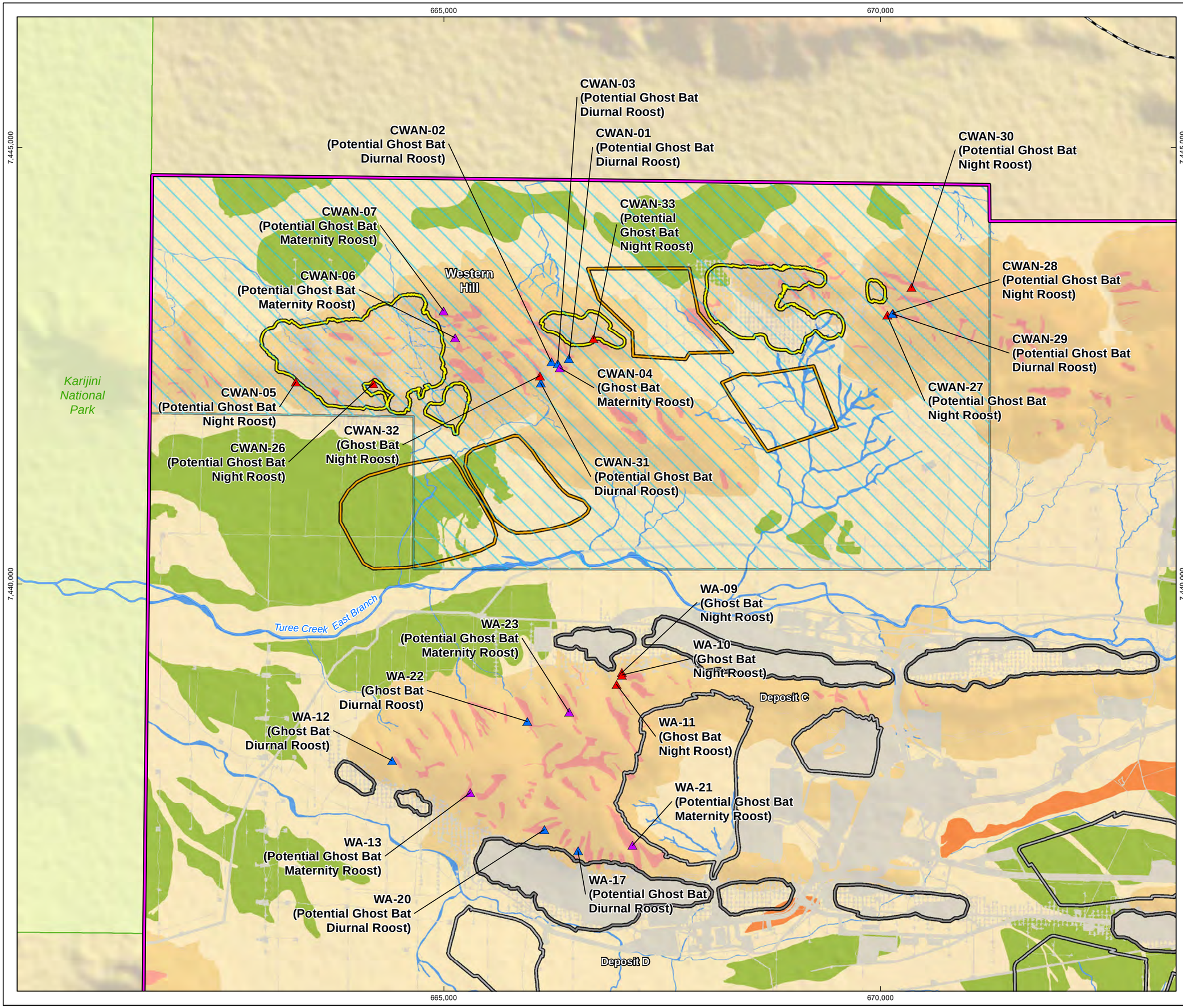

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Figure 1-3
Fauna Habitat Types and Significant Habitat Features within the Revised Development Envelope – Western Hill

Drawn: A.D.
Plan: PDE0186401v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Extension Area

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

- Pit
- Waste Landform

Caves

- Category 2
- Category 3
- Category 4
- Disturbed

High Significance Fauna Habitat

- Gorge/Gully
- Hillcrest and Hillslope

Moderate Significance Fauna Habitat

- Drainage Line
- Cracking Clay
- Footslopes and Plains
- Mixed Acacia Woodland

- National Park
- Rio Tinto Railway
- Major Creek

N

0 1 2
Kilometres

Map units in metres

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1.2 Key Environmental Factor

This GBMP has been developed to meet the Western Australian EPA's terrestrial fauna key environmental factor objective and relevant policy and guidance and predicted and potential impacts from the implementation of the Proposal.

The ghost bat and Pilbara leaf-nosed bat are listed as Threatened Species (Vulnerable) under the EPBC Act. This GBMP has been prepared to mitigate threats to such MNES species to meet the requirements of DCCEEW policy and guidance. The environmental values of the two species, including predicted and potential impacts of the Proposal, are outlined in Table 1-2.

Table 1-2: Potential direct and indirect impacts of the Proposal

Environmental Value (Environmental Receptor)	Predicted Impacts (Stressor, pressure, receptor)		Potential Impacts	
	Direct (Stressor, pressure)	**Indirect (Stressor, pressure)**	**Direct (Stressor, pressure)**	**Indirect (Stressor, pressure)**
Terrestrial Fauna Ghost bat (*Macroderma gigas*) and Pilbara leaf-nosed bat (*Rhinonicteris aurantia*), and confirmed and potential high value / critical habitat.	**Proposed clearing and ground disturbance** Loss or modification of foraging and roosting habitat: • Removal of up to five category 4 roosts CWAN-05, CWAN-09, CWAN-26, CWAN-33 and WA-16 (not considered critical habitat). • Reduction of confirmed and potential high value / critical and supporting habitat.	**Threatening processes (noise, dust, light and fauna interactions)** Changes to the environment from general activities may influence /change behaviour, and/ or use of habitats in the development envelope.	Fauna interaction/vehicle strike	**Mine activities, including blasting, causing vibration** Alteration of the structure of roosts. Blasting and/or mine pit development may create instability or structural damage to caves, which may change microclimate. **Feral Animals** Increase in feral animal presence, with potential to predate bats.

1.3 Condition Requirements

Conditions required under MS 1251 and EPBC approval 2021/8923 that this GBMP addresses are outlined in Table 1-3.

Table 1-3: MS 1251 conditions addressed in the GBMP

Condition number and wording	Relevant section of the GBMP
MS 1251 B2 Terrestrial Fauna	
B2-1 The proponent must ensure the implementation of the **proposal** achieves the following environmental **outcomes**:	As below
B2-1 (1) **disturb** no more than the following for the **significant amendment**: (c) four (4) Pilbara leaf-nosed bat caves (category 4) as shown in Figure 10.	Section 2
(2) **disturb** no more than five (5) ghost bat caves (category 4) as shown in Figure 10;	
(3) no impacts to the structural integrity or microclimate of caves listed in **Mining Exclusion Zone 1A and 1B** as shown in Figure 8A and Figure 8B that would reduce the capacity to support ghost bats (*Macroderma gigas*);	
(4) no **ground disturbing activities** in **Mining Exclusion Zone 1A, 1B and 2**, as shown in Figure 8A, Figure 8B and Figure 9 except for **low impact activities** which may be undertaken within no more than 5% of the total area of **Mining Exclusion Zone 1A, 1B and 2**;	
(5) no **disturbance** to ghost bat (*Macroderma gigas*) and Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) roosts within the **Mining Exclusion Zone 1A, 1B and 2**;	
(6) no **disturbance** to ghost bat (*Macroderma gigas*) and Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) within the **Mining Exclusion Zone 1A** and **MEZ 2** from noise and vibration attributable to the **significant amendment**;	
B2-4 The proponent must implement the **proposal** to achieve the following environmental **objectives**:	Section 2.3
(1) maintain **viability** of the ghost bat populations within the **development envelope** during operations and post-mining operations; and	
B2-7 The proponent must prepare and submit a Ghost Bat Management Plan, that satisfies the requirements of condition C4 and C5, to ensure the environmental **outcomes** and **objectives** required by conditions B2-1(1)(c), B2-1(2), B2-1(3), B2-1(4), B2-1(5) and B2-1(6) are achieved. The plan shall include:	This Plan
(1) at least twelve (12) months of monitoring to determine the **baseline** population size of the ghost bat colony, including natural variation in population numbers and **baseline** distribution of bat movement and dispersal activity within the **development envelope**;	Section 2.1
(2) protocols and procedures to monitor usage and activity levels of ghost bat movement within the **critical caves** in **Mining Exclusion Zone 1A** and **1B** during construction, operation, closure and for at least twenty-four (24) months post-closure;	
(3) protocols and procedures to monitor ghost bat usage as the **proposal's** activities move to within 350 **m** of **critical caves – group A** in **Mining Exclusion Zone 1A** and 150 **m** of **critical caves – group B** in **Mining Exclusion Zone 1B** and 150 **m** during the development of the mining pits for the **significant amendment**; and	

Condition number and wording	Relevant section of the GBMP
(4) protocols and procedures to monitor feral cat activity for **critical caves** in **Mining Exclusion Zone 1A** and **1B** during construction, operation, closure and twenty-four (24) months post-closure.	Section 2.3
EPBC 2021/8923 MNES Fauna Species	
23) Prior to the commencement of blasting within 350 m of critical caves, the approval holder must submit a Ghost Bat Management Plan to the department for the Minister's approval. The Ghost Bat Management Plan submitted to the department must satisfy the requirements of condition B2-7 of the WA Recommended Conditions and Condition 6 of this approval	This plan
24) The approval holder must not undertake any blasting within 350 m of critical caves unless the Minister has approved the Ghost Bat Management Plan in writing.	This plan
25) The approval holder must implement the Ghost Bat Management Plan approved by the Minister for the life of the approval.	This plan
6) To avoid and mitigate harm to the protected matters, the approval holder must comply with the following conditions: a) ensure mining does not harm the structural integrity, microclimate or use by ghost bat of any critical caves, b) ensure that no person approaches within 150 m of any critical cave unless authorised to do so by the approval holder, c) ensure no haul truck comes within 150 m of any entrance to a critical cave, and d) ensure that none of the retained bat caves are closed.	Section 2

1.4 Rationale and Approach

1.4.1 Management Approach

Rio Tinto has applied a risk-based approach to the management of ghost bat and Pilbara leaf-nosed bats, the purpose of which is to mitigate the impacts identified in Table 1-2, utilising research completed as part of the proposal to inform the management of conservation listed bats at Greater West Angelas.

Blast controls will be applied to all blasting carried out within 350 m of any site listed as vibration sensitive. All caves (MEZ 1A, MEZ 1B and MEZ 2) are considered to be vibration sensitive and critical caves (MEZ 1A and MEZ 1B) have been given the highest environmental significance rating. Refer to Section 2.1.3 for further information regarding methodology used to determine vibration level triggers and thresholds.

Other Rio Tinto procedures and governance processes assist to reduce and avoid (where practicable) impacts to ghost bats and Pilbara leaf-nosed bats. All legal obligations from environmental approvals (both State and Federal) are registered and maintained within an internal legal compliance register (Enablon). The conditions and commitments contained in this register are then assigned to relevant personnel within the business to ensure appropriate maintenance and workflow of tasks associated with implementing obligations. This approach ensures that any task associated with an obligation is tracked and appropriately closed out.

Prior to any disturbance on site, an internal approval process (Land Access Management System (LAMS)) is created to ensure all obligations associated with the activity are implemented prior to work commencing, including appropriate exclusion zones, restricted activities or conditioned limits. This is recorded within the live geographical information system (GIS) files to be used in the field when completing tasks.

1.4.2 Rationale

The ghost bat is the main species within the West Angelas development envelope and the target species of the GBMP. The presence of seven category 2 ghost bat caves within the development envelope suggests that the species resides permanently within the development envelope. The Pilbara leaf-nosed bat is not a resident within the West Angelas development envelope. All of the caves recorded within the development envelope are classified as nocturnal refuges (category 4 – non-critical) for the Pilbara leaf-nosed bat. Despite extensive survey efforts (using echolocation etc.), none of the caves has the usage frequency or structural characteristics to represent critical habitat (category 1 to 3).

A comprehensive monitoring program has been developed across 27 caves within including 2 caves outside the development envelope. Selected caves are proposed to be monitored for multiple parameters based on the category, location and characteristics of the caves.

The monitoring at caves is based on the known science of the cave, and those considered most appropriate to inform compliance against conditions. However, access to caves may not always be possible due to accessibility, heritage restrictions, weather or safety considerations. Access may also be subject to Traditional Owner consent, engagement or other requirements. The Pilbara is an extreme environment, and while monitoring equipment is robust and checked regularly, extreme temperature, temperature variations, strong winds, dust and lightening and native fauna may damage equipment and lead to gaps in data. Whilst the Proponent endeavours to collect all data as described in Section 2, there may be gaps in data for reasons described above. Gaps in data due to the above limitations are unlikely to significantly impact the ability to interpret the data and provide meaningful assessment.

The monitoring program is designed to provide multiple sources of data to provide an assessment of compliance against conditions as specified in Table 1-3 and to assess the presence and patterns of ghost bats and Pilbara Leaf-Nosed bats within the development envelope and as such, any potential disturbance to populations as a result of the Proposal. A summary of proposed monitoring in each MEZ

is provided below, for a detailed explanation of the rationale for proposed monitoring in relation to each condition refer to Table 1-4.

All **critical caves** (MEZ 1A and 1B) will be subject to the following monitoring[1]:

- acoustic data (echolocation calls) (all critical caves);
- microclimate (temperature and humidity) as an indicator of cave conditions and structural integrity (all critical caves);
- noise levels (CWAN-02 using representative monitoring of nearby caves);
- geotechnical sensitivity assessment when blasting is within 350 m.
- feral cat activity;
- vibration levels when blasting is within 350 m using methodology described in Section 2.1.3; and
- supporting scat monitoring (including genetic analysis – Appendix D) at selected caves based on access, mine plan and ghost bat usage (indicative scat monitoring shown in Table 2-5 but is subject to change). Note: Cave CWAN-04 currently has a high geotechnical sensitivity and poses a safety risk for entry to personnel on a regular basis. Cave WA-23 has been assessed as unsafe to enter (Biologic 2024).

Non-critical (MEZ 2) caves will be subject to the following monitoring at selected caves, as shown in Figure 1-4 and Figure 1-6:

- acoustic data (echolocation calls) at 15 of the 27 MEZ 2 caves;
- microclimate (temperature and humidity) as an indicator of cave conditions and structural integrity at 15 of the 27 MEZ 2 caves;
- noise levels at 5 of the 27 MEZ 2 caves;
- geotechnical sensitivity assessment when blasting is within 350 m.
- vibration levels when blasting is within 350 m using methodology described in Section 2.1.3; and
- supporting scat monitoring (including genetic analysis – Appendix D) at selected caves based on access, mine plan and ghost bat usage (indicative scat monitoring shown in Table 2-5 but is subject to change).

Reference caves (3) inside and outside the development envelope will be subject to the following monitoring:

- acoustic data (echolocation calls);
- microclimate (temperature and humidity) as an indicator of cave conditions and structural integrity ;
- noise levels; and
- supporting scat assessment (including genetic analysis – Appendix D).

[1] Subject to access, heritage and safety constraints

Table 1-4: Rationale for Choice of Provisions

Outcome	Summary of Current Knowledge and Study Findings	Key Assumptions and Uncertainties	Rationale for Choice of Provision, Indicator/s and/or Management Action/s
Environmental Value – Terrestrial Fauna: ghost bat (*Macroderma gigas*); Pilbara leaf-nosed bat (*Rhinonicteris aurantia*)			
Key surveys and studies: (Biologic, 2016; Biologic, 2018a; Biologic, 2018b; Biologic, 2021b; Biologic, 2021a; Biologic, 2021c; Biologic, 2022a)			
MS 1251 Condition B2-1 The proponent must ensure the implementation of the proposal achieves the following environmental outcomes: (1) disturb no more than the following for the significant amendment: (a) 126 ha of the fauna habitat identified as gorge/gully habitat as shown in Figure 11; (b) 3,731 ha of the fauna habitat identified as hillcrest/hillslope habitat as shown in Figure 11; and (c) four (4) Pilbara leaf-nosed bat caves (category 4) as shown in Figure 10. (2) disturb no more than five (5) ghost bat caves (category 4) as shown in Figure 10;	**Ghost bat:** All caves have the potential to provide roosting habitat for the ghost bat. This includes caves of the following categories (as per (Bat Call WA, 2021a)) and shown in Figure 1-4 and Figure 1-6: • Seven category 2 roosts (AA1, WA-13, WA-21, WA-23, CWAN-04, CWAN-06, CWAN-07) • 13 category 3 roosts (L2, L3, WA-17, WA-20, A1, WA-12, WA-22, CMAR-01, CWAN-01, CWAN-02, CWAN-03, CWAN-29, CWAN-31) • 21 retained category 4 roosts: (I1, A2, WA-09, WA-10, WA-11, CWAN-05, CWAN-09, CWAN-26, CWAN-33, CMAR-04, CWAN-27, CWAN-28, CWAN-32, CWAN-08, CWAN-11, CWAN-30, CWAN-34, CDHI-001, CDHI-002, CMAR-02, CMAR-03) Category 2 caves are critical habitat for the species. The grouping of category 3 and 4 caves immediately surrounding these caves is also considered critical and described as “apartment blocks” that support the ecological function of category 2 caves. Isolated category 3 or 4 caves are not considered critical habitat, as these caves are used opportunistically. CWAN-04 (category 2) and CWAN-01, CWAN-02, and CWAN-03 (category 3) are within an apartment block located at Western Hill, all other caves are isolated caves. Five category 4 caves for the ghost bat are expected to be directly impacted by the Proposal and 37 roosts will be retained. All category 2 and 3 caves within the development envelope will be retained. Mining Exclusion Zones (MEZs) have been established (MEZ 1; critical caves and MEZ 2; remaining retained caves) around all retained ghost bat caves within the development envelope to ensure the Proposal does not directly impact these caves. **Pilbara leaf-nosed bat:** The Pilbara leaf-nosed bat has been recorded at 12 locations surrounding the development envelope; and five locations within the development envelope, two of which were within the Action Area. Recordings of the species originate from the area surrounding cave CWAN-04, located within Hillcrest/Hillslope habitat at Western Hill. The timing of the calls suggests that these individuals were from a nearby cave site known as Turee Creek Roost within Karijini National Park, approximately 13.5 km to the west of the development Envelope, foraging within the development Envelope and potentially utilising Cave CWAN-04 as a nocturnal refuge. A high concentration of calls has been recorded at the Upper Turee Creek Roost. The concentration of the calls and the characteristics of the Upper Turee Creek Roost indicates that it is likely to be a permanent diurnal roost for the species (Biologic 2021c). All of the caves recorded within the development envelope are considered to have the potential to be nocturnal refuges (category 4) non-critical habitat for the Pilbara leaf-nosed bat (Biologic 2021c). The above survey effort, along with ongoing cave monitoring required for MS 1113 compliance and historic sampling outside of the development envelope, all provide assurance that there is no category 1, 2 or 3 Pilbara leaf-nosed bat roosts in the Proposal Area (pers. comm Robert Bullen, 23 November 2023).	<u>Assumptions</u> • Protection of roosting and foraging habitat will enable the persistence of bats within the development envelope. <u>Uncertainties</u> • Limited data is available on the sensitivity of bats to light, noise and vibration. • There is limited understanding of the long-term behaviour of bats in relation to the use of roosts and movement between or abandonment of roosts. • There is limited data on the likely impact of climate change and drought on bats.	**Choice of Provision** To meet the intent of this condition, Rio Tinto has proposed the following environmental criteria for the Proposal: • An early warning response criteria of 80% reduction in maximum extent of critical fauna habitat within the development envelope • A trigger response criteria of 90% reduction in maximum extent of critical habitat reduction • A threshold criteria for disturbing over the maximum extent of critical fauna habitat and/or disturbance of more than the 5 ghost bat caves and/or disturbance of more than 4 Pilbara leaf-nosed bat caves. In the event of these exceedances a number of response actions will be employed to ensure that threshold levels are not reached. **Rationale** Protection of the critical foraging and roosting habitat aims to maintain the ecological function and viability of the habitat. Clearing limits for critical Gorge/Gully and Hillcrest/Hillslope habitats, and caves are proposed to be outcome-based provisions as these can be quantified accurately. Bats require a range of caves to be able to move around due to climatic changes/conditions. The impact of the proposal is reduced by maintaining a spread of caves and connecting habitat throughout the development envelope allowing the bats to adapt and move as necessary.
MS 1251 Condition B2-1 (3) no impacts to the structural integrity or	The distribution of ghost bats in the Pilbara is largely determined by the presence of suitable roosting sites, which can be natural caves, or	Assumptions:	**Choice of Provision**

Outcome	Summary of Current Knowledge and Study Findings	Key Assumptions and Uncertainties	Rationale for Choice of Provision, Indicator/s and/or Management Action/s

microclimate of caves listed in MEZ 1A and 1B as shown in Figure 8A and Figure 8B that would reduce the capacity to support ghost bats (*Macroderma gigas*);
 	
DN 2021/8923 Condition 6(a) ensure mining does not harm the structural integrity, microclimate or use by ghost bat of any critical caves
	underground mines and adits (Bat Call WA 2021a). In the Hamersley Ranges, natural roosts generally comprise deep, complex caves beneath bluffs or low rounded hills composed of Marra Mamba or Brockman Iron Formation (TSSC, 2016).
	
	A review of published literature reveals that there are few known maternity roosts in natural caves within the Pilbara region (Armstrong & Anstee 2000), with centralised breeding sites in the Pilbara largely restricted to abandoned mines in the Chichester Ranges.
	
	Ghost bats move between a number of caves seasonally, or as dictated by weather conditions, and therefore require a range of cave sites. Outside of the breeding season, male bats are known to disperse widely (>100 km), especially during the wet season when conditions generally allow bats to use caves that would otherwise not be suitable (TSSC, 2016).
	
	Armstrong and Anstee (2000) reported high relative humidity (82 - 84%) at two known maternity roosts in the Hamersley Ranges. The remaining caves however had relative humidity readings of between 14 - 31%. While ghost bats appear to prefer roosting in relatively humid caves, it is thought that temperature is a more important factor influencing roost suitability, with the species preferring relatively warm caves of around 23 to 28°C (TSSC 2016).
	
	Rio Tinto have conducted geotechnical assessments on six caves in the Silvergrass East area (Rio Tinto , 2020), where the geotechnical sensitivity (robustness) of the caves were assessed to guide the tolerable blast vibration range required to protect the integrity of the structure (i.e. structural integrity and integrity of the microclimate), not the potential impact to bats (e.g. stress/disturbance) (Rio Tinto , 2020). Blast vibration thresholds weren't recommended based on guidance that are in place for protection of heritage sites, specifically caves and shelters, discussions with the Rio Tinto's internal Explosive and Dangerous Goods team and the Australian Standard AS2187.2 – Ground Vibration and Air blast Overexposure. Blast vibration threshold recommendations ranged from 25 to 100 mm/s and combine the geotechnical sensitivity of the cave with the environmental significance of the roost (Rio Tinto , 2020).
	
	In 2014, BHP commissioned a study to determine the susceptibility of caves to blasting impacts, within Marra Mamba iron formation geology. The quantitative assessment utilised a number of different techniques, including vibration monitoring, laser scanning and structural mapping, plus visual observations. The study concluded that for blasting to create fresh fractures in intact block rocks, vibration will need to be at least 320 mm/s and blasting further than 50 m from a cave is unlikely to show impacts of severe damage to Pilbara leaf-nosed bat roosts (BHP, 2025).
		• Managing blast vibration will be effective to prevent disturbance to the structural integrity of retained roosts.
		• Maintaining the structural integrity of the cave will maintain the microclimate
		
		Uncertainties:
		
		• Limited data on sensitivity of ghost bats to changes in microclimate in roosting caves.
		• The impact of climate change on the species, the carrying capacity of caves and the foraging habits of the ghost bat is unknown.
			As there is limited information on the required microclimate for ghost bats, the following environmental criteria has been proposed to protect structural integrity of the critical caves to meet the requirements of MS 1251 Condition B2-1(3) and DN 2021/8923 Condition 6 (a):
			
			• For activities within 350 m of the critical caves, maximum vibration levels have been proposed:
			  ○ Low geotechnical sensitivity a trigger PPV limit of 75mm/s
			  ○ Medium geotechnical sensitivity a trigger PPV limit of 50mm/s
			  ○ High geotechnical sensitivity a trigger PPV limit of 25mm/s
			
			These limits will be applied to protect structural integrity. Additional work will be completed within the Noise and Vibration Management Approach Report (B2-5) to understand vibration limits appropriate to ensure disturbance to bats from vibration is limited. Where the values differ, the more conservative value will be applied.
			
			Rationale
			
			Whilst structural integrity and microclimate can be measured at caves, identification of changes attributable to the Proposal and the impact on ghost bats is difficult to quantify. Structural integrity of a cave may change however may not impact the capacity to support ghost bats and vice versa. Rio Tinto has completed significant geotechnical work to understand the appropriate vibration levels based on geotechnical stability to protect the structural integrity of caves. The Proponent is required to undertake blasting trials (B2-9) which will help to further inform if the proposed limits are appropriate.
			
			From data collected to date in the Pilbara, relative humidity and temperature as monitored in caves is highly variable. As there is limited information on the impact of microclimate changes to ghost bats, vibration limits will be used as the main threshold. Additional monitoring to be completed to inform of any changes includes:
			
			• microclimate (temperature and humidity) as an indicator of cave conditions and structural integrity; monitoring and trend
			• Acoustic/echolocation monitoring
			• Geotechnical assessments
			• Blasting trials.
			
			The Proponent will provide relevant baseline with respect to microclimate (temperature and humidity) prior to operational blasting within 350 m of critical caves – group A and within 150 m of critical caves – group B.

MS 1251 Condition B2-1(4) no ground disturbing activities in MEZ 1A, 1B and 2, as shown in Figure 8A, Figure 8B and Figure 9 except for low impact activities which may be undertaken within no more than 5% of the total area of MEZ 1A, 1B and 2; DN 2021/8923 Condition 6(b) ensure that no person approaches within 150 m of any critical cave unless authorised to do so by the approval	**Ghost bats** Within the development envelope, 37 records of ghost bat were recorded via several methods, including ultrasonic recordings, scat monitoring including genetic analysis and direct observations (comprising both alive and deceased individuals). The population of ghost bats occurring in the development envelope is assumed to be a breeding population due to: • The presence of two confirmed category 2 (maternity) roosts, including one within the development envelope • The range and extent of suitable habitats for roosting and foraging within the development envelope.	Assumptions: • Protection of roosting and foraging habitat will enable the persistence of bats within the development envelope. • Providing MEZ's around the roosts will protect the bat roosts from disturbance. • Temperature and humidity is used as an indicator of the structural integrity of the cave. Ongoing stable temperature and humidity that aligns with baseline levels indicates that the cave has not	**Choice of Provision** To meet both the outcomes of MS 1251 B2-1 (4) and B2-1 (5) and DN 2021/8923 6 (b), 6 (c) and 6 (d) Rio Tinto has proposed environmental criteria (trigger and thresholds) relating to buffer distances and disturbances from the roosts in MEZ 1 and 2, including: • A 10 m stand off from MEZ 1 and/or MEZ 2 has been included as a trigger to assess the need and ensure appropriate additional controls are in place (Table 2-3) prior to approaching the MEZ 1 and/or MEZ 2 boundary. • A trigger has been selected of 4% of MEZ 1 or MEZ 2 disturbed for low impact activities. If clearing for low impact activities reaches 4% within MEZ areas response actions will be carried out as detailed in Table 2-3.

Outcome	Summary of Current Knowledge and Study Findings	Key Assumptions and Uncertainties	Rationale for Choice of Provision, Indicator/s and/or Management Action/s
holder DN 2021/8923 Condition 6(c) ensure no haul truck comes within 150 m of any entrance to a critical cave MS 1251 B2-1(5) no disturbance to ghost bat (*Macroderma gigas*) and Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) roosts within the MEZ 1A, 1B and 2; DN 2021/8923 Condition 6(d) ensure that none of the retained bat caves are closed	The ghost bat population in the development envelope is expected to meet the definition of an important population as defined in the Significant Impact Guidelines (TSSC 2016). The Proponent has established MEZs around significant roosts within the development envelope to ensure no direct impacts to the roosts. Buffers around caves should be of a size that ensures that the cave remains a viable roost and should take into account all perceived threats during and after any mining operations. Currently there is no consensus on an appropriate buffer size for caves with distances varying depending on site specific factors. Buffers for critical caves have ranged from 40 m to 340 m, with typical buffers in the Pilbara suggested to be between 200 and 250 m (Bat Call WA, 2021a). However, there is evidence that caves with large-scale mining operations (i.e. pits) within 100–200 m are continuing to be used by ghost bats and remain viable diurnal roosts at (but not limited to); Wodgina, Abydos, Cattle Gorge, Mining Area C, West Angelas and Robe Valley (Bat Call WA, 2021a), noting that trends in usage may have changed from pre-mining levels. Conversely, at several other caves ghost bat presence and usage either did not substantially change or increased at distances of ~100– 150 m further complicating an assessment of an appropriate buffer to mitigate indirect impacts to critical habitat roosts (Bat Call WA, 2021a). Additionally, there did not appear to be a correlation with category of cave for these results. Rio Tinto's West Angelas Operations have progressed from distances of between 70 and 535 m from ghost bat caves to between 67 and 229 m in more recent years (Rio Tinto, 2023). Monitoring of cave AA1 in 2017 – 2019 suggested that mine developments within 136 m of the roost did not have adverse impacts on ghost bat activity. **Pilbara leaf-nosed bat roosts** Historical survey effort, along with ongoing cave monitoring required for MS 1113 compliance and historic sampling outside of the development envelope, all indicate that there is no category 1, 2 or 3 Pilbara leaf-nosed bat roosts in the Proposal Area (pers. comm Robert Bullen, 23 November 2023). Retained caves in the development envelope are category 4 caves for the Pilbara leaf-nosed bat and protection of caves applied for the ghost bat are adequate to protect the Pilbara leaf-nosed bat roosts within the development envelope.	been compromised, i.e. through cracking or other changes to structure from the Proposal. • MEZ 2 category 4 caves comprise overhangs and temperature and humidity align with the ambient values. For this reason, no monitoring of temperature and humidity in category 4 caves is proposed. Uncertainties: • Limited data on the likely impact of climate change and drought on the ghost bat and Pilbara leaf-nosed bat.	• Threshold will be reached if disturbance not considered low impact occurs within MEZ 1A, MEZ 1B and/or MEZ 2, if over 5% of MEZ 1A, MEZ 1B and/or MEZ 2 are disturbed for low impact activities or if a cave within MEZ 1A, MEZ 1B or MEZ 2 is disturbed. Examples of low impact activities that will be allowed within the MEZ boundaries includes minor clearing for maintaining access for light vehicles, maintenance of culverts, monitoring activities and investigations. The only known Pilbara leaf-nosed bat roost is external to the development envelope (UTR) and therefore will not be impacted by ground disturbance through the implementation of the Proposal. **Rationale** The maintenance of buffer zones has potential to minimise impacts (DSEWPAC 2012) to ghost bats and Pilbara leaf-nosed bats caves. The MEZ have been applied to minimise light, dust, noise and vibration impacts on the bat populations. While there is limited published data on these impacts to bats, this MEZ size is considered conservative and were informed information in BatCall WA 2022a and 2022b. This report showed that MEZs around caves should be of a size that ensures that the cave remains a viable roost and should take into account all perceived threats during and after any mining operations. Monitoring to inform the effectiveness of the buffers protecting the roosts will be measured in selected caves as specified in Section 2 (Provisions) through: • Acoustic/echolocation monitoring; • Land disturbance reconciliations; • Microclimate monitoring; • Geotechnical assessments; and • Blasting trials.
MS 1251 B2-1(6) no disturbance to the ghost bat (*Macroderma gigas*) and Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) within the MEZ 1A and MEZ 2 from noise and vibration attributable to the significant amendment;	**Ghost bats** A 1985 study on ghost bats sensitivity to noise peaked at 10 – 20 kHz and 25-43 kHz (Guppy et al. 1985), suggesting they are more sensitive to noise in this range (Turner, 2024). Wind, heavy mobile equipment and traffic are typically dominant at lower frequencies (e.g. below 5kHz) (Turner 2024), and are outside the peak sensitivities recorded presented above (Guppy et al 1985 and (Guppy et al 1988), however there is limited research on how this may impact ghost bats Two studies undertaken in the Pilbara found that short-term exploration drilling within 50–85 m of a diurnal roost site did not cause ghost bats to abandon the specific caves under investigation (Armstrong, 2010) (Bullen & Creese, 2014). The authors of both studies (Armstrong 2010; Bullen and Creese 2014), however, cautioned that ghost bats may react differently to the noise and vibration caused by activities other than drilling (e.g. blasting, pad construction by a bulldozer, nearby construction of roads or infrastructure). Ghost bats have been observed recolonising caves that have retained a viable internal structure and microclimate post mining (Bat Call WA, 2021a). Limited studies have been completed on noise impacts on Pilbara leaf-nosed bats. However, a blasting trial was conducted at Rio Tinto's	Assumptions: • Noise being monitored precludes natural noise i.e. noise filtering will be completed to remove 'natural' noise (i.e. wind etc). • Category 2 and 3 caves represent critical habitat (when in an apartment block) for the ghost bat and, due to their nature are more likely to be inhabited more frequently and for longer periods by ghost bats. As such monitoring is prioritised these caves to aim to collect the most data possible whilst ensuring safety of personnel and minimising disturbance to the ghost bat and other fauna. Uncertainties: • Limited data on sensitivities of ghost bats/Pilbara leaf-nosed bats to light, noise, dust and vibration. • Bats use of caves near mining sites indicates that the effects of noise and vibration remain uncertain.	**Choice of Provision** A selection of MEZ 1A and MEZ 2 caves will be monitored based on their category, dimensions and known usage from baseline surveys, MEZ 2 caves to be monitored for bat calls, noise and vibration are detailed in Table 2-5. Where caves are adjacent to other caves of higher category, monitoring is carried out at the cave closest to impact and the nearby caves (at further distance) are not monitored (CWAN-02 and CWAN-04). Where caves are located at significant distance from the significant amendment and there is no source or pathway for impact, and the cave is not a reference cave, monitoring is not proposed. Caves selected for noise and vibration monitoring (vibration monitoring are carried out at caves when blasting within 350 m of the cave. Caves selected for monitoring include a selection of caves located close to mining operations which can be considered impact caves and a selection of caves that are located at distance from current and future mining operations and can be considered reference caves. Regional investigations are ongoing to aim to locate additional category 2 ghost bat caves to add to the regional knowledge. The GBMP will be updated to include these in the monitoring program through adaptive management as required to inform ghost bat knowledge. Rio Tinto has committed to preparing a Noise and Vibration Management Approach Report (B2-5) detailing the approach for managing noise and vibration from the significant amendment during both the maternity and non-maternity periods and will be informed by trial blasting (Condition B2-9). Due to limited available data on the impact

Outcome	Summary of Current Knowledge and Study Findings	Key Assumptions and Uncertainties	Rationale for Choice of Provision, Indicator/s and/or Management Action/s
	Gudai-Darri project (formally known as Koodaideri) to study the response of a Pilbara leaf-nosed bat colony to vibration with a threshold of 10 mm/s (Biota, 2013). The trial did not observe any disturbance to bats at a PPV of 12.2 mm/s from a blast at a distance of 136 m. Ghost bats at West Angelas have been recorded more frequently in Category 2 and 3 caves rather than Category 4 caves. Cat 2 caves are critical habitat for the ghost bat and are important for the ongoing presence of ghost bat in an area. Category 3 caves which are located adjacent to Category 1 or Category 2 caves are considered critical habitat important for the ongoing presence of ghost bat in the area. While isolated Category 3 caves are not considered critical habitat essential to the long-term viability of a population, such caves may play an important role in facilitating genetic exchange between neighbouring colonies by enabling the long-distance movement of individuals. Category 2 and 3 caves are likely to be inhabited more frequently and for longer periods due to their nature and provide the best opportunity for collecting echolocation and scat data (including genetic analysis). As such monitoring is prioritised in Category 2 and 3 caves, rather than in Category 4 caves (Table 2-5). The monitoring program (summarised in Table 2-5) aims to achieve sufficient data to inform compliance with conditions whilst maintaining safety of personnel and minimising disturbance to ghost bats and other fauna utilising caves within the West Angelas area.		of noise and vibration on bat populations, this report will provide guidance on this approach and will provide the choice of provisions for this condition. Rio Tinto will update the GBMP once the Noise and Vibration Management Approach Report has been accepted by the CEO. Until the approach to managing noise and vibration impacts has been accepted by the CEO, no operational blasting will occur, in accordance with condition B2-9(4). **Rationale** The maintenance of buffer zones has the potential to minimise impacts (DSEWPAC 2012) to caves, ghost bats and Pilbara leaf-nosed bats. The MEZ boundaries have been put in place to minimise light, dust, noise and vibration impacts on the bat populations. While there is limited published data on these impacts to bats, this buffer size is considered conservative. Monitoring to inform that noise and vibration is not disturbing the bats will include: • Noise monitoring with AI filtering; • Vibration monitoring; • Microclimate monitoring; and • Acoustic/echolocation monitoring.
MS 1251 B2-4 The proponent must implement the proposal to achieve the following environmental objectives: (1) maintain viability of the ghost bat populations within the development envelope during operations and post-mining operations	Pilbara ghost bats generally have high levels of contemporary gene flow that become limited at distances greater than 250 km, which is likely driven by female philopatry and the distribution of suitable roosts (TSSC, 2016). There is clear evidence of geographic population genetic structure between Pilbara subpopulations (Chichester, West Hamersley, and East Hamersley) when using mitochondrial markers (TSSC, 2016). In contrast, although there appears to be some differentiation among subpopulations at autosomal microsatellite markers, there was also evidence of gene flow throughout the Pilbara, potentially greatest across the north-west of the region. Facilitating dispersal among disparate subpopulations is crucial to prevent localized extinctions in the Pilbara, where colony sizes are typically smaller compared with other parts of Australia (TSSC 2016). Furthermore, the total population size of ghost bats in the Pilbara is estimated to be low, suggested to be approximately 1,300–2,000 individuals (TSSC 2016). Genotyping of scats and identification of ghost bat individuals has been undertaken across seven years at the West Angelas site. During this period, between two and 40 individuals have been identified using caves. The genetic effective population at West Angelas has been calculated for three monitoring years and did not vary greatly (12 – 14 individuals) and is comparable with the genetic effective population at Robe Valley and other sites in the Pilbara (Biologic 2022a; Ottewell et al. 2017; Ottewell et al. 2021). It is expected that there are overlapping local populations of ghost bats in the West Angelas area, particularly as there are known ghost bat roosts to the north (~5.5 km) and east of the West Angelas area within the nightly foraging range of the species. Of the individuals identified, between 1 and 6 were recaptures, indicating that between 7.5 - 50% of the local population may be frequently using the area. When evaluated against the extrapolated population size this equates to 10 - 66 individuals potentially being considered 'residents' of the area. On average 17 individuals are identified each year, with approximately three recaptures, equating to 17.6% of the population potentially being frequent visitors (Table 5). When evaluated against the average	Assumptions: • Surveys completed to inform the Environment Review Document for the Revised Proposal collected data from one point in time, which does not allow for the creation of valuable triggers and thresholds for the viability of ghost bat population in the development envelope. Therefore, data will be collected as per Table 2-5 to close this gap. Data collected from critical caves will be considered baseline information until mining activities move to within 500m. Uncertainties: • Natural variation of the population size of ghost bats in the Pilbara and sub-regions (Hamersley and Chichester) is unknown. • While population sizes can be estimated from use of genetics and call data, there is a time lag with regards to detecting change (positive or negative) to a population (likely 3 to 5 years) • Population sizes relating to long-term viability are still unknown • Limitations in current genetic technology and potential for scat contamination prior to collection (i.e. pregnant females urinating on male scats) • ghost bats have been known to be absent for varying periods from caves they previously were present, only to return. It is unknown what causes these absences. • Impacts of sampling timing and methods on results are unknown	**Choice of Provision** Rio Tinto has proposed the following to understand the requirement of maintaining the viability of the ghost bat population, including: • Scat deposition - presence of scats; and • Scat analysis - genetic analysis and hormone analysis. Table 2-5 provides the proposed monitoring summary and Appendix E provides a more detailed summary of monitoring with rationale provided for when a cave is not selected for monitoring. One year of scat data was collected in baseline gathering (2021), which is not a large enough sample size to accurately determine trigger and threshold criteria, therefore objective criteria have been proposed. Once enough data has been collected from non-impacted caves to provide enough statistical power for triggers and thresholds this plan will be updated. Caves will be deemed to be non-impacted until mining or clearing activities are within 500m. The following management target has been proposed: • Continued ghost bat persistence in the development envelope through continued scat collection, ultrasonic records and opportunistic observations. **Rationale** <u>Scat Deposition</u>: The rate of scat deposition from ghost bats within a cave is another method of monitoring presence of ghost bat, and usage of a cave over a long period of time. The analysis of scat deposition can indicate consistent use of a cave (regular deposition) and changes in usage (significant changes in the deposition of scat). If ghost bats are present, scats will not be collected, rather the number of bats will be recorded. Scat monitoring has to be measured against the potential for disturbance to critical caves from ongoing cave entry, and thus is not proposed at each critical cave, each year, rather is at selected caves. The results from scat monitoring are unlikely to be useful in setting a trigger or threshold as there is a significant delay between collection and final analysis and reporting of scat results Annual scat collection is proposed with no monitoring to occur within the breeding season (October to December). A mixture of Category 2 and 3 caves across the development envelope will be selected for collection and analysis to understand potential changes in ghost bat usage of caves, as well as provide a better sample size of activity within the development envelope. Caves for scat analysis will be selected based on access, mine plan, usage of the cave by ghost bats and consideration of

Outcome	Summary of Current Knowledge and Study Findings	Key Assumptions and Uncertainties	Rationale for Choice of Provision, Indicator/s and/or Management Action/s
	extrapolated population size this equates to 23 individuals potentially being considered 'residents' of the area. The discrepancy between presence and use of the caves from echolocation data and population estimates from scat analysis is stark, emphasising the difficulty of monitoring due to the transient nature of the population.		potential impacts/disruption to bats. Some critical caves were unable to be sampled continually due to Traditional Owner sensitivities in the same cave and have therefore been removed. Monitoring external to the development envelope is limited due to tenure access, however regional sites will be selected to help inform and/or validate any patterns discerned from the Revised Proposal monitoring program. <u>Scat Analysis:</u> Genetic tagging of ghost bat scats to identify individuals is an emerging non-invasive method, that can be applied to monitoring cave/roost usage, tracking individuals and connectivity between caves/roosts in an area (Bat Call WA, 2021a). A genetic population size can be calculated using this data and may be used to infer if the local population is isolated or well connected to the surrounding area. A limitation of genetics analysis is the time the analysis takes to determine the individual genotypes - six months minimum. Genetic analysis is therefore not considered ideal in the development of the early warning criteria in Environmental Management Plans, especially given that presence/absence could be detected from scat collection alone. Using faecal progesterone levels to indicate pregnancy within a population is a technique used for multiple species. Samples with progesterone levels above 970 ng/g were considered likely to represent those originating from pregnant females. Females have the potential to contaminate male scats with progesterone, as such presenting the number of individuals (unique genotypes) that are detected with elevated progesterone is unlikely to be accurate (Biologic 2020). **Complimentary management targets:** Additional monitoring parameters to ensure the viability of the ghost bat populations include: • Management of feral animals; • Management of light impacts; and • Management of fauna interactions.
(2) minimise disturbance to other ghost bat roosts (caves A1, A2, L1, L2, L3, WA-9, WA-10, WA-11, WA-12, WA-17, WA-20 and WA-22) shown in Figure 9.	Refer to the current knowledge and study findings for conditions B2-1 (4), B2-1 (5) and B2-1 (6). Caves listed in this condition; B2-4 (2) are protected within MEZ 2 to which land disturbance restrictions, limits on impact to roosts and limits to impacts from noise and vibration to the ghost bat already apply. The provisions described in relation to conditions B2-1(4), B2-1 (5) and B2-1 (6) adequately address and ensure compliance with condition B2-4(2).	Refer to the key assumptions and uncertainties for conditions B2-1 (4), B2-1 (5) and B2-1 (6).	Refer to the rationale for choice of provision, indicator/s and/or management action/s conditions B2-1 (4), B2-1 (5) and B2-1 (6).

Figure 1-4 shows the locations of critical caves and associated MEZ 1 (A and B) as specified in Ministerial Statement 1251. Figure 1-5 shows the locations of critical caves as specified in Decision Notice 2021/8923. Figure 1-6 shows the location of retained non-critical caves and associated MEZ 2 as specified in Ministerial Statement 1251 and caves defined as 'retained caves' in Decision Notice 2021/8923.

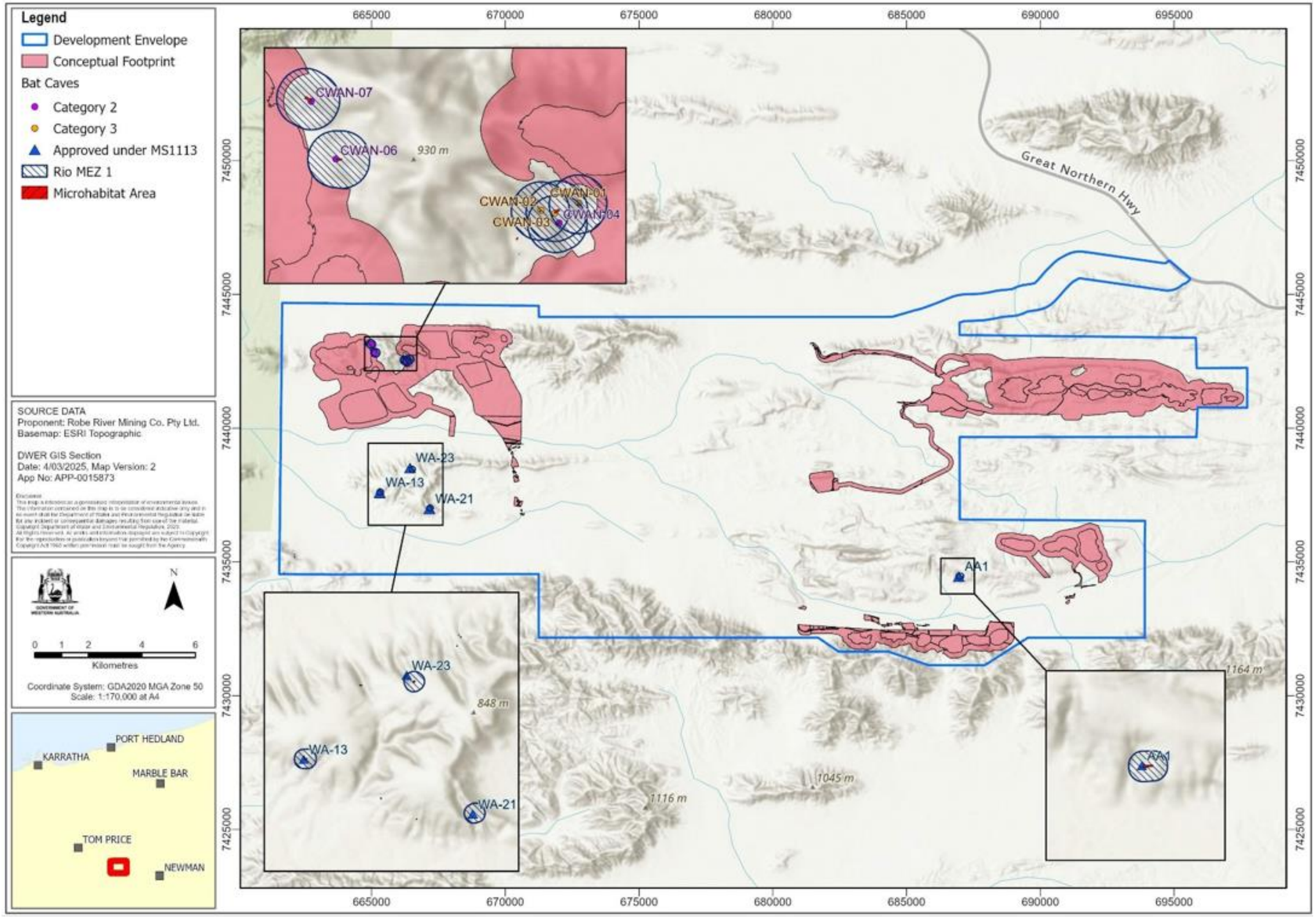

Figure 1-4: Ministerial Statement 1251 Critical Caves and MEZ 1 (A and B)

RioTinto

Figure 1-5
Mining Exclusion Zone 1A

Drawn: Rio Tinto.
Plan: PDE00979884v3
Date: July 2025

Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

660,000
670,000
680,000
690,000
7,450,000
7,440,000
7,430,000

CWAN-07
CWAN-06
CWAN-02
CWAN-01
CWAN-03
CWAN-04

Karijini National Park

Great Northern Highway

Legend

- Development Envelope
- Significant Amendment - Conceptual Footprint

Bat Caves

- Category 2
- Category 3
- Highway
- MEZ 1A
- National Park

N

0 1 2 3 4 5
Kilometres

Map units in metres

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Figure 1-6
MS 1251 MEZ 2 (non-critical caves), DN 2021/8923 (retained caves)

Drawn: Rio Tinto.
Plan: RTIO-1122575v1
Date: July 2025

Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Development Envelope
- Significant Amendment - Conceptual Footprint
- Category 3
- Category 4
- Assessed under approval proposal
- MEZ 2
- Highway
- National Park

N

0 1 2 3 4 5
Kilometres

Map units in metres

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660,000 670,000 680,000 690,000

7,450,000
7,440,000
7,430,000

Karijini National Park

Great Northern Highway

CWAN-32 CWAN-31 CWAN-30 CWAN-29 CWAN-28 CDHI-001 A2 A1 CDHI-002 I1 L3 L2 WA-11 WA-09 WA-10 WA-12 WA-22 WA-20 WA-17 CMAR-02 CMAR-01 CMAR-03 CWAN-08 CWAN-11 CWAN-34

2. ENVIRONMENTAL MANAGEMENT PLAN PROVISIONS

This section of the GBMP identifies the provisions that the Proponent will implement to ensure the defined environmental outcomes and objectives are met during the implementation of the Proposal. Outcome and objective-based provisions are detailed in Table 2-3 to Table 2-4.

The GBMP will be updated to align with the adaptive management approach (refer to Section 3).

2.1 Baseline Monitoring

2.1.1 Ghost bat

A total of 42 caves have been recorded at West Angelas of which 5 ghost bat caves have been approved to be impacted (MS 1251). A total of 37 ghost bat caves will be retained and comprise:

- 7 Category 2 (maternal diurnal roost) ghost bat caves;
- 14 Category 3 (diurnal roost) ghost bat caves; and
- 16 Category 4 (nocturnal refuge) ghost bat caves.

Evidence of ghost bats has been recorded at 30 caves within the West Angelas Revised Proposal development envelope via several methods as below:

- Ultrasonic call recordings at 16 caves;
    - 6 category 2 caves,
    - 8 category 3 caves; and
    - 2 category 4 caves.
- Scat (deposition and genetic analysis) at 30 caves;
    - 7 category 2 caves,
    - 12 category 3 caves; and
    - 11 category 4 caves.
- The remains (skeleton) of ghost bat pups at 2 caves (CWAN-04 (category 2) and CWAN-29 (category 3); and
- Live individuals observed at 5 caves;
    - 2 category 2 caves (AA1 and CWAN-06); and
    - 3 category 3 caves (A1, L3 and A2).

Twenty-one (21) of the retained caves at West Angelas have been monitored for ghost bat presence and usage (7 Category 2 caves, 11 Category 3 caves, and 3 Category 4 caves). Of the 21 caves, 15 caves are related to the Approved Proposal and have been monitored as a requirement of MS 1113, totalling 219 months of data. The remaining 6 caves are critical caves related to the Significant Amendment (MEZ 1A) and have been monitored since 2023, amounting to 91 months of data, which meets the requirements of condition B2-7(1).

Baseline echolocation monitoring of the 6 MEZ 1A caves related to the significant amendment at Western Hill identified in 2019 (Biologic 2020d) has to date demonstrated limited ghost bat presence. Monitoring indicates that there has been no roosting at the 3 category 2 roosts (CWAN-04, CWAN-06 and CWAN-07) or 3 category 3 roosts (CWAN-01, CWAN-02, and CWAN-03). This reflects the trend observed from historical monitoring undertaken as a part of MS 1113 where decreases in presence and occupancy of roosts have been detected across the site (Stantec, 2025).

Scat deposition assessment in the 3 category 2 MEZ 1A caves (CWAN-04, CWAN-06 and CWAN-07) recorded large numbers (>1,500) of scats during their initial assessments in 2019, indicating historic

use by ghost bats, however, temporal trends in usage are not discernible from the number of scats recorded from a singular assessment.

Scat deposition at CWAN-04 indicates this cave is used somewhat frequently, with an approximate deposition of 2.27 scats per day. Additionally, the skeleton of a ghost bat pup was recorded at CWAN-04 suggesting it has previously been used as a maternal roost, or at a minimum used during the maternity period (Stantec, 2025).

The detection of ghost bat presence through echolocation monitoring has been variable, having only been established in 2021 for 3 caves (A1, AA1 and L3) with the remaining caves established in 2022 and 2023 (Stantec, 2025). An increase in presence was detected across the site in 2023, particularly between April and August. Based on the monitoring data and known ecology of the species, this may have been influenced by resource/prey availability (March 2023 recorded ~80 mm above the long-term average rainfall) (Biologic 2024b), or breeding cycle (Section 2).

Baseline data for CWAN-10 and CMAR-01 reference caves and any other relevant additional baseline data will be provided in the updated version of this Ghost Bat Management Plan to be submitted after approval of the Noise and Vibration Management Approach Report (NVMAR).

2.1.2 Pilbara leaf-nosed bat

The Pilbara leaf-nosed bat has been recorded at 12 locations surrounding the development envelope; and 5 locations within the development envelope, two of which are within the DN 2021/8923 Action Area (Biologic 2021c). Recordings of the species originate from the area surrounding cave CWAN-04, located within Hillcrest/Hillslope habitat at Western Hill. The timing of the calls suggests that these individuals were from a nearby cave site known as Upper Turee Roost within Karijini National Park, approximately 13.5 km to the west of the development envelope, foraging within the development envelope and potentially utilising Cave CWAN-04 as a nocturnal refuge. A high concentration of calls has been recorded at the Upper Turee Roost. The concentration of the calls and the characteristics of the Upper Turee Roost indicates that it is likely to be a permanent diurnal roost for the species (Biologic 2021c).

All of the caves recorded within the development envelope are considered to have the potential to be nocturnal refuges (category 4) non-critical habitat for the Pilbara leaf-nosed bat (Biologic 2021c). The above survey effort, along with ongoing cave monitoring and historic sampling outside of the development envelope, all provide assurance that there is no category 1, 2 or 3 Pilbara leaf-nosed bat roosts in the development envelope (pers. comm Robert Bullen, 23 November 2023).

Caves within the development envelope can potentially be occupied by both ghost bat and Pilbara leaf-nosed bat species.

A summary of monitoring up to 2023 is provided in Table 2-1.

Table 2-1: Bat baseline data collection

Cave ID	Roost Category	Coords			Type	Monitoring										Results
		MEZ	Lat.	Long.		Monitoring Dates	Months of Data	Echolocation	Microclimate	Scat Deposition	Scat Analysis (includes genetics)	Noise	Vibration	Cave Visitation	Trapping	VHF tracking (# of individuals)	Scat Deposition Rate during 2024 monitoring or (number recorded in baseline survey)
A1	3	2	-23.1134	118.7764	Impact	Monthly: Sep-21 to Sep-23 Annual: 1997 to 2021	Monthly: 21 months Annual reporting: 12 yrs	✓	✓	✓	✓			X[#]			Not undertaken in 2024
A2	3	2	-23.1131	118.7764	Impact	Monthly: Sep-22 to Sep-23 Annual: 2012 to 2022	Monthly: 13 months Annual reporting: 6 yrs	✓	✓	✓	✓			X[#]			Not undertaken in 2024
AA1	2	1B	-23.1883	118.8266	Impact	Monthly: Sep-21 to Sep-23 Annual: 1978 to 2021	Monthly: 21 months Annual reporting: 11 yrs	✓	✓	✓	✓			✓			0.757
L2	3	2	-23.1883	118.7878	Impact	Monthly: Sep-22 to Sep-23 Annual: 1998 to 2022	Monthly: 13 months Annual reporting: 13 yrs	✓	✓	✓	✓			✓			0
L3	3	2	-23.1883	118.7875	Impact	Monthly: Sep-21 to Sep-23 Annual: 1978 to 2021	Monthly: 21 months Annual reporting: 12 yrs	✓	✓	✓	✓			✓			0.064
WA-9	4	2	-23.1497	118.6313	Impact			✓	✓	✓	✓			✓			0
WA-10	4	2	-23.1498	118.6315	Impact			✓	✓	✓	✓			✓			0.017
WA-11	4	2	-23.1507	118.6311	Impact			✓	✓	✓	✓			✓			0.019
WA-12	3	2	-23.1589	118.6059	Impact			✓	✓	✓	✓			✓			0
WA-13	2	1B	-23.1622	118.6147	Impact	Monthly: Sep-22 to Sep-23 Annual: 2019 to 2022	Monthly: 13 months Annual reporting: 4 yrs	✓	✓	✓	✓			✓			0
WA-17	3	2	-23.1681	118.6269	Impact			✓	✓	✓	✓			X[#]			Not undertaken in 2024
WA-20	3	2	-23.1659	118.6231	Impact			✓	✓	✓	✓			✓			0
WA-21	2	1B	-23.1675	118.6331	Impact			✓	✓	✓	✓			✓			0.003
WA-22	3	2	-23.1549	118.6210	Impact			✓	✓	✓	✓			✓			0
WA-23	2	1B	-23.1543	118.6263	Impact			✓	✓	✓	✓			X[#]			Not undertaken in 2024
CWAN-01	3	1A	-23.1172	118.6253	Impact	Jun-24 – Sep-25	16	✓	✓^	✓[B]							(10 ghost bat scats)
CWAN-02	3	1A	-23.1176	118.6233	Impact	Jun-24 – Sep-25	16	✓	✓^	✓[B]							No scats recorded)
CWAN-03	3	1A	-23.1177	118.624	Impact	Sep-23 – Sep -25	25	✓	✓^	✓[B]							20 ghost bat scats)
CWAN-04	2	1A	-23.1182	118.6243	Impact	Sep-23 – Sep -25	25	✓	✓^	✓[B]							2.27 (~1,500 ghost bat scats recorded; 600 fresh scats over 9 months)
CWAN-06	2	1A	-23.1152	118.6125	Impact	Sep-23 – Sep -25	25	✓	✓^	✓[B]							(~1,500 ghost bat scats; 20 fresh scats off sheet)
CWAN-07	2	1A	-23.1124	118.6112	Impact	Sep-23 – Sep -25	25	✓	✓^	✓[B]							(~5,000 ghost bat scats; 20 fresh scats off sheet)
CWAN-10	3	2	-23.2175	118.7649	Reference	Baseline only	Baseline only			✓[B]							(No ghost bat scats, potential nocturnal refuge)
CMAR-01	3	2	-23.1842	118.5839	Reference	Baseline only	Baseline only			✓[B]							(300 ghost bat scats, potential day roost)
CMEE-05	2	NA	-23.2141	118.8794	Reference	Jan-22	Up to 36 months	✓	✓	✓[B]	✓[B]						(6,000 ghost bat scats during baseline survey)

Impact sites; are located within a proposals development envelope with the potential to be impacted by direct and/or indirect impacts. Reference sites are located outside a proposals development envelope, where potential impacts are not expected.
^ Monitoring conducted, results not available at time of writing
[B] From baseline surveys
X[#] caves not recommended for entry or inaccessible

2.1.3 Geotechnical assessment of caves and application of structural vibration limits

All environmentally significant sites located within 350 m of blasting activities must undergo an in-field geotechnical investigation to assess their geotechnical sensitivity before any blasting occurs within this distance. Geotechnical assessments have been completed for all critical caves (MEZ 1A and MEZ 1B) within the development envelope (Appendix C). Additional assessments will be undertaken for all caves within MEZ 2 prior to any blasting proposed within 350 m of these sites.

The geotechnical assessment provides conclusions, derived from observation and exercise of professional judgement, relating to the potential impacts of mine blasting activities on the geotechnical stability and/or visual amenity of the site.

Ground vibrations induced by blasting activities at mining operations can be a source of damaging energy to a site. To mitigate the risk of impact, the Proponent implements a blast vibration threshold for every protected site within proximity of planned blasting activity; blast vibration thresholds are established based on the cave's geotechnical sensitivity to vibrations (referred to as the site Geotechnical Sensitivity, rated Low, Moderate, or High) and its significance as an environmental site (referred to as the Environmental Significance, rated Very Low, Low, Moderate, High, or Very High). By their nature, critical caves have the highest environmental significance rating, with the rating of very high applied for all geotechnical assessments of critical caves.

A risk matrix is used to determine the vibration limit as shown in Figure 2-1. The recommended vibration limit for significant environmental site/s with high geotechnical sensitivity (25 mm/s) was derived from a report by Snowden (2007a and b) on the protection of the Jundaru heritage site at Hope Downs 1.

The 25 mm/s vibration limit represents 50% of the threshold below which damage to sensitive structures is considered very slight, as identified by Hoek and Bray (1991, Rock Slope Engineering). This conservative approach was subsequently reviewed and deemed acceptable by Coffey (2007) during their geotechnical assessment of the Jundaru site.

Overall, recommended vibration limits are designed with sufficient factors of safety, reducing the risk of effect to as low as reasonably practicable. These evidence based limits have been proposed as trigger levels for condition MS 1251 condition B2-1 (3) and Decision Notice 2021/8923 condition 6(a).

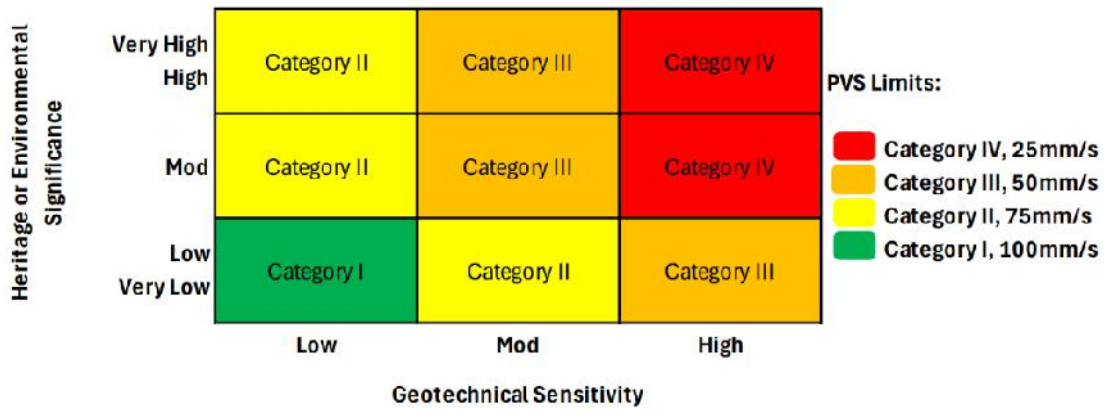

Figure 2-1: **Blast vibration category matrix**

The results of the geotechnical assessments of critical caves within the development envelope is shown in Table 2-2 and detailed assessments are provided in Appendix C.

Table 2-2: Geotechnical and environmental assessment of critical caves

Cave	Geotechnical Sensitivity Rating	Environmental Sensitivity	Blast Vibration Category from Matrix[2]	Rationale
CWAN-04	High	Very high	IV	Highly weathered bedded rock mass, the presence of adverse defects and the existence of several medium size blocks that could be released. The maximum reasonable consequence of blast vibrations is believed to be the detachment of medium to large size blocks from the ceiling, walls, and brow, as well as a partially collapse of part of the brow or the shelf located on the north-west wall. General unravelling throughout the cave is also possible due to the weathering of the rock mass
AA1	High	Very high	IV	Ghost bat maternity cave, geotechnical assessment has been completed by a Geotechnical Engineer.
WA-21	Moderate	Very high	III	Very poor quality of some of the rockmass that could collapse, potentially closing off two of the three entrances into the cave system. If this was to occur, entrance could still be gained through alternative external opening
WA-23	Moderate	Very high	III	Roosting chamber could not be inspected or assessed. The rockfall potential of the surrounding area was assessed as low geotechnical sensitivity due to the absence of historical rockfalls on the ‘shelter’ floor and no loose rocks in the roof or walls. Some discontinuities define ‘slabs’ that could dislodge with some disturbance. The conclusion can be drawn that the bat / roosting chamber has developed in similar material and is likely to have similar characteristics. Although the geotechnical sensitivity of the entrance ‘shelter’ and the anticipated sensitivity of the roosting cave is low, the sensitivity has been escalated to moderate to account for the uncertainty related to the roosting chamber.
CWAN-03	Moderate	Very high	III	Highly weathered bedded rock mass and the presence of adverse defects. The maximum reasonable consequence of blast vibrations is believed to be the detachment of small to medium size blocks and slabs from the ceiling, walls, and brow. Unravelling throughout the cave is also possible due to the weathering of the rock mass
CWAN-07	Moderate	Very high	III	Presence of a few medium size blocks that could be detached. The maximum reasonable consequence of blast vibrations is believed to be the dislodgment of the wedge located at the top-north of the cave entrance. This could substantially alter the cave's appearance and may partially block the entrance. Additionally, surficial unravelling of the ceiling, sidewalls, and brow could also occur.
CWAN-01	Low	Very high	II	Absence of adverse defects and the rock mass integrity. The maximum reasonable consequence of blast vibrations is deemed to be occasional small-scale surficial rockfalls from the ceiling, walls and brow with no direct impact on the stability of the cave
CWAN-02	Low	Very high	II	General absence of adverse defects or significant unstable blocks. The maximum reasonable consequence of blast vibrations is deemed to be surficial ravelling from the ceiling, walls and brow due to the highly weathered rock mass
CWAN-06	Low	Very high	II	General absence of adverse structures or large unstable blocks. The maximum reasonable consequence of blast vibrations is believed to be small-scale surficial ravelling from the cave’s brow, ceiling and sidewalls constituting a minor change to the site’s visual appearance without impacting overall stability.
CWAN-07	Low	Very high	II	Absence of adverse defects and the rock mass integrity. The maximum reasonable consequence of blast vibrations is deemed to be occasional small-scale surficial rockfalls from the ceiling, walls and brow with no direct impact on the stability of the cave
WA-13	Low	Very high	II	Historical rockfall evidence as well as the interaction of the geological structures that defines prominent blocks in the roof. The location of the vast majority of historical rockfalls are located at either end of the chamber and rocks go all the way up to ~2 m in diameter. The brow on either end appears solid but large blocks have detached in the past and some smaller loose material is also present on the face crest. Large-scale block failure should not compromise cave entry.

[2] Recommended Structural integrity PPV Blast threshold (mm/s) for critical caves: CWAN-04 & AA1; 25mm/s, WA-21, WA-23, CWAN-03 and CWAN-04; 50mm/s and CWAN-01, CWAN-02, CWAN-06, CWAN-07 and WA-13; 75mm/s

Vibration limits are the primary controls for structural integrity, with microclimate (temperature and humidity) used as a supporting indicator for structural integrity. Triggers and thresholds for temperature and humidity are considered unnecessary and are not proposed for the following reasons:

- Relative humidity in ghost bat roosts can range from 50% up to 100% (Armstrong and Anstee 2000) and the degree to which the species requires humidity within this large range is relatively unknown (Baudinette et al. 2000).
- Permanent Ghost Bat roosts generally have stable temperatures between 23–28°C (TSSC 2016), based on the species' physiological preference for temperatures around 28°C (Baudinette et al. 2000). There are no permanent roosts at West Angelas.
- From data collected to date in the wider Pilbara, relative humidity and temperature in caves is naturally highly variable in the absence of changes to structural integrity (Stantec 2025). As such, a change in microclimate may not result in the cave being unsuitable for the species.
- The impact pathway for a change in microclimate from the Proposal would be from blasting impacting the structural integrity of the cave. As such vibration limits are considered the most suitable trigger and thresholds for condition B2- 1(3), supported by microclimate monitoring (temperature and humidity).

Temperature and humidity data for caves that have been monitored historically is provided in the Ghost Bat Monitoring Performance Report (Stantec 2025). Some monitoring was too recent to include in this report. As such the Proponent will provide relevant outstanding baseline with respect to microclimate (temperature and humidity) in accordance with future update to the GBMP in accordance with Ministerial Conditions.

2.2 Provisions

This GBMP comprises both outcomes based and objective based provisions as described in Table 1-4. This section details the provisions proposed to meet the requirements of conditions of MS 1251 and DN 2021/8923 as detailed in Table 1-3.

Outcomes based provisions are documented in Table 2-3 with objectives based provisions documented in Table 2-4.

Monitoring proposed at each cave is summarised in Table 2-5, and Appendix E. This does not include land disturbance assessment in relation to condition B2-1 of MS 1251 and Conditions 6 a) b) and c) which will be carried out annually or as triggered.

Table 2-3: Outcomes based Provisions

EPA factor: Terrestrial Fauna
Outcome: The Proponent will ensure no impacts to high value / critical habitat attributable to the **Significant Amendment**, other than existing and approved.
The Proponent will ensure no direct disturbance within MEZ 1A, 1B and MEZ 2, other than existing and approved.
EPA objective: To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.
DCCEEW objective: Manage threating processes associated with implementation of the Proposal, where relevant to minimising impacts to EPBC Act listed threatened species.
Key environmental values: EPBC Act listed threatened species and Terrestrial Fauna – ghost bat; Pilbara leaf-nosed bat.
Key impacts and risks: Potential adverse long-term (post operational phase) impact on ghost bat and Pilbara leaf-nosed bat or high value / critical habitat attributable to the Proposal.

Indicators	Response Actions	Monitoring[3]	Timing/Frequency	Responsible	Reporting
MS 1251 Conditions: **B2-1(1): Disturb no more than the following for the significant amendment;** **B2-1 (1)(a): 126 ha of the fauna habitat identified as gorge/gully as shown in Figure 11; and** **B2-1 (1)(b): 3,731 ha of the fauna habitat identified as hillcrest/hillslope as shown in Figure 11.**					
Early Warning Indicator					
1. More than 101 ha (80% of threshold) of fauna habitat identified as gorge/gully is disturbed for the Significant Amendment. and/or **2.** More than 2,985 ha (80% of threshold) of fauna habitat identified as hillcrest/hillslope is disturbed for the Significant Amendment.	**Investigate by review of:** • In-field inspections • Site specific observations, e.g., clearing extent • Confirm extent of existing ground disturbance via audit of clearing records. • Do not authorise any further AR's if trigger criterion would be exceeded. • Notify Registered Manager for forward planning purposes.	**Land Clearing Reconciliation:** 1. Annual aerial image capture (satellite or Remotely Piloted Aircraft) 2. Annual land clearing reconciliation against relevant upper clearing limits for fauna habitat identified as gorge/gully and/or hillcrest/hillslope habitat.	1. Annual imagery capture and analysis 2. Annual, or as triggered	1. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 2. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team)	NA, internal process only.
Trigger Criteria					
1. More than 113 ha (90% of threshold) of fauna habitat identified as gorge/gully is disturbed for the Significant Amendment. and/or **2.** More than 3,357 ha (90% of threshold) of fauna habitat identified as hillcrest/hillslope is disturbed for the Significant Amendment.	**Investigate potential cause of exceedance by review of** • Internal ground disturbance, authorisations and actuals. If investigations indicate that trigger exceedance is attributable to the Significant Amendment, implement appropriate trigger level response actions, for example: • Cease clearing within critical habitat. • Review total clearing allocations. • Report internally as an incident. • Do not authorise any further internal Approval Requests (AR) if threshold criteria would be exceeded. • Rehabilitate areas no longer required for operations.	**Land Clearing Reconciliation:** 1. Annual aerial image capture (satellite or Remotely Piloted Aircraft) 2. Annual land clearing reconciliation against relevant upper clearing limits for fauna habitat identified as gorge/gully and/or hillcrest/hillslope habitat.	1. Annual imagery capture and analysis 2. Annual, or as triggered	1. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 2. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team)	• The environmental outcome will be reported on against the trigger criterion for each calendar year in the ACAR and ACR. • If any trigger criterion was exceeded during the reporting period, the ACAR and ACR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of the Trigger Criteria Response Actions.

[3] Physical access for monitoring may not always be possible due to accessibility, heritage restrictions, weather or safety considerations. Access may also be subject to Traditional Owner consent.

Indicators	Response Actions	Monitoring[3]	Timing/Frequency	Responsible	Reporting
Threshold Criteria					
1. More than 126 ha of fauna habitat identified as gorge/gully is disturbed for the Significant Amendment. and/or 2. More than 3,731 ha of fauna habitat identified as hillcrest/hillslope is disturbed for the Significant Amendment.	**Threshold Criteria Response Actions:** • Immediately cease clearing activities within the gorge/gully and hillcrest/hillslope fauna habitats. • Investigate threshold breach. • Offsetting in accordance with Impact Reconciliation Procedure (IRP). • Undertake corrective rehabilitation, and/or seek amendment to approvals. • Undertake further education and awareness training. • Continue to implement threshold contingency actions until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria are being met.	**Land Clearing Reconciliation:** 1. Annual aerial image capture (satellite or Remotely Piloted Aircraft) 2. Annual land clearing reconciliation against relevant upper clearing limits for fauna habitat identified as gorge/gully and/or hillcrest/hillslope habitat 3. Monitor threshold contingency actions to validate success of mitigation strategy.	1. Annual imagery capture and analysis 2. Annual, or as triggered 3. As required	1. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 2. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 3. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) and other teams as required	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria attributable to the Significant Amendment, the exceedance will be reported in writing to the CEO within seven business days of the exceedance being identified. • The Proponent will provide a report to the CEO within 21 days of the exceedance being reported. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR and ACR. • If any of the threshold criterion have been exceeded during the reporting period, the ACAR and ACR will include a description of the effectiveness of the Threshold Criteria Response Actions that have been implemented to manage the impact.
MS 1251 Conditions: **B2-1 (1) (c) disturb no more than four Pilbara leaf-nosed bat caves as shown in Figure 10;** **B2-1 (2): disturb no more than five (5) ghost bat caves (category 4) as shown in Figure 10;** *Note; all retained caves (except for five (5) ghost bat caves to be impacted) are in MEZs and therefore protected by trigger and threshold criteria outlined below* **B2-1 (4): no ground disturbing activities in MEZ 1A, 1B and 2, as shown in Figure 8A, Figure 8B and Figure 9 except for low impact activities which may be undertaken within no more than 5% of the total area of MEZ 1A, 1B and 2;** **B2-1 (5): no disturbance to ghost bat (*Macroderma gigas*) and Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) roosts within the MEZ 1A, 1B and 2**. **B2-4 (2): minimise disturbance to other ghost bat roosts (caves A1, A2, L1, L2, L3, WA-9, WA-10, WA-11, WA-12, WA-17, WA-20 and WA-22)** **EPBC DN 2021/8923 Conditions:** **6 (b): ensure that no person approaches within 150 m of any critical cave unless authorised to do so by the approval holder** **6 (c): ensure no haul truck comes within 150 m of any entrance to a critical cave** **6 (d): ensure that none of the retained bat caves are closed**					
Trigger Criteria					
1. Mining activities[4] come within 10 m of MEZ 1A, MEZ 1B or MEZ 2 **or** 2. Over 4% of MEZ 1A, MEZ 1B or MEZ 2 is disturbed for low impact activities **or** 3. Low impact activities come within 10m of cave within MEZ 1A, MEZ 1B or MEZ 2	**Trigger Criteria Response Actions:** **Investigation may include review of:** • Internal ground disturbance, authorisations and actuals. **If investigations indicate that trigger exceedance is due to the Proposal, implement trigger level response actions, for example:** • Cease clearing within or near MEZ's. • Review total clearing allocations. • Report internally as an incident. • Do not authorise any further internal Approval Requests (AR) if threshold criteria would be exceeded. • Rehabilitate areas no longer required for operations.	**Land Clearing Reconciliation:** 1. Aerial image capture (satellite or Remotely Piloted Aircraft). 2. Land clearing reconciliation (against GIS exclusion and disturbance layers) to ensure the exclusion zones are not impacted or entered without authorisation.	1. Annual imagery capture and analysis 2. Annual, or as triggered	1. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 2. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team)	• The environmental outcome will be reported on against the trigger criterion for each calendar year in the ACAR and ACR. • If any trigger criterion was exceeded during the reporting period, the ACAR and ACR will discuss potential reasons for exceedance of the trigger criterion and include a description of the effectiveness of the Trigger Criteria Response Actions.

[4] Not inclusive of any low impact activities (as defined in Ministerial Statement 1251).

Indicators	Response Actions	Monitoring[3]	Timing/Frequency	Responsible	Reporting
Threshold Criteria					
1. Disturbance of more than four Pilbara leaf-nosed bat (category 4) caves **or** 2. Disturbance of more than five ghost bat (category 4) caves **or** 3. Ground disturbing activities (except for low impact activities) occur in MEZ 1A, MEZ 1B or MEZ 2 **or** 4. Low impact activities exceed 5% disturbance within MEZ 1A, MEZ 1B or MEZ 2. **or** 5. Low impact activities impact a cave within MEZ 1A, MEZ 1B or MEZ 2	**Threshold Criteria Response Actions:** • Implement Trigger Response Criteria as detailed above • Continue to implement threshold contingency actions until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria are being met • Monitor threshold contingency actions to validate success of mitigation strategy	**As above**			• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria attributable to the Significant Amendment, the exceedance will be reported in writing to the CEO within seven business days of the exceedance being identified • The Proponent will provide a report to the CEO within 21 business days of the exceedance being reported • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR and ACR • If any of the threshold criterion have been exceeded during the reporting period, the ACAR and ACR will include a description of the effectiveness of the threshold contingency actions that have been implemented to manage the impact
MS 1251 Condition: **B2-1 (3): no impacts to the structural integrity or microclimate of caves listed in MEZ 1A and 1B as shown in Figure 8A and Figure 8B that would reduce the capacity to support ghost bats (*Macroderma gigas*);** **B2-4 (2): minimise disturbance to other ghost bat roosts (caves A1, A2, L1, L2, L3, WA-9, WA-10, WA-11, WA-12, WA-17, WA-20 and WA-22)** **EPBC DN 2021/8923 Condition:** **6(a): ensure mining does not harm the structural integrity, microclimate or use by ghost bat of any critical caves**					
Trigger Criteria					
1. Vibration levels at critical caves exceed design parameters of: • 75 mm/s PPV limit for critical caves with a low geotechnical sensitivity (Blast vibration category II) • 50 mm/s PPV limit for critical caves with a medium geotechnical sensitivity (Blast vibration category III) • 25 mm/s PPV limit for critical caves with a high geotechnical sensitivity (Blast vibration category IV)	**Investigate potential cause of exceedance by review of:** • Review vibration results to ensure result is correct and attributable to the significant amendment • If investigations indicate that trigger exceedance is attributable to the significant amendment, implement appropriate trigger level response actions, for example: • If vibration exceeds modelled PPV limits, visual inspection and blast vibration model review will be undertaken. • Assessment of geotechnical stability of the impacted cave • Review of blast vibration modelling and update to the blasting criteria	1. Vibration modelling 2. Vibration monitoring 3. Annual visual assessment 4. Temperature monitoring in selected caves (Table 2-5) as described in Appendix D. 5. Humidity monitoring in selected caves (Table 2-5) as described in Appendix D.	□□ Each blast within 350 m of a MEZ 1A or MEZ 1B or MEZ 2 cave (refer to monitoring methods Appendix D) □ Each blast within 350 m of a MEZ 1A or MEZ 1B or MEZ 2 cave (refer to monitoring methods Appendix D) □ Annual or as triggered (if vibration exceeds modelled PPV limits, visual inspection is required) (refer to monitoring methods Appendix D). □ Continuous (access and device dependent), downloaded and reviewed annually. □ Continuous (access and device dependent), downloaded and reviewed annually.	1. Drill and Blast Team 2. Drill and Blast Team 3. Geotechnical expert 4. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 5. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team)	• The environmental outcome will be reported on against the trigger criterion for each calendar year 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 actions.

Indicators	Response Actions	Monitoring[3]	Timing/Frequency	Responsible	Reporting
Threshold Criteria					
1. Trigger exceedance And 2. A change to the structural integrity (microclimate; temperature and humidity) of a critical cave that is confirmed by a suitably qualified expert that it will significantly reduce its capacity to support ghost bat usage.	**Threshold Criteria Response Actions may include trigger response actions, as well as:** • Cease blasting activities within 350 m of affected critical cave until full review of blast criteria completed. • Review of temperature and humidity data (microclimate data as an indicator of structural integrity) at impacted cave. • Review of bat call data at impacted cave. • Undertake rehabilitation works if possible. • Continue to implement threshold contingency actions until the CEO has confirmed by notice in writing that it has been demonstrated that the threshold criteria are being met.	As above	As above	As above	• In the event that monitoring, tests, surveys or investigations indicate exceedance of threshold criteria attributable to the Significant Amendment: • The exceedance will be reported in writing to the CEO within seven (7) business days of the exceedance being identified, and within two (2) business days to the Department (DCCEEW). • The Proponent will provide a report to the CEO within twenty-one (21) days of the exceedance being reported. • The Proponent will provide the details of the incident to the Department (DCCEEW) within 12 business days. • The environmental outcome will be reported against the threshold criterion for each calendar year in the ACAR. • the ACAR will include a description of the effectiveness of the threshold contingency actions that have been implemented to manage the impact.

Table 2-4: Objective based Provisions

MNES Fauna Species and Terrestrial Fauna: ghost bat					
Key environmental values: ghost bat (*Macroderma gigas*); Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) **Key impacts and risks:** Disturbance to the ghost bat or Pilbara leaf-nosed bat as a result of the Proposal, due to potential impacts to the structural integrity or microclimate of caves or as a result of noise and vibration **Outcome:** *Minimise impacts to ghost bat and Pilbara leaf-nosed bat associated with implementation of the Proposal*					
Objective-based provisions					
Objective: Manage threatening processes associated with implementation of the Proposal, where relevant to minimising impacts to ghost bat and Pilbara leaf-nosed bat					
Management Targets	**Management Actions**	**Monitoring[5]**	**Timing/Frequency**	**Responsibility**	**Reporting**
B2-1 (6) no disturbance to the ghost bat (*Macroderma gigas*) and Pilbara leaf-nosed bat (*Rhinonicteris aurantia*) within the MEZ 1A and MEZ 2 from noise and vibration attributable to the significant amendment; **B2-4 (2): minimise disturbance to other ghost bat roosts (caves A1, A2, L1, L2, L3, WA-9, WA-10, WA-11, WA-12, WA-17, WA-20 and WA-22)**					
No disturbance to the ghost bat and Pilbara leaf-nosed bat within MEZ 1A and MEZ 2 as a result of noise and vibration attributable to the Significant Amendment.	**Supporting Action[6]:** • Review noise levels at MEZ 1A caves and selected MEZ 2 caves[7] as detailed in Table 2-5. • Review actual PPVs for blast vibration against modelled PPVs at MEZ 1A caves and MEZ 2 caves when in 350 m of a blast and during blast trials. ○ Review blast vibration and noise data against acoustic and secondary (scat) monitoring data where applicable when blasting within 350 m and during blast trials.	**Supporting Parameters:** 1. Noise monitoring at entrance to MEZ 1A caves and selected MEZ 2 caves without impacting egress /ingress (access and device dependent)[8] (Table 2-5; Appendix D). 2. Blast vibration monitoring for all blasting within 350 m of caves within MEZ 1A and MEZ 2 (Table 2-5; Appendix D).	**Timing/Frequency:** 1. All blasting activities within 350 m of caves within MEZ 1A and selected MEZ 2 caves. Data to be reviewed at least bi-annually. 2. All blasting within 350 m of caves within MEZ and MEZ 2 caves. Vibration levels to be reviewed after each blast.	1. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 2. Drill and Blast Team	• Annual reporting on the management target will be included in the ACAR. • Annual reporting on the review and revision of management actions.
MS 1251 Conditions: **B2-4 (1): maintain viability of the ghost bat populations within the development envelope during operations and post-mining operations;** **B2-7: The plan shall also include:** **(1): at least twelve (12) months of monitoring to determine the baseline population size of the ghost bat colony, including natural variation in population numbers and baseline distribution of bat movement and dispersal activity within the development envelope;** **(2): protocols and procedures to monitor usage and activity levels of ghost bat movement within the critical caves in MEZ 1A and 1B during construction, operation, closure and for at least twenty-four (24) months post-closure;** **(3): protocols and procedures to monitor ghost bat usage as the proposal's activities move to within 350 m of critical caves – group A in MEZ 1A and 150 m of critical caves – group B in MEZ 1B during the development of the mining pits for the Significant Amendment;**					

[5] Physical access for monitoring may not always be possible due to accessibility, weather or safety considerations. Access may also be subject to Traditional Owner consent.

[6] Actions in relation to noise and vibration will be updated after approval of the Noise and Vibration Management Approach Report. Operational blasting will not occur prior to approval of buffer distances in accordance with the requirements of condition B2-9(4).

[7] Refer to rationale table Table 1-4 in relation to noise monitoring for MEZ 2 cave; condition B2-1 (6)

Management Targets	Management Actions	Monitoring[5]	Timing/Frequency	Responsibility	Reporting
• Continued ghost bat persistence in the development envelope during operations and 24 months post closure. Persistence to be measured through ongoing scat collection, ultrasonic records and opportunistic observations. Population estimates to be calculated using similar (transferrable) methodology as described in Stantec 2025.	• Implement ghost bat monitoring at caves within MEZ 1A and MEZ 1B (and others) identified in Table 2-5, where safe to do so, to detect ghost bat presence/absence and any potential trend in occupation to determine the baseline population size within the development envelope (Table 2-5; Appendix D). • Ensure at least 12 months of baseline data prior to Proposal activity moving within 350 m of MEZ 1A caves and within 150 m of MEZ 1B caves. • Ensure monitoring as specified in this table and in Table 2-5 is implemented prior to activities moving within 350 m of critical caves in MEZ 1A and within 150 m of critical caves in MEZ 1B. • Continue to review ghost bat populations persistence within the development envelope during construction, operation, closure and for at least twenty-four (24) months post-closure. • Use monitoring data to determine ghost bat persistence in the development envelope using a similar (transferrable) methodology to that described in Stantec 2025.	1. Acoustic (bat call), noise, vibration, scat deposition and analysis and feral animal monitoring as detailed in Table 2-5 will be undertaken to measure ghost bat presence during construction, operations and for 24 months post closure for ghost bat use of caves (Table 2-5; Appendix D)Table 2-5. 2. Maternity caves will not be subject to field visits within breeding season (1 October-31 December). 3. Review monitoring data to assess ghost bat evidence of breeding, presence of juveniles and population numbers to determine ghost bat viability.	1. Acoustic: Continuous/semi continuous recording with annual analysis (device and access dependent) of selected MEZ 1A and MEZ 2 caves, downloaded at least bi-annually. 2. Scat deposition and analysis: Annual collection and analysis, and/or opportunistic at selected MEZ 1 and MEZ 2 caves. 3. Vibration and noise: Vibration is monitored during blasts as detailed in Appendix D. 4. Noise monitoring will be semi-continuous and/or blast dependent at selected caves (Table 2-5, Appendix E) Acoustic and scat monitoring will be carried out during construction, operation, closure and for at least twenty-four (24) months post-closure. Noise and vibration monitoring will be carried out during construction and operations phases only.	1. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 2. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team) 3. Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team)	• The environmental objective will be reported on against the management target for each calendar year in the ACAR. • If a target was not met during the reporting period, the ACAR will discuss the effectiveness of the management actions and whether revision of the management action is required.
B2-7 (4): protocols and procedures to monitor feral cat activity for critical caves in MEZ 1A and 1B during construction, operation, closure and twenty-four (24) months post-closure.					
• Minimise and control presence of feral animals on site	Baseline monitoring undertaken to estimate number of cats present in the development envelope, and ongoing monitoring. Feral animal presence managed on site including: • Feral animal control program undertaken. This includes traditional trapping methods or implementation of Felixers at strategic locations near critical habitat. • Prohibiting feeding animals. • Prohibiting keeping pets, unless legally required. • Appropriate waste disposal for food scraps and other putrescible wastes.	1. Bi-annual cat control comprising traditional trapping, baiting or other methods including Felixer (if available); OR 2. If used, Felixer to provide information of number of cats being fired once in toxic mode and cameras providing presence/absence of other feral fauna (foxes etc). 3. Camera feral cat monitoring undertaken MEZ 1A and MEZ 1B cave entrances 4. Record opportunistic observations within the development envelope and/or at significant environmental features. 5. Record number of animals removed through control programs. 6. Inspection of waste disposal areas within the development envelope. Indicative monitoring methods and management control are presented in Appendix D.	Items 1, 2 and 3 will be undertaken on an ongoing basis at selected intervals throughout construction, operations, closure and for 24 months post closure. Items 4, 5 and 6 will be undertaken throughout construction and operations only. If available, Felixers may be used for short campaigns at each critical cave or there may be multiple Felixers used throughout MEZ 1A and MEZ 1B, further investigation and information is required to inform Felixer strategy.	All items Health, Safety, Environment, and Communities (HSEC) (Environment Operations Team)	• NA

Table 2-5: Summary of Proposed Cave Monitoring

Cave type, impact / reference	Cave (category)	MEZ	Distance to operations (approx.) [m]	Disturbance Limit [m]	Construction and operations					Construction, operations, closure and 24 months post closure		
					Geotechnical sensitivity assessment (if blasting within 350 m)	Structural Integrity monitoring (Temp / humidity)	Noise monitoring	Vibration monitoring (during blasting)	Visual Inspection	Feral cat camera monitoring	Acoustic monitoring	Indicative Scats[9] (includes genetic analysis)
Impact	CWAN-04 (2)	MEZ 1A	160	150	Y	Y	Y	<350m	<350m	Y	Y	Y
Impact	CWAN-07 (2)	MEZ 1A	150	150	Y	Y	Y	<350m	<350m	Y	Y	Y
Impact	AA1 (2)	MEZ 1B	145	100	Y	Y	N	<350m	<350m	Y	Y	Y
Impact	WA-13 (2)	MEZ 1B	>300	100	Y	Y	N	<350m	<350m	Y	Y	Y
Impact	WA-23 (2)	MEZ 1B	>300	100	Y	Y	N	<350m	<350m	Y	Y	N
Impact	CWAN-01 (3)	MEZ 1A	150	150	Y	Y	Y	<350m	<350m	Y	Y	N
Impact	CWAN-02 (3)	MEZ 1A	170	150	Y	Y	N	<350m	<350m	Y	Y	N
Impact	CWAN-03 (3)	MEZ 1A	175	150	Y	Y	Y	<350m	<350m	Y	Y	N
Impact	CWAN-06 (2)	MEZ 1A	150	150	Y	Y	Y	<350m	<350m	Y	Y	Y
Impact	WA-21 (2)	MEZ 1B	250	100	Y	Y	N	<350m	<350m	Y	Y	N
Non critical Caves												
Impact	CWAN-30 (4)	MEZ 2	105	20	Y	N	N	<350m	<350m	N	N	N
Impact	CWAN-29 (3)	MEZ 2	70	75	Y	Y	Y	<350m	<350m	N	Y	Y
Impact	CWAN-31 (3)	MEZ 2	100	75	Y	N	N	<350m	<350m	N	N	N
Impact	A1 (3)	MEZ 2	120	75	Y	Y	N	<350m	<350m	N	Y	N
Impact	A2 (3)	MEZ 2	230	26	Y	Y	N	<350m	<350m	N	Y	N
Impact	CDHI-001 (4)	MEZ 2	110	20	Y	Y	N	<350m	<350m	N	Y	N
Impact	L2 (3)	MEZ 2	25	75	Y	Y	N	<350m	<350m	N	Y	N
Impact	L3 (3)	MEZ 2	20	75	Y	Y	Y	<350m	<350m	N	Y	Y
Impact	WA-09 (4)	MEZ 2	27	20	Y	Y	N	<350m	<350m	N	Y	N
Impact	WA-10 (4)	MEZ 2	25	20	Y	Y	N	<350m	<350m	N	Y	N
Impact	WA-11 (4)	MEZ 2	160	20	Y	Y	N	<350m	<350m	N	Y	N
Impact	WA-12 (3)	MEZ 2	340	75	Y	N	N	<350m	<350m	N	N	N
Impact	WA-17 (3)	MEZ 2	115	75	Y	N	N	<350m	<350m	N	N	N
Impact	WA-20 (3)	MEZ 2	180	75	Y	Y	N	<350m	<350m	N	Y	N
Impact	WA-22 (3)	MEZ 2	>300	75	Y	Y	N	<350m	<350m	N	Y	N
Impact	CWAN-11 (4)	MEZ 2	60	20	Y	N	Y	<350m	<350m	N	Y	N
Impact	CWAN-08 (4)	MEZ 2	90	20	Y	Y	Y	<350m	<350m	N	Y	Y
Impact	CWAN-34 (4)	MEZ 2	100	20	Y	N	Y	<350m	<350m	N	Y	N
Impact	CWAN-27 (4)	MEZ 2	70	20	Y	N	N	<350m	<350m	N	N	N
Impact	CWAN-28 (4)	MEZ 2	60	20	Y	N	N	<350m	<350m	N	N	N
Impact	CWAN-32 (4)	MEZ 2	155	20	Y	N	N	<350m	<350m	N	N	N
Impact	CDHI-002 (4)	MEZ 2	25	20	Y	N	N	<350m	<350m	N	N	N
Impact	CMAR-02 (4)	MEZ 2	>350	20	Y	N	N	<350m	<350m	N	N	N
Impact	CMAR-03 (4)	MEZ 2	>350	20	Y	N	N	<350m	<350m	N	N	N
Impact	CMAR-04 (4)	MEZ 2	>350	20	Y	N	N	<350m	<350m	N	N	N
Impact	L1 (4)	MEZ 2	>350	20	Y	N	N	<350m	<350m	N	N	N
Reference Caves												

[9] Subject to safe cave entry as per RTIO procedures. Whilst caves may have been historically classified as not recommended for entry, ongoing assessment will be carried out to determine if safe entry can be achieved in the future.

Cave type, impact / reference	Cave (category)	MEZ	Distance to operations (approx.) [m]	Disturbance Limit [m]	Construction and operations					Construction, operations, closure and 24 months post closure		
					Geotechnical sensitivity assessment (if blasting within 350 m)	Structural Integrity monitoring (Temp / humidity)	Noise monitoring	Vibration monitoring (during blasting)	Visual Inspection	Feral cat camera monitoring	Acoustic monitoring	Indicative Scats[9] (includes genetic analysis)
Reference	CWAN-10 (3)	NA	>300	Outside DE	Y	Y	Y	<350m	<350m	N	Y	Y
Reference	CMEE-05 (2)	NA	>300	Outside DE	Y	Y	Y	<350m	<350m	N	Y	Y
Reference	CMAR-01 (3)	MEZ 2	>300	75	Y	Y	Y	<350m	<350m	N	Y	Y

2.3 Reporting

For each calendar year, the environmental objectives and outcome will be reported against their associated trigger, threshold criteria, management targets and supporting/complementary reporting where relevant in the ACAR and ACR for the Proposal (Table 2-6).

In the event that trigger or threshold criteria are exceeded or management targets are not met during the reporting period, the ACAR and ACR will include a description of the effectiveness of any management contingency actions that have been implemented to manage the impact.

In the event that monitoring, surveys or investigations indicate exceedance of threshold criteria, the exceedance will be reported in writing to the DWER CEO within seven days and to DCCEEW within two business days of the exceedance being identified.

A stand-alone report will be produced for DWER within 21 days and DCCEEW within 12 business days following any instance of exceeding threshold criteria or failure to meet a management target.

The report will include:

- all corrective measures and investigations which the approval holder has already taken in respect of the incident,
- the potential impacts of the incident,
- the method and timing of any corrective measures that the approval holder proposes to undertake to address the incident, and
- any variation of these conditions or revision of a plan that will be required to prevent recurrence of the incident and/or to address its consequences.

Table 2-6: West Angelas Revised Proposal GBMP Reporting Table

Key Environmental Factors: Terrestrial Fauna (ghost bat; Pilbara leaf-nosed bat)	
Environmental Outcomes and Objectives with Associated Criteria and Management Targets.	**Reporting periods 1 January-31 December**
Outcomes Based Provisions	
Early Warning Indicator	**Status report:** **Early warning criteria not exceeded** **Early warning criteria exceeded**
More than 101 ha (80% of threshold) of fauna habitat identified as gorge/gully is disturbed for the Significant Amendment. and/or More than 2,985 ha (80% of threshold) of fauna habitat identified as hillcrest/hillslope is disturbed for the Significant Amendment.	
Trigger Criteria	**Status report:** **Trigger criteria not exceeded** **Trigger criteria exceeded**
More than 113 ha (90% of threshold) of fauna habitat identified as gorge/gully is disturbed for the Significant Amendment. and/or More than 3,357 ha (90% of threshold) of fauna habitat identified as hillcrest/hillslope is disturbed for the Significant Amendment.	
Mining activities[10] come within 10 m of MEZ 1A, MEZ1B or MEZ 2 or Over 4% of MEZ 1A, MEZ 1B or MEZ 2 disturbed for low impact activities or Low impact activities come within 10m of cave within MEZ 1A, MEZ 1B or MEZ 2	
Vibration levels at critical caves exceed design parameters of: 75 mm/s PPV limit for critical caves with a low geotechnical sensitivity (Blast vibration category II) and/or 50 mm/s PPV limit for critical caves with a medium geotechnical sensitivity (Blast vibration category III) and/or	

[10] Not inclusive of any low impact activities (as defined in MS 1251).

25 mm/s PPV limit for critical caves with a high geotechnical sensitivity (Blast vibration category IV)	
Threshold criteria:	**Status report:** **Threshold criteria not exceeded** **Threshold criteria exceeded**
More than 126 ha of fauna habitat identified as gorge/gully is disturbed for the Significant Amendment. and/or More than 3,731 ha of fauna habitat identified as hillcrest/hillslope is disturbed for the Significant Amendment.	
Disturbance of more than four Pilbara leaf-nosed bat (category 4) caves or Disturbance of more than five ghost bat (category 4) caves or Ground disturbing activities (except for low impact activities) occur in MEZ 1A, MEZ 1B or MEZ 2 or Low impact activities exceed 5% disturbance within MEZ A1, MEZ 1B or MEZ 2 or Low impact activities impact a cave within MEZ 1A, MEZ 1B or MEZ 2	
Trigger exceedance. and A change to the structural integrity (microclimate; temperature and humidity) of a critical cave that is confirmed by a suitably qualified expert that it will significantly reduce its capacity to support ghost bat usage.	
Objective Based Provisions	
Management Targets	**Status report:** **Management target not exceeded** **Management target criteria exceeded**
No disturbance to the ghost bat and Pilbara leaf-nosed bat within MEZ 1A and MEZ 2 as a result of noise and vibration attributable to the significant amendment.	
Continued ghost bat persistence in the development envelope during operations and 24 months post closure. Persistence to be measured through ongoing scat collection, ultrasonic records and opportunistic observations. Population estimates to be calculated using similar (transferrable) methodology as described in Stantec 2025.	
Minimise and control presence of feral animals on site	

3. ADAPTIVE MANAGEMENT AND REVIEW

The conceptual framework for the development of Rio Tinto's EMPs (including this GBMP) provides details of the review and adaptive management process (Appendix A). 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.

As outlined in Section 4 of the EPA guideline (EPA, 2024a), the Proponent will seek formal approval from DWER to amend the GBMP, based on the outcomes of the review, if required.

4. STAKEHOLDER ENGAGEMENT

4.1 Key Stakeholders

Consistent with the DCCEEW and DWER expectations for this GBMP to align with the principles of EIA, the Proponent will consult with stakeholders, including but not limited to the Department of Biodiversity, Conservation and Attraction - Park and Wildlife Service and the DWER EPA Services, and Compliance and Reporting during the environmental impact assessment of the Amended Proposal.

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6. APPENDICES

Appendix A: 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 A1). 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 Project'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 Project. 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 Project 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 based) and associated criteria.

A stressor-pressure-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 a matrix assessment with four factors relating to predicted impacts from the Project 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 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 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 Project.

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.

Table A1: Management level assessment matrix

Factor	Level of required management (increasing to right)				
Likelihood	Rare	Unlikely	Possible	Likely	Almost Certain
Consequence	Environmental values (species, communities /ecosystems) with no formal recognition for conservation purposes	Environmental values (species, communities /ecosystems) with no formal recognition for conservation purposes but may hold local environmental significance	Environmental values (species, communities /ecosystems) recognised as being of conservation interest	Environmental values (species, communities /ecosystems) directly protected under State and Commonwealth legislation	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.

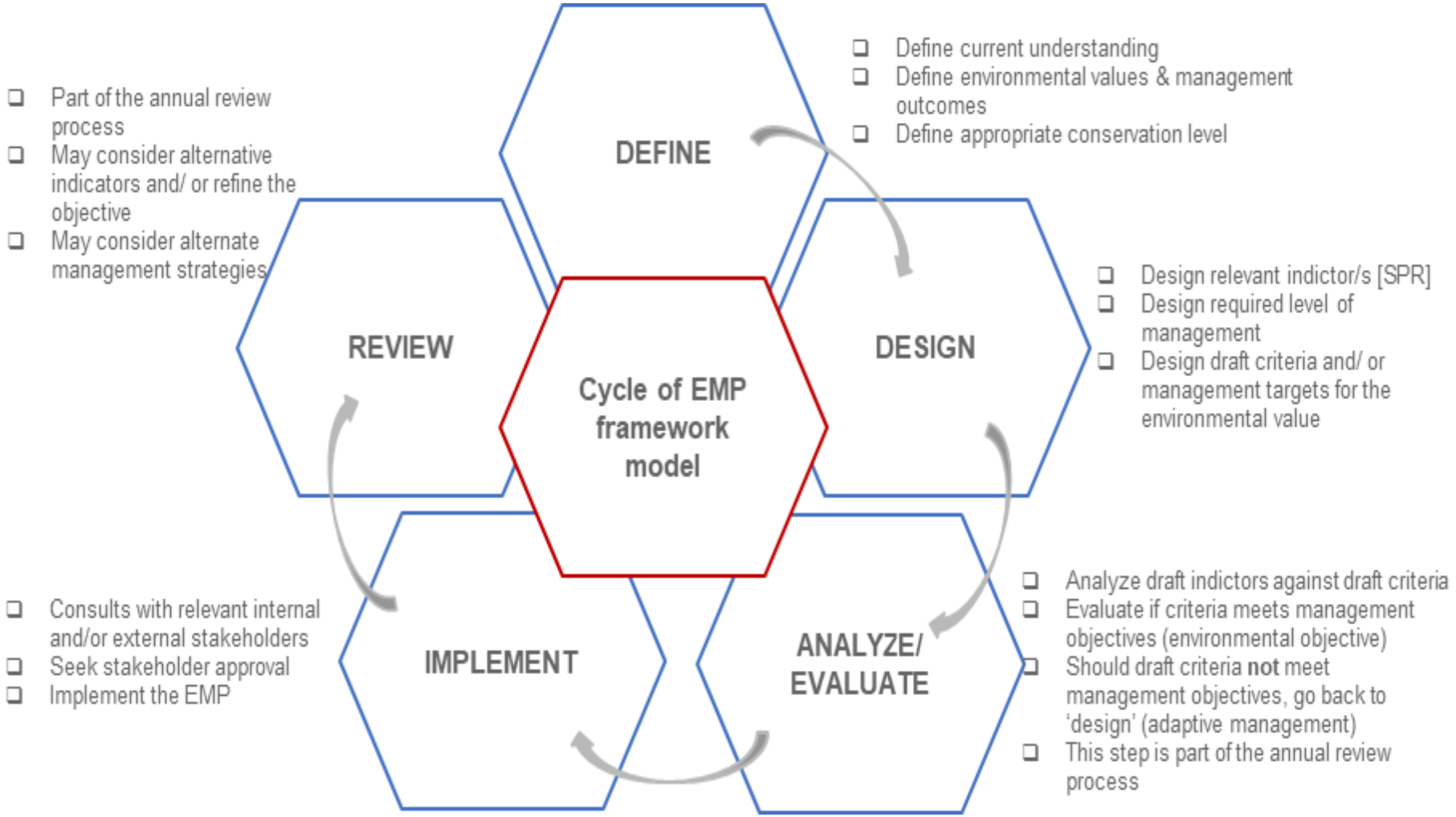
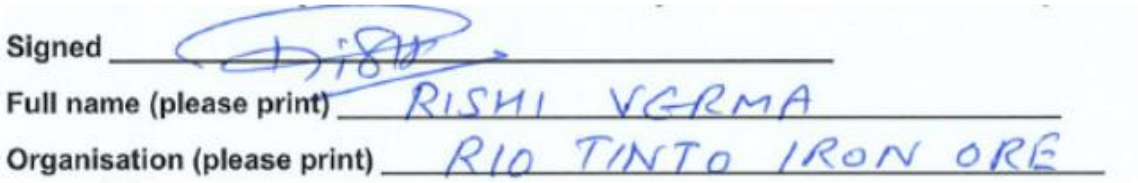


Figure A 1: Cycle of the conceptual Environmental Management Plan framework mode

Appendix B: Declaration of Accuracy

In making this declaration, I am aware that section 491 of the *Environment Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act) makes it an offence in certain circumstances to knowingly provide false or misleading information or documents to specified persons who are known to be performing a duty or carrying out a function under the EPBC Act or the *Environment Protection and Biodiversity Conservation Regulations 2000* (Cth). The offence is punishable on conviction by imprisonment or a fine, or both. I am authorised to bind the approval holder to this declaration and that I have no knowledge of that authorisation being revoked at the time of making this declaration.



Date 31 /03 / 2026

Appendix C: Geotechnical Sensitivity Analysis of Critical caves (MEZ 1A and MEZ 1B)

RTIO Mine Technical Services – Geotechnical Engineering
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Geotechnical Assessment: Environmental Site Bat Cave AA1

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1.0 Summary

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Geotechnical Sensitivity Rating:	□ □□□□
Personnel:	□□□□□□ □ □□□□□□□ □□□ □□t□□□□□□□□□□□□ □□□□r□□t□□d□□t□ □□□□□ M□□ □ □□□□□ □□□ □□□□r Dr□□□□ □□□t □□□□□□□r □ □□
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2.0 Process Outline

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3.0 Site Summary

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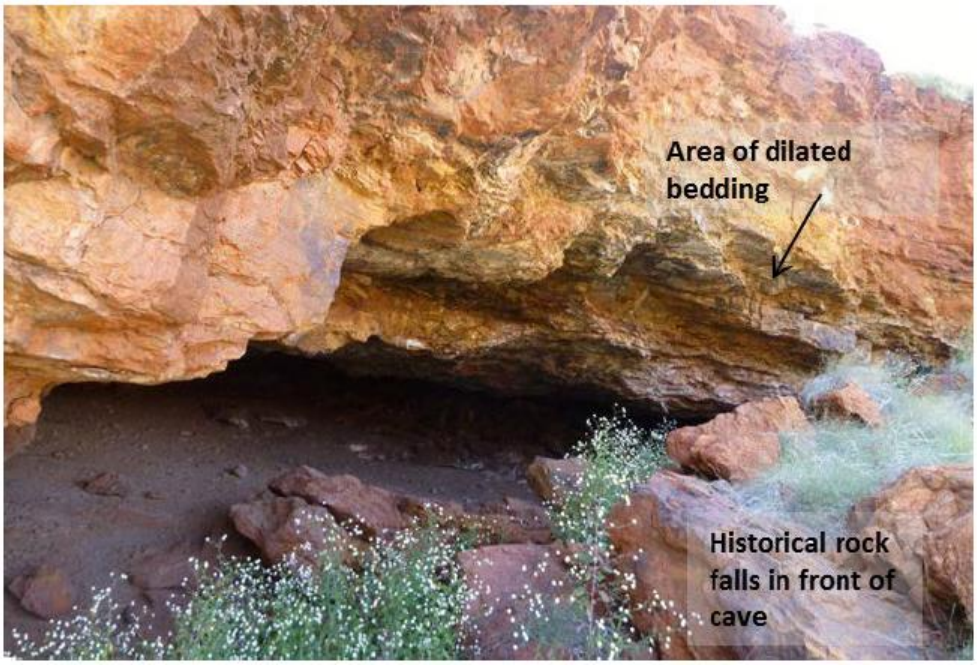

Figure 1: General view of the entrance into the cave. The pile of historical rockfalls can be seen in the foreground.

Figure 2: Close up of the open bedding in the crest of the cave. Note the mobile phone for scale.

Figure 3: Conditions inside the cave. Note the historical rock falls in the left photo. The photo on the right shows some of the cross bedding joints in this area.

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6000
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Site visit report

From	Slabber van Deventer
Department	D3 Assurance and Systems
To	Carina Vinatea
CC	Fanie Wessels
Reviewed By	Fanie Wessels
Reference	Site Bat Cave WANG Dep C & D July 2019
Date	15 July 2019

Geotechnical assessments – West Angelas Dep C & D Ghost Bat Sites

1 Summary

The D3 Assurance and Systems team was requested to geotechnically assess the Ghost Bat roost sites located at the West Angelas Mine Operations. The caves were all located in the deposit C & D mining areas. The purpose of the assessments is to determine the level of blast control needed to be put in place to mitigate large scale damaged induced by mining, and to highlight any other possible geotechnical hazards within the sites that may present a safety risk for future access. It is important to note that the recommended blast vibration limits is based on physical damage to the cave, e.g. partial collapse of the cave, and does not cover air blast, vibration or noise disturbance to the ghost bats.

The geotechnical sensitivity (robustness) of the site was assessed in conjunction with the assessed environmental significance to determine the tolerable blast vibration range required to protect the integrity of the structure. Blast vibration thresholds were based on guidance that were developed for protection of heritage sites, specifically caves and shelters, based on discussions with the Explosive and Dangerous Goods team and referring to the Australian Standard AS2187.2 – Ground Vibration and Air blast Overexposure (Reference 1) as a guideline. The objective is to define vibration levels where routine mining activities (excavation and blasting) do not negatively impact on the integrity of the identified cave. However, natural weathering processes will continue to physically act on the cave and might eventually affect the integrity of the cave.

The tolerable vibration level for the sites are summarised in **Table 2**. Site WA-21 and WA-23 have recommended Peak Particle Velocity (PPV) threshold values of 25mm/s. Two other sites have a threshold of 50mm/s and the remaining five sites a threshold of 75mm/s. The scaled distance method, as outlined in the AS2187.2:2006, should be used to determine the expected vibration levels at the sites. If the predicted PPV levels exceed the thresholds, more detailed blast management plans must be developed for the relevant sites.

2 Introduction

This report documents the outcome of the geotechnical assessments and the recommended blast vibration threshold levels.

A list of sites to be assessed was provided by the Rio Tinto Environmental team. Similar assessments have been done for heritage sites in the Pilbara. It is important to note that the Geotechnical assessment from a heritage perspective considers the possibility of any disturbance to the site, from a relative small rockfall to total collapse of the site. This is different from the approach for environmental assessment, where smaller rockfalls were not considered, unless it affects the specific bat roosting areas or is of a

safety concern for personnel doing monitoring. The main consideration from a bat cave perspective is the permanent, large scale collapse of the site, impacting on future Ghost Bat use of the site.

Development of a blast vibration threshold is based on a combination of the geotechnical sensitivity and the environmental significance for a site.

A visit to inspect and assess the sites were conducted on 2 – 3 July 2019. The inspection was carried out by Slabber van Deventer (Specialist Engineer Geotechnical) in the company of Luke Jenkins (WADCD Environmental Lead) and Daniel Wright (Mining Engineer, Ops Readiness WANG & RV). **Table 1** shows the locations of sites that were inspected.

Site Name	Easting	Northing	Cave Status	Comments
WA-09	667040	7438984	Night Roost	
WA-10	667039	7438954	Night Roost	
WA-11	666980	7438952	Night Roost	Site could not be located
WA-12	664405	7437977	Day Roost	
WA-13	665302	7437607	Maternity Roost	
WA-17	666536	7436942	Day Roost	
WA-20	666150	7437184	Day Roost	
WA-21	667181	7437031	Maternity Roost	
WA-22	665954	7438424	Day Roost	
WA-23	666434	7438531	Maternity Roost	

Table 1 – Coordinate locations of sites visited in July 2019

3 Methodology

The level of required blast control depends on a combination of environmental significance and geotechnical sensitivity. These assessments are recorded on a matrix and the vibration thresholds, and other possible controls, determined depending on where it plots on the risk matrix **(Figure 21)**. The Peak Particle Velocity (PPV) thresholds are based the Australian Standard AS2187.2 – Ground Vibration and Air blast Overexposure and discussions with the Explosive and Dangerous Goods team.

Some of the terminology used to describe the different areas of the caves or overhangs are explained in **Figure 1**.

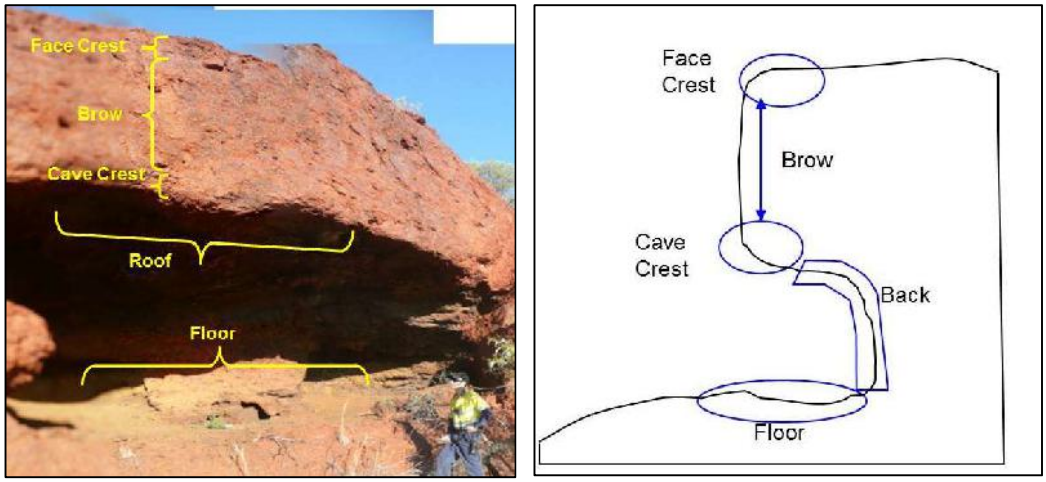

Figure 1 – Explanation of terminology used in this report

Size descriptions for the caves are based on the hydraulic radius measured in the field. In general, caves are referred to (regarding size) as:

- Small caves – 1-50 m^2
- Medium caves – 51-100 m^2
- Large caves – 101-150 m^2
- Very Large caves >150 m^2

The description of historical rock-falls are based on size of particles in the rock-fall. In general, the sizes are as follows:

- Very small rock-fall – very small size gravels and cobbles/slabs (> 0.1m)
- Small rock-fall – small size boulders/slabs (0.1 – 0.3m)
- Medium rock-fall – medium size boulders/slabs (0.3 – 0.6m)
- Large rock-fall – large size boulders/slabs (0.6 – 1.0m)
- Very large rock-fall – very large size boulders/slabs (> 1.0m)

Fabric descriptions are based on thickness of beds. In general, the sizes are as follows:

- Very closely bedded (20 – 60mm)
- Laminated (6 – 20 mm)
- Closely (thinly) laminated (< 6mm)

4 Geotechnical Assessments

A brief description of each site and the geotechnical rating follows below.

4.1 WA-09

WA-09 is a small, dome shaped cave **(Figure 2)** with two distinct chambers that has formed in highly weathered BIF and patches of hardcap material **(Figure 3)**. Dimensions are: main cave – 5m (w) x 3.5m (h) x 8m (d); second (right rear) chamber – 1.5m (w) x 1.5m (h) x 2m (d). The cave, which is controlled by bedding, has an uneven roof due to dissolution and block dropouts and a flat floor that rises up towards the back of the cave. Relic, non-continuous, bedding is present and dips at ~45deg at an oblique angle towards the cave entrance. Joint sets are difficult to define but a few short (<1m), randomly orientated discontinuities can be found inside the cave. No large structural concerns were noted inside the cave. A moderate amount of historical rockfalls is present on the floor (with sizes < 1m in diameter) **(Figure 3)**. The cave has a medium rockfall risk with some smaller loose blocks visible in the roof and walls (<football size) which could drop down if disturbed but these will not close off access to the cave. The brow is ~3m high with some loose rocks on the crest/surface that could pose a rockfall risk. The roof and wall condition of the smaller, dome shaped second chamber can be described as very good.

The geotechnical sensitivity of the cave is **low** and the environmental significance is rated as **medium**.

Figure 2 – Cave entrance and overview of the brow condition (left hand photo). Right hand photo highlights a large discontinuity and some defined blocks to the right of the entrance

Figure 3 – General view of the main camber on the left (with historical rockfalls) and a close up showing the second chamber on the right

4.2 WA-10

WA-10 is a medium size, dome shaped cave, with two distinct chambers, that has formed in weathered BIF and patches of hardcap material **(Figure 4)**. Dimensions are: main cave – 9m (w) x 3.5m (h) x 9m (d); second rear chamber – 3m (w) x 1.5m (h) x 3m (d). The cave's uneven roof shape is controlled by bedding, dissolution, block dropouts and a fault. It has a flat floor that slopes upwards towards the back of the cave. The roof has a stepped/tiered profile: 1.5m at the brow, 2.5m mid cave and 6m at the back of the cave. The 6m height seems to be dictated by a large fault that strikes parallel to the cave crest. Relic, non-continuous, bedding is present which is moderate in length (<4m), strikes oblique to the cave crest and dips at ~25deg north. Joint sets are difficult to recognise and will thus play a minor role in rockfalls or potential instability. Some randomly orientated discontinuities can be found throughout the cave (max length <4m). No large structural concerns were noted. A moderate amount of historical rockfalls are present on the floor (sizes <1.5m diameter) **(Figure 4)**. No loose blocks/rocks are visible in the walls and roof but some well-defined block of up to 0.5m in diameter (defined by open discontinuities) have been noted **(Figure 5)**, but will not close off access to the cave if they were to dislodge. The brow is ~5m high, has an open crack running perpendicular to the entrance and some loose rocks on the face **(Figure 4)**. General rockfall potential for the site is rated low. The roof and wall condition of the smaller, dome shaped second chamber can be described as fair with plenty of dissolution cavities present.

The geotechnical sensitivity of the cave is **low** and the environmental significance is rated as **medium**.

Figure 4 – Cave entrance and overview of the brow condition (left hand photo). Right hand photo highlights second chamber entrance and shows a sample of the historical rockfalls

Figure 5 – Both photos indicate defined blocks in the cave. Take note that they are not loose

4.3 WA-22

WA-22 is a very large, dome shaped cave, with three distinct chambers, that has formed in BIF **(Figure 6)**. Dimensions are: main cave – 14m (w) x 6m (h) x 13m (d); second (rear) chamber – 6m (w) x 1m (h) x 6m (d); third chamber which opens up behind the second chamber but could not be accessed due to a very low entrance height (<30cm). The entrance from the main cave to the second chamber is 1.5m (w) x 1m (h) **(Figure 7)**. The cave, which is controlled by bedding and strong jointing, has an uneven roof due to some dissolution, block dropouts and a flat floor that slopes upwards towards the back of the cave. Sub horizontal bedding is prominent and continuous (spanning the whole width of the cave). Two very prominent, sub vertical, cross cutting joint sets are present that interacts with bedding to form pronounced blocks in the roof. A heavily jointed beam like structure (~2m wide) is present just inside the dripline. A favourably orientated single large, open discontinuity (~4m length) is present on the north wall. No large structural concerns were noted. A large amount of historical rock falls is present on the floor (sizes up to 1m in diameter) see **Figure 6**. No obvious loose rocks are visible in the cave (roof or walls). The site is assessed to have a moderate rock fall potential taking into account historical rockfalls as well as the prominent geological structures and their interaction. Large block dropouts will not cut off access to the cave or rear chambers nor will it affect the cave stability. The brow is ~4m high, appears solid and has no loose material on the crest or face. The rock condition of the second chamber can be rated as good with a smaller amount of historical rockfalls present than in the main cave. No assessment of the third chamber was done due to restricted access **(Figure 7)**.

The geotechnical sensitivity of the cave is **low** and the environmental significance is rated as **medium**.

Figure 6 – General view of the cave location as well as inside the main cave. Note the large amount of historical rockfalls and 'blocky' nature of the rocks

Figure 7 – Entrance to second chamber in the left photo. Right hand photo shows a view inside the second chamber as well as the height of the entrance to the third chamber

4.4 WA-23

The entrance leading to the roosting cave comprises a small, dome shaped shelter that has formed in highly weathered caprock 2m above 'ground level' **(Figure 8)**. The 'shelter' has an irregular roof and floor formed by dissolution and erosion. Shelter dimensions are: 6m (w) x 4.5m (h) x 3.5m (d); dimensions of any additional chambers are unknown. The entrance from the 'shelter' to the roosting cave is estimated at 1.8m (w) x 1.5m (h) and appears stable **(Figure 8)**. Some very weak relic bedding and jointing can be found dotted around the site. Some short, open discontinuities can be seen in the 'shelter' walls and roof. No large structural concerns were observed. The rockfall potential has been assessed as low due to the absence of historical rockfalls on the 'shelter' floor and no loose rocks in the roof or walls. Some discontinuities does define 'slabs' that could dislodge with some disturbance. A sizable overhang exist on the face crest of the brow (1m thick x 2m long) that could detach over time. No other hazards could be identified on the ~6m high brow.

Note: *The bat / roosting cave at site WA-23 could not be inspected or assessed. To gain access to the roosting cave a >2m sheer face needs to be scaled which is not possible without a ladder. General site assessment was made from 'Ground Level' observations. The quality and appearance of the general rock mass around the corner from site WA-23 is similar to what is described above for the 'shelter' so the conclusion can be drawn that the bat / roosting cave has developed in similar material and is likely to have similar characteristics.*

Although the geotechnical sensitivity of the entrance 'shelter' and the anticipated sensitivity of the roosting cave is low**,** the sensitivity will be escalated to **moderate** to account for the uncertainty related to the roosting cave. The environmental significance is rated as **high**.

Figure 8 – General view of the site on the left and a close up of the entrance to the second chamber on the right

4.5 WA-12

WA-12 is a small, dome shaped, low roof cave, with two distinct chambers, that has formed in BIF **(Figure 9)**. Dimensions are: first chamber – 3m (w) x 1m (h) x 3m (d); second (rear) chamber – 10m (w) x 1m (h) x 4m (d). The chambers have an uneven roof and a flat, level floor covered with sediment. The shape of the cave is controlled by bedding. The small, first chamber opens up into a larger rear chamber through a 2m (w) x 0.5m (h) opening. Prominent, continuous bedding runs the full width of the shelter and dips at ~35deg away from the entrance (at an oblique angle to the crest). Three cross cutting joint sets were identified that vary from closed to open and have a maximum length of <1m. One set strikes perpendicular and the other two oblique to the crest. Dip for the three sets vary from sub vertical to ~70deg. No large discontinuities or structures were noted. Some historical rockfalls (football – backpack size) partially blocks the entrance to the second chamber **(Figure 10)** but there is very little historical rockfalls on the floor of the first or second chamber **(Figure 9)**. The small amount of rockfalls across both chambers and the absence of any loose rocks in the roof or walls gives WA-12 a low rockfall risk. The solid brow is ~3m high but does have some loose rocks on the face crest that could come down. The site is partially obscured by some large boulders (up to ~2m in diameter) that appears to have come of the brow at some stage **(Figure 10)**.

The geotechnical sensitivity of the cave is **low** and the environmental significance is rated as **medium**.

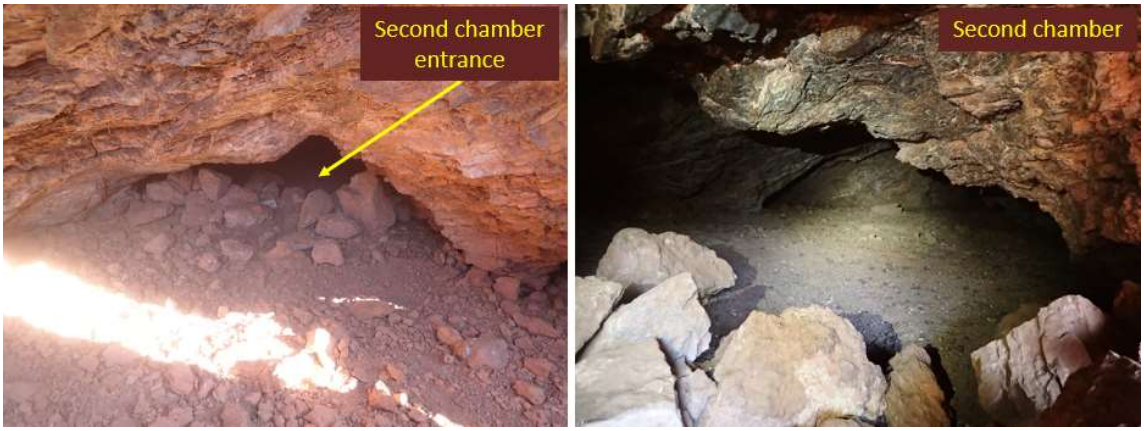

Figure 9 – Left: Entrance to second chamber and condition of first chamber floor. Right: view inside second chamber and condition of the floor (limited rockfalls)

Figure 10 – Left: closer shot of rocks covering second chamber entrance. Right: general view of the site showing the brow condition and boulders in front of the cave

4.6 WA-13

WA-13 is a very large, dome shaped cave, with two entrances on opposite sides of the large single chamber **(Figure 11)**. The shape of the cave is controlled by the BIF in which it has formed. Dimensions are 9m (w) x 3m (h) x 33m (d). The cave's irregular roof shape is controlled by bedding and block dropouts. It has a flat floor that slopes upwards from the larger entrance (northwest end)

towards the smaller entrance (southeast end). Bedding is prominent across the full width of the cave and displays some folding. Bedding on the one wall is horizontal but dips at ~30deg, away from the cave at an oblique angle to the entrance, on the opposite wall. Two prominent cross cutting joint sets was identified, varying from closed to open and has a maximum length of 3m. Set one dips sub vertical and strike oblique to the cave entrance, set two dips sub vertical and strikes perpendicular to the cave entrance. Some open, randomly orientated discontinuities were also identified with lengths <1.5m. No large-scale structural concerns were identified. The site does pose a moderate rockfall risk looking at the historical rockfall evidence as well as the interaction of the geological structures that defines prominent blocks in the roof **(Figure 12)**. The location of the vast majority of historical rockfalls are located at either end of the chamber and rocks go all the way up to ~2m in diameter **(Figure 11)**. The brow on either end (1 and 3m high respectively) appears solid but large blocks have detached in the past and some smaller loose material is also present on the face crest **(Figure 13)**. Large-scale block failure should not compromise cave entry.

The geotechnical sensitivity of the cave is **low** and the environmental significance is rated as **high**.

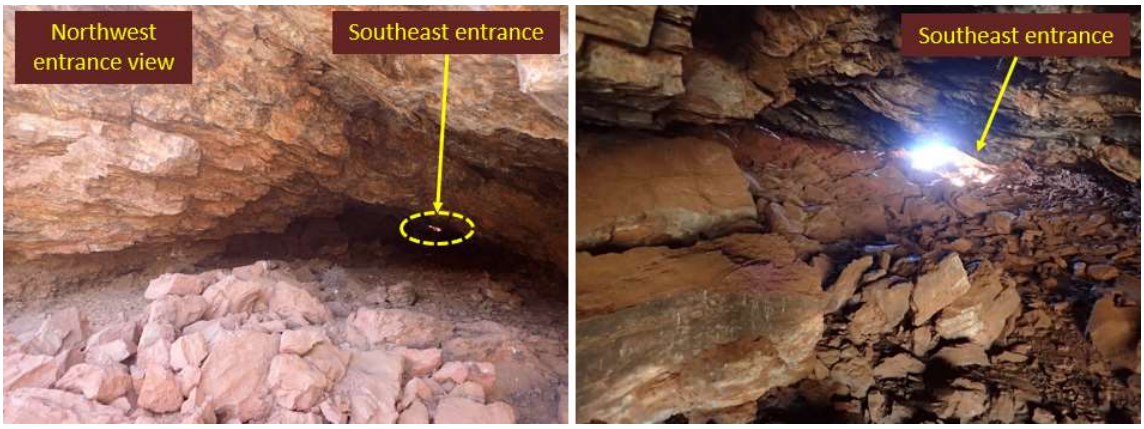

Figure 11 – View of both entrances and historical rockfalls around the entrances

Figure 12 – General view of some of the structures observed in the cave

Figure 13 – Left hand photo shows an example of a well-defined block. Right hand photo shows the condition of the southeast brow and blocks outside the entrance

4.7 WA-20

WA-20 is a small, northwest facing, dome shaped cave with two chambers that has formed in BIF **(Figure 14)**. Dimensions are: main cave – 4m (w) x 2.5m (h) x 10m (d); second (left rear) chamber – 0.5m (w) x 0.5m (h) x 1.5m (d). The cave, which is controlled by bedding, has an even roof and a flat floor that rises up slightly towards the back of the cave. A small dissolution cavity is present on the back wall. Bedding is prominent, spans the width of the cave and dips at ~30deg towards the back of the chamber with a strike angle that is oblique to the cave crest. Two joint sets were recorded: Set 1 – strikes parallel to the crest and dips sub vertical, set 2 – dips at 80deg (to the east) with a strike that is oblique to the crest. Both sets are healed and shorter than 30cm. A single large, healed, ~3m long, discontinuity was noted in the roof that strikes perpendicular to the crest. No large structural concerns were identified. The volume of historical rockfalls is low (rock sizes <backpack) and located more towards the back left hand side of the cave **(Figure 15)**. The brow is ~1.5m high with a prominent overhang/canopy. Plenty of cracking and dilation is present in the bedding of the brow with numerous loose rocks noted on the face crest **(Figure 14)**. The cave has been assessed as having a moderate rockfall risk due to the poor condition in certain areas of the brow / overhang / canopy. Partial collapse of the canopy **(Figure 15)** will not affect access to the cave but total collapse could potentially close off all access. As a whole, the canopy appears solid and stable. The rockmass condition of the small second chamber on the back left hand side of the cave is rated as good.

The geotechnical sensitivity of the cave is **low** and the environmental significance is rated as **medium**.

Figure 14 – View of the cave entrance and complete brow on the left. Right hand photo shows some of the cracking and dilation in the front part of the brow

Figure 15 – View inside the main chamber and floor condition on the left. Total extent of the overhang / canopy in the photo on the right

4.8 WA-17

WA-17 is a small, dome shaped, low roof cave, consisting of a single chamber, that has formed in BIF **(Figure 16)**. Dimensions are 3.5m (w) x 1m (h) x 11m (d). The cave has an uneven roof that is controlled by bedding and block dropouts. The floor is flat and slopes upwards towards the back of the cave. Bedding is prominent, spans the width of the site and displays some folding inside the cave. Bedding planes are open to dilated, strikes perpendicular to the crest and vary in dip from horizontal to ~25deg north (towards right hand side of cave). Two cross cutting joint sets are present that both strike obliquely to the crest – difficult to measure inside the cave so orientation obtained from exposures in the brow. A large, closed, ~3m long discontinuity was noted in the roof, and it strikes perpendicular to the entrance. No large structures were noted but significant dilation was observed between bedding planes just outside the cave and in the surrounding rockmass (gorge). It is unclear how deep seated the dilation is and if it could affect the stability of the cave. A moderate amount of historical rockfalls **(Figure 16)** can be found on the floor throughout (rocks <0.75m) with the largest pile located 5m inside the drip line on the right hand side of the cave. No loose rocks could be identified on the roof or walls but dilation is present on some of the bedding planes in the walls. The brow is ~2.5m high with large dilation and open discontinuities present in the bedding planes **(Figure 17)**. Upward of five large boulders (<1.0m in diameter) can be found just outside the cave entrance which appears to have detached from the brow. Large-scale collapse / detachment of blocks off the brow could close off access to the cave. The overall rockfall risk has been assessed as medium.
Note: *Due to the low nature of the cave, rocks could be dislodge from the roof if personnel were to crawl inside the cave with their backs brushing up against the roof and egress from the cave is slow if anything was to happen, it is therefore recommended that entrance to the cave be minimized.*

The geotechnical sensitivity of the cave has been rated as **moderate** due to the significant dilation present in the bedding. The environmental significance is rated as **medium.**

Figure 16 – Cave entrance of the left with some of the big blocks pointed out. View inside the cave (with general floor condition) on the right with bedding dip indicated

Figure 17 – Brow on the left with some structures and defined blocks (yellow ellipses) pointed out. Right hand side photo of the bedding condition on the walls just inside the cave entrance

4.9 WA-21

WA-21 is a very large, southwest facing, dome shaped cave, with three distinct chambers of varying roof heights, that has formed in BIF and hardcap material **(Figure 18)**. There are three external entrances into the cave system: two for chamber 1 (C1) and one for chamber 2 (C2) **(Figure 20)**. Dimensions are; first chamber – 12m (w) x 2m (h) x 9m (d); second chamber – 8m (w) x 5m (h) x 10m (d) an third (rear) chamber – 8m (w) x 1m (h) x 3m (d). The opening from C1 into C2 is 4m (w) x 0.75m (h) and from C2 into C3 is 1.5m x 1.5m. Roofs in C1 and C2 is very irregular, due to block dropouts and dissolution, with the roof in C3 being more regular. The floor in all three chambers rises towards the back of the chamber and varies from relatively flat to very uneven. The shape of the entire cave system is largely controlled by bedding. Bedding is prominent and continuous, spanning the full width of the cave. Weathering varies from very high in C1 to low in C2 and C3. Bedding characteristics are: healed (C3) to dilated (C1), rough stepped to smooth undulating surfaces, spacing 5 – 30cm, striking oblique to C1 entrance (east – west) and dipping at 30deg in to the right hand (south) wall of C1. Two joint sets are present with set 1 striking perpendicular to bedding, dips sub vertical, has spacing of ~30cm and varies from closed to open. Set 2 – strikes perpendicular to the entrance of C1, dip sub vertical, has spacing of ~15cm and varies from closed to open. Numerous short, dilated discontinuities with random orientations are present especially in C1. One large structure (appears to be a fault) was identified in C2 (**Figure 19)**. The structure is sub vertical, strikes perpendicular to the entrance of C1, is ~6m long and varies from closed to open. Structural concerns do exist around the very poor quality of the rockmass in C1 that could collapse, potentially closing off two of the three entrances into the cave system. If this was to occur, entrance could still be gained through the external opening to C2. A large amount of historical rockfalls is present in C1 with rocks of up to ~2m in diameter - in contrast to very little historical rockfalls in C2 and C3. Numerous loose rocks and defined slabs were identified in C1 **(Figure 18)** whereas in C2 and C3 little loose material was observed. Rockfall potential for C1 is rated as very high but for C2 and C3 the potential is assessed as low. The brow outside C1 is ~4m high in competent looking hardcap material but does have some lose material sitting on the face crest. Two very large rocks (>5m in diameter) are present a couple of meters in front of C1's entrance that appears to have detached from the brow.

Given the concerns related to the rockmass in C1, the geotechnical sensitivity of the cave has been rated as **moderate** and the environmental significance is rated as **high.**

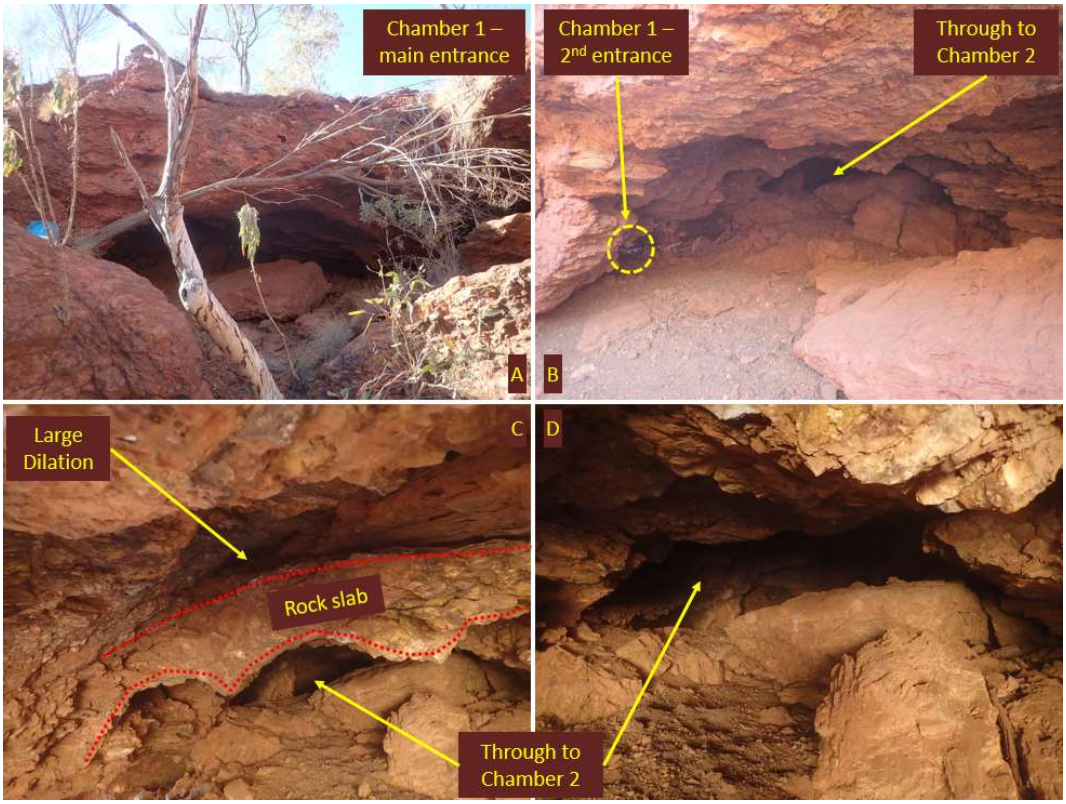

Figure 18 – Photo A: Entrance to C1 and brow condition. Photos B – D: General view inside C1, condition of the rockmass and historical rockfalls

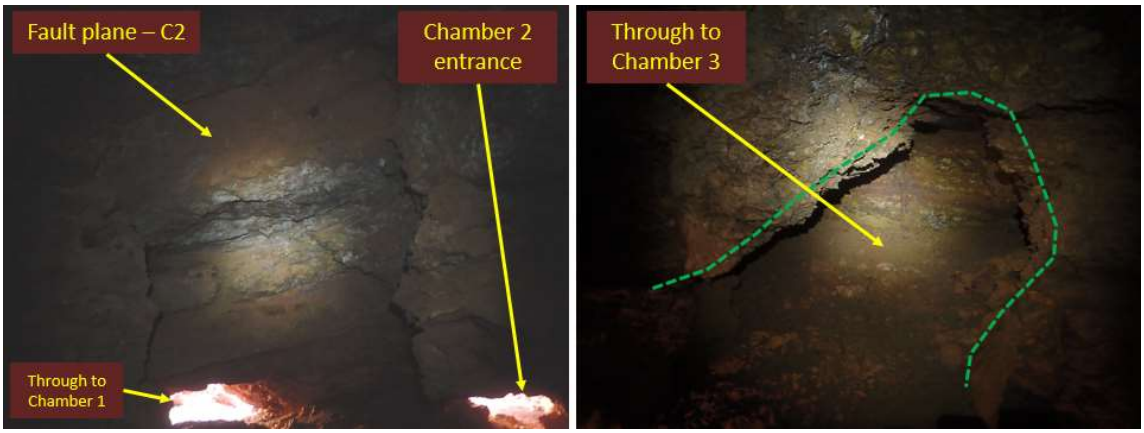

Figure 19 – Left hand photo taken inside C2. Right side shows the entrance to C3 located at the back of C2

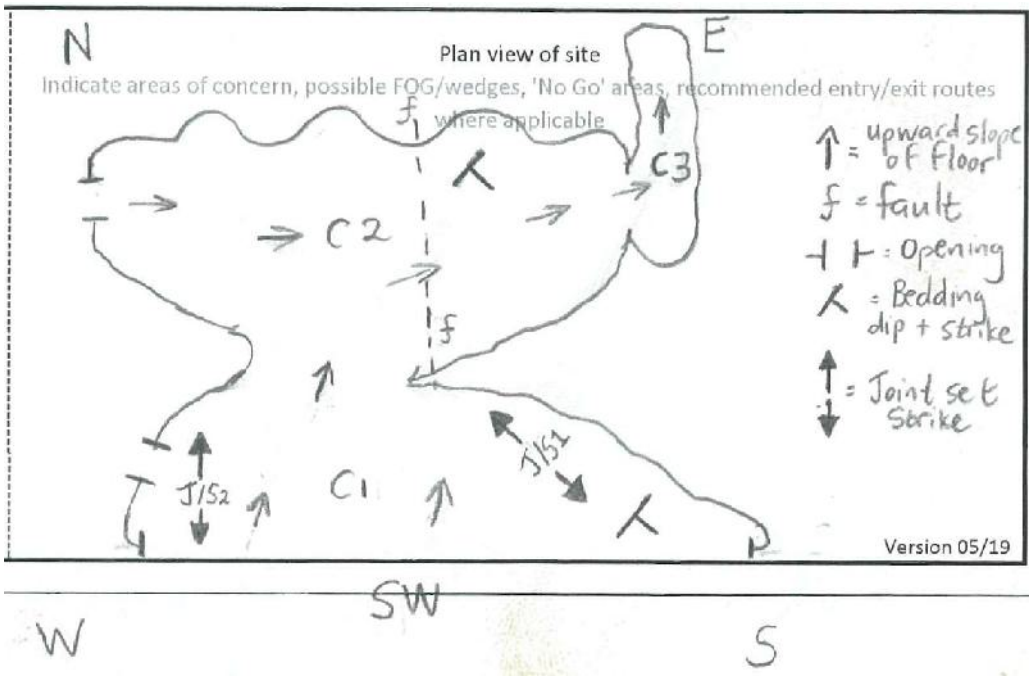

Figure 20 – Diagram of cave system layout, fault location and structure orientations (Not drawn to scale)

5 Recommendations

The recommended blast vibration thresholds are based on a combination of the environmental significance and the geotechnical sensitivity. The results are summarised in **Table 2** and **Figure 21**. The scaled distance method as outlined in the Australian Standard AS2187.2:2006 should be used to determine the expected vibration levels at the sites. In the absence of site specific data, use of proxy constants K = 1140 and b = -1.6 can be used as a starting point. If the calculated vibration levels exceed the recommended thresholds, the Drill and Blast team can:

- develop site specific K and b values, or
- modify the blast design to reduce the maximum charge weight

If the predicted estimated thresholds levels still be exceeded following these modifications, a more detailed blast management plan should be developed.

Environmental Site Name	Geotechnical Sensitivity	Environmental Significance	Maximum Recommended PPV Blast Threshold Value (mm/s)
WA-09	Low	Medium	75
WA-10	Low	Medium	75
WA-11	N/A	Medium	N/A
WA-12	Low	Medium	75
WA-13	Low	High	50
WA-17	Moderate	Medium	50
WA-20	Low	Medium	75
WA-21	Moderate	High	25
WA-22	Low	Medium	75
WA-23	Moderate	High	25

Table 2 – Summary of recommended blast vibration thresholds

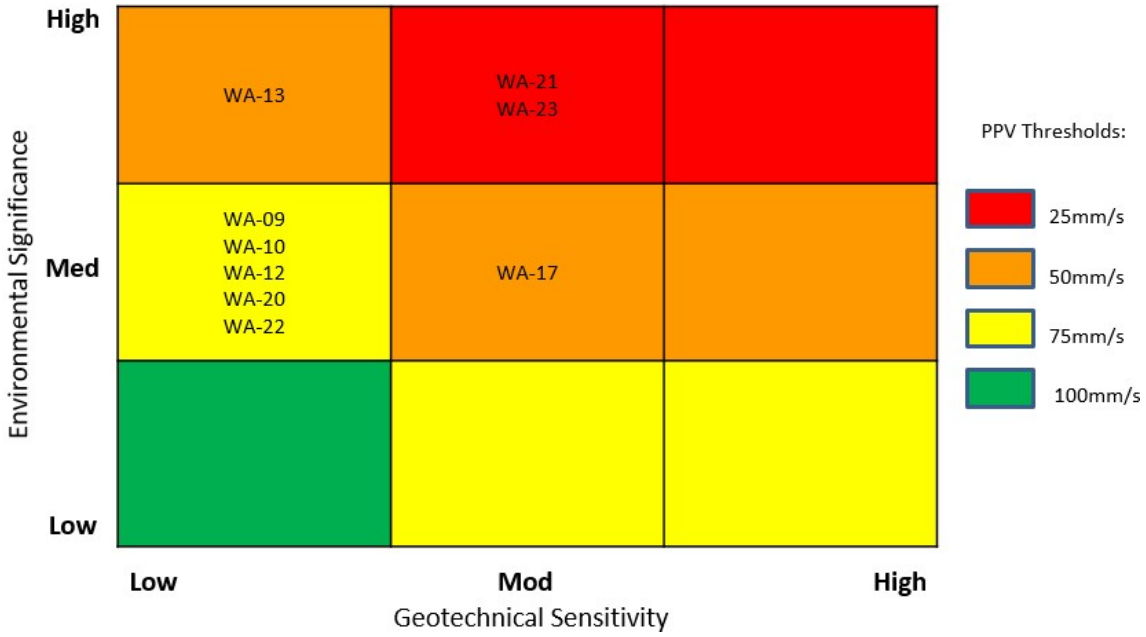

Figure 21 – PPV recommendations based on combined environmental and geotechnical assessments

References

1. Australian Standard AS 2187.2. 2006. Appendix J. *Ground Vibration and Air blast overexposure.*
2. RTIO-CR-0253131 - 20160209 AD Final RS Guidance note.pdf

RTIO Mine Technical Services – Geotechnical Engineering
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Geotechnical Assessment: Environmental Site CWAN-01

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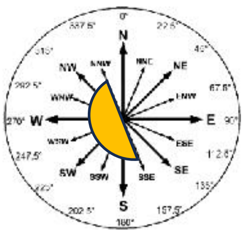
1.0 Site Assessment Details

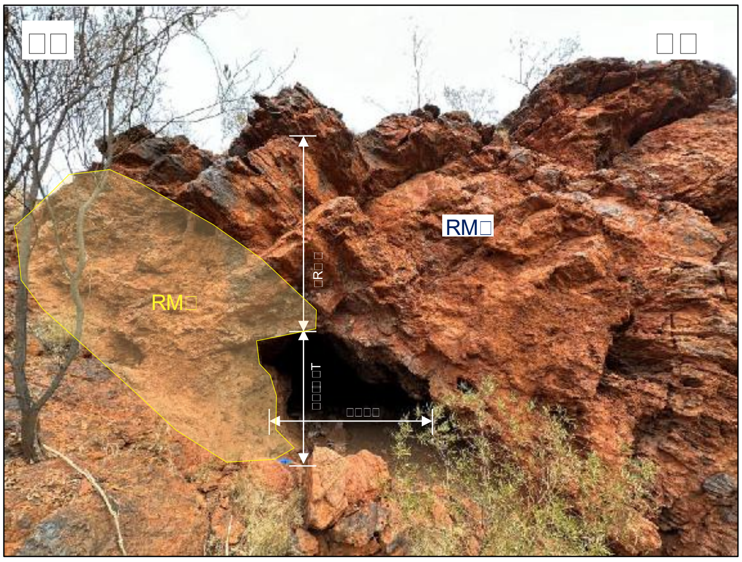
Mining Operation:	[illegible]
Deposit:	[illegible]
Site ID:	[illegible]
Site Type:	[illegible]
Site Coordinates:	[illegible]
Personnel:	[illegible]
Date of assessment:	[illegible]

2.0 Site Description

[illegible] **CWAN-01** [illegible]

Span	[illegible]
Depth	[illegible]
Height	[illegible]
Brow	[illegible]
Facing	[illegible]





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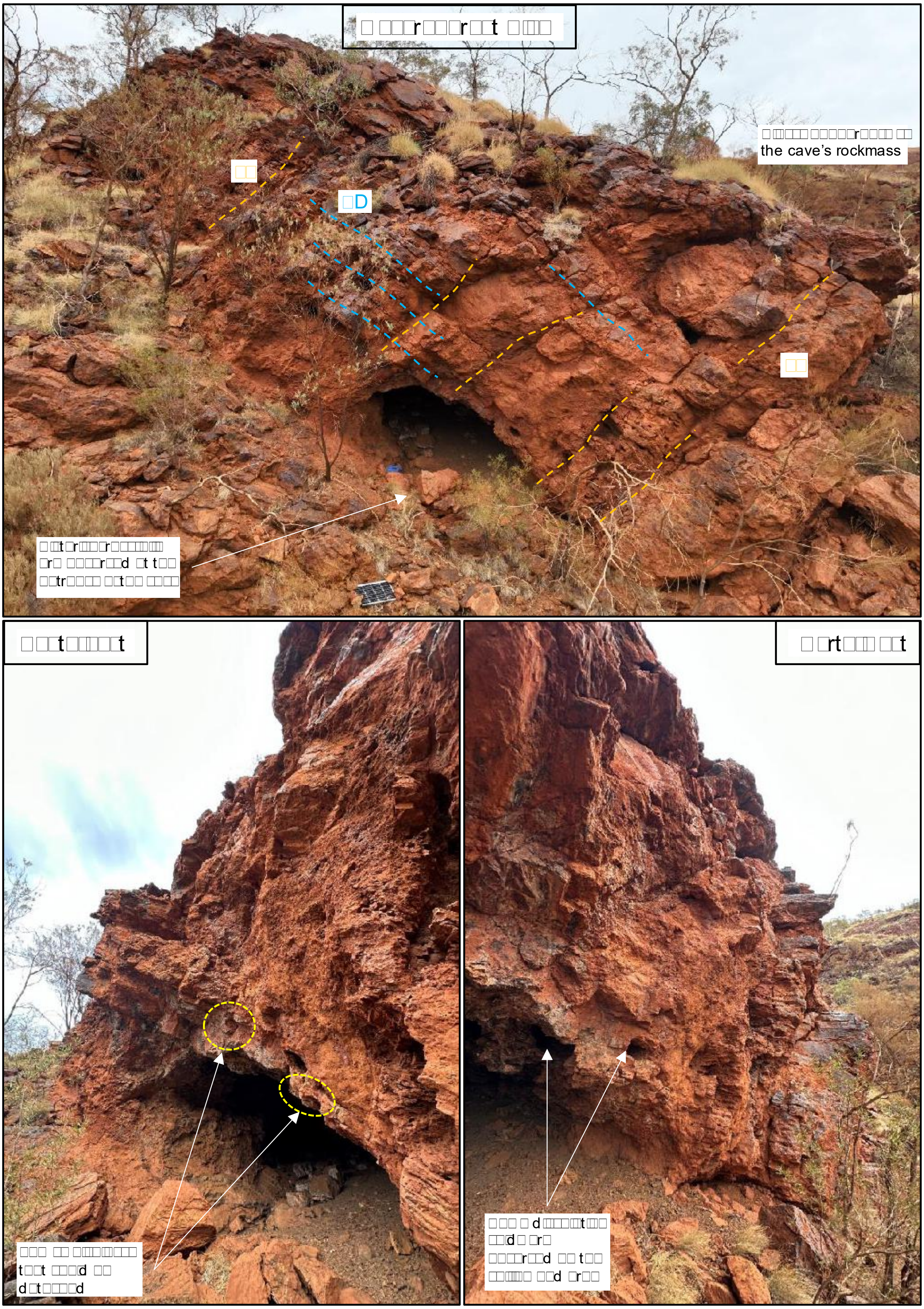

Figure 2:

[illegible]

Table 1: [illegible]

Set ID	Type	Count	Spacing	Aperture	Length	Dip	Dip dir.	Roughness	Alteration	Infill type	Weather.
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

- RM1: “Intact or Massive” rock mass structure and “Fair” surface conditions → [illegible]
- RM2: “Very Blocky” rock mass structure and “Fair” surface condition → [illegible]

[illegible]

Table 2: [illegible]

Site ID:	CWAN-01	RM1	RM2
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

[illegible]

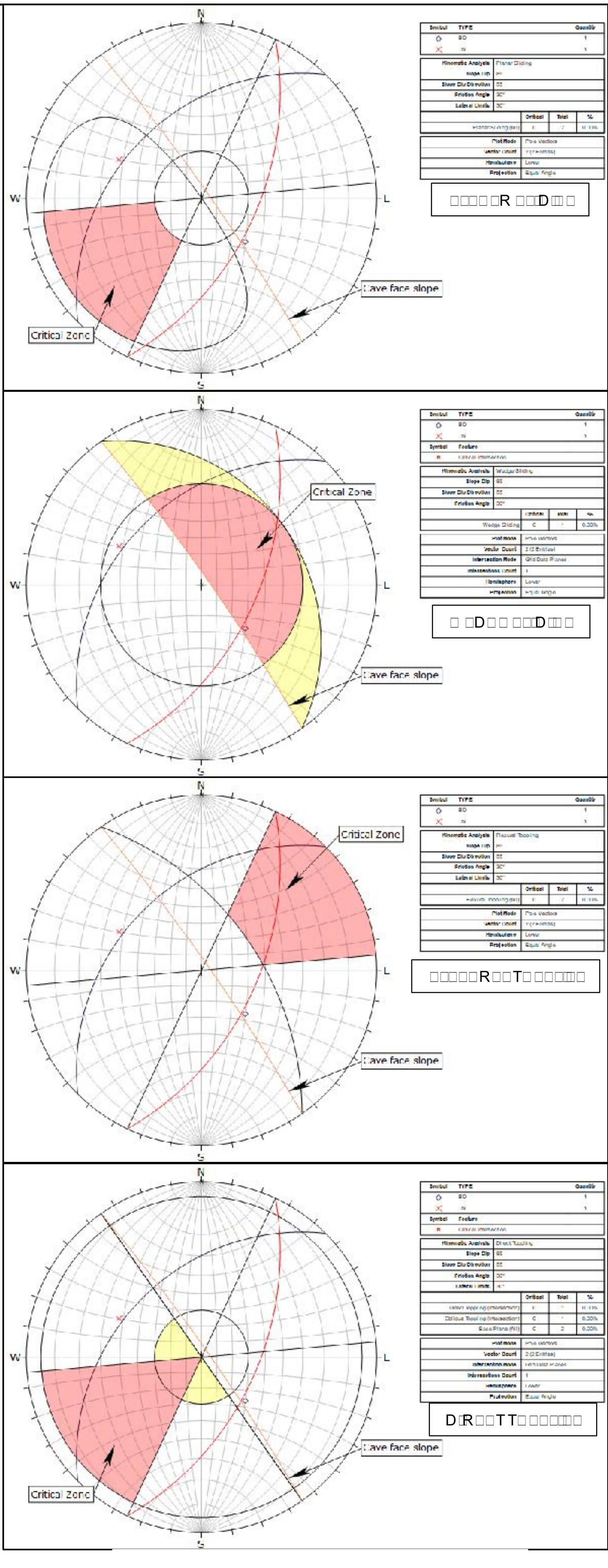

Figure 3:

Table 3: [illegible]

Type of failure	Degree of potential risk
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

3.0 Geotechnical Sensitivity Rating

[illegible] **CWAN-01** [illegible] **Low** [illegible]

RTIO Mine Technical Services – Geotechnical Engineering
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[illegible] 158 St. George's Terrace
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Geotechnical Assessment: Environmental Site CWAN-02

[illegible]

T[illegible] R[illegible] T[illegible] RT[illegible] **CWAN-02** [illegible] **West Angelas Western Hill** [illegible]

[illegible] RT[illegible] of planned blasting activity; blast vibration thresholds are established based on the cave's [illegible] *Geotechnical Sensitivity* [illegible] M[illegible] *Environmental Significance* [illegible] M[illegible] T[illegible] *Guidance Note - Cave Site Geotechnical Assessments*[illegible]

[illegible] **CWAN-02** [illegible] R[illegible] **Low.**

1.0 Site Assessment Details

Mining Operation:	[illegible]
Deposit:	[illegible]
Site ID:	[illegible]
Site Type:	[illegible]
Site Coordinates:	[illegible]
Personnel:	[illegible]
Date of assessment:	[illegible]

2.0 Site Description

[illegible] **CWAN-02** [illegible] The cave's ceiling has an irregular [illegible] rockfalls are scattered throughout the inside and outside of the cave's entrance. Some slabs are formed at the [illegible]

Span	[illegible]
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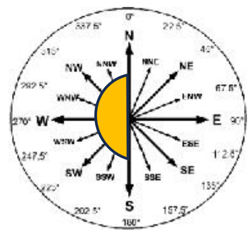
Height	[illegible]
Brow	[illegible]
Facing	[illegible]



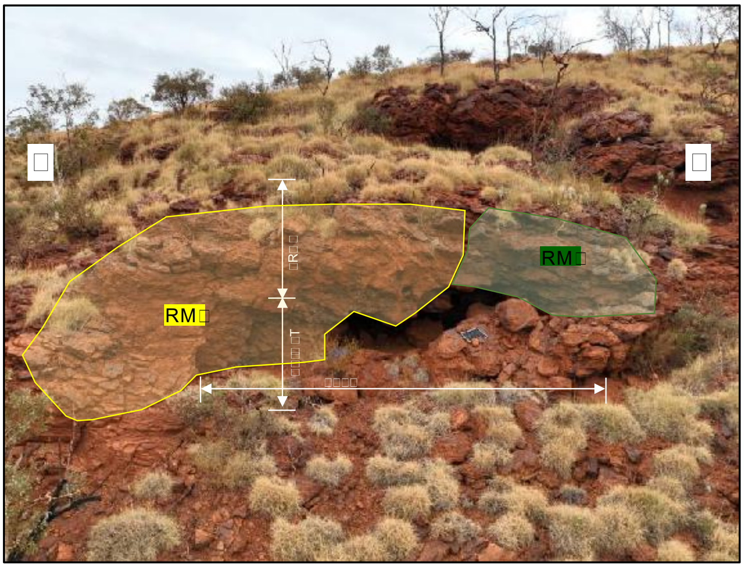


Figure 1: [illegible]

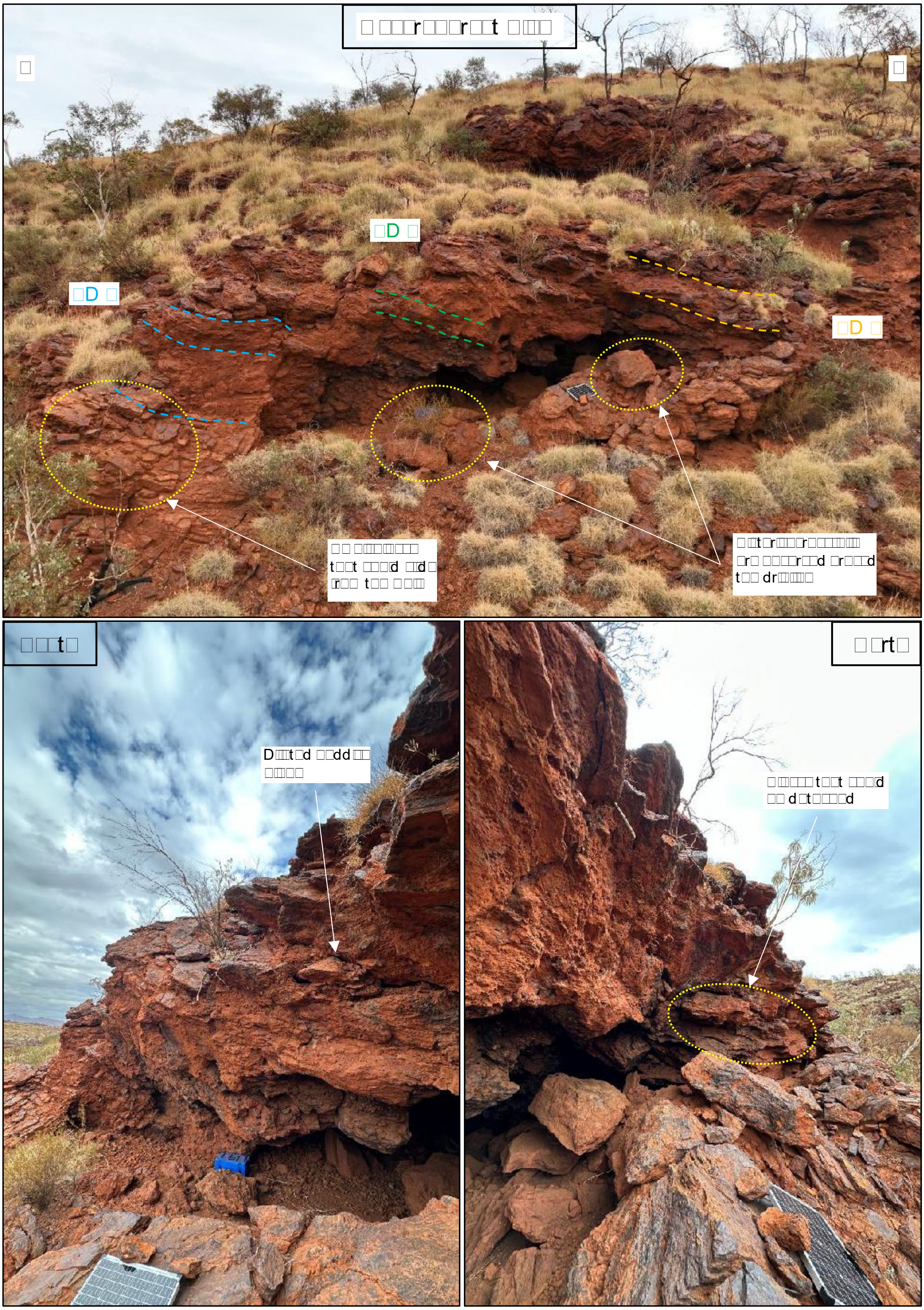


Figure 2: [illegible]

The bedding is the main defect observed. It's folded and chang [illegible]

Table 1: [illegible]

Set ID	Type	Spacing	Aperture	Length	Dip	Dip dir.	Roughness	Alteration	Infill type	Weather.
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] RM [illegible] RM [illegible]

- RM1: “Very Blocky” rock mass structure and “Fair” surface conditions → [illegible]
- RM2: “Blocky/Disturbed/Seamy” rock mass structure and “Fair” surface conditions → [illegible]

[illegible]

Table 2: [illegible]

Site ID:	CWAN-02	RM1	RM2
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

[illegible]

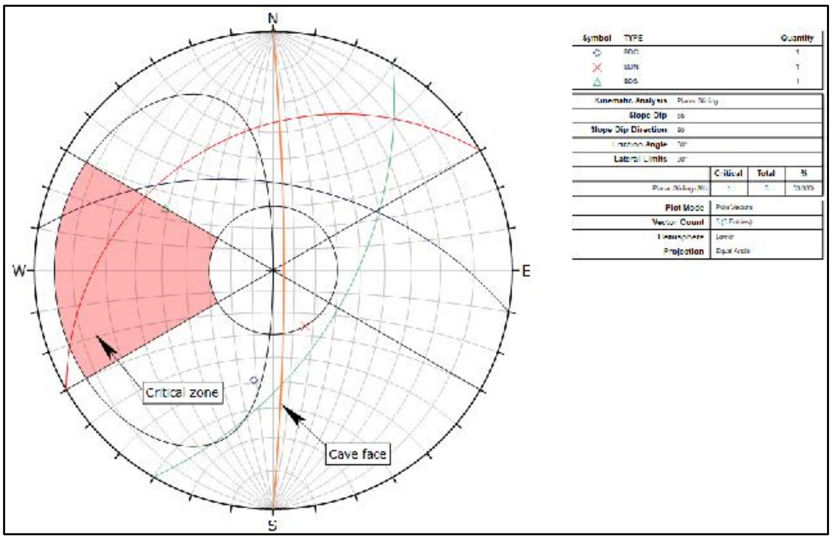


Figure 3: [illegible]

[illegible]

3.0 Geotechnical Sensitivity Rating

[illegible] **CWAN-02** [illegible] **Low** [illegible]

RTIO Mine Technical Services – Geotechnical Engineering
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Geotechnical Assessment: Environmental Site CWAN-03

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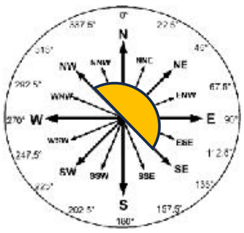
1.0 Site Assessment Details

Mining Operation:	[illegible]
Deposit:	[illegible]
Site ID:	[illegible]
Site Type:	[illegible]
Site Coordinates:	[illegible]
Personnel:	[illegible]
Date of assessment:	[illegible]

2.0 Site Description

[illegible] **CWAN-03** [illegible] The cave's [illegible]

Span	[illegible]
Depth	[illegible]
Height	[illegible]
Brow	[illegible]
Facing	[illegible]



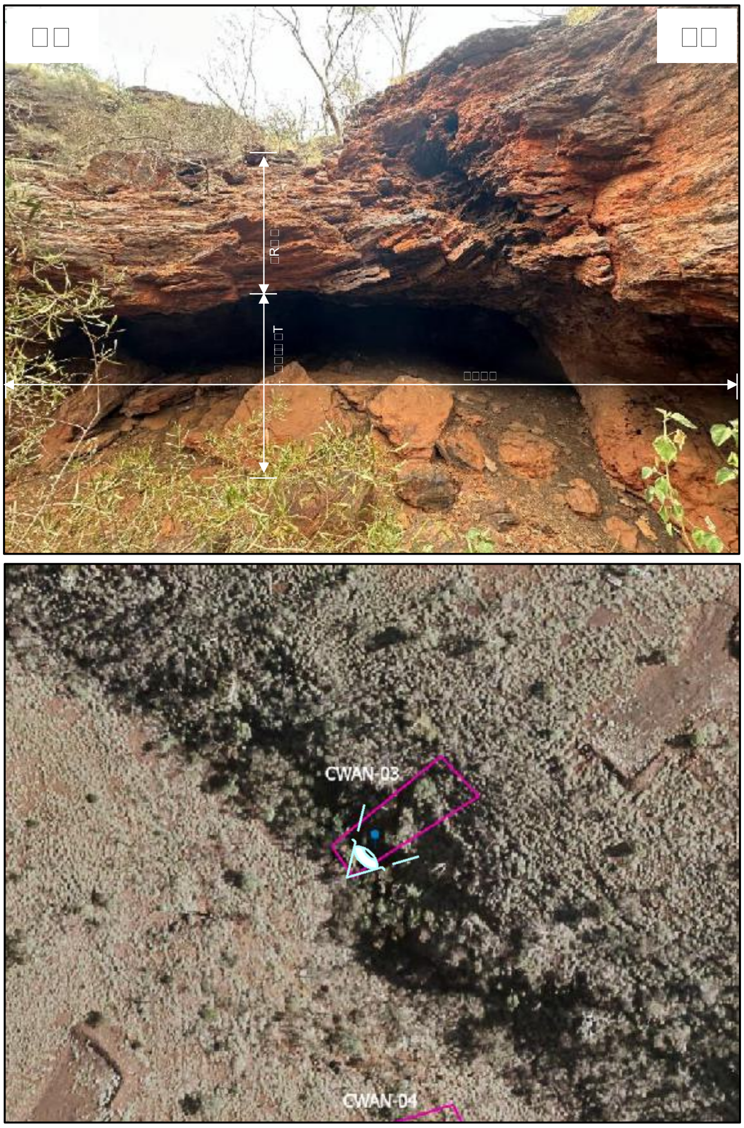


Figure 1: [illegible]

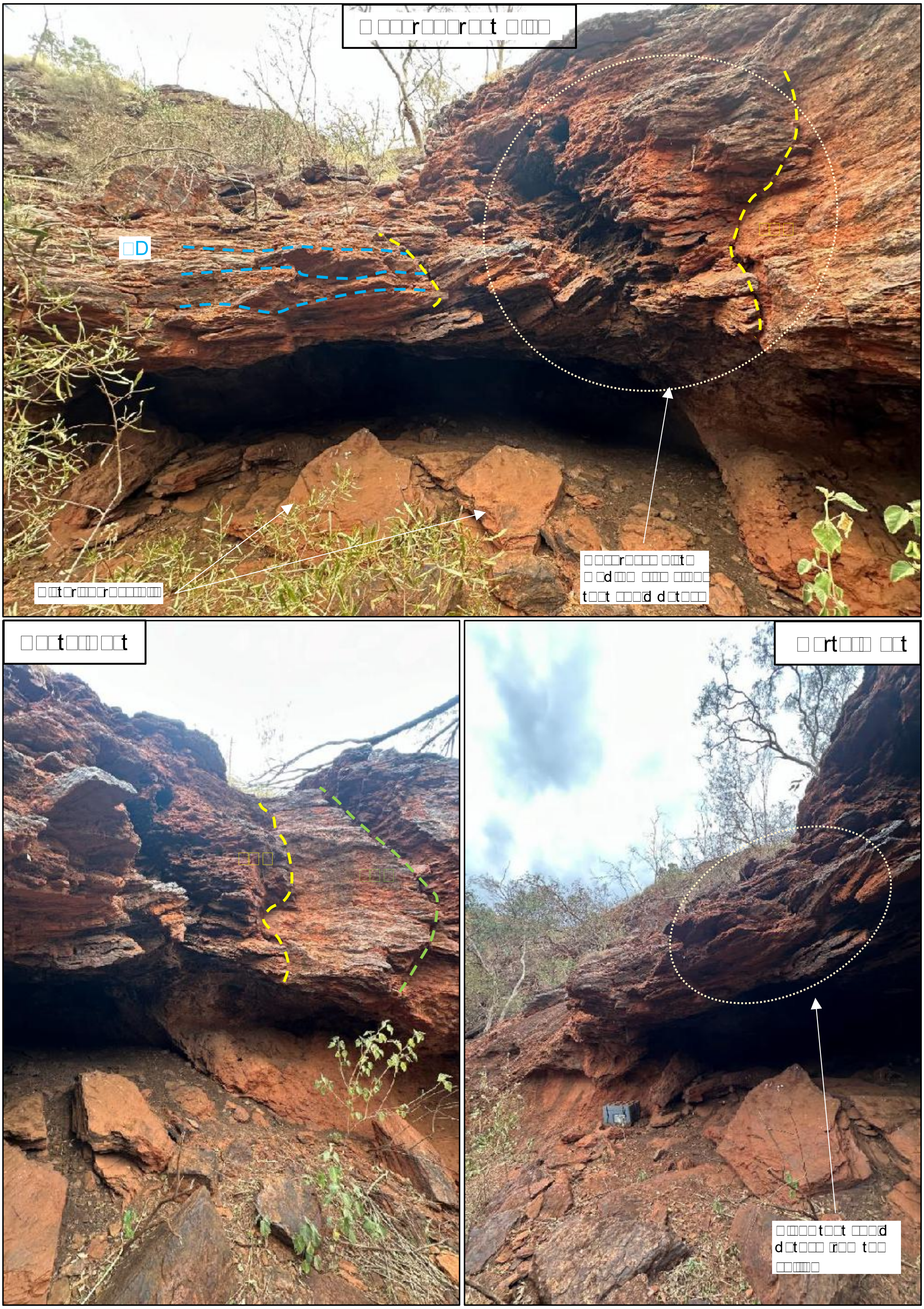


Figure 2:

[illegible] It's slightly folded, it's mainly tight but several planes are dilatated forming slabs that could detach, mostly on the ceiling and [illegible]

Table 1: [illegible]

Set ID	Type	Count	Spacing	Aperture	Length	Dip	Dip dir.	Roughness	Alteration	Infill type	Weather.
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] mass present in the cave. Considering a “Blocky/Disturbed/Seamy” rock mass structure and “Fair” surface [illegible]

Table 2: [illegible]

Site ID:	CWAN-03	
[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]
	[illegible]	[illegible]

[illegible]

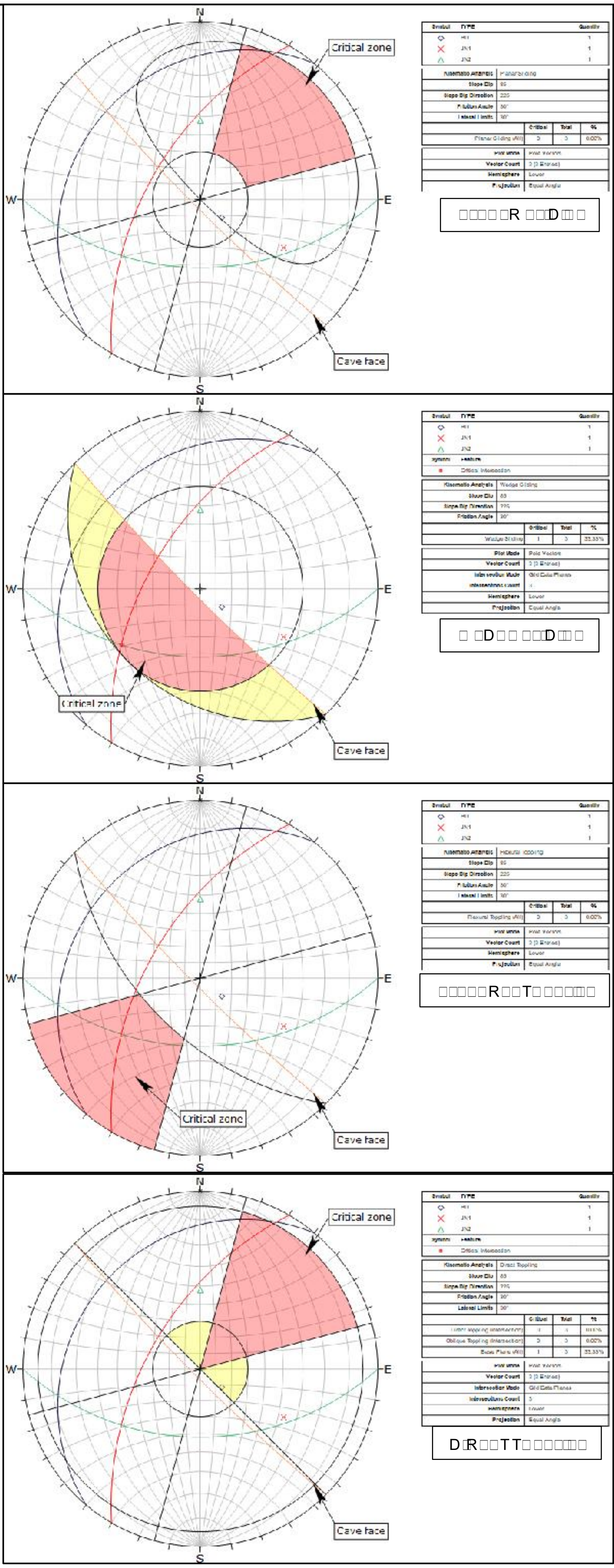


Figure 3:

Table 3: [illegible]

Type of failure	Degree of potential risk
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible] facing area of the cave's brow [illegible]

3.0 Geotechnical Sensitivity Rating

[illegible] **CWAN-03** [illegible] **Moderate** [illegible]

RTIO Mine Technical Services – Geotechnical Engineering
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Geotechnical Assessment: Environmental Site CWAN-04

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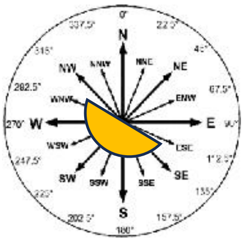
1.0 Site Assessment Details

Mining Operation:	[illegible]
Deposit:	[illegible]
Site ID:	[illegible]
Site Type:	[illegible]
Site Coordinates:	[illegible]
Personnel:	[illegible]
Date of assessment:	[illegible]

2.0 Site Description

[illegible] **CWAN-04** [illegible]

Span	[illegible]
Depth	[illegible]
Height	[illegible]
Brow	[illegible]
Facing	[illegible]



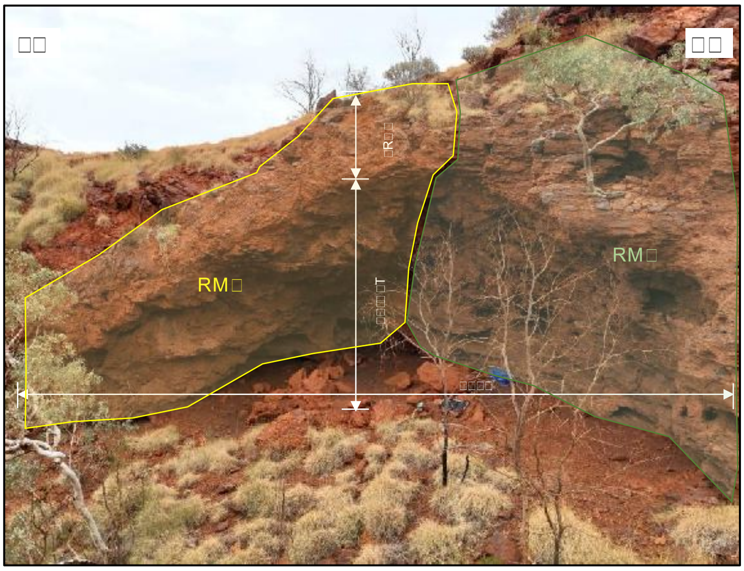


Figure 1: [illegible]

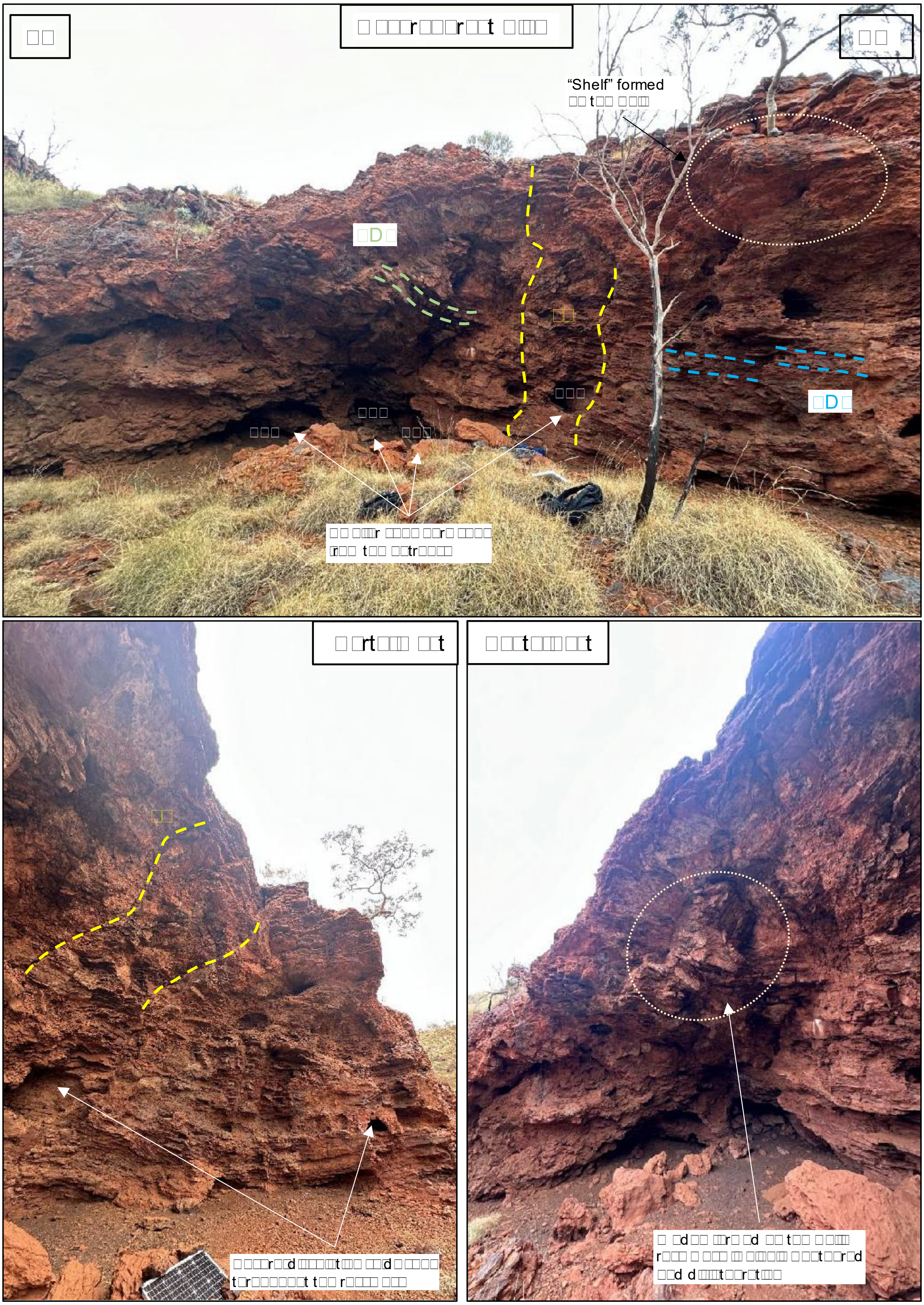


Figure 2: [illegible]

[illegible]

[illegible]

Table 1: [illegible]

Set ID	Type	Count	Spacing	Aperture	Length	Dip	Dip dir.	Roughness	Alteration	Infill type	Weather.
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible]

- RM [illegible] → [illegible]
- RM [illegible] → [illegible]

[illegible]

Table 2: [illegible]

Site ID:	CWAN-04	RM1	RM2
[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]

[illegible]

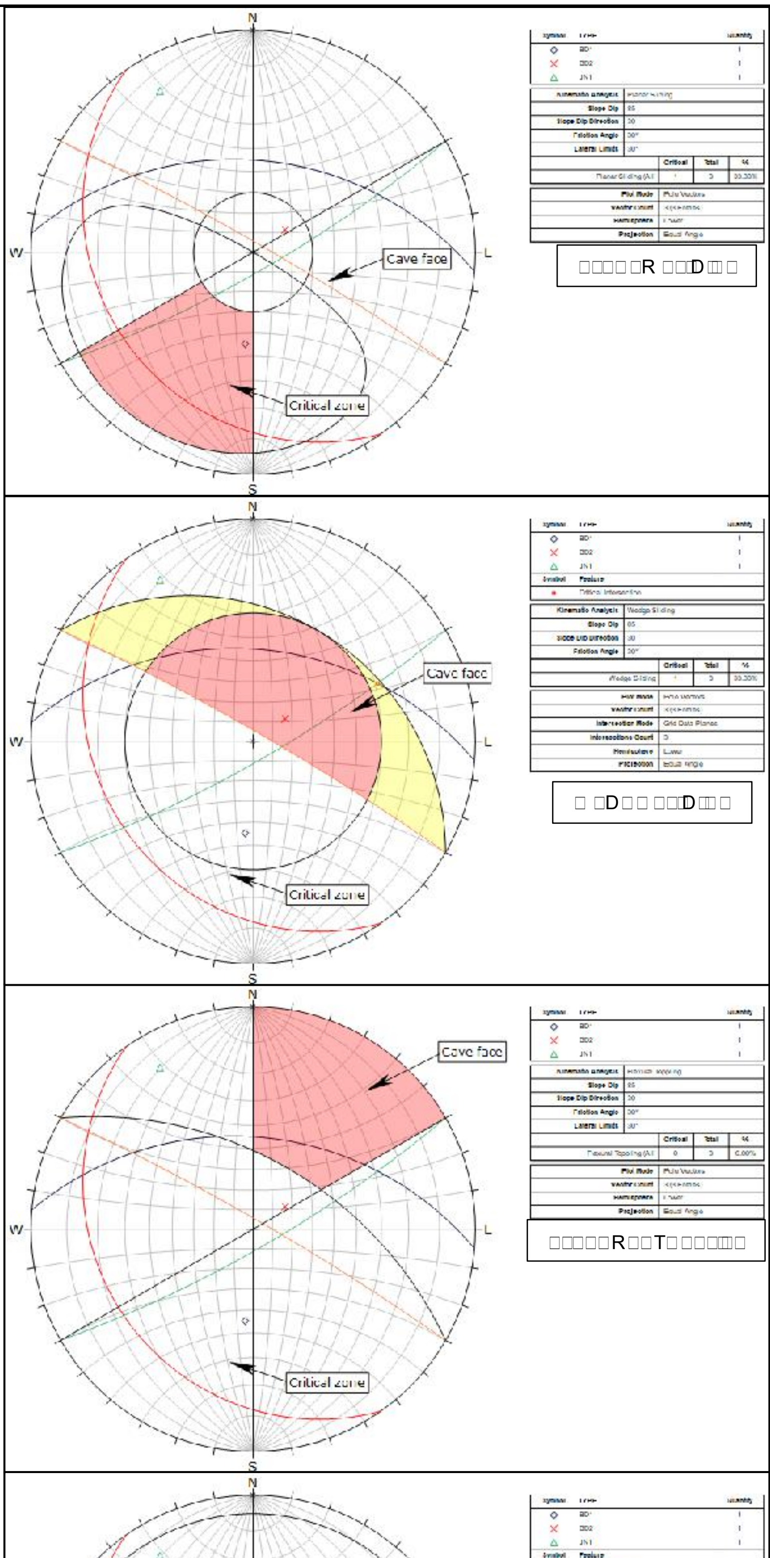


Figure 3:

Table 3: [illegible]

Type of failure	Degree of potential risk
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

3.0 Geotechnical Sensitivity Rating

[illegible] **CWAN-04** [illegible] **High** [illegible]

RTIO Mine Technical Services – Geotechnical Engineering
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[illegible] 158 St. George's Terrace
[illegible]
[illegible]

[illegible] R[illegible]rt

Geotechnical Assessment: Environmental Site CWAN-06

[illegible]

[illegible] **CWAN-06** [illegible] **West Angelas Western Hill** [illegible]

[illegible] of planned blasting activity; blast vibration thresholds are established based on the cave's [illegible] *Geotechnical Sensitivity* [illegible] *Environmental Significance* [illegible] *Guidance Note - Cave Site Geotechnical Assessments* [illegible]

[illegible] **CWAN-06** [illegible] **Low.**

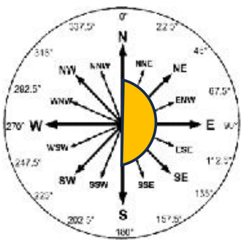
1.0 Site Assessment Details

Mining Operation:	[illegible]
Deposit:	[illegible]
Site ID:	[illegible]
Site Type:	[illegible]
Site Coordinates:	[illegible]
Personnel:	[illegible]
Date of assessment:	[illegible]

2.0 Site Description

[illegible] **CWAN-06** [illegible]. The cave's brow has a [illegible]

Span	[illegible]
Depth	[illegible]
Height	[illegible]
Brow	[illegible]
Facing	[illegible]



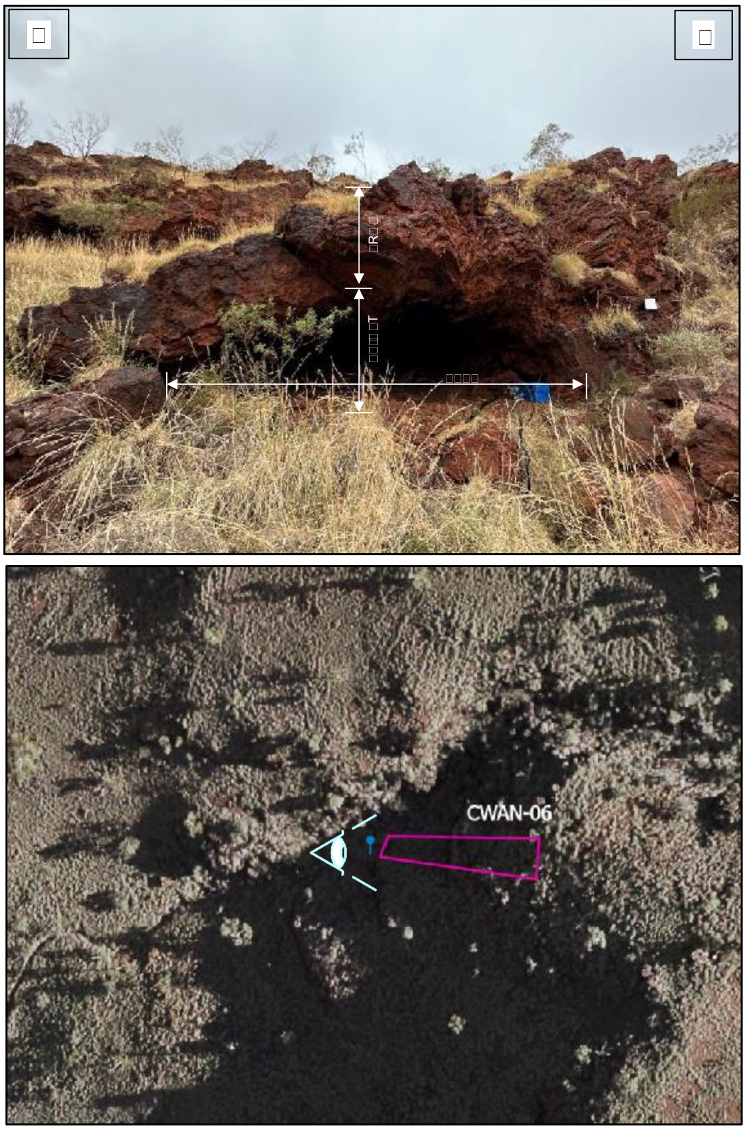


Figure 1: [illegible]

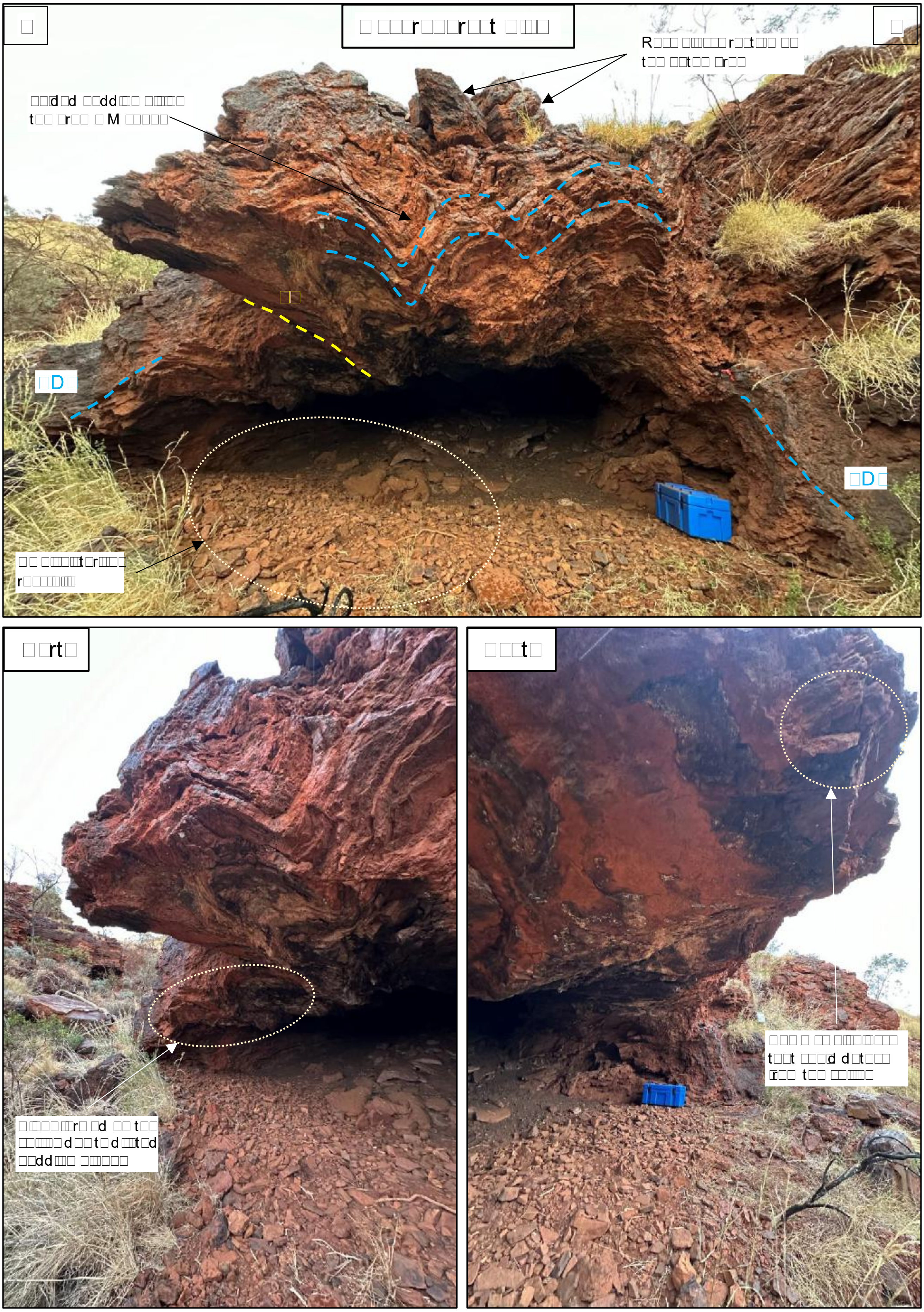


Figure 2: [illegible]

[illegible] dips towards the north, while on the south wall, it dips towards the south. At the center of the cave's [illegible]

[illegible]

Table 1: [illegible]

Set ID	Type	Count	Spacing	Aperture	Length	Dip	Dip dir.	Roughness	Alteration	Infill type	Weather.
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] Considering a "Blocky/Disturbed/Seamy" rock mass structures and "Fair" surface [illegible]

Table 2: [illegible]

Site ID:	CWAN-06	
[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]
	[illegible]	[illegible]

[illegible]

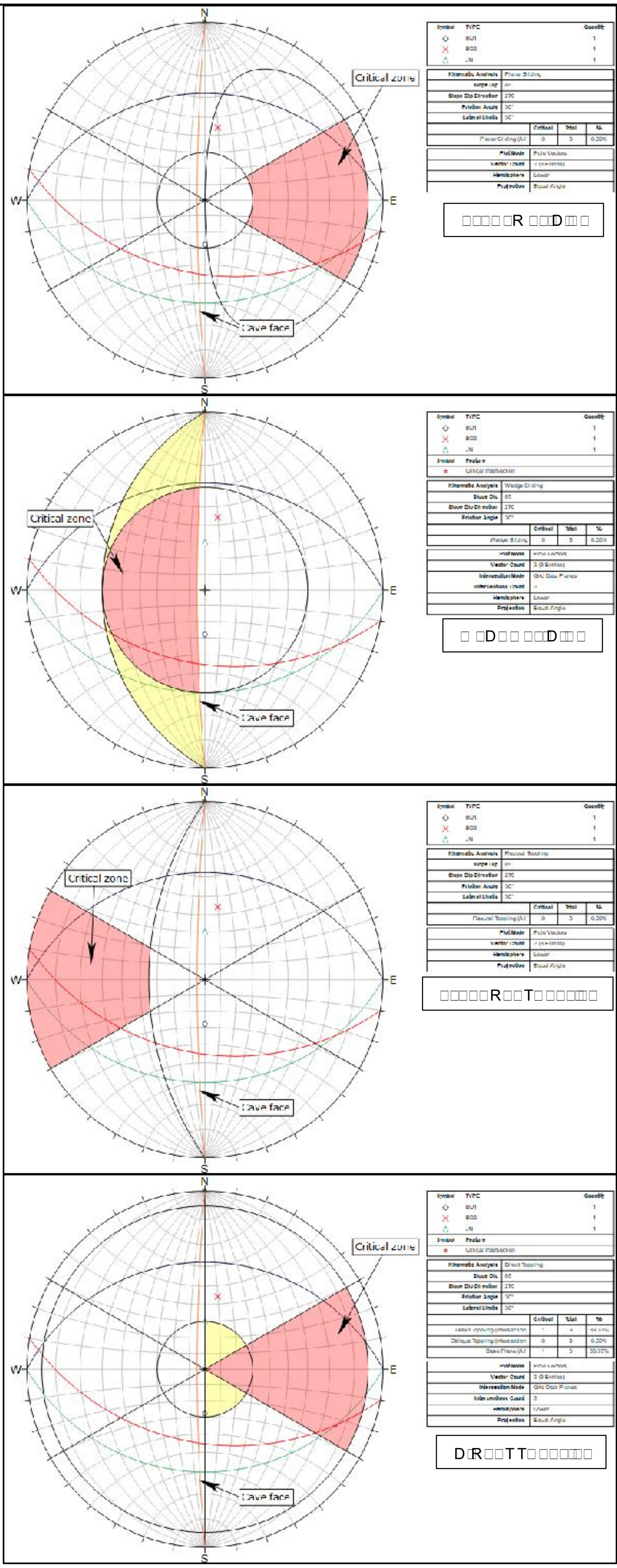

N
S
W
E
Critical zone
Cave face
Symbol
TYPE
Quantity
BD1
BD2
JN
Kinematic Analysis
Planar Sliding
Wedge Sliding
Flexural Toppling
Direct Toppling

Figure 3:

Table 3: [illegible]

Type of failure	Degree of potential risk
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

3.0 Geotechnical Sensitivity Rating

[illegible] **CWAN-06** [illegible] **Low** [illegible] and sidewalls constituting a minor change to the site's visual appearance without [illegible]

RTIO Mine Technical Services – Geotechnical Engineering
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Geotechnical Assessment: Environmental Site CWAN-07

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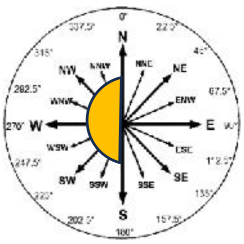
1.0 Site Assessment Details

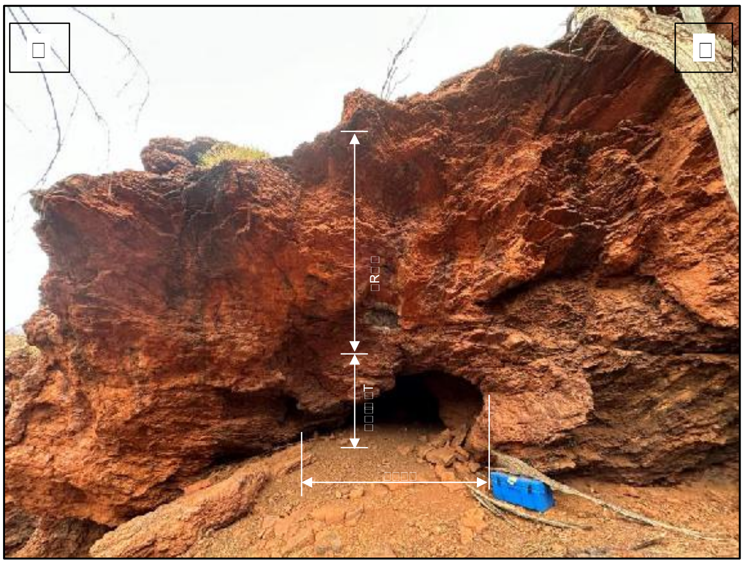
Mining Operation:	[illegible]
Deposit:	[illegible]
Site ID:	[illegible]
Site Type:	[illegible]
Site Coordinates:	[illegible]
Personnel:	[illegible]
Date of assessment:	[illegible]

2.0 Site Description

[illegible] **CWAN-07** [illegible]

Span	[illegible]
Depth	[illegible]
Height	[illegible]
Brow	[illegible]
Facing	[illegible]





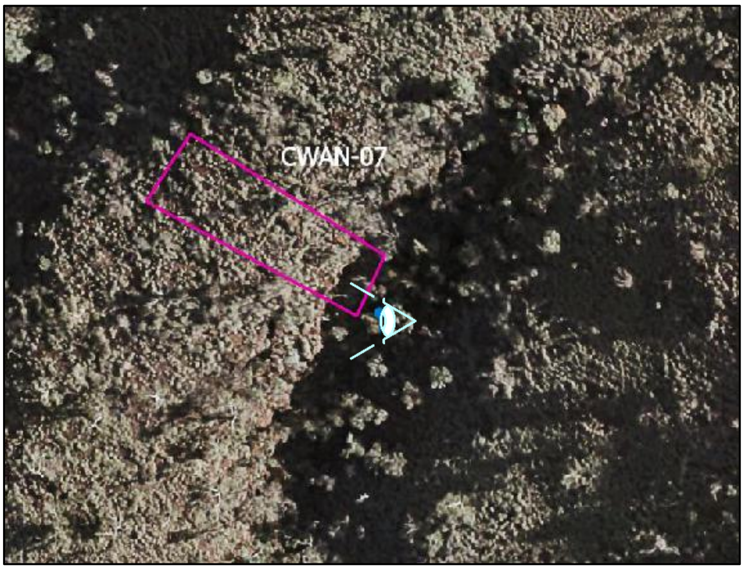


Figure 1: [illegible]

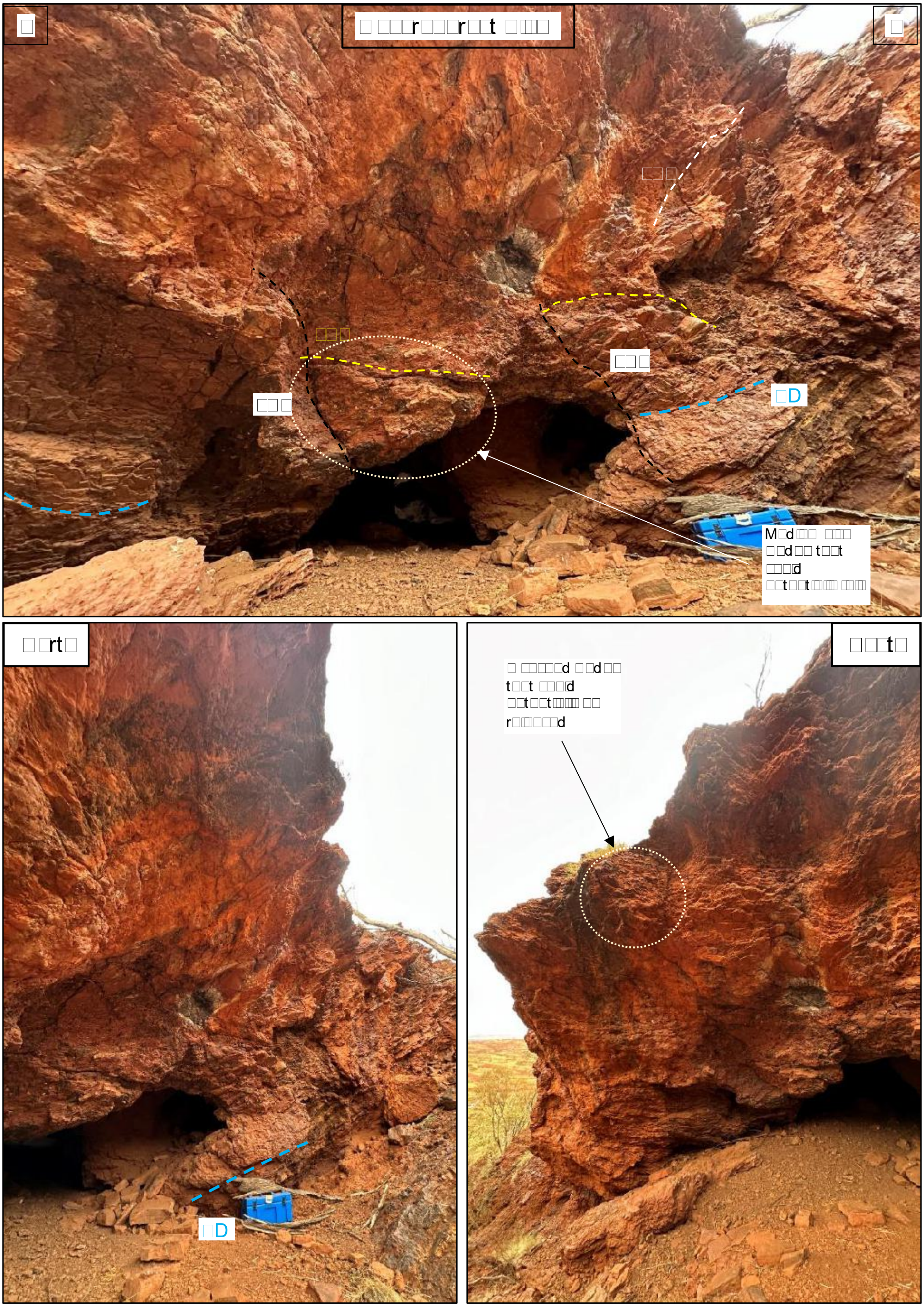


Figure 2:

[illegible]

Table 1: [illegible]

Set ID	Type	Count	Spacing	Aperture	Length	Dip	Dip dir.	Roughness	Alteration	Infill type	Weather.
[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

[illegible] mass present in the cave. Considering a “Very Blocky” rock mass structure and “Fair” surface conditions, the [illegible]

Table 2: [illegible]

Site ID:	CWAN-07	
[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]
	[illegible]	[illegible]

[illegible]

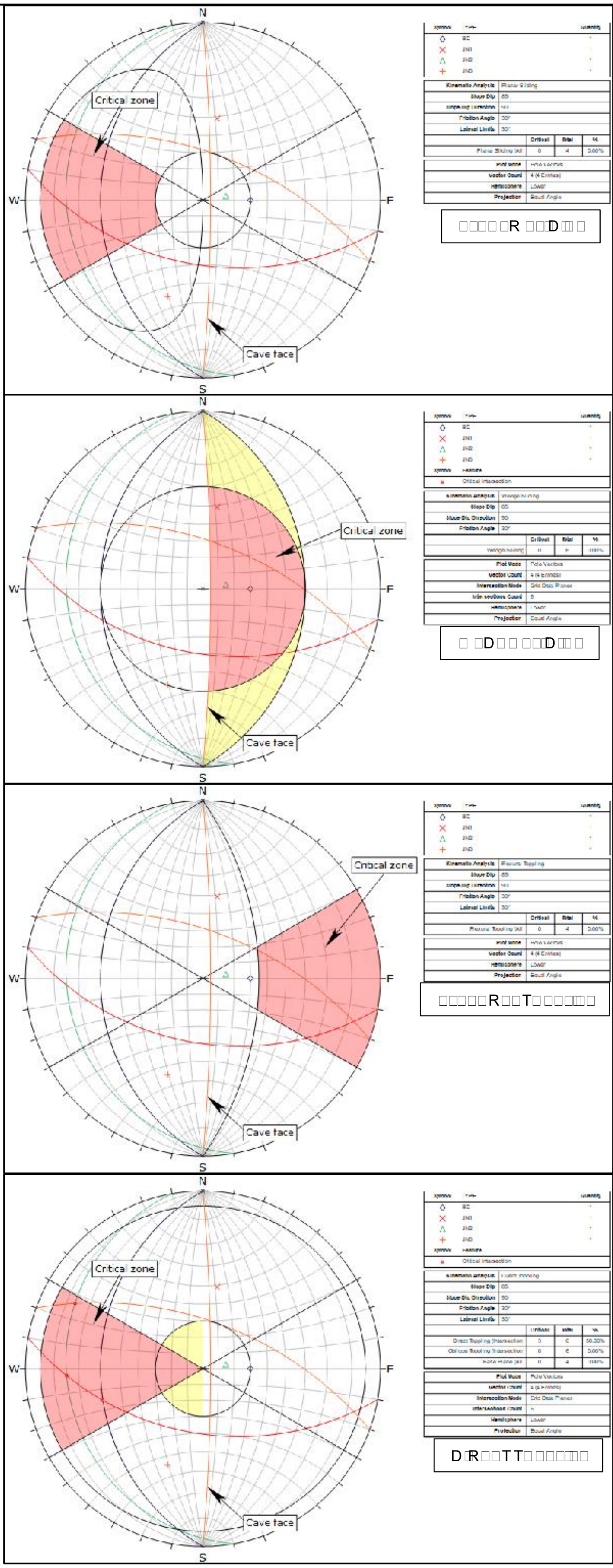


Figure 3: [illegible]

Table 3: [illegible]

Type of failure	Degree of potential risk
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
D[illegible] T[illegible]	[illegible]

[illegible]

3.0 Geotechnical Sensitivity Rating

[illegible] **CWAN-07** [illegible] **Moderate** [illegible]

Appendix D: Monitoring Methods

1. MEZ 1A, MEZ 1B and MEZ 2 Ghost Bat Cave Monitoring

a) Blast vibration modelling and monitoring

All blasting within 350 m of caves within MEZ 1A, MEZ 1B and MEZ 2 shall use an approved blast vibration model to ensure blast vibration impacts are adequately considered and controlled. Vibration will be predicted using a 'scaled distance' blast vibration model and the probability of a vibration limit exceedance calculated. This calculation will be made by a blast or geotechnical expert and will follow externally published and peer reviewed methodology which leverages the individual blast vibration model and blast specific parameters to calculate the probability exceedance. Blasts shall not proceed where predicted blast vibration exceeds criteria to ensure that the caves are protected from significant damage (damage that negatively impacts the integrity of the cave such that future ghost bat use of the site is prevented) (Rio Tinto 2025).

Blast vibration monitoring is an integral part of ensuring compliance to the Ghost Bat Management Plan. Vibration monitoring is conducted for all operational blasts within 350 m of MEZ 1A, MEZ 1B and MEZ 2 caves. Vibration monitors will be installed prior to any operational blasting activity commencement. Factors that need to be considered when installing monitors are as follows:

- As close to the avoidance exclusion zone of the vibration sensitive protected site/s as practicable to ensure accuracy of results, unless otherwise agreed by relevant parties.
- The monitors can be safely installed and allow future suitable access for personnel.
- Orientation of the monitor aligned between pit & protected site.
- Where possible installed in the same geological strata that forms the vibration sensitive protected site/s.

Blast vibration monitoring will be reviewed after each blast and if blast vibration monitoring exceeds the vibration limit for the cave a detailed technical review of the model will be undertaken and blasting adjusted as required.

b) Photographs and Visual Assessment

A set of photographs of caves within MEZ 1A, MEZ 1B and MEZ 2 will be prepared as a point of reference for assessment and should be updated annually at a minimum to account for any naturally occurring changes in landscapes. Photographs where safe to do so. These are either recorded manually or using an Unmanned Aerial Vehicle (UAV) (drone), where possible to do so safely. These are to be reviewed if an exceedance occurs of a vibration\overpressure recorded of ≥120% of cave limit. Vibration limits are conservative and take into account a factor of safety, therefore exceedances of >120% of the limit are considered significant. If an exceedance of >100% but <120% of the limit occurs, the model will be reviewed and a review of factors contributing to the exceedance will be undertaken.

Where possible fixed vibration monitoring points with autonomous monitoring will be used with the option to take photographs before and after each recorded blast vibration event. If only portable monitors are used, manual recording of photographs or uncrewed aerial vehicle (UAV) footage to obtain adequately detailed photos must be considered wherever possible to do so safely.

All efforts should be taken to ensure that manual & UAV photographs are taken from the same perspective with as much of the internal structure of protected site visible as practically possible. Where possible time of day when photos are captured should remain consistent to reduce variation in angle and shadows, for ease of image comparison.

c) Noise

Background

There has been limited research on noise and vibration impacts to ghost bats, and of those that have been undertaken, some limitations have been identified. Additionally, caves (and bats potentially roosting within them) are likely to differ in their relative sensitivities to noise and vibration based on (but not limited to); geology (e.g. robustness, and weathering), internal structure (chambers, constrictions), and reproductive season (sensitivity whilst breeding or pregnant vs. outside reproductive season). Further research and adaptive monitoring on these secondary impacts will aid in addressing this knowledge gap. This is proposed to be addressed through the development of a Noise and Vibration Management Approach (MS Condition B2-5).

DBCA noted in Appeals Convenor (2024) that at present, there is no empirical scientific data to determine an appropriate buffer to avoid impacts to ghost bats and their habitat from mining-related noise and vibrations. DBCA also recommended that a staged approach to blasting programs, with monitoring of the impacts after activities, would allow for the buffer to potentially be reduced (pending no evidence of impacts) over time and this has been applied to the West Angelas Revised Proposal (MS 1251 Condition B2-9).

Currently there is only one published trial (Bullen and Creese 2014) measuring noise and vibration levels at ghost bat caves. Additionally, there is currently no standardised location for where noise is measured i.e. at the entrance to the cave, or within the roost closer to the main chamber.

Methods and Analysis

Noise monitoring (device dependent) will be conducted at a select number of caves as identified in Table 2-5 (at the entrance) prior to mining activities being within 350 m to understand baseline noise and to learn more about noise in relation to ghost bats.

Noise monitoring at all critical (MEZ 1A and 1B) caves will be carried out except at CWAN-02 (category 3) as noise monitoring at CWAN-01 is considered representative. Both caves are category 3 in the same apartment block and cave CWAN-02 is located closer to the impact and is therefore likely to be subject to a higher noise potential. For non-critical (MEZ 2) caves, two impact and three reference caves have been selected for noise monitoring. Caves not selected for noise monitoring are either represented by noise monitoring at nearby similar caves (L2), are category 4 ghost bat caves (nocturnal roosts) (blasting occurs during day-light hours only at West Angelas), are greater than 350 m from blasting or have no history or use. Caves WA,09, WA-10, WA-11, WA-12, WA-17, WA-20 and WA-22 are greater than 1 km from the significant amendment are highly unlikely to be affected by significant amendment, therefore noise monitoring is not proposed.

Data is accessed remotely via a data management system which uses AI filtering to remove any natural noise (i.e. not mining specific). Data will be reviewed at least bi-annually.

d) Microclimate (Temperature and Humidity Monitoring)

Background

Permanent ghost bat roosts generally have stable temperatures between 23–28°C (TSSC 2016), based on the species' physiological preference for temperatures around 28°C (Baudinette et al. 2000). Relative humidity for ghost bat roosts ranges from 50–100% (Armstrong and Anstee 2000); however, the degree to which the species requires this is relatively unknown (Baudinette et al. 2000). Although the species may select roost sites based on humidity, the range of humidity levels recorded at sites used by the species varies widely thus, temperature is considered more important than humidity when assessing roost suitability (Armstrong and Anstee 2000).

Temperature and humidity data loggers are deployed within specified caves to assess the interior microclimate (temperate and relative humidity) and to determine whether any changes in microclimate has occurred within caves. A significant step change in the internal temperature and humidity (microclimate) may be an indication of changes to the structural integrity of a cave and its

ongoing stability. Data from ongoing monitoring at Rio Tinto sites indicates temperature and humidity naturally vary significantly therefore, a change in microclimate independent of a change in structural integrity (and vice versa) may not result in the cave being unsuitable for the species.

Methods and Analysis

Temperature and humidity will be monitored on a continuous basis (device dependent) and calibrated with ambient temperature and humidity, at caves specified in Table 2-5. A selection of caves will be monitored to understand the potential impact of microclimate on ghost bat presence when mining is further than 350 m away, however all MEZ 1A will be monitored once mining is within 350 m and all MEZ 1B caves monitored once mining is within 150 m, as committed to in this GBMP. Data is collected in the field at periodic intervals and reviewed annually.

Temperature and humidity (microclimate) monitoring is an indicator of structural integrity and will be carried out at all critical caves (MEZ 1A and 1B) caves and all non-critical (MEZ 2) category 3 caves where <350 m from proposed activities, and reference caves. Recently identified category 4 ghost bat overhangs will not be monitored (CWAN-30, CWAN-11, CWAN-34, CWAN-27, CWAN-28, CWAN-32 and CDHI-002) as they are at ambient temperature and humidity such that monitoring of these parameters is not relevant. Historically identified category 4 overhangs in this group have been historically monitored and will continue to be monitored, however the relevance of continued monitoring of temperature and humidity at category 4 caves may be reconsidered in the future. Caves CWAN-31 (cat 3), A2 and A3 are >350 m from blasting and risk of impact to the structural integrity of the cave is unlikely.

2. Ghost bat presence / absence monitoring

e) 6.1. Echolocation (Acoustic) Monitoring Program

Background

Echolocation monitoring will be undertaken to assess ongoing presence/absence from critical caves (or a selection of caves depending on access constraints). Activity level and number of bats present at roosts monitored in the Pilbara, varies in both a seasonal and year to year manner. Echolocation is suited for this purpose as the majority of bats consistently produce echolocation calls while flying and call structure is often species-specific, although it can exhibit plasticity depending on the environment (Hanrahan et al. 2024).

Echolocation monitoring is undertaken using Ultrasonic recorders (SM4) to record ghost bat calls to help classify and monitor presence and levels of ghost bat activity at monitoring locations. Ultrasonic recorders are typically located at known or expected diurnal roosts rather than foraging locations due to the short, steeply frequency-modulated and very low amplitudes of ghost bat calls, making acoustic detection away from the roost a challenge (Hanrahan et al. 2024). The detection of ghost bats with ultrasonic recorders away from cave entrances is less reliable, unless an approach based on an acoustic lure is used (e.g. refer to the new method described in recent papers by Hanrahan et al. 2024; Ruykys et al. 2024). To increase the effectiveness of ultrasonic recorders, microphones are located at constriction points and/or within roost chambers so that there is an increased probability of recording ghost bat calls and socialisations. Locating the microphone within the roost chamber also reduces the risk of weather exposure or fauna interactions that can impact equipment reliability.

Whilst ultrasonic recorders have challenges in picking up foraging ghost bats, it remains a reliable, well tested, low impact and integral method of long-term monitoring of roost usage.

The total number of calls, the time of the first and last call and indications of diurnal roosting are recorded and summarised for each month. Because any individual is likely to emit multiple calls at any site during any night, the total number of calls is treated as a measure of ‘activity’ (e.g. many overlapping calls indicates multiple bats and signifies relative abundance), rather than providing a total number of individuals present.

Methods and Analysis

The caves equipped with echolocation monitoring (acoustic, SM4) for this EMP are detailed in Table 2-5. Due to some caves being located within an apartment block, or further away from mining operations, limited availability of subject matter experts for undertaking this work and the associated data review and analysis, not all non-critical caves will be monitored individually.

Caves may have heritage considerations or restrictions that prevent monitoring from occurring. Where appropriate, additional regional roosts from Rio Tinto sites may be referenced to provide context. Data will be collected bi-annually, analysed by a suitably qualified consultant (or digitally by AI with tested parameters advised by experts) and reported annually, or as required by trigger events.

f) Scats – Deposition and Genetic Analysis

Background

The rate of scat deposition from ghost bats within a cave is a method of monitoring presence of ghost bat and usage of a roost over a long period of time.

It can be calculated by installing drop sheets on the cave floor below the section of cave ceiling considered most likely to support roosting prior to the maternity period. All parts of the cave floor where scats have previously been deposited are covered ensuring that any new scats deposited in the cave are deposited onto the sheets and easily identified. During each subsequent visit, the

number of scats collected on the sheets are counted, and the sheets cleared of scats in preparation for any later visits. The total number of new scats is divided by the number of nights between visits to calculate the scat deposition rate. The analysis of scat deposition can indicate consistent use of a cave (regular deposition) and changes in usage (significant changes in the deposition of scat).

This method provides for good information that can be considered along with other information from other methods to understand viability for ghost bat species. However this method requires multiple human entries to roosts and is high cost and safety, cultural sensitivities and ethics need to be considered to ensure that bats are not disturbed through the application of this monitoring method. For this reason scat monitoring programs that are undertaken in this way are not proposed to be undertaken every year or in every roost to minimise the potential impacts to bats from the monitoring methods.

The scats of ghost bats can be analysed for genetic markers that can identify individuals (genetic analysis), and hormone analysis to identify elevated progesterone levels in females (a sign of pregnancy/breeding). A key aspect in understanding the demography of a local population of wild living highly mobile animals is to be able to repeatedly identify individuals. Multi-temporal analysis of samples can also be used to infer population dynamics and survival (Oyler-McCance et al. 2018) and is referred to as genetic mark-recapture. The sex of individuals can also be identified from genotyping of scats which provides information on the abundance of males and females (sex ratio) in a colony and/or local population for a given time. Undertaking genetic analysis can have lengthy timeframes due to the limited number of experts in this field.

When genetic analysis is undertaken over multiple years (i.e. multi-temporal sampling), the following demographics can be determined: longevity/lifespan of the species in the wild, home ranges, local population size, connectivity between roosts, and emigration/immigration of individuals. When undertaken at a regional scale, genetic analysis of scats can estimate effective genetic population size and reveal regional geneflow and movement.

Scat analysis is a valuable tool to monitor the population that echolocation/acoustic monitoring alone cannot provide but is not suited for giving finer-scale data e.g. nightly roost usage. Another limitation of scat analysis is the time the analysis takes to determine the individual genotypes and hormone analysis - six months minimum. Scat analysis is therefore not considered ideal in the development of the early warning criteria in Environmental Management Plans.

Methods and Analysis

Monitoring of scats is not required at all caves within the development envelope to inform the population assessment for ghost bats. Scat monitoring of a subset of caves can provide sufficient information to inform the population assessment. All category 2 ghost bat critical caves have been selected for scat where possible. Category 3 ghost bat critical caves are not proposed to be monitored for scats as there is less usage of these caves and more valuable information can be achieved by monitoring category 2 ghost bat caves whilst minimising disturbance to ghost bats through cave entry. Cave WA-21 has been monitored for 7 years, with data available up until 2023, and has not shown signs of usage historically. Scat collection caves are flexible and will be identified on an annual basis, with the most recent data used to inform which caves will be assessed for scats based each year. Table 2-5 indicates selected caves based on currently knowledge and the minimum number of caves to be assessed, this is subject to change as new knowledge is available.

Drop sheets will be deployed annually at selected caves to be collected by September to capture peak progesterone levels prior to cave access restrictions in the maternity season. Scat counts will be undertaken by a suitable qualified consultant, with genetic analysis undertaken by DBCA or other suitable consultant or expert. Analysis will be undertaken to determine viability of the ghost bat population as well as estimates of resident and transient members. Timeframes for results from scat programs ranges from 1-3 years depending on safe and culturally acceptable access to caves, availability of technical experts in the field and in genetic analysis.

3. Feral Cats

g) Feral Cat Monitoring and Control

Feral Cat camera arrays have been designed to detect feral cat presence near MEZ 1A and MEZ 1B caves. This involves a camera set up at the entrance of each critical cave approximately 40 cm off the ground (Comer et al., 2020; Lohr et al., 2021; Palmer et al., 2021). Cameras will be passive and at a 45-degree angle to the cave, focusing on the entrances to ghost bat critical caves (MEZ 1A and MEZ 1B). Camera data will be downloaded and reviewed at regular intervals, at least bi-annually.

Cat control will be undertaken utilising traditional trapping methods, or transitioning to Felixer units or similar available technology once appropriate licencing/procurement has been finalised. Availability of Felixers or other available technology, approval to use them, testing and suitability will be investigated prior to installing units for use and will inform the strategy for use. Ongoing research and investigation into other technologies will be carried out as appropriate.

4. Viability of ghost bat population

The assessment will review all monitoring information (from echolocation, scat, and observation datasets) to evaluate whether ghost bats are persisting within the development area, using a methodology similar to Stantec (2025). The Proponent utilises appropriately qualified bat experts to undertake the analysis of collected data and information for ghost bats.

However, several limitations in current monitoring methods need to be acknowledged. These limitations relate to the difficulties with monitoring a cryptic species in an arid environment, where the majority of monitoring occurs in rocky habitat or in cave structures. In addition some ghost bat caves are also culturally important sites that have additional cultural access requirements or restrictions. The Proponent continues to work with internal and external bat experts to further develop monitoring methods for ghost bats.

Regardless of the limitations, the Proponent is undertaking monitoring that provides for multiple streams of data to allow for bat experts to assess viability in accordance with ministerial conditions.

Limitations of Current Monitoring Methods

- **Direct observations**
  Counting bats visually is unreliable because not all individuals in a cave can be seen. This means the observed count often underestimates the true population.
- **Echolocation monitoring**
  ghost bats can navigate without making detectable echolocation calls, and calls cannot be linked to specific individuals. This also results in underestimates.

Genetic Scat Analysis

- **What it can do**
  Scat DNA can identify individuals, detect movements between roosts, and estimate **genetic effective population size (Ne)**.
  - *Ne* reflects how many bats are effectively breeding and maintaining genetic diversity.
  - Lower *Ne* = higher risk of inbreeding and reduced genetic resilience.
- **Limitations of Ne**
  - Ne is usually smaller than the actual number of adult bats (census population, *Nc*).
  - Ghost bat populations are not closed — movement between sites and long-distance gene flow (>250 km) influence estimates.
  - Sampling mixed-age bats with overlapping generations can make Ne appear artificially low.

- **Why Ne is still useful**
  Even with these limitations, DBCA and researchers use Ne at a local scale because:
  - It can track **changes over time**,
  - All samples collected in a similar way will share the same bias,
  - Trends (increasing or decreasing Ne) are still meaningful.

Relationship Between Ne and Nc

- *Nc* is ideally the number of adult, breeding bats — usually obtained from direct counts.
- Because direct counts are difficult, researchers often estimate *Nc* from *Ne*.
- A common assumption is Ne ≈ 10% of Nc — but for ghost bats, this ratio is **not yet proven** and may not be accurate.
- Estimating *Nc* from *Ne* is more appropriate at the whole-Pilbara scale rather than for individual project areas.

Advances in Genetic Methods

- Two DNA methods exist:
  1. **Microsatellite markers** — older method, prone to errors unless labour-intensive correction is applied.
  2. **SNP markers** — newer technology, more accurate, lower error, easier to compare between labs.
- The development of **Pilbara-specific SNP markers** has improved confidence in identifying individual ghost bats and improves overall reliability of population analyses.

Appendix E: Table E:1 Summary of proposed cave monitoring and rationale

Cave type, impact/reference	Cave (category)	MEZ	Distance to operations (approx.) [m]	Disturbance Limit [m]	Construction and operations					Construction, operations, closure and 24 months post closure		
					Geotechnical sensitivity assessment (if blasting < 350 m)	Structural Integrity monitoring (Temp / humidity)	Noise monitoring	Vibration monitoring (during blasting)	Visual Inspection	Feral cat camera monitoring	Acoustic monitoring	Indicative Scats[11] (includes genetic analysis)
Critical Caves												
Impact	CWAN-04 (2)	MEZ 1A	160	150	Y	Y	Y	<350m	<350m	Y	Y	N (ENR)
Impact	CWAN-07 (2)	MEZ 1A	150	150	Y	Y	Y	<350m	<350m	Y	Y	Y
Impact	AA1 (2)	MEZ 1B	145^	100	Y	Y	N	<350m	<350m	Y	Y	Y
Impact	WA-13 (2)	MEZ 1B	>300	100	Y	Y	N	<350m	<350m	Y	Y	Y
Impact	WA-23 (2)	MEZ 1B	>300	100	Y	Y	N	<350m	<350m	Y	Y	N (ENR)
Impact	CWAN-01 (3)	MEZ 1A	150	150	Y	Y	Y	<350m	<350m	Y	Y	N (rep Cat 2s)
Impact	CWAN-02 (3)	MEZ 1A	170	150	Y	Y	N (rep CWAN-04)	<350m	<350m	Y	Y	N (rep Cat 2s)
Impact	CWAN-03 (3)	MEZ 1A	175	150	Y	Y	Y	<350m	<350m	Y	Y	N (rep Cat 2s)
Impact	CWAN-06 (2)	MEZ 1A	150	150	Y	Y	Y	<350m	<350m	Y	Y	Y
Impact	WA-21 (2)	MEZ 1B	250^	100	Y	Y	N	<350m	<350m	Y	Y	N (NHU)
Non critical Caves												
Impact	CWAN-30 (4)	MEZ 2	105	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	CWAN-29 (3)	MEZ 2	70	75	Y	Y	Y	<350m	<350m	N	Y	Y
Impact	CWAN-31 (3)	MEZ 2	100	75	Y	N (Blasting >350m)	N (rep Cat 2s)	<350m	<350m	N	N (no calls)	N (rep Cat 2s)
Impact	A1 (3)	MEZ 2	120^	75	Y	Y	N (Blasting >350m)	<350m	<350m	N	Y	N (ENR)
Impact	A2 (3)	MEZ 2	230^	26	Y	Y	N (Blasting >350m)	<350m	<350m	N	Y	N (ENR)
Impact	CDHI-001 (4)	MEZ 2	110^	20	Y	Y	N (Cat 4)	<350m	<350m	N	Y	N (Cat 4)
Impact	L2 (3)	MEZ 2	25^	75	Y	Y	N (rep L3)	<350m	<350m	N	Y	N (rep L3)
Impact	L3 (3)	MEZ 2	20^	75	Y	Y	Y	<350m	<350m	N	Y	Y
Impact	WA-09 (4)	MEZ 2	27^	20	Y	Y	N (Cat 4)	<350m	<350m	N	Y	N (Cat 4)
Impact	WA-10 (4)	MEZ 2	25^	20	Y	Y	N (Cat 4)	<350m	<350m	N	Y	N (Cat 4)
Impact	WA-11 (4)	MEZ 2	160^	20	Y	Y	N (Cat 4)	<350m	<350m	N	Y	N (Cat 4)
Impact	WA-12 (3)	MEZ 2	340	75	Y	N (NHU)	N (NHU)	<350m	<350m	N	N (NHU)	N (NHU)
Impact	WA-17 (3)	MEZ 2	115^	75	Y	N (NHU)	N (ENR, NHU)	<350m	<350m	N	N (NHU)	N (ENR, NHU)
Impact	WA-20 (3)	MEZ 2	180	75	Y	Y	N (Blasting >350m)	<350m	<350m	N	Y	N (NHU)
Impact	WA-22 (3)	MEZ 2	>300	75	Y	Y	N (Blasting >350m)	<350m	<350m	N	Y	N (NHU)
Impact	CWAN-11 (4)	MEZ 2	60^	20	Y	N (Cat 4)	Y	<350m	<350m	N	Y	N (Cat 4)
Impact	CWAN-08 (4)	MEZ 2	90	20	Y	Y (IR)	Y	<350m	<350m	N	Y	Y
Impact	CWAN-34 (4)	MEZ 2	100	20	Y	N (Cat 4)	Y	<350m	<350m	N	Y	N (Cat 4)
Impact	CWAN-27 (4)	MEZ 2	70	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	CWAN-28 (4)	MEZ 2	60	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	CWAN-32 (4)	MEZ 2	155	20	Y	N (Cat 4)	N (rep Cat 2s)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	CDHI-002 (4)	MEZ 2	25	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	CMAR-02 (4)	MEZ 2	>350	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	CMAR-03 (4)	MEZ 2	>350	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	CMAR-04 (4)	MEZ 2	>350	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)
Impact	L1 (4)	MEZ 2	>350^	20	Y	N (Cat 4)	N (Cat 4)	<350m	<350m	N	N (Cat 4)	N (Cat 4)

[11] Subject to safe cave entry as per RTIO procedures. Whilst caves may have been historically classified as not recommended for entry, ongoing assessment will be carried out to determine if safe entry can be achieved in the future.

Cave type, impact/reference	Cave (category)	MEZ	Distance to operations (approx.) [m]	Disturbance Limit [m]	Construction and operations					Construction, operations, closure and 24 months post closure		
					Geotechnical sensitivity assessment (if blasting < 350 m)	Structural Integrity monitoring (Temp / humidity)	Noise monitoring	Vibration monitoring (during blasting)	Visual Inspection	Feral cat camera monitoring	Acoustic monitoring	Indicative Scats[11] (includes genetic analysis)
Reference Caves												
Reference	CWAN-10 (3)	NA	>300	Outside DE	Y	Y	Y	<350m	<350m	N	Y	Y
Reference	CMEE-05 (2)	NA	>300	Outside DE	Y	Y	Y	<350m	<350m	N	Y	Y
Reference	CMAR-01 (3)	MEZ 2	>300	75	Y	Y	Y	<350m	<350m	N	Y	Y

Table E:2 Glossary for Table E:1

Term	Meaning
N (ENR)	Entry Not Recommended based on geotechnical assessment.
N (rep CWAN-04)	Monitoring is not proposed as a nearby similar cave is being monitored for the parameter and is considered representative
N (NHU)	Monitoring is not proposed as there is no or very limited historic use (NHU) of the cave by ghost bats and resources are better used targeting active caves
N (Cat 4)	Monitoring is not proposed as the cave is Category 4 for ghost bat and monitoring is not effective as bats are less likely to be present and caves are not maternity caves
N (Blasting >350m)	Monitoring is not proposed as blasting is greater than 350 m from the cave and monitoring is not required
Y	Monitoring is proposed
Y (IR)	Information Required. Monitoring is proposed in this cave where it may not be for other caves of the same category. Further information is sought for this specific cave and informs understanding in reference caves
N (no calls)	Acoustic monitoring is not proposed as there is no history of calls recorded at this cave and resources are better used elsewhere, targeting caves that indicate or have previously recorded ghost bat usage
<350m	If blasting is <350 m from cave
^	Distance is from existing disturbance and proposed future disturbance is at a greater distance
N – Feral Cat Monitoring, not required by conditions	To be determined: Feral cat monitoring is required at critical caves only; condition B2-7 (4) and all critical caves are proposed to be monitored as shown in Table 2-5. Results of feral cat monitoring and outcomes of feral cat control will be reviewed and monitoring may be expanded to non-critical caves (MEZ 2) in the future.