



Environmental Review Document

West Angelas Revised Proposal

Robe River Mining Co. Pty. Ltd.

Assessment Number: 2290

December 2023

Robe River Mining Co. Pty. Ltd.

152-158 St Georges Terrace, Perth WA 6000

GPO Box A42, Perth WA 6837

RTIO-0997696

Disclaimer and Limitation

This report has been prepared by Rio Tinto's Iron Ore Group (Rio Tinto) on behalf of Robe River Mining Co. Pty. Ltd. (the Proponent), specifically for the West Angelas significant amendment. Neither the report nor its contents may be referred to without the express approval of Rio Tinto unless the report has been released for referral and assessment.

Document Status						
Rev	Author	Reviewer/s	Date	Approved for Issue		
				To Whom	GM Signature	Date
v1	ELA	E. Mason/SME/ M. Brand	March 2023	YAC NAC		13/03/2023
v2	ELA	E. Mason/ M. Brand	May 2023	EPAS		13/03/2023
v3	Rio Tinto	E. Mason/ C. Baxter	August 2023	EPAS		24/08/2023
v4	Rio Tinto	E. Mason/ C. Baxter/ SME	November 2023	EPAS		30/11/2023
Final	Rio Tinto	E. Mason/C. Ellis	December 2023	EPAS		14/12/2023

Invitation to make a submission

1) The Environmental Protection Authority (EPA) invites people to make a submission on the environmental review for this Proposal.

Robe River Mining Co. Pty. Ltd. (the Proponent) proposes extending the existing West Angelas Iron Ore Mine, including developing new above and below water table pits and associated infrastructure to sustain the existing operations (the Proposal). The Proposal is located approximately 100 km northwest of the town of Newman in the East Pilbara region of Western Australia. The Proposal will require clearing up to 5,350 ha of native vegetation. It will require groundwater abstraction for dewatering, water supply to support the development of new mining areas, and associated infrastructure.

The existing operations at West Angelas are approved under Ministerial Statement 1113 (MS 1113) issued under Part IV of the *Environmental Protection Act 1986* (EP Act) (WA), and EPBC approval decision 2018/8299 issued under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) (Cth).

This ERD has been prepared in accordance with the EPA's *Procedures Manual (Part IV Divisions 1 and 2)*. The ERD is the report by the Proponent on their environmental review describing the Proposal and its likely effects on the environment.

This ERD is available for a public review period of 8 weeks from Monday 8th January 2024, closing on Wednesday 6th March 2024.

Information on the Proposal from the public may assist the EPA in preparing its assessment report in which it will make recommendations on the Proposal to the Minister for Environment.

Why write a submission?

2) The EPA seeks information that will inform its consideration of the likely effects of the Proposal, if implemented, on the environment. This may include relevant new information that is not in the ERD, such as alternative courses of action or approaches.

In preparing its assessment report for the Minister for Environment, the EPA will consider the information in submissions, the Proponent's responses and other relevant information.

Submissions will be treated as public documents unless provided and received in confidence, subject to the requirements of the *Freedom of Information Act 1992*.

Why not join a group?

3) It may be worthwhile joining a group or other groups interested in making a submission on similar issues. Joint submissions may help to reduce the workload for an individual or group. If you form a small group (up to 10 people), please indicate the names of all participants. If your group is larger, please indicate how many people your submission represents.

Developing a submission

You may agree or disagree with, or comment on, information in the ERD.

- When making comments on specific elements of the ERD:
 - Clearly state your point of view and give reasons for your conclusions
 - Reference the source of your information, where applicable
 - Suggest alternatives to improve environmental outcomes.

What to include in your submission

Include the following in your submission to make it easier for the EPA to consider your submission:

- Your name and address
- Date of your submission
- Whether you want your contact details to be confidential
- Summary of your submission, if it is long
- A list of points so that issues raised are clear, preferably by environmental factor
- Refer each point to the page, section and if possible, paragraph of the ERD
- Attach any reference material, if applicable. Make sure your information is accurate.
-

The closing date for public submissions is: 4 March 2024.

The EPA prefers submissions to be made electronically via the EPA's Consultation Hub at <https://consultation.epa.wa.gov.au>.

Alternatively, submissions can be:

- Posted to: Chairman, Environmental Protection Authority, Locked Bag 10, Joondalup DC WA 6919; or
- Delivered to: Environmental Protection Authority, Prime House, 8 Davidson Terrace, Joondalup WA 6027.

If you have any questions on how to make a submission, please contact EPA Services at the Department of Water and Environmental Regulation on (08) 6364 7000.

SCOPING CHECKLIST

Section 40AA Considerations (June 2023 guidance)

As the Proposal is a significant amendment to Ministerial Statement 1113, the ERD includes the following required information:

Required Work	Section and Page No.
Section 40AA requirements	
The approved proposal, such that the environmental impacts may be considered in the context with the significant amendment.	Section 2.1.1, pg 5
The combined effects that implementation of the significant amendment with the approved proposal might have on the environment.	Section 7.6.1.3, pg 276 Section 7.6.3, pg 278 Section 8.4.1.1, pg 337 Section 8.5.2, pg 355 Section 9.4.2, pg 456 Section 9.6.1, pg 482 Section 10.2.1, pg 503 Section 10.4, pg 543 Section 10.6, pg 550 Section 11.4.1, pg 582 Section 11.7, pg 594 Section 13.4.1, pg 675
The existing implementation conditions and whether the Proponent considers these should be inquired into or proposes amendments.	Appendix A.8: Environmental Management Plan, pg 797
Consideration of existing implementation conditions are adequate to ensure the Proposal's ongoing elements are consistent with the EPA's environmental objectives.	Appendix A.8: Environmental Management Plan, pg 797
Consideration of whether outcome conditions and associated monitoring can replace existing management plan conditions	Appendix A.8: Environmental Management Plan, pg 797
Where existing management plan conditions are proposed to continue, include updated plans to address combined impacts and to ensure amended proposal meets current EPA objectives.	Appendix A.8: Environmental Management Plan, pg 797 Appendix A.9: Groundwater Environmental Management Plan, pg 797
Consideration of Section 3.2.1 of the Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual	Throughout draft ERD

Scoping Checklist (2021 guidance)

Required Work	Section and Page No.
Are all of the preliminary environmental factors identified in the record of the level of assessment required by the Chair's determination included in the ERD?	Section 6, pg 66 Section 7, pg 211 Section 8, pg 282 Section 9, pg 377 Section 10, pg 502 Section 11, pg 579
Have potential impacts on MNES under the relevant preliminary environmental factor included in the ERD?	Section 9, pg 377 Section 13, pg 637
Have specific technical studies and investigations been undertaken for each environmental factor, as required?	Section 6.3.2, pg 76 Section 7.3.1, pg 213 Section 8.3.1, pg 283 Section 9.3.1, pg 378 Section 10.3.1, pg 503 Section 11.4.1, pg 582
Is all of the information from survey data in the required format, and interpreted as required by the most relevant Environmental factor guidelines at the time the ERD is published?	Section 6.3.2, pg 76 Section 7.3.1, pg 213 Section 8.3.1, pg 283 Section 9.3.1, pg 378 Section 10.3.1, pg 503 Section 11.4.1, pg 582
Have offsets been proposed/investigated or an Impact Reconciliation Procedure been prepared (for proposals within the Pilbara Interim Biogeographic Region)?	Section 12, pg 596 Appendix G.1: pg 799
Have environmental outcomes been proposed?	Section 6.13, pg 209 Section 7.7, pg 280 Section 8.7, pg 375 Section 9.7, pg 500 Section 10.7, pg 578 Section 11.7, pg 594
Is monitoring of environmental outcomes proposed consistent with the EPA's EMP Instructions?	Appendix A.8: Environmental Management Plan, pg 797
Have environmental management plans been prepared (where required by the ESD)? Has a justification been provided for inclusion of any objectives based environmental management plans?	Appendix A.8: Environmental Management Plan, pg 797
Have peer review of the scope, methodologies, findings and/or conclusions of surveys and investigations, and/or other specific additional information been provided?	Section 7.3.4.4, pg 230
Has stakeholder identification and consultation been undertaken?	Section 4.1, 55

ESD Additional Specific Work as specified in the ESD

Task No.	Required Work	Section and Page No.
Social Surroundings		
1.	Provide evidence of consultation with relevant stakeholders, demonstrate how issues raised through consultation have been addressed, and specify how the Proponent will minimise impacts to social surroundings values within the Development Envelope.	Section 4, pg 52 Section 6.3.2, pg 73 Appendix A.6
2.	Provide a detailed description and assessment of the potential impacts (direct, indirect and cumulative) to visitors to Karijini National Park.	Section 6.5.4, pg 158
3.	<p>Conduct and undertake meaningful investigations, consultation and engagement with relevant Traditional Owner groups to identify tangible and intangible cultural heritage values within and outside the Development Envelope that could be directly or indirectly impacted by the Proposal (to the extent that they are impacted upon by the physical or biological environment):</p> <ul style="list-style-type: none"> • Provide evidence of meaningful investigations, engagement and consultation undertaken with Traditional Owner groups such as survey reports and documented consultation outcomes • Provide details of the methodology used for the investigations and engagement, including (but not limited to) the timing, scope, activities undertaken and stakeholders involved, and a description of how the methodology adequately identifies tangible and intangible cultural heritage values for consideration in the assessment of impacts to social surroundings 	Section 6.3.2, pg 73 Appendix A.6
4.	Prepare a Social, Cultural and Heritage Management Plan for each Traditional Owner group, in consultation with each group, that describes the social, cultural and heritage values within the relevant Country and specifies how the Proponent will avoid (where possible) and minimise impacts to social, cultural and heritage values within and directly adjacent to the Development Envelope.	Appendix B.2.d and Appendix B.3.b
Inland Waters		
1.	Conduct peer review of hydrogeological modelling (undertaken to determine the EPA objective for Inland Waters, as it relates to groundwater, can be met) associated with additional deposits of the West Angelas Revised Proposal where below water table mining is proposed and at Western Hill Deposit due to the proximity to Karijini National Park	Section 7.3.4, pg 200
Terrestrial Fauna		
1.	Update the existing West Angelas Environmental Management Plan (EMP), in accordance with the requirements of <i>EPA Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans</i> (2020 or any subsequent revisions) that describes any proposed management and/or monitoring plans that will be implemented to ensure residual impacts (direct and indirect) are not greater than predicted as a result of the Significant Amendment.	Appendix A.8
2.	Where significant residual impacts to MNES remain and contributions to the Pilbara Environmental Offsets Fund are not proposed, include a discussion of the consideration of the <i>EPBC Act Environmental Offsets Policy</i> .	Section 12.6

Task No.	Required Work	Section and Page No.
Subterranean Fauna		
1.	Determine and quantify any significant residual impacts by applying the Residual Impact Significance Model in the WA Environmental Offsets Guidelines (2014, or any subsequent revisions) and include reference to the Commonwealth Offsets Assessment Guide for any MNES. Where significant residual impacts remain, propose an appropriate offsets package that is consistent with the WA Environmental Offsets Policy and Guidelines (or any subsequent revisions).	Table 12-3, pg 564
2.	If offsets are proposed for subterranean fauna, a thorough assessment of the outcome of the proposed offset will be provided which demonstrates that EPA's objective can be met.	N/A
Greenhouse Gas Emissions		
1.	<p>Prepare and implement a Greenhouse Gas Environmental Management Plan in accordance with the most recent 'final' published guidance which will demonstrate, but not limited to, the following:</p> <ul style="list-style-type: none"> a. The Proponents' contribution towards the State's aspiration of net zero emissions by 2050, in relation to Scope 1 and 2 GHG emissions as outlined in the State GHG Policy and Guideline b. The intended reduction in Scope 1 and 2 emissions, via interim targets c. That all reasonable and practicable measures have been applied to avoid, reduce and offset the Scope 1 and 2 emissions from the Proposal 	Appendix A.7
Environmental Offsets		
1.	Where offsets are proposed for any environmental factor, the content for offsets detailed in the ERD instructions will be provided, including sufficient evidence about whether and how an offset is likely to counter-balance a significant residual impact.	Section 12.5.1, pg 570
2.	<p>Where current offsets exist for the approved proposal, current offsets practice applies in accordance with relevance guidance including:</p> <ul style="list-style-type: none"> • Biodiversity factors: WA Environmental Offset Policy and the WA Environmental Offset Guidelines, and complete the WA Environmental Offsets template and the WA Residual Impacts Significance Model table template • Greenhouse has emissions factor: Government of Western Australia's Greenhouse gas emissions policy for major projects and EPA's Environmental Factor Guideline – Greenhouse Gas Emissions 	Section 12.2, pg 539
3.	<p>Where a contribution to the Pilbara Environmental Offsets Fund is proposed to offset significant residual impacts for any environmental factor, provide an impact reconciliation procedure prepared in accordance with Instructions on how to prepare <i>Environmental Protection Act 1986 Part IV</i> Impact Reconciliation Procedures and Impact Reconciliation Reports (2018, or any subsequent revisions) and the Template for <i>Environmental Protection Act 1986 Part IV</i> Reconciliation Procedures (2018, or any subsequent revisions).</p> <p>Where a contribution to the Pilbara Environmental Offsets Fund is not appropriate (i.e. its not related to native vegetation or fauna habitat that is not native vegetation) other appropriate offsets will be proposed with due consideration of the WA Environmental Offsets Policy and Guidelines (or any subsequent revisions).</p>	Appendix G.1

Cumulative Impact Assessment

Required Work	Section and Page No.
<p>For all preliminary environmental factors, a summary of the activities associated with the Proposal, boundaries (of the cumulative impact assessment) and environmental values that will be considered for the cumulative impact assessment will be provided in relation to each preliminary key environmental factor.</p>	<p>Section 6.7, pg 205 Section 7.7, pg 280 Section 8.7, pg 375 Section 9.7, pg 500 Section 10.7, pg 578 Section 11.7, pg 594</p>
<p>The ERD will include cumulative impact assessment to assess the following:</p>	
<ul style="list-style-type: none"> Inland waters: Assess and quantify cumulative impacts on ground and surface water from the Proposal 	<p>As far as possible within data limitations. Section 7.7, pg 280</p>
<ul style="list-style-type: none"> Flora and vegetation: Assess cumulative impacts of the implementation of the Proposal on identified environmental values including any significant vegetation types, listed ecological communities, potential groundwater dependent ecosystems, and Priority flora. Include a quantitative assessment of the cumulative impact of the Proposal on significant vegetation units, listed ecological communities, potential groundwater dependent ecosystems and Priority flora. Describe and assess cumulative impacts within local, regional and State contexts, as appropriate. 	<p>As far as possible within data limitations. Section 8.7, pg 375</p>
<ul style="list-style-type: none"> Terrestrial fauna: Assess and quantify the extent of direct and indirect cumulative impacts of implementation of the Proposal to fauna, including SRE and the following MNES species: Northern Quoll (<i>Dasyurus hallucatus</i>), Ghost Bat (<i>Macroderma gigas</i>), Pilbara Leaf-nosed Bat (<i>Rhinonicteris aurantia</i> [Pilbara Form]), Pilbara Olive Python (<i>Liasis olivaceus barroni</i>), Grey Falcon (<i>Falco hypoleucos</i>), Night Parrot (<i>Pezoporus occidentalis</i>) and Fork-tailed Swift (<i>Apus pacificus</i>). 	<p>As far as possible within data limitations. Section 9.7, pg 500</p>
<ul style="list-style-type: none"> Subterranean fauna: Describe and assess the extent of direct, indirect and cumulative impacts to subterranean fauna as a result of implementation of the Proposal, taking into consideration the significance of fauna and fauna habitat values. Quantify the extent of direct and indirect cumulative impacts, including where feasible, percentages of habitat types to be disturbed or otherwise impacted 	<p>As far as possible within data limitations. Section 10.7, pg 578</p>
<ul style="list-style-type: none"> Greenhouse Gas: the West Angelas Greenhouse Gas (GHG) Management Plan, required by condition 9 of Ministerial Statement 1113 (approval of the GHG Management Plan is pending), will be updated to include the Proposal subject to this assessment. The GHG Management Plan will provide context and, where relevant, information on the entire existing approved West Angelas operations and the Proposal subject to this assessment. The plan will also include updates of estimates of peak, annual average and total GHG emissions from existing approved West Angelas operations and the Proposal subject to this assessment 	<p>As far as possible within data limitations. Section 11.7, pg 594</p>
<ul style="list-style-type: none"> Social surroundings: Provide a detailed description and assessment of the potential direct and indirect cumulative impacts to social surroundings as a result of changes to the environment from the Proposal with specific consideration given to Traditional Owners, pastoralists and visitors to Karijini National Park and their activities on the land including areas adjacent to and surrounding the Proposal which have the potential to be impacted. 	<p>As far as possible within data limitations. Section 6.7, pg 205</p>

EXECUTIVE SUMMARY

The Proposal

Robe River Mining Co. Pty. Ltd. (the Proponent) proposes to extend the existing West Angelas Iron Ore Mine in the Pilbara region of Western Australia.

The Proposal includes a proposed consolidation and modernisation of the Ministerial Statements (MS) for the existing operations: MS 1113. Mining by the Proponent commenced around 1998, and this Proposal intends to utilise existing infrastructure within the Approved Proposal.

The Proposal has been referred for assessment under the (WA) *Environmental Protection Act 1986* (EP Act) through the Environmental Protection Authority (EPA), and the (Cth.) *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) through the Department of Climate Change, Energy, the Environment and Water (DCCEEW). This Environmental Review Document (ERD) has been prepared in accordance with EPA and DCCEEW guidance to report on the Proposal's potential environmental impacts and their mitigation. In accordance with the requirements of the EPA decision on the referral, it will be made available for public comment for a period of 8 weeks.

The Proposal is located approximately 100 km northwest of Newman in the East Pilbara region of Western Australia (WA). The Proposal is located within the Native Title Determination Areas of the Ngarlawangga People and the Yinhawangka People (Figure ES1). Extensive consultation with the Traditional Owners has resulted in substantial changes to the Proposal's design and improved social and environmental outcomes.

A general description of the Proposal is provided in Table ES1. Table ES2 describes the key proposal elements. The Proponent will request an amendment to the Proposal Content Document via s43A prior to the EPA's assessment of the Proposal to align the PCD with the Proposal as described and presented in this ERD.

Table ES1: General Proposal Content Description

Items	Details
Proposal Title	West Angelas Revised Proposal
Proponent Name	Robe River Mining Co Pty Limited
Short Description	<p>The Proposal is located approximately 130 km northwest of Newman in the East Pilbara region of Western Australia. The Proposal is located within Yinhawangka and Ngarlawangga Peoples Native Title Determination Areas. The Proposal includes the development of AWT and BWT iron ore deposits and associated infrastructure including:</p> <ul style="list-style-type: none"> • Development of above and below water table mine pits • Associated activities which may include as relevant, but are not limited to, the following: <ul style="list-style-type: none"> ○ Mineral waste management: including waste rock landforms (WRL), 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 (ANFO) storage and laydown areas ○ Linear infrastructure including heavy and light vehicle access roads, rail and associated infrastructure, conveyors, utilities corridors, pipelines and power (including sub-stations) and communications distribution networks ○ Infrastructure for surface water management including crossings, diversion drains, levees and culverts

Items	Details
	<ul style="list-style-type: none">○ Groundwater abstraction and utilisation, and associated infrastructure○ Dewatering to enable below water table mining and associated infrastructure (including bores and pipelines)○ Infrastructure for management and use of water from dewatering● Offices and accommodation villages● Renewable energy including renewable energy generation, energy storage and associated ancillary infrastructure

Table ES2: Proposal Elements that have the Potential to have a Significant Effect on the Environment

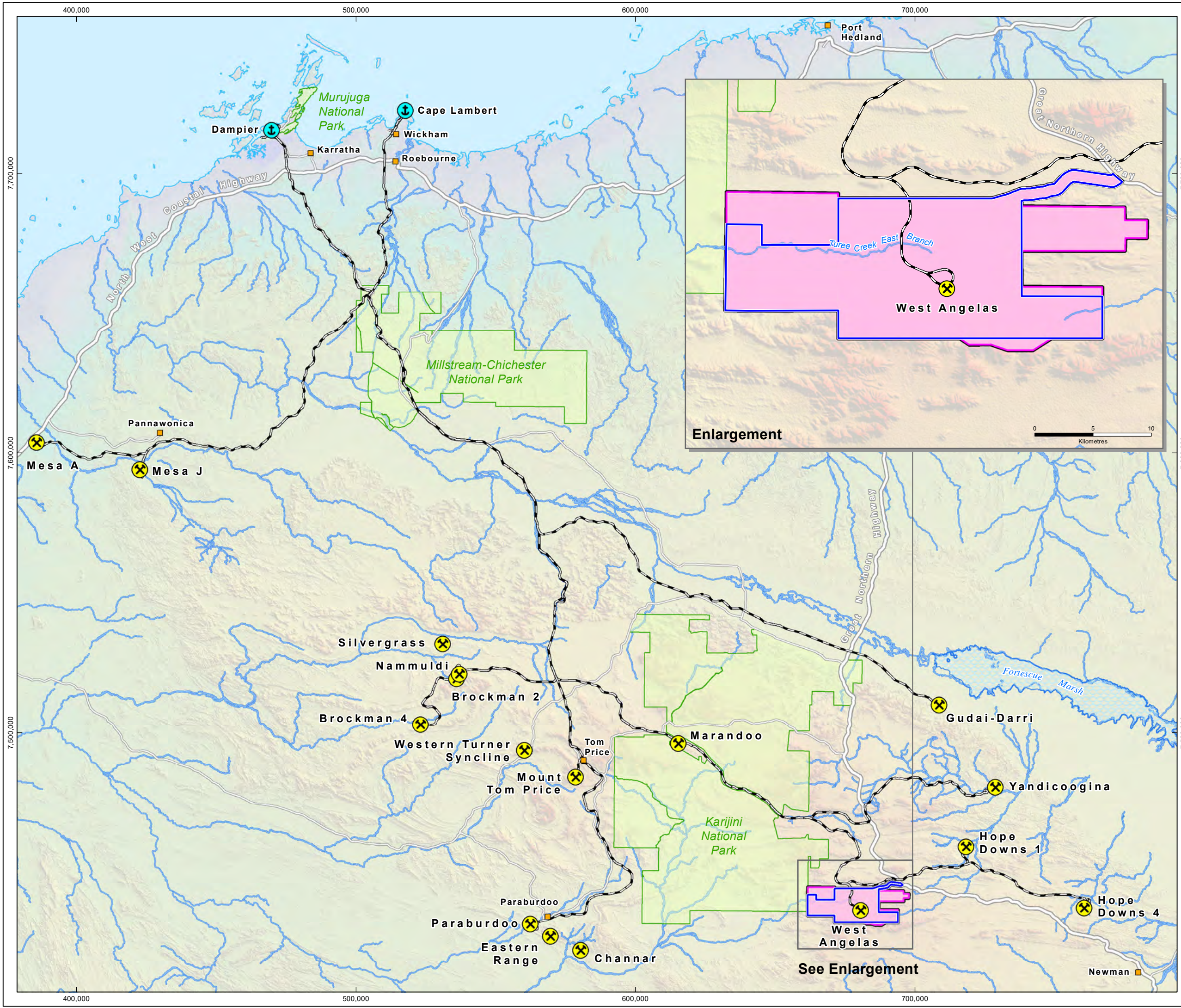
Element	Location	Approved Proposal Extent (MS 1113)	Proposal	Revised Proposal
Physical Elements				
Mine and associated infrastructure	Figure ES-2	<p>Clearing of no more than 12,205 ha within a 28,322 ha Mine Development Envelope including:</p> <ul style="list-style-type: none"> No clearing within Ghost Bat Cave AA1, WA-13, WA-21 and WA-23 Exclusion Zones No clearing within the West Angelas Cracking Clay Priority Ecological Community (PEC-2015-5) No more than 20 ha of clearing to other representations of the West Angelas Cracking Clay Priority Ecological Community No more than 25 ha of clearing of riparian vegetation No clearing of Hilltop, Hillslope, Ridge or Cliff habitat for the Managed Aquifer Recharge Scheme infrastructure No clearing of: <ul style="list-style-type: none"> Water features - WMAR-01 and WMAR-03 Caves - CMAR-02, CMAR-03 and CMAR-04 <p>Clearing of no more than 0.6 ha of Major Drainage habitat for the Managed Aquifer Recharge scheme infrastructure</p> <p>Below water table pits are to be backfilled to a level to prevent the formation of permanent pit lakes.</p>	<p>Clearing up to an additional 5,350 ha within a 36,779 ha Development Envelope:</p> <ul style="list-style-type: none"> No direct or significant indirect impacts to Deposit H Waterhole or Turtle Pool No more than 2 ha of other representations of West Angelas Cracking Clay Priority Ecological Community (Section 8) No more than 35 ha of clearing of riparian vegetation (Section 8) No direct disturbance to Ghost bat roosts listed in Table 9-21, (Section 9) 	<p>Clearing no more than 17,555 ha within a 36,779 ha Development Envelope, including:</p> <p>No clearing within Ghost Bat Cave AA1, WA-13, WA-21 and WA-23 Exclusion Zones</p> <p>No direct disturbance to Ghost bat roosts listed in Table 9-21, (Section 9)</p> <p>No clearing within the West Angelas Cracking Clay Priority Ecological Community (PEC-2015-5)</p> <p>No more than 22 ha of clearing to other representations of West Angelas Cracking Clay Priority Ecological Community</p> <p>No more than 60 ha of clearing of riparian vegetation</p> <p>No clearing of Hilltop, Hillslope, Ridge or Cliff habitat for the Managed Aquifer Recharge Scheme infrastructure</p> <p>No clearing of:</p> <ul style="list-style-type: none"> Water features - WMAR-01 and WMAR-03 Caves - CMAR-02, CMAR-03 and CMAR-04 Clearing of no more than 0.6 ha of Major Drainage habitat for the Managed Aquifer Recharge scheme infrastructure <p>No direct impacts to Deposit H Waterhole</p> <p>Below water table pits are to be backfilled to a level to prevent the formation of permanent pit lakes</p>

Element	Location	Approved Proposal Extent (MS 1113)	Proposal	Revised Proposal
Linear Infrastructure	Figure ES-2	<p>A 413 km rail network transports processed ore from West Angelas to port facilities located at Cape Lambert</p> <p>Clearing no more than 1,500 ha within a 19,400 ha Linear Infrastructure Development Envelope, including:</p> <ul style="list-style-type: none"> • Five existing sidings (Spoonbill, Bellbird, Rosella, Brockman Refuge and Emu) and potential additional sidings to support the rail network • Turee Creek B Borefield, pipeline, powerline, access roads and other associated infrastructure 	Not applicable	<p>No change</p> <p>A 413 km rail network transports processed ore from West Angelas to port facilities located at Cape Lambert</p> <p>Clearing no more than 1,500 ha within a 19,400 ha Linear Infrastructure Development Envelope, including:</p> <ul style="list-style-type: none"> • Five existing sidings (Spoonbill, Bellbird, Rosella, Brockman Refuge and Emu) and potential additional sidings to support the rail network • Turee Creek B Borefield, pipeline, powerline, access roads and other associated infrastructure
Operational Elements				
Surplus water management	NA	<p>Dewatering water will be used on-site in the first instance to supply water for operational purposes.</p> <p>Surplus dewatering water, exceeding the operational requirement, is discharged to a local ephemeral tributary of Turee Creek East.</p> <p>The surface discharge extent will not extend within 2 km of the boundary of Karijini National Park under natural no-flow conditions</p>	<p>Additions:</p> <p>Option for temporary storage of surplus water in disused mine pits and potential Infiltration to the aquifer</p> <p>Use in Managed Aquifer Recharge Project</p> <p>Provision of surplus water for use by others</p>	<p>Dewatering water will be used on-site in the first instance to supply water for operational purposes. Use of surplus water may include:</p> <ul style="list-style-type: none"> • Use in processing • On-site other use • Options for temporary storage in disused mine pits • Infiltration to the aquifer • Use in Managed Aquifer Recharge Project • Provision to other users <p>Surplus dewatering water exceeding the operational requirement is discharged to a local ephemeral tributary of Turee Creek East</p> <p>The surface discharge extent will not extend within 2 km of the boundary of Karijini National Park under natural no-flow conditions</p>

Element	Location	Approved Proposal Extent (MS 1113)	Proposal	Revised Proposal
Proposal Elements with Greenhouse Gas Emissions				
Annual average emissions				
Scope 1	Diesel and land clearing – 54,550 t CO ₂ -e pa			
Scope 2	Electricity – 8,985 t CO ₂ -e pa			
Scope 3	8.9 Mt CO ₂ -e pa			
Rehabilitation and Closure				
<p>The key closure objective is to rehabilitate the site to create a safe, stable, non-polluting landscape consistent with the post-mining land use and maintain environmental and cultural heritage values</p> <p>Rehabilitation and closure activities will be carried out in accordance with the approved Mine Closure Plan (MCP)</p>				
Other Elements that Affect the Extent of Effects on the Environment				
Proposal Time	Maximum project life	The operational phase is estimated at ~ 15 years (not including construction and closure implementation phases)		

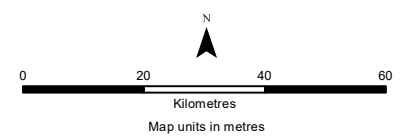
Figure ES1
Regional Location and Revised
Development Envelope

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



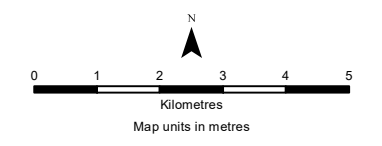
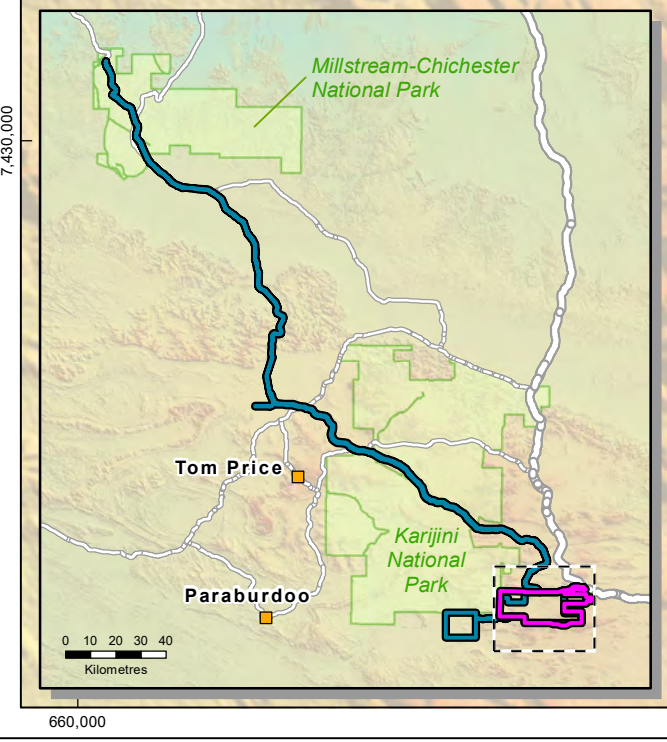
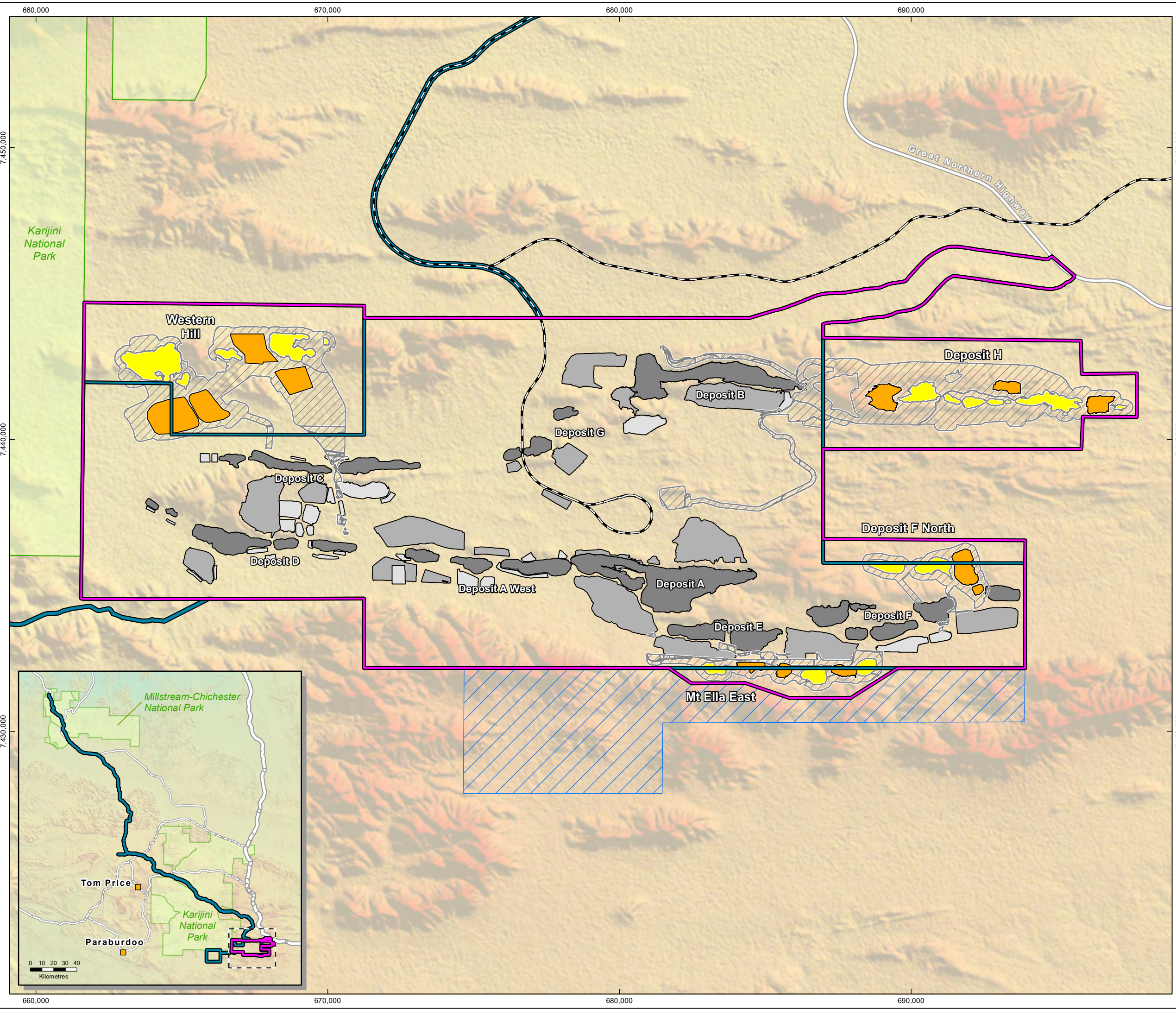
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Figure ES2
Revised Development Envelope
and Indicative Location
of Key Proposal Elements

Drawn: GIS Team
Plan: PDE0186387v7
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Approved Development Envelope 1113 - Linear Infrastructure
- Survey Reference
- Conceptual Footprint**
 - Conceptual Pit
 - Conceptual Waste Landform
 - Conceptual Associated Mine Disturbance
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - Stockpile
- National Park
- Rio Tinto Railway
- Highway
- Major Road



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Key Environmental Factors

The EPA identified the following key environmental factors for this Proposal:

- Social Surroundings (Section 6)
- Inland Waters (Section 7)
- Flora and Vegetation (Section 8)
- Terrestrial Fauna (Section 9)
- Subterranean Fauna (Section 10)
- Greenhouse Gas Emissions (Section 11).

In addition, the EPA is assessing the Proposal under an accredited assessment on behalf of the Commonwealth of Australia under the EPBC Act. The relevant Matters of National Environmental Significance (MNES) are listed as “threatened species and communities” (s. 18 and 18A) and “migratory species” (s. 20 and 20A) of the EPBC Act. Impacts on MNES are assessed in Section 13.

Cumulative Impacts

The Proposal is located within the Pilbara bioregion and the Hamersley subregion, both subject to impacts from multiple developments, including other iron ore mining projects (EPA 2014). The cumulative loss of vegetation and associated environmental values in the Hamersley subregion has been identified as a concern by the EPA (2014). Therefore, the proposed clearing is considered significant and is proposed to be offset.

Eleven (11) major iron ore projects within 100 km of the Proposal and the Proponent's existing iron ore operations (Existing Operations) have been used for the cumulative impact assessment. The Proponent has considered the Proposal's potential to impact further environmental values already affected by these developments. The review of key flora and vegetation, fauna and hydrological values did not find any instances where the current threat level of an ecological community or species would be increased as a result of the Proposal or where impacts on surface and groundwater regimes might change outcomes for environmental values. The review of social and cultural values has identified concern amongst Traditional Owner groups about cumulative visual amenity along with dust impacts, and the Proponent is committed to working innovatively to minimise dust emissions and ensure the Proposal has been designed to avoid potential significant cumulative impacts to Social Surroundings due to impacts to cultural and heritage values in consultation with Ngarlawangga and Yinhawangka People.

Environmental Outcome, Objectives and Management Plans

The mitigation hierarchy has been applied to the Proposal concerning the key environmental values. The key outcomes and objectives include:

- Establish MEZs (no direct impacts) around Ghost Bat: category 2, 3 and 4 caves (with the exception of four category 4 caves intersecting with the Conceptual Footprint). No direct disturbance is permitted in a MEZ except for activities that support monitoring, management and implementation of contingency actions (if required) as outlined in an approved Environmental Management Plan (EMP)
- Establish MRZs around category 2 and apartment block caves and critical and supporting habitat linking roost clusters. MRZ permit low impact activities with disturbance up to 20% of the MRZ surface affected, which support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP (Appendix A.8)
- Limit the extent of disturbance on critical (high significance) habitat for MNES fauna species:
 - Gorge/Gully – clearing of no more than 126 ha

- Hillcrest/Hillslope – clearing of no more than 3,371 ha
- Limit the extent of disturbance of regionally significant vegetation ‘West Angelas Cracking Clay Priority 1 Priority Ecological Community’ – clearing of no more than 2 additional ha
- No impact to Deposit H Waterhole hydrological regime
- No impact to Turtle Pool hydrological regime
- Establishment of extensive and ongoing social surroundings consultation with relevant external stakeholders particularly the Yinhawangka and Ngarlawangga People.

The full list of anticipated outcomes and objectives is included in Table ES3, and further details is provided in the Environmental Outcome Sections.

The Proponent has prepared several draft management plans that address the expected environmental outcomes and objectives. The management plans supplement the existing management frameworks that the Proponent already has in place across its diverse operations and have been prepared in accordance with relevant guidelines where they exist. A summary of each of the Proposal’s management plans is provided below:

- An **Environmental Management Plan** (EMP; Appendix A.8) focuses on mitigating potential impacts on key flora and vegetation, fauna species and hydrological regimes associated with the Proposal and monitoring and reporting key performance indicators
- **Groundwater Environmental Management Plan** (GW EMP; Appendix A.9:) outlines the mitigation measures to ensure that the requirement of the Proponent to ensure there is no drawdown at the boundary of or within Karijini National Park (Condition 6-1(1) of MS 1113 can be met. Note the GW EMP attached with this EMP is the current approved EMP. It is proposed to submit the updated draft Groundwater EMP prior to the response to submissions stage of the assessment to align with updates required and scheduled for current operations.
- A **Social and Cultural Heritage Management Plan** (SCHMP; Appendix B.2.d and B.3.b) for each Traditional Owner Group have been co-developed in consultation with the Ngarlawangga People and the Yinhawangka People with consideration of concerning impacts of social surroundings values and the relevant avoidance and mitigation strategies. The SCHMP sets the principles and protocols under which the Proponent will continue to engage and work with the Traditional Owner groups
- A **Greenhouse Gas Environmental Management Plan** (GHG EMP; Appendix A.7) demonstrates the Proponents’ contribution toward Western Australia’s aspiration of net zero emissions by 2050 and the interim emission reduction targets for the Proposal
- A **Mine Closure Plan** (MCP; Appendix A.5) has been prepared in accordance with current guidance (DMIRS 2020a) and describes the proposed closure outcomes and how they will be refined over the life of operations and plans for achieving those outcomes

These management plans are expected to be subject to subsequent approval and reporting under instruments issued under the EP and EPBC Acts.

Environmental Offset

The Proposal will result in significant residual impacts when assessed against current legislation and government policy, even after thoroughly applying the mitigation hierarchy. These impacts are principally related to the Proposal's contribution to the cumulative loss of vegetation in the Pilbara Bioregion and the removal of habitat for several significant fauna species.

In accordance with government policies, the Proponent will offset these residual impacts by means of contributions to the Pilbara Environmental Offsets Fund (PEOF), which itself has the aim of delivering environmental offsets in the Pilbara Bioregion through a strategic landscape-scale approach, building on regional programs developed in partnership with traditional owners, conservation agencies, industry and government. An Impact Reconciliation Procedure (IRP; Appendix G.1) outlines the methods used to determine the quantum of impact and required offsets.

Table ES3: Summary of Potential Impacts, Proposed Mitigation and Proposed Environmental Outcomes for the Proposal

Key Environmental Factor 1: Social Surroundings	
Potential Impacts	<p>Direct Impacts</p> <ul style="list-style-type: none"> • Direct disturbance of Country and cultural heritage (including waterholes, creeklines, camping sites, hunting grounds, other important cultural sites and places and heritage sites, plants and animals and their habitat, physical changes to landscape, aquifers and creeks, and interference with cultural obligations and spiritual beliefs tied to Country, water, flora and fauna) • Restriction of access to Country (including waterholes, creeklines, camping sites, hunting grounds, and important cultural sites and places affecting the ability of Traditional Owners to exercise Native Title rights and undertake cultural activities) • Changes to local landforms and installation of infrastructure which may result in altered visual landscapes and amenity (social and cultural dimensions, use, experience, and enjoyment of Country) within Country, and interference with cultural obligations and spiritual beliefs tied to Country <p>Indirect Impacts</p> <ul style="list-style-type: none"> • Indirect impact to cultural heritage, including interference with cultural obligations and spiritual beliefs tied to water, as a result of altered hydrological regimes • Indirect disturbance of cultural sites and places as a result of active mining • Alteration to groundwater and surface water regimes impacting Traditional Owner sense of place (physical changes to aquifers and creeks, and interference with cultural obligations and spiritual beliefs tied to water) • Alteration of the sense of place and amenity (social and cultural dimensions, use, experience and enjoyment of Country) due to dust, noise, vibration, light and waste/litter • Disturbance, or reduced presence of plants and animals which are used socially or culturally, or which have cultural associations due to dust, noise and vibration • Alterations to surface water and groundwater hydrological regimes, affecting surface water and groundwater dependent values • Changes to local landforms and installation of infrastructure which may result in altered visual landscapes and amenity • Changes to the physical (including noise and dust levels) and biological attributes of the environment which may impact visual and general amenity • Impacts to general public visual amenity due dust and general amenity due to noise

<p>Mitigation Hierarchy</p>	<p>Traditional Owner Cultural Heritage - Water</p> <p>Avoid</p> <ul style="list-style-type: none"> • Mining of ore reserves at Western Hill will be limited to AWT to avoid mine pit dewatering for this Proposal, owing to the proximity of Karijini National Park • Groundwater Environmental Management Plan will be implemented to ensure no change to groundwater levels at the boundary of, or within Karijini National Park that are attributable to the Proposal • No additional surplus water discharge to Turee Creek East as a result of the Proposal. Continue to avoid discharge footprint (wetting front) within 2 km of KNP in accordance with requirements of MS 1113 • Groundwater is abstracted according to programs that have been modelled to ensure dewatering volumes are minimised while ensuring safe access to BWT mine pits. Ongoing groundwater level monitoring is used to verify the models and adjust dewatering programs as required • Operational water demand will be supplied from mine dewatering in the first instance (where feasible), reducing the requirement for water supply volumes • Direct impacts to the Deposit H Waterhole site complex will be avoided through implementation of heritage site boundaries • Infrastructure interactions with upper catchment of Turtle Pool will have culvert/floodway designed and installed to ensure existing flows to the pool are maintained • Major infrastructure, including WRL, have been preferentially located outside of the ephemeral watercourses and their tributaries • The Proposal will avoid interactions with significant water features, where it is practicable to do so • Turtle Pool is outside the Revised Development Envelope and will not be impacted directly by the Proposal • Catchment impacts will be limited to an extent that ensures water levels within Deposit H Waterhole are in accordance with pre mining water levels and vegetation in the downstream gully is not significantly impacted, taking into consideration natural variation as detailed in the West Angelas EMP (Appendix A.8) • WRL will be preferentially placed outside of the floodplain of local creek lines and watercourses • Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements and industry guidelines, including within secondary containment, and not within or near creeklines, or within floodplains <p>Abstraction of groundwater to allow dry mining of BWT ore will be minimised (sump pumping only) to ensure water level in Turtle Pool is in accordance with pre mining levels taking into consideration natural variation. Monitoring and management are detailed in the West Angelas EMP (Appendix A.8)</p> <ul style="list-style-type: none"> • The Conceptual Footprint has been designed to minimise impacts to watercourses within the Revised Development Envelope. The Proposal largely relies on existing infrastructure, including crossings • Alternative water sources external to Deposit H aquifer be considered as part of mine designs. This mine design alternative is currently subject to further technical investigation and will be consulted with both Traditional Owner groups, understanding that water for production would need to be sourced from other aquifers at West Angelas operations
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- Water use will be continually reviewed and updated against dust suppression effectiveness and technological advancement, with resulting options considered in consultation with Traditional Owners over the life of the operation. Such reviews will include the implementation of trials on alternative techniques and strategies
- Reuse of Deposit H surplus water from mine pit dewatering will preferentially occur at Deposit H in accordance with Traditional Owner wishes
- Implement established procedures for the early identification of PAF materials to ensure adequate blending with NAF/high ANC materials, or encapsulation if required
- Implement the Rio Tinto (Pilbara-wide) Mineral Waste Management Plan to ensure mineral waste risks are identified, monitored and managed throughout all phases of the WAN RP
- If PAF waste material is encountered at Western Hill the SCARD will be implemented to adequately manage the risk
- PAF material will be encapsulated within NAF material within waste landforms to minimise potential for contaminated leachate
- Pits will be backfilled to cover any exposed PAF material at closure to prevent further exposure and potential for generation of AMD
- Update Groundwater Environmental Management Plan (Rio Tinto 2022d) prior to commencement of mining at Western Hill and implement
- All structures within creeklines and floodplains will be appropriately armoured or otherwise protected to ensure erosion risks are minimised
- Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will not be stored within or near creeklines, or within floodplains
- All personnel involved in the storage and handling of potentially contaminating materials will be appropriately trained and supported by adequate resources including signage, spill kits and PPE
- Prioritise dust suppression and monitoring, particularly around Deposit H Waterhole and Turtle Pool as a recommendation from social surroundings consultation with Ngarlawangga Traditional Owners
- Surface water diversion drains will be designed, constructed and maintained so as to minimise mobilisation and transport of sediment laden runoff to sensitive environmental receptors
- Minimise clearing within and preferentially locate non critical infrastructure outside of Turee Creek East catchments directly adjacent to Karijini National Park at Western Hill
- Pits will be isolated from significant creeklines and their floodplains to minimise interception of surface water catchment flows
- Linear infrastructure will be designed to convey high frequency flood events (up to 1 in 10 AEP) through culverts or similar structures to minimise impediment of flows
- Infrastructure may be designed to allow overtopping in lower frequency events to minimise upstream flooding and scouring downstream of culvert outlets
- Deposit H pit design will be agreed with Ngarlawangga Traditional Owners prior to implementation (see SCHMP, Appendix B.2.d).

Rehabilitate

Key Environmental Factor 1: Social Surroundings	
	<ul style="list-style-type: none"> • Modelling will be used to ensure the integrity of legacy structures, such as WRL, is retained over the long term • All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure • Landforms will be stabilised and revegetated at closure to minimise sediment runoff • BWT mine pits will be backfilled to a level where the formation of permanent post-closure pit lakes will be avoided • Reinstate surface drainage systems as far as practicable as the completion of mining unless otherwise agreed to.
Mitigation Hierarchy	<p>Traditional Owner Cultural Heritage – Access and Connection to Country</p> <p>Avoid</p> <ul style="list-style-type: none"> • The Proponent will avoid as far as practicable restricting access to culturally important areas (and on which cultural activities are conducted and within which resources are collected) <p>Minimise</p> <ul style="list-style-type: none"> • The Conceptual Footprint has been reduced to minimise impacts to access to important cultural areas (including areas on which traditional practices are conducted and resources are collected) • The Proponent will continue to consult with Traditional Owners to confirm all areas required to remain accessible (within health and safety limitations) and investigate Mine Design and access design options to further minimise restrictions, ensure no worse off access and non-prevention of access on these areas and access generally • Traditional Owner access to sites that may be identified through ongoing surveys and consultation, will be facilitated throughout the life of the Proposal. Access track options are being investigated to provide Traditional Owners unrestricted access to the Deposit H Waterhole site complex • Land Access Protocols (LAP) will be updated or developed with Traditional Owners to facilitate and support access • The Proponent will maintain ongoing communication with Ngarlawangga and Yinhawangka to ensure that access to the places specified in the LAP is properly managed throughout the life of the Proposal. This will involve regular joint review of the LAP. Additional places, such as those identified in future surveys, will be included in the LAPs as required. • The Proponent will prepare SCHMPs with each Traditional Owner group that will address processes and/or arrangements to facilitate access within the Revised Development Envelope. SCHMP will be co-designed with Traditional Owners to ensure each plan’s aims, objectives and actions are agreed with each group prior to implementation • The Proponent will consult with Traditional Owners regarding post-closure access in relation to final landform design <p>Rehabilitate</p>

Key Environmental Factor 1: Social Surroundings	
	<ul style="list-style-type: none"> • The MCP will be updated to reflect consultation with Traditional Owners on a regular basis to ensure its objectives remain relevant and are informed by stakeholder expectations, including post-closure access • Post-closure continued access to important cultural areas will be maintained in accordance with relevant health and safety requirements • The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020a), that will detail measures to manage public safety and post-closure access. The SCHMPs are also expected to include aspects of Traditional Owner consultation and engagement directly relevant to closure planning and implementation, including post-closure access
Mitigation Hierarchy	<p>Traditional Owner Cultural Heritage – Care for and Protection of Country</p> <p>Avoid</p> <ul style="list-style-type: none"> • The Proponent has refined the Proposal scope and Revised Development Envelope via a Section 43A application under the EP Act and Section 156A application under the EPBC Act which significantly reduced potential impacts at Mt Ella East • Yinhawangka <ul style="list-style-type: none"> ○ Deposit J has been removed from the Proposal altogether, with the Revised Development Envelope and Conceptual Footprint changed to reflect this via a Section 43A application under the EP Act and Section 156A application under the EPBC Act ○ The Conceptual Footprint has been amended to avoid direct impacts to the Western Hill site complex, the Mt Ella East site complex, (now outside the Revised Development Envelope), and the unnamed range to the south of the existing West Angelas operations • Ngarlawangga <ul style="list-style-type: none"> ○ The Conceptual Footprint has been amended to avoid direct impacts to the Deposit H Waterhole site complex and the Mt Ella Range (now outside the Revised Development Envelope) • Heritage site boundaries, the Proponents CHMS, and commitment to no direct impacts as a result of this Proposal be implemented in some sections of the Revised Development Envelope, which will avoid direct impacts to important cultural sites and places within these areas • Disturbance will be managed using the Proponent’s Integrated Heritage Management Process (IHMP), CHMS, and the Rio Tinto Approvals Request database to avoid unauthorised disturbance of sites of cultural significance. Information derived from surveys and consultations is used in the Proponent’s GIS to spatially manage heritage and other important places, such as through the creation of exclusion boundaries, so that personnel designing a project can seek to avoid significant places where possible • Prior to all disturbance heritage clearance surveys will be conducted to ensure all heritage sites are identified, with Proposal activities designed to avoid heritage sites if possible <p>Minimise</p>

Key Environmental Factor 1: Social Surroundings	
	<ul style="list-style-type: none"> • The Conceptual Footprint has been minimised through project optimisation to reduce the total extent of disturbance • Consultation and engagement will be undertaken, as agreed with Traditional Owners under SCHMP processes, to inform decisions to relocate activities to minimise disturbance to important cultural sites and places • Pre-disturbance heritage surveys will inform decision to relocate activities to minimise potential impacts to heritage sites where possible • Mine design optionality and potential impacts to important cultural sites and heritage sites will be assessed with Traditional Owners through appropriate consultation forums • Salvage of artefacts will occur for sites unavoidably impacted, where salvage is not possible these values will be recorded • The Proponent will engage with Traditional Owners to provide Proposal workforce with cultural awareness training including importance of avoiding areas outside approved disturbance, other heritage requirements and recognition of artefacts • Proponent workforce will not be permitted to access areas outside direct disturbance and operational areas without authorisation (e.g. in order to undertake monitoring, surveys and required activities). Access to some areas and conduct of some activities is expected to require Proponent personnel to be accompanied by Traditional Owners with appropriate cultural authority <p>Rehabilitate</p> <ul style="list-style-type: none"> • The repatriation of salvaged heritage materials will be undertaken in accordance with Traditional Owners preferences, to be discussed and confirmed as part of ongoing consultations with the relevant Traditional Owner groups. Salvage of heritage materials will occur from sites approved to be disturbed in accordance with the requirements of relevant AH Act/ACH Act approvals, and in accordance with the Proponent's IHMP and SCHMPs as relevant • Prior to any repatriation salvaged heritage material will be stored in keeping place(s), that are set up in accordance with appropriate standards to ensure proper protection and conservation and be readily accessible by, and under the supervision and control of, Traditional Owners. The Proponent will explore opportunities for joint funding of keeping places with other resource companies given Traditional Owner lands intersect other operations in the region
Mitigation Hierarchy	<p>Traditional Owner Amenity, Sense of Place and Use and Enjoyment of Country</p> <p>Minimise</p>

- The Proponent has refined its mine plan to minimise visual impact on landforms by removing Deposit J and significantly amending Mt Ella East sections of the Revised Development Envelope
- The Proponent is currently preparing SCHMPs with each Traditional Owner group that will include processes and/or arrangements to ensure consultation with each Traditional Owner group in respect of future mine designs, mine design changes, and Life of Mine Planning consultations
- The Proponent is currently preparing SCHMPs with each Traditional Owner group that will include processes and/or arrangements to ensure consultation with each Traditional Owner group in respect to site closure planning and proposed closure outcomes, including with respect to final landforms
- The Revised Development Envelope has been reduced and will minimise areas of potential disturbance and associated dust creation
- The Conceptual Footprint has been minimised through project optimisation to reduce the total extent of clearing.
- The Proponent will avoid unnecessary clearing (causing dust [and noise]) by ensuring that no ground disturbance occurs without prior assessment and authorisation
- Areas of focus for dust monitoring and/or management, and to inform dust minimisation options to include in design and operation of Proposal, based on dust modelling include:
 - Options to minimise dust accumulating in culturally important areas – minimisation / management options to be discussed further – e.g. increase dust suppression/ water carts near creeks/ creek crossings paving road sections
 - Vehicles will be required to travel at safe operating speeds on unsealed roads and will be restricted from accessing rehabilitated surfaces except for management purposes as per current practices
 - Options to minimise visual impacts from dust from specific locations
 - The Proponent will implement dust management measures, such as dust suppression and sediment traps to minimize indirect impacts to important cultural sites and places
- Vibration limits will apply to category 2 and 3 Ghost Bat caves (including within Ghost Bat apartment block caves) within the Revised Development Envelope to manage vibration impacts and maintain caves' structural integrity as per Table 9 22 (Section Terrestrial Fauna) and the EMP
- MRZ/MEZ buffers (Table 13 -17 Section MNES) will minimise noise, vibration and light pollution received by the high significance habitat and structures within the area
- Equipment design will be specified to be within Australian standard noise limits and/or fitted with noise mufflers in accordance with manufacturing specifications
- The Proponent will implement noise management measures, such as plant and equipment modifications and installation of baffles to minimise indirect impacts to relevant places of social and cultural significance
- The Proponent will implement vibration management measures, such as Blast Management Plans to minimise indirect impacts to cultural sites and places of significance, including relevant rockshelter heritage sites and key caves identified as important bar roosting sites

Key Environmental Factor 1: Social Surroundings	
	<ul style="list-style-type: none"> • Management of all waste and litter is subject to standard site operating procedures, which require all waste and litter to be contained and disposed of appropriately • The Proponent commits to ensuring waste management and site housekeeping actions are undertaken to minimise the visual impact of litter and waste • The Proponent will prepare SCHMPs with each Traditional Owner group that will include processes and/or arrangements to ensure ongoing consultation with each Traditional Owner group in respect of waste and litter management • SCHMP to include involvement of Traditional Owners in site observations to allow feedback on (among other things) waste/litter <p>Rehabilitate</p> <ul style="list-style-type: none"> • The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020a), that will detail proposed closure landform designs and rehabilitation processes • Progressive backfilling opportunities will be investigated during the life of the operation, where practicable (e.g. when not limited by mine sequencing, pit designs and timing). Consultation with Traditional Owners on mine development will occur through Life of Mine Planning consultation opportunities • The Proponent will consult with Traditional Owners on the proposed closure outcomes for the operation, including final landform design. Consultation on closure will be ongoing throughout the life of the operation • The SCHMPs describe the agreed engagement framework with each Traditional Owner group in respect of consultation to inform closure planning • Revegetation and rehabilitation to minimise ongoing erosion and creation of dust following operations. Self-sustaining ecosystems that are compatible with the surrounding environment are intended to be re-established • Vibration monitoring equipment will be removed once blasting activities have ceased within the set distance of the BMP • The Proponent will continue to implement standard environmental operating procedures to ensure all waste and litter is removed and correctly disposed of for closure
Mitigation Hierarchy	<p>Karijini National Park and Local Viewpoints</p> <p>Minimise</p>

Key Environmental Factor 1: Social Surroundings	
	<ul style="list-style-type: none"> • The Revised Development Envelope has been reduced and will minimise areas of potential disturbance and associated dust creation • The Conceptual Footprint has been minimised through project optimisation to reduce the total extent of clearing • The Proponent will avoid unnecessary clearing (causing dust [and noise]) by ensuring that no ground disturbance occurs without prior assessment and authorization • The Proponent will implement dust management measures, such as dust suppression and sediment traps to minimise indirect impacts to Karijini National Park and other nearby viewpoints <p>Rehabilitate</p> <ul style="list-style-type: none"> • Revegetation and rehabilitation to minimise ongoing erosion and creation of dust following operations. Self-sustaining ecosystems that are compatible with the surrounding landscape are intended to be re-established
Residual Impacts, including Assessment of Significance	<p>Non-Significant Residual Impacts</p> <ul style="list-style-type: none"> • Impacts to the vitality of the Deposit H Waterhole site complex due to catchment reduction • Minimal drawdown (cone of depression) of groundwater via sump pumping to access BWT ore at Deposit H, with no impact to Turtle Pool. • No direct impacts to Deposit H Waterhole site complex, Turtle Pool, Mt Ella East site complex, Western Hill site complex, the Range, the unnamed hill range to the south of the existing West Angelas operation • The visual amenity of Karijini National Park and high viewpoints • Upstream water impacts that concern Turee Creek Pastoral Station • Temporary loss of access to Country limiting the Ngarlawangga and Yinhawangka ability to Care for Country, to use and enjoy Country and conduct cultural activities • Localised impact on plants and animals disturbed by Proposal, managed through SCHMP • Indirect impacts to cultural sites • There are no predicted significant impacts predicted to the general public. The Revised Development Envelope is not frequented by member of the public for recreational activities • No European heritage sites have been documented within the Revised Development Envelope <p>Significant Residual Impacts</p>

Key Environmental Factor 1: Social Surroundings	
	<ul style="list-style-type: none"> • The loss of water from dewatered aquifers due to water’s sacred nature and the multigenerational timeframe for recharge; however, the volume of water proposed to be abstracted is limited and will not result in the abstraction of entire aquifers. Traditional Owners have acknowledged dewatering is required for the Proposal • The loss of access to those parts of Country that remain as permanent abandoned pit voids will be felt by Ngarlawangga and Yinhawangka peoples as an enduring impact their cultural heritage • Impacts to cultural heritage and Country through the physical changes • Direct disturbance of heritage sites: <ul style="list-style-type: none"> • Of the 44 potential or known heritage site and other culturally important areas identified within the Ngarlawangga portion of the Revised Development Envelope, 17 intersect the current proposed Conceptual Footprint, with up to four known rock shelter sites and in the order of 13 other sites, including artefact scatters, quarries and scarred trees • Of the 84 potential or known heritage site and other culturally important areas identified within the Yinhawangka portion of the Revised Development Envelope, 24 intersect the current proposed Conceptual Footprint, with up to 9 known rock shelter sites and in the order of 15 other sites, including artefact scatters, quarries and scarred trees • There are other cultural sites in the broader landscape which have the potential to be indirectly impacted through dust, noise, vibration, changes to landforms and visual amenity, workforce visitation and changes to biological attributes • Permanent changes to landscape and landforms will impact cultural heritage, usage and amenity of Country
Proposed Environmental Outcomes	<p>In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Social Surroundings are:</p> <ul style="list-style-type: none"> • Avoid, where practicable, and otherwise minimise direct and indirect impacts as a result of implementation of the Proposal to Ngarlawangga and Yinhawangka cultural heritage and amenity values in accordance with the respective SCHMPs. • Avoid, where practicable, and otherwise minimise direct and indirect impacts in relation to Turee Creek Pastoral Stations Social Surroundings, particularly upstream water values

Key Environmental Factor 2: Inland Waters	
Potential Impacts	<p>Direct Impacts</p> <ul style="list-style-type: none">• Lowering of groundwater levels• Groundwater mounding from surplus storage in disused mine pits• Changes to surface water catchments• Changes to Surface Hydrological Regime of Turee Creek from the Continued Discharge of Surplus Water <p>Indirect Impacts</p> <ul style="list-style-type: none">• Impacts to water quality via:<ul style="list-style-type: none">○ Potential AMD from Pits and WRL○ Sediments and Other Contaminants in Stormwater Runoff / Accidental Spills• Temporary in-pit storage of surplus mine dewater <p>Cumulative Impacts</p> <ul style="list-style-type: none">• Cumulative reduction to the size of catchments including Turee Creek East and Weeli Wolli Catchment• Cumulative groundwater drawdown

Key Environmental Factor 2: Inland Waters

Mitigation Hierarchy	<p>Avoid</p> <p>The Proponent will/have:</p> <ul style="list-style-type: none"> • Forego BWT ore reserves at Western Hill to avoid mine pit dewatering, owing to the proximity of Karijini National Park • Monitor groundwater levels at the boundary of, or within the national park that are attributable to the Proposal as a result of supply abstraction, as specified in the EMP • Ensure water levels within the waterhole at Deposit H Waterhole and Turtle Pool are modelled to continue to fill in accordance with pre mining regime, taking into consideration natural variation as detailed in the West Angelas EMP • Ensure surplus water storage in pits will only occur where pit lakes would not be expected to cause mounding in areas of shallow water table (i.e., <20 m bgl) • Located Major infrastructure, including WRL outside of the ephemeral watercourses and their tributaries. Where WRL cannot be located outside of ephemeral drainage lines, flows will be diverted around WRLs through the use of diversion bunds or drains if required • Ensure no additional surplus water discharge to Turee Creek East as a result of the Proposal • Continue to avoid discharge footprint (wetting front) extending within 2 km of Karijini National Parl in accordance with requirements of MS 1113 • Ensure discharge will remain otherwise unchanged and will be managed in accordance with the requirements of MS 1113 and the West Angelas EMP • Backfill BWT mine pits will be backfilled to a level where the formation of pit lakes will be avoided • Construct surface water diversion drains that avoid natural flows from entering disturbed areas, including mining voids, where possible. • Ensure the flow diversions will be designed, constructed and maintained so as to minimise mobilisation and transport of sediments to sensitive environmental receptors. Specifically in relation to Deposit H Waterhole, a toe bund will be constructed at the base of the Western waste landform, the diversion drain will be rock armoured where required, and sediment traps will be constructed where appropriate. • Ensure potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements and industry guidelines, including within secondary containment • Impacts to water quality from PFAS will be avoided by implementation of regulator requirement to use fluorine-free fire-fighting foams <p>Minimise</p> <ul style="list-style-type: none"> • Groundwater drawdown will be minimised by: <ul style="list-style-type: none"> ○ Abstracting groundwater in accordance with programs that have been modelled to ensure dewatering volumes are minimised while ensuring safe access to BWT mine pits. Ongoing groundwater level monitoring is used to verify the models and adjust dewatering as required
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Key Environmental Factor 2: Inland Waters

- Supplying operational water demand from mine dewatering in the first instance (where feasible) to reduce the requirement for water supply volumes
- Changes to surface water catchment will be minimised by:
 - Isolating the pits from significant creeklines and their floodplains
 - Minimising clearing within and preferentially locate non-critical infrastructure outside of Turee Creek East catchments directly adjacent to Karijini National Park at Western Hill
 - Placement of sedimentation basins at the outlet of stormwater drainage to prevent migration of sediment off site
 - Designing linear infrastructure to convey high frequency flood events (up to 1 in 10 ARP) through culverts or similar structures to avoid impediment of flows
 - Designing infrastructure to allow overtopping in lower frequency events to minimise upstream flooding and scouring downstream of culvert outlets
 - Protecting surface water fed ephemeral pools WB-WAJ1 and WB-WAJ2 via Heritage site exclusion areas
- Changes to surface hydrological regime of Turee Creek will be minimised by:
 - Storing surplus water in disused mine pits to reduce both discharge to Turee Creek and abstraction for supply
- Impacts to water quality from potential AMD from pits and WRL will be minimised by:
 - Implementing established procedures for the early identification of PAF materials to ensure adequate blending with NAF/high ANC materials, or encapsulation if required
 - Implementing the Mineral Waste Management Plan
 - Implementing SCARD plan if PAF waste material is encountered
 - Encapsulating PAF material within NAF material within waste landforms to minimise the potential for contaminated leachate
 - Backfilling pits to cover any exposed PAF material at closure
 - Updating and implementing Groundwater Environmental Management Plan prior to commencement of mining at Western Hill
- Water quality impacts arising from sediments and other contaminants (including PFAS) in stormwater runoff and accidental spills will be minimised by:
 - Armouring or protecting all structures within creeklines and floodplains
 - Prohibiting storage of potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, within or near creeklines, or within floodplains
 - Training and supporting all personnel involved in the storage and handling of potentially contaminating materials by adequate resources including signage, spill kits and PPE

Key Environmental Factor 2: Inland Waters	
	<ul style="list-style-type: none"> ○ Impacts to water quality from PFAS will be minimised by implementation of the internal guidance note E15 PFAS at Rio Tinto operations ○ Prioritising dust suppression and monitoring, particularly around Deposit H Waterhole and Turtle Pool ● Impacts from temporary in-pit storage of surplus mine dewater will be minimised by: <ul style="list-style-type: none"> ○ Surplus water storage in mine pits that do not have exposed PAF is the proposed surplus water strategy once mine pits are available and criteria for storage are met. ● Impacts from fibrous materials will be minimised by: <ul style="list-style-type: none"> ○ Implementation of the internal Fibrous Materials Management Plan (FMMP) and compliance with all relevant legislation regarding the handling of fibrous materials (i.e., <i>Occupational Safety and Health Regulations 1996 and Mines Safety and Inspection Regulations 1995</i>) <p>Rehabilitate</p> <p>The Proponent will regularly update the Mine Closure Plan (Appendix A.5), which includes closure objectives relevant to the restoration and/or maintenance of values associated with Inland Waters, including:</p> <ul style="list-style-type: none"> ● All surface water diversions remaining after closure are designed and engineered to minimise impacts on local hydrological regimes, ensure long term stability across the realistic range of expected flow events, and do not significantly cause or contribute to water quality impacts ● Modelling groundwater level recovery timeframes in future iterations of the Mine Closure Plan (MCP; Appendix A.5) ● Decommissioning or transferring to a 3rd party or Traditional Land Owner all dewatering and production bores that are no longer required, in accordance with relevant guidelines ● Removal of drainage diversions (other than pits, which will be appropriately bunded) unless specified to be retained ● All contamination will be appropriately managed at closure, as per the Contaminated Sites Act 2003 ● Modelling will be used to ensure the integrity of legacy structures, such as WRL, is retained over the long term ● All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure ● The stabilisation and revegetation of landforms at closure is anticipated to minimise sediment runoff
Residual Impacts, including Assessment of Significance	Proposal Non-Significant Residual Impacts

Key Environmental Factor 2: Inland Waters	
	<ul style="list-style-type: none"> • Reduction in catchment of the Turee Creek East Catchment by up to ~3%, which may reduce Turee Creek flow events into Karijini National Park by ~9% • Impact to the catchment reporting to Deposit H Waterhole does not impact pool filling frequency and level comparative to the pre mining regime of the pool • Drawdown at Western Hill is not modelled to propagate towards Karijini National Park and no groundwater dependent sensitive receptors are located within the modelled impact area • Deposit H Waterhole is surface water fed and will not be impacted by drawdown at Deposit H • No abstraction of groundwater will occur for production supply or to access BWT ore via bores at Deposit H. Production supply water will be sourced from alternative locations within the WAN RP DE and BWT ore will be accessed via sump pumping of groundwater, and water will be retained within the pit to infiltrate. Proposal abstraction and/or dewatering of ~1.92 GL, has been assessed as part of the Proposal. Due to minimal amount of abstraction/dewatering and mitigation measures applied to sensitive receptors and limited amount of BWT mining proposed, the assessment is that this is not a significant residual impact and can continue to be managed under the RiWI Act. • In relation to the Approved Proposal groundwater abstraction is currently authorised by Groundwater Licence (GWL) No. 98740(13) which currently permits an annual abstraction of 14,000,000 kL, and GWL No. 103136(9) which currently permits an annual abstraction of 3,102,500 kL. Water abstraction related to the Revised Proposal will continue to be managed via Licence requirements under the RiWI Act. <p>Proposal Significant Residual Impacts</p> <p>After implementing the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to Inland Waters.</p>
Proposed Environmental Outcomes	<p>Proposal Outcomes</p> <ul style="list-style-type: none"> • No significant change to the water levels at Deposit H Waterhole as a result of any impacts to the catchment attributable to the Proposal • No significant impact to vegetation downstream of the Deposit H Waterhole as a result of impacts to the reporting catchment • No significant change to the Turtle Pool as a result of any impacts to the catchment attributable to the Proposal • No drawdown of groundwater associated with the Proposal at the boundary of or within Karijini National Park as a result of supply abstraction at Western Hill. The Groundwater Environment Management Plan Revision 3 (RTIO-HSE-0349522) approved 14 June 2022 (your reference A2106795) will continue to be implemented and will be updated to address management and monitoring of groundwater prior to commencement of abstraction for supply at Western Hill • No significant impacts to groundwater quality related to Western Hill. The current approved Groundwater Environmental Management Plan will continue to be implemented for the Approved Proposal and updated before mining begins at Western Hill. • No change to discharge of surplus dewatering to Turee Creek as a result of the Proposal <p>Revised Proposal Outcomes</p>

Key Environmental Factor 2: Inland Waters

- The Revised Proposal will continue to be managed to ensure that Condition 6-1(1) of current approval MS 1113 and Condition 3(a) of current approval DN 2018/8299 is achieved; *'ensure there is no drawdown of groundwater associated with the proposal at the boundary of, or within, Karijini National Park'*
- The Revised Proposal will continue to be managed in accordance with the current approved requirement of 'Dewatering water will be used onsite in the first instance to supply water for operational purposes. Surplus dewatering water, exceeding the operational requirement is discharged to a local ephemeral tributary of Turee Creek East. The surface discharge extent will not extend within 2 km of the boundary of Karijini National Park under natural no-flow conditions'

Key Environmental Factor 3: Flora and Vegetation	
Potential Impacts	<p>Direct Impacts</p> <ul style="list-style-type: none"> • Clearing of Native Vegetation (including Riparian Vegetation) • Clearing of individuals of Priority flora species <p>Indirect Impacts</p> <ul style="list-style-type: none"> • Degradation or alteration of vegetation as a result of altered hydrological/hydrogeological regimes • Degradation of vegetation condition due to increased abundance and diversity of weeds • Degradation of vegetation from dust deposition and potential increase in bushfire risk <p>Cumulative Impacts</p> <ul style="list-style-type: none"> • Clearing of native vegetation • Clearing of conservation significant flora
Mitigation Hierarchy	<p>Avoid</p> <ul style="list-style-type: none"> • Reduction of the Revised Development Envelope resulting in avoidance of clearing of native vegetation and Priority species • Deposits F North and H will avoid impacts on the natural flows of large creek systems and the vegetation communities supported by them • Riparian vegetation along the major creeklines is not proposed to subject to additional surplus water discharge as a result of the Proposal • No BWT mining at Western Hill to ensure no significant groundwater drawdown risk to pGDE receptors in Karijini National Park <p>Minimise</p> <ul style="list-style-type: none"> • The Proponent will avoid introducing new weeds species listed as WoNS entering the Revised Development Envelope by implementing the <i>West Angelas EMP</i> • Clearing of native vegetation and priority flora species will be minimised by: <ul style="list-style-type: none"> ○ Implementing upper clearing limits for regional significance vegetation West Angelas Cracking Clays Priority 1 PEC ○ Implementing upper clearing limit for riparian vegetation ○ Ensuring clearing occurs only in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request System ○ Utilising existing disturbed areas wherever practicable ○ Conducting a site induction program to provide information on vegetation protection and ground disturbance authorisation procedures

- Degradation of vegetation condition due to increased abundance and diversity of weeds will be minimised through continued implementation of *West Angelas EMP*, which include:
 - A baseline weed and introduced species survey will be commissioned to inform the survey and control program
 - The survey and control program will include a review to identify and target high risk areas (e.g., environmental value, existing weed presence, status of weeds that are present, and potential for further transfer/dispersal e.g., waterways and high trafficable areas)
 - Implement the targeted survey and control program at target high risk areas
 - Use the results of the survey and control program to inform targeted management
 - The results of the survey and outcomes of weed management will be reported annually in the Annual Compliance Assessment Report (including to DCCEEW)
- Degradation or alteration of vegetation as a result of altered hydrological regime will be minimised by:
 - Using surplus water in accordance with water use hierarchy to facilitate the natural flow as much as possible
 - Limiting impact to Deposit H Waterhole and Turtle Pool Catchment to ensure sufficient flows are maintained to facilitate filling of the pool in line with pre mining frequency and level
 - Implementing Groundwater Environmental Management Plan to ensure no change to groundwater levels at the boundary of, or within Karijini National Park that are attributable to the Proposal as a result of supply abstraction to minimise potential impacts on PGDE within Karijini National Park
- Degradation of vegetation from dust deposition and the potential increase in fire risk will be minimised by:
 - Implementing dust suppression techniques such as sprayers on crushers and water trucks is expected to minimise dust generation during construction and operation
 - Limiting the amount of disturbed land to as small as reasonable reduces the amount of dust producing surfaces
 - Implementing of management measures, hot works permit system, vehicle movement (not leaving cleared tracks) and disposal of potential fire-starting waste [e.g., cigarette butts] to minimise the risk of bushfires as a result of the Proposal
 - Locating firefighting equipment around the site and in vehicles. Fire response procedures and personnel training will also be provided, including site inductions on fire prevention and management
- Impacts to non-listed species that are otherwise culturally important to Traditional Owner Groups will be minimised by:
 - Conducting ethnobotanical / traditional ecological knowledge surveys with Traditional Owners to provide more information on native honeybees, honey trees and myriad other species of cultural importance
- Working with Traditional Owners to ensure culturally important plants are considered for use in rehabilitation

Rehabilitate

Key Environmental Factor 3: Flora and Vegetation

- The Proponent has prepared an MCP (Appendix A.5) includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use, the measures include:
- Undertake progressive rehabilitation to minimise the extent of cleared areas using recovered topsoil or other identified growth media
- Consult with Yinhawangka on backfilling pits at Mt Ella East, and adhere to any management actions agreed to in the SCHMP
- Local provenance¹ seed and propagated material will be used (if required) to rehabilitate disturbed areas
- Undertake weed spraying during rehabilitation, especially during the life of mine
- Include indicative closure completion criteria to ensure that the only weed species recorded within rehabilitation areas are also present within the local uncleared area
- If suitable species are identified through the ethnobotanical heritage surveys or other sources, the seed mixes will be detailed within the MCP with processes for consultation and involvement of Traditional Owners regarding MCPs to be included in the co-designed SCHMPs

¹ Local is defined as Pilbara IBRA and/or as defined in NVCPs

Key Environmental Factor 3: Flora and Vegetation

<p>Residual Impacts, including Assessment of Significance</p>	<p>Proposal –Non - Significant Residual Impacts</p> <ul style="list-style-type: none"> • Estimated clearing of the following Priority flora species: • 285 recorded individuals of P2 <i>Aristida lazaridis</i> (2.6% of known individuals in the state) • 21 recorded individuals of P2 <i>Eremophila pusilliflora</i> (0.23% of known individuals in the state) • 316 recorded individuals of P2 <i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET15708) (5.2% known individuals in the state) • 6 recorded individuals of P2 <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725) (0.9% of known individuals in the state) • 13 recorded individuals of P3 <i>Acacia effusa</i> (0.14% of known individuals in the state) • 243 recorded individuals of P3 <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> (1.8% of known individuals in the state) • 1,728 recorded individuals of P3 <i>Eremophila naaykensis</i> (A.L.Curtis & K.R.Thiele) (12% of known individuals in the state) • 75 recorded individuals of P3 <i>Grevillea saxicola</i> (1.4% of known individuals in the state) • 711 recorded individuals of P3 <i>Indigofera gilesii</i> (6.6% of known individuals in the state) • 356 recorded individuals of P3 <i>Isotropis parviflora</i> (5.4% of known individuals in the state) • 1 recorded individual of P3 <i>Olearia mucronata</i> (0.35% of known individuals in the state) • 634 recorded individuals of P3 <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (0.6% of known individuals in the state) • 34 recorded individuals of P3 <i>Solanum kentrocaule</i> (2% of known individuals in the state) • 27,468 recorded individuals of P3 <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) (17.5% of known individuals in the state) • 1 recorded individual of P4 <i>Acacia bromilowiana</i> (0.03% of known individuals in the state) • 263 recorded individuals of P4 <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) (2% of known individuals in the state) • Estimated clearing of approximately 9% of the high local significance vegetation (H15 and P8) within the Revised Development Envelope • Degradation or alteration of vegetation as a result of altered hydrological regimes • Degradation of vegetation condition due to increased abundance and diversity of weeds • Degradation of vegetation from dust deposition and potential increase in bushfire risk <p>Proposal Significant Residual Impact</p>
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Key Environmental Factor 3: Flora and Vegetation	
	<ul style="list-style-type: none"> • Clearing up to 4,922 ha of native vegetation in good to excellent condition. This is considered a significant impact for the Proposal as per the EPAs cumulative environmental impacts of development in the Pilbara region • Clearing of up to 2 ha vegetation type (P15) considered to represent the Priority 1 PEC - West Angelas Cracking-Clays (P1). This PEC is restricted to the West Angelas area • Clearing of up to 35 ha of riparian vegetation <p>Revised Proposal Significant Residual Impact</p> <ul style="list-style-type: none"> • Clearing up to 17,555 ha of native vegetation • Clearing of up to 22 ha vegetation type (P15) considered to represent the Priority 1 PEC - West Angelas Cracking-Clays (P1). This PEC is restricted to the West Angelas area • Clearing of up to 60 ha of riparian vegetation
Proposed Environmental Outcomes	<p>In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Flora and Vegetation are set out below:</p> <p>Proposal Outcomes</p> <ul style="list-style-type: none"> • Clearing will not exceed: <ul style="list-style-type: none"> ○ 5,350 ha of native vegetation, which includes approximately 4,922 ha of vegetation in Good to Excellent condition ○ 2 ha of the West Angelas Cracking-Clays (P1) or vegetation type P15 mapped within the Revised Development Envelope ○ 35 ha of riparian vegetation • No direct or indirect disturbance to the West Angelas Cracking Clay Priority Ecological Community (Representation PEC-2015-5) due to the Revised Proposal that results in an irreversible impact <p>In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Revised Proposal, the anticipated environmental outcomes that apply to Flora and Vegetation are set out below:</p> <p>Revised Proposal Outcomes</p> <ul style="list-style-type: none"> • Clearing will not exceed: <ul style="list-style-type: none"> ○ 17,555 ha of native vegetation ○ 22 ha of the West Angelas Cracking-Clays (P1) or vegetation type P15 mapped within the Revised Development Envelope ○ 60 ha of riparian vegetation • No direct or indirect disturbance to the West Angelas Cracking Clay Priority Ecological Community (Representation PEC-2015-5) due to the Revised Proposal that results in an irreversible impact

Key Environmental Factor 3: Flora and Vegetation**Assessment of Offsets (if relevant)**

Following application of the mitigation hierarchy, the following residual environmental impacts are considered significant impacts and therefore require an offset:

- Clearing of approximately 4,922 ha of native vegetation in good to excellent condition will be offset at a rate of approximately \$890/ha
- Clearing up to 35 ha of riparian vegetation will be offset at a rate of \$1,780/ha

The offsets are in line with the State and National offset guidelines and are expected to counterbalance the significant residual impacts

Key Environmental Factor 4: Terrestrial Fauna

Potential Impacts	<p>Direct Impacts</p> <ul style="list-style-type: none">• Habitat loss/ reduction and fragmentation as a result of clearing• Loss of fauna individuals• Clearing of SRE habitat and loss of SRE individuals <p>Indirect Impacts</p> <ul style="list-style-type: none">• Degradation or alteration of habitat as a result of altered hydrological regimes• Habitat degradation associated with construction and operational activities• Disturbance from light, noise and/or vibration, resulting in the displacement of fauna associated with construction and operational activities <p>Cumulative Impacts</p> <p>The Proposal has the potential to contribute to regional impacts on fauna habitats and species present within the Revised Development Envelope</p>
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Key Environmental Factor 4: Terrestrial Fauna

Mitigation Hierarchy	<p>Avoid</p> <ul style="list-style-type: none"> • The Revised Development Envelope and Conceptual Footprint have been continually refined during the design phase from 7,200 ha (as referred) to 5,350 ha and Revised Development Envelope from 41,484 (as referred²) ha to 36,779 ha (amended via s.43 A) • The Revised Development Envelope and Conceptual Footprint have been continually refined during the design phase to avoid direct impacts to high significance fauna habitats as much as practicable. This includes the avoidance of 17 category 2, 3 and 4 caves in the Proposal Area; Ghost Bat roosts; and water habitat features • MEZs and MRZs have been established around 17 caves within the Proposal Area, with no mining disturbance permitted in MEZs and limits on disturbance within MRZs. An additional 20 caves are currently protected under MS 1113 Restriction and Exclusion Areas • MRZs and MEZs will be included in the Proponent's GIS system to ensure known locations are avoided • The Proponent will ensure clearing only occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system • The Revised Development Envelope and Conceptual Footprint have been modified during the design phase resulting in avoidance of impacts to high suitability SRE habitats • The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system • Major infrastructure, including WRLs, have been preferentially located outside the ephemeral watercourses and their tributaries • Direct impacts to ephemeral pool WB-WAH1 (Deposit H Waterhole) located north of Deposit H will be avoided, and a heritage exclusion area will be established around the pool • Pools WB-WAJ1 and WB-WAJ2 are outside the Conceptual footprint and will not be impacted due to proximity with the Range to the south of Mt Ella <p>Minimise</p> <ul style="list-style-type: none"> • Loss of fauna habitat and fragmentation will be minimised via: <ul style="list-style-type: none"> ○ The design of the Revised Development Envelope and Conceptual Footprint to minimise, where practicable, disturbance of high significance fauna habitats (Gorge/Gully and Hillcrest/Hillslope) ○ Restricting clearing of high significance fauna habitat within authorised extents (clearing limits)
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² Under the State Environmental Protection Act 1986 after amendment to the Development Envelope via S45C. Development Envelope referred under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act) was 39,851 ha, amended to 36,779 ha via an application under S156A of the EPBC Act.

Key Environmental Factor 4: Terrestrial Fauna

- Including the known locations of significant fauna habitat types into the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents
- Ensuring clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system
- Remaining key landform corridors such as major drainage lines (i.e. Turee Creek) as intact as possible to ensure habitat connectivity is maintained
- Loss of fauna individuals will be minimised via:
 - Implementation of the West Angelas EMP (Appendix A.8)
 - Restricting majority of the light vehicle movements outside of operating mine areas to only occur during daylight hours, which will minimise interaction with nocturnal species
 - Undertaking progressive clearing to allow fauna to migrate away from clearing activities or machinery movements
 - Implementing speed limits to minimise the risk of fauna injury or mortality from vehicle strike
 - Confining vehicle traffic to defined roads and tracks
 - Removing any roadkill from trafficable areas to reduce the risk of an increase in predator numbers and of secondary vehicle strikes on scavenging fauna
 - Avoiding the use of barbed wire fencing where possible, otherwise, place reflectors on any barbed wire fences to help prevent the entanglement of bat species
 - Providing information on significant fauna including their appearance and habitats during site induction programs. Training would also discuss standard operating procedures in the event of fauna interactions
 - Ensuring artificial water sources at turkeys' nests and sediment ponds will have egress points
- Loss of SRE species and SRE habitat will be minimised via:
 - The design of the Revised Development Envelope and Conceptual Footprint to minimise, where practicable, disturbance of high suitability SRE habitat (Gorge/Gully habitat)
 - Restricting clearing of high suitability habitat through authorised Proposal clearing extents
 - Clearing limits applied to MNES habitat will simultaneously result in clearing limits being applied to high suitability SRE habitat (Gorge/Gully)
 - Including known locations of significant SRE habitat (Gorge/Gully) into the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents
 - Ensuring clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system

- Degradation/alteration of habitat as a result of altered surface catchments will be minimised by:
 - Isolating the pits from significant creeklines to minimise the interception of catchment flows
- Habitat degradation associated with construction and operational activities will be minimised by:
 - Implementing management measures such as dust suppression to minimise disturbance to fauna habitats
 - Requiring vehicles to travel at safe operating speeds on unsealed roads and restrict vehicles from accessing rehabilitated surfaces except for management purposes as per current practices
 - Undertaking feral animal monitoring and subsequent control in high risk areas and/or high value habitat as outlined in the EMP within the Revised Development Envelope and in co-operation with regional control programs and Traditional Owners as per current practices
 - Fencing landfill facilities and covering putrescible wastes to minimise the attraction of animals
 - Minimise surface water ponding after rehabilitation through the design and construction of the borrow pits
 - Implementing measures such as maintaining fire breaks and hot works procedures and ensuring fire equipment will be available in buildings and vehicles
 - Providing fire response procedures and personnel training, including site induction on fire prevention and management
- Disturbance from light, noise and/or vibration, and possible displacement of fauna associated with construction activity and mining operations will be minimised by:
 - Applying vibration limits to category 2 and 3 Ghost Bat caves (including within Ghost Bat apartment block caves) within the Revised Development Envelope to manage vibration impacts and maintain caves' structural integrity as per Table 9-22
 - Noise limits will apply to retained category 2 Ghost Bat caves in the Proposal Area to as per Table 9-22 (Section Terrestrial Fauna) and the EMP. MRZ/MEZ buffers (Table 13-17, Section MNES) will minimise noise, vibration and light pollution received by the high significance habitat and structures within the area
 - MRZ/MEZ buffers
 - Lighting will be designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020). These include:
 - Installing permanent lighting only where required, mainly in-pit and operational areas
 - Shielding permanent and temporary lighting and directing to active mine areas to minimise light spill
 - Directing permanent lighting away from sensitive areas (e.g. MEZs, MRZs, significant caves, critical habitat)
 - Positioning temporary lighting (e.g. trailer mounted units) to minimise direct light spill into sensitive areas where it may be required to provide a safe working environment for short periods
 - Equipment design will be specified to be within Australian standard noise limits and/or fitted with noise mufflers in accordance with manufacturing specifications

Key Environmental Factor 4: Terrestrial Fauna	
	<ul style="list-style-type: none"> ○ Implementing MRZ and MEZ around caves will minimise light, noise and vibrations received by the high value habitat and structures within this area ○ Implementing Blast Management Plan to manage impacts from vibrations and maintenance of the structural integrity of significant caves <p>Rehabilitate</p> <ul style="list-style-type: none"> ● Prepare and regularly update an MCP, which includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms are stable and consider ecological and hydrological factors. Linear infrastructure, including crossings, will be fully decommissioned if no longer required ● Habitat elements to be considered as part of the rehabilitation design includes: <ul style="list-style-type: none"> ○ Vegetation is known to provide preferred food or shelter preference ○ Managing feral predators and herbivores across both reference and rehabilitated areas ○ Rehabilitation will be conducted in accordance with the Rio Tinto <i>Iron Ore Rehabilitation Handbook</i> and will include fauna and habitat monitoring ● Rehabilitation will be undertaken progressively to <ul style="list-style-type: none"> ○ Minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement ○ Restore any vegetation impacted by alterations to the hydrological regimes ● Temporary infrastructure will be removed at closure to allow natural flow paths and catchments to be re-established in these areas
Residual Impacts, including Assessment of Significance	<p>Proposal Non-Significant Residual Impact</p> <ul style="list-style-type: none"> ● Direct impacts to up to four category 4 Ghost Bat and Pilbara Leaf-nosed Bat roost caves. ● Degradation/alteration of habitat as a result of altered hydrological regimes ● Habitat degradation associated with construction and operational activities ● Disturbance from light, noise and/or vibration, and possible displacement of fauna associated with construction activity and mining operations ● Cumulative loss of vegetation and fauna habitat <p>Proposal Significant Residual Impacts</p> <ul style="list-style-type: none"> ● Clearing up to 126 ha (~20%) of Gorge/Gully (High significance) habitat in addition to the 2 ha currently approved under DN 2018/8299, which represents critical habitat for the following significant fauna species; Northern Quoll, Ghost Bat and Pilbara Olive Python and

Key Environmental Factor 4: Terrestrial Fauna

supporting habitat for Pilbara Leaf-nosed Bat. This clearing is proposed to be managed via upper limits of clearing as per Table 9 15 and will be offset

- Clearing up to 3,731 ha (~31%) of Hillcrest/Hillslope (High significance) habitats in addition to the 484 ha currently approved under DN 2018/8299, representing critical habitat for Ghost Bats and supporting habitat for Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat. This clearing is proposed to be managed via upper limits of clearing as per Table 9 15 and will be offset
- Clearing approximately 2,242 ha (~14%) of the remaining fauna habitat types, Cracking Clay, Drainage Line, Foothills and Plain and Mixed Acacia Woodland (Moderate significance) which provides supporting habitat for the Ghost Bat (within 12 km of critical habitat). This clearing is proposed to be offset.

Revised Proposal Significant Residual Impacts

- Clearing of up to 128 ha of Gorge/Gully habitat within the Revised Development Envelope
- Clearing of up to 4,215 ha of Hillcrest/Hillslope habitat within the Revised Development Envelope
- Clearing of up to 22 ha of Cracking Clay habitat within the Revised Development Envelope

Key Environmental Factor 4: Terrestrial Fauna	
Proposed Environmental Outcomes	<p>Proposal Outcomes</p> <p>In consideration of the proposed avoidance and management measures and the likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Terrestrial Fauna with respect to this Proposal are set out below:</p> <ul style="list-style-type: none"> • Clearing from the Proposal will not exceed: <ul style="list-style-type: none"> ○ 126 ha of Gorge/Gully habitat within the Revised Development Envelope ○ 3,731 ha of Hillcrest/Hillslope habitat within the Revised Development Envelope ○ 2 ha of Cracking Clay habitat within the Revised Development Envelope • No direct disturbance to Ghost Bat roosts retained within MEZs and MRZs (category 2 and 3) and MRZs only (category 4), caves CWAN-01, 02, 03, 04, 06, 07, 08, 11, 27, 28, 29, 30, 31, 32, 34 and CDHI-001 and 002 (Table 9 22). • No direct or indirect impacts to the structural integrity and microclimate of Ghost Bat caves retained in the Proposal Area as a result of the Proposal. • No direct impacts to the three surface water fed ephemeral pools within Proposal Area (WB-WAH1, WB-WAJ1 and WB-WAJ2) <p>Revised Proposal Outcomes</p> <p>The anticipated environmental outcomes that apply to Terrestrial Fauna with respect to the Revised Proposal are set out below:</p> <ul style="list-style-type: none"> • Clearing from the Revised Proposal will not exceed: <ul style="list-style-type: none"> ○ 128 ha of Gorge/Gully habitat within the Revised Development Envelope ○ 4,215 ha of Hillcrest/Hillslope habitat within the Revised Development Envelope ○ 22 ha of Cracking Clay habitat within the Revised Development Envelope • No direct disturbance to Ghost Bat roosts retained within MEZs and MRZs (category 2 and 3) and MRZs only (category 4), caves CWAN-01, 02, 03, 04, 06, 07, 08, 11, 27, 28, 29, 30, 31, 32, 34 and CDHI-001 and 002 (Table 9 22) and no direct or indirect impacts to the structural integrity and microclimate of these caves. • No clearing within the Ghost Bat Cave AA1, WA-13, WA-21 and WA-23 CMAR-01, CMAR-02, CMAR-03 and CMAR-04 Exclusion Zones (Table 9 22) Minimise disturbance due to the revised proposal 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 clearing of water features WB-WAH1, WB-WAJ1, WB-WAJ2, WMAR-01 and WMAR-03 • Minimise direct and indirect impacts from the Proposal on significant species' habitat in accordance with the EMP.
Assessment of Offsets (if relevant)	<p>Following the application of the mitigation hierarchy, the following residual environmental impacts are considered significant impacts and therefore require an offset:</p>

Key Environmental Factor 4: Terrestrial Fauna	
	<ul style="list-style-type: none"> • Clearing up to 3,857 ha of critical Gorge/Gully habitat for Northern Quoll, Ghost Bat, and Pilbara Olive Python and clearing of critical Hillcrest/Hillslope habitat for Ghost Bat (this includes Pilbara Leaf-nosed Bat supporting habitat) at a rate of \$3,306/ha • Clearing of approximately 79 ha of supporting Drainage Line habitat within 1 km of critical Gorge/Gully habitat for Northern Quoll and Pilbara Olive Python and 12 km from critical Gorge/Gully and Hillcrest/Hillslope habitat for Ghost Bat (this includes Pilbara Leaf-nosed Bat supporting habitat) at a rate of \$1,653/ha • Clearing up to 2 ha of West Angelas Cracking Clay Priority Ecological Community habitat is of regional significance and provides a supporting habitat for Ghost Bat within 12 km of critical habitat at a rate of \$1,780/ha³ • Clearing approximately 2,181 ha of clearing supporting habitat (Mixed Acacia Woodland and Foothills and Plain habitat types) within 12 km of critical Ghost Bat habitat at a rate of \$1,653/ha <p>The offsets align with the State and National offset guidelines and are expected to offset the significant residual impacts</p>

³ State PEOF rate is higher so has been used for Cracking Clay PEC

Key Environmental Factor 5: Subterranean Fauna	
Potential Impacts	<p>Direct Impacts</p> <ul style="list-style-type: none"> • Loss of individuals or permanent reduction of troglofauna habitat as a result of mining (i.e. pit excavation) • Loss of individuals or permanent reduction of stygofauna habitat values through mining and associated groundwater drawdown (i.e. pit dewatering and water supply) <p>Indirect Impacts</p> <ul style="list-style-type: none"> • Changes to surface inputs of flow/volume of water, nutrients and oxygen Changed hydrological regime • Changes to the structure and presence of underground voids • Desiccation of subterranean habitat • Fragmentation of previously connected/contiguous habitat by excavation • Contamination from spills, leaching and environmental incidents <p>Cumulative Impacts</p> <ul style="list-style-type: none"> • Cumulative impacts represent the combination of ‘combined’ impacts as described above, with impacts from known and reasonably foreseeable third-party operations within the region.
Mitigation Hierarchy	<p>Minimise</p> <ul style="list-style-type: none"> • Loss of individuals or reduction in troglofaunal and/or stygofauna habitat will be minimised by: <ul style="list-style-type: none"> ○ Minimising pit dewatering to that required to safely access below water table resources ○ Minimising clearing to only that required for implementation of the Proposal ○ Using water from mine dewatering on site in the first instance to minimise the requirement for additional groundwater abstraction for operational water supply ○ Abstracting groundwater within licence limits and monitoring groundwater levels to ensure impact remains within the predicted range of drawdown. Abstraction of groundwater managed under Groundwater Licence GWL98740 Abstraction licence. ○ Monitoring MAR to ensure it is working as intended under MS 1113 • Indirect impacts to subterranean fauna will be minimised by/via: <ul style="list-style-type: none"> ○ Restricting clearing and/or disturbance to within the Approved Development Envelope ○ Appropriate design of waste landforms specifically encapsulation of PAF waste rock and minimisation of oxidation to prevent changes to groundwater quality ○ Appropriate design of hazardous material storages in accordance with relevant guidelines and Australian Standards

Key Environmental Factor 5: Subterranean Fauna	
	<ul style="list-style-type: none"> ○ Construction and maintenance of surface water drainage systems to control and contain runoff from mining areas and divert clean stormwater away from pits and other mining disturbance areas ○ Monitoring of groundwater quality during operations ○ Provision of spill kits and implementation of spill management procedures ○ Progressive rehabilitation will be undertaken ○ Major disruption to surface hydrology patterns will be managed via drainage management procedures <p>Rehabilitate</p> <ul style="list-style-type: none"> ● Backfill of pits to enable potential groundwater recovery over time and avoid ongoing evaporative losses ● The Closure Plans include a closure objective to ensure that the final landform is stable and considers hydrogeological factors, including backfilling pits in accordance with the West Angelas Mine Closure Plan and Condition 7 of MS 1113 (Rehabilitation) ● Progressive rehabilitation will be undertaken which will assist with re-establishing nutrient, oxygen, and water flows into the subterranean environment ● Opportunistic investigation into backfilling of pits to surface if possible
Residual Impacts, including Assessment of Significance	<p>Proposal Non-significant residual impacts</p> <ul style="list-style-type: none"> ● Up to 216,261,000 cubic metres (2%) of suitable AWT (troglifauna) habitat directly impacted by the Proposal (12% Revised Proposal) ● Medium predicted impacts to seven troglifauna taxa (taxa currently known only from single sites within proposed pits), and Low predicted impacts to 35 troglifauna taxa following implementation of the Proposal ● Approximately 588 ha (3%) of the 20,095 ha of mapped 2D troglifauna habitat potentially indirectly impacted by the placement of waste landforms and stockpiles from the Proposal ● Up to 141,535,000 cubic metres (14%) of suitable BWT (stygo fauna) habitat directly impacted by the Proposal (17% Revised Proposal) ● Low predicted impacts to two stygo fauna taxa following implementation of the Proposal and for Revised Proposal ● Approximately 120 ha (7%) of the 1,605 ha of mapped 2D stygo fauna habitat potentially indirectly impacted by the placement of waste landforms and stockpiles from the Proposal
Proposed Environmental Outcomes	<p>After application of avoidance and management measures, no significant residual impacts to troglifauna and stygo fauna as a result of the Proposal remain.</p> <p>Proposal Outcomes in relation to troglifauna</p>

Key Environmental Factor 5: Subterranean Fauna	
	<ul style="list-style-type: none"> • Direct impact to up to 216,261,000 cubic metres (2%) of suitable AWT (troglifauna) habitat (12% for Revised Proposal) • Medium predicted impacts to seven troglifauna taxa (taxa currently known only from single sites within proposed pits), and Low predicted impacts to 35 troglifauna taxa following implementation of the Proposal • Potential indirect impact to approximately 588 ha (3%) of the 20,095 ha of mapped 2D troglifauna habitat by the placement of waste landforms and stockpiles <p>Proposal Outcomes in relation to stygofauna</p> <ul style="list-style-type: none"> • Direct impact to up to 141,535,000 cubic metres (14%) of suitable BWT (stygofauna) habitat (17% for Revised Proposal) • Low predicted impacts to two stygofauna taxa following implementation • Potential indirect impacts to approximately 120 ha (7%) of the 1,605 ha of mapped 2D stygofauna habitat by the placement of waste landforms and stockpiles. <p>Revised Proposal Outcomes in relation to troglifauna</p> <ul style="list-style-type: none"> • Direct impact to up to 1,076,640,000 cubic metres (12%) of suitable AWT (troglifauna) habitat • Medium predicted impacts to seven troglifauna taxa (taxa currently known only from single sites within proposed pits), and Low predicted impacts to 35 troglifauna taxa <p>Revised Proposal Outcomes in relation to stygofauna</p> <ul style="list-style-type: none"> • Direct impact to up to 2,539,893,000 cubic metres (17%) of suitable BWT (stygofauna) habitat • Low predicted impacts to two stygofauna taxa.
Assessment of Offsets (if relevant)	No significant residual impacts have been identified for subterranean fauna and as such no offsets are proposed in relation to this factor

Key Environmental Factor 6: Greenhouse Gas Emissions	
Potential Impacts	<p>Potential Impacts</p> <p>Generation of greenhouse gases through combustion of fossil fuels and land clearing (Scope 1 emissions) and generation of power (Scope 2). The Proposal is expected to contribute 63,535 t CO₂-e total Scope 1 and Scope 2 emissions per annum (average) through 2025 to 2046 period, as follows:</p> <ul style="list-style-type: none"> • Scope 1 emissions: ~54,550 t CO₂-e per year (Average) • Scope 2 emissions: ~8,985 t CO₂-e per year (Average) <p>Through the ~22 year LoM, the Proposal is expected to emit a combined total of 1,397,779 t CO₂-e Scope 1 and Scope 2 emissions.</p> <p>Cumulative Impacts</p> <p>The Proposal will increase the total mine life as the existing approved mines reach the end of their productive life. The Revised Proposal is expected to contribute approximately 104,167 t CO₂-e per annum (average), as follows:</p> <ul style="list-style-type: none"> • Scope 1 emissions: 88,404 t CO₂-e per annum (average) • Scope 2 emissions: 15,763 t CO₂-e per annum (average) <p>Through the LoM, the Revised Proposal is expected to contribute ~2,916,678 t CO₂-e Scope 1 and 2 emissions</p>
Mitigation Hierarchy	<p>Avoid</p> <ul style="list-style-type: none"> • The Proponent has study and development processes that identify, assess and where practicable develop existing, innovative and new technology developments • Emission abatement projects may be implemented as part of the Proposal or at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld, as part of the RTIO decarbonisation strategy <p>Reduce</p> <p>The Proponent will reduce GHG emissions by:</p> <ul style="list-style-type: none"> • Reducing ancillary vehicle movements, e.g. Using buses to transport personnel between site and accommodation • Investigating progressive backfilling of the pits as far as practicable to reduce the amount of total material moved (TMM) and truck operating hours • Investigate opportunities to continuously improve productivity and minimise Scope 1 and 2 emissions during the construction and operation of the Proposal include: <ul style="list-style-type: none"> ○ Increasing effective utilisation through reducing idle time/ queue time and parking up equipment wherever possible ○ Increasing the efficiency of operations (including waste and ore haulage) through mine planning, design and scheduling ○ Regular maintenance and servicing of equipment

Key Environmental Factor 6: Greenhouse Gas Emissions	
Residual Impacts, including Assessment of Significance	<p>Non-Significant Residual Impacts</p> <ul style="list-style-type: none"> • The Proposal is expected to contribute net GHG emissions (Scope 1 and 2 emissions) of approximately 838,816 t CO₂-e through the ~22 year life of the project
Proposed Environmental Outcomes	<p>In consideration of the proposed management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Greenhouse Gases are:</p> <ul style="list-style-type: none"> • The Proponent shall take measures to reduce emissions 15% by 2025 and 50% by 2030 and then deliver emissions reductions in a linear trajectory (based on five-yearly targets) to net zero GHG emissions by 2050 • The Proponent shall take measures to ensure that net GHG emissions associated with the Proposal do not exceed: <ul style="list-style-type: none"> ○ 41,050 t CO₂-e for the period between 1 January 2024 and 31 December 2025 ○ 335,114 t CO₂-e for the period between 1 January 2026 and 31 December 2030 ○ 251,336 t CO₂-e for the period between 1 January 2031 and 31 December 2035 ○ 127,537 t CO₂-e for the period between 1 January 2036 and 31 December 2040 ○ 83,779 t CO₂-e for the period between 1 January 2041 and 31 December 2045 ○ 0 t CO₂-e for the period between 1 January 2046 and 31 December 2050 <p>The proponent will implement the GHG EMP (Appendix A.7) to meet these outcomes which is consistent with the EPA factor objective for GHG</p>
Assessment of Offsets (if relevant)	<p>The Proponent will offset emissions where abatement is insufficient against the interim and long-term targets outlined in Section 3.2.1 of the GHG EMP. Offsets will be delivered by retiring credible offsets units in 2025, 2030, 2035, 2040, 2045 and 2050, as follows:</p> <ul style="list-style-type: none"> • calculate Safeguard Mechanism obligations purchased within the relevant five-year cumulative period to determine if ACCUs purchased met EPA requirements in these time periods • Integrate principles of the ICROA in relation to the sourcing and use of credible offsets units for carbon offsetting • Credible offset units sourced will be based on the principles outlined in ICROA's Technical Specification: real, measurable, permanent, and additional. Independently verified and unique • Only credible offset units sourced from projects that are, or will be validated, verified and registered

Summary of Holistic Impact Assessment

In addition to providing a detailed assessment of the potential environmental impacts and mitigation measures for individual environmental factors, the Proponent has also sought to understand the environment as a whole. A detailed understanding informs the environmental and cultural values, processes and the holistic views and concerns raised through consultation with the Ngarlawangga People and the Yinhawangka People as the Traditional Owners of the land in proximity to the Proposal but also consideration of nearby pastoralists and visitors to Karijini National Park.

Many of the significant environmental values within the Revised Development Envelope were identified in multiple environmental factors. As such, they have already been the focus of mitigation actions across these environmental factors and require no additional or different mitigation to be applied. This includes Deposit H Waterhole, Turtle Pool, creeks, rocky habitats and caves identified in the Inland Waters, Flora and Vegetation, Terrestrial Fauna and Social Surroundings environmental factors.

One impact which was identified as a potential holistic impact was dust. However, the impact assessment identified that no significant impacts on the environment are expected due to the Proposal's dust emission. The Proponent does note that dust, in the context of cumulative emissions in the Pilbara, can potentially have a significant impact. The Proponent is committed to investigating ways to improve dust emission management within the bioregion.

Summary of Cumulative Impact Assessment

The Proposal is located within the Pilbara bioregion and will potentially impact three vegetation associations in the Hamersley subregion: Hamersley 18, Hamersley 29 and Hamersley 82. The cumulative loss of vegetation and associated environmental values in the Hamersley subregion has been identified as a concern by the EPA (2014). Therefore, the proposed clearing is considered significant and is proposed to be offset.

There are at least 11 other existing and reasonably foreseeable developments within 100 km of the Proposal, including the Proponent's West Angelas operations. For that reason, the Proponent has considered the Proposal's potential further to impact environmental values under pressure from these developments. The review of key flora and vegetation, fauna and hydrological values did not find any instances where the current threat level of an ecological community or species would be significantly increased as a result of the Proposal or where impacts to groundwater regimes might exacerbate existing pressures. Whilst there are cumulative impacts to surface water regimes, particularly Turee Creek East and Weeli Wolli catchments, the Proposal does not substantially contribute to the cumulative reduction on these catchments and cumulative impacts are not considered to be significant.

The review of social and cultural values has confirmed that a widespread concern exists amongst Traditional Owner groups about cumulative impacts to surface water values, which also have significant cultural value to Traditional Owners, and this is discussed within the ERD.

Further, as discussed throughout this document, it is considered that the existing obligations and commitments prescribed under a range of regulatory instruments and decision-making processes, are appropriate to manage potential cumulative impacts associated with the Proposal in addition to new conditions proposed for consideration by the EPA.

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Abbreviations

Abbreviation	Description
3D	Three dimensional
ABS	Australian Bureau of Statistics
ACCU	Australian Carbon Credit Unit
ACH Act	<i>Aboriginal Cultural Heritage Act 2021</i>
ACHMP	Aboriginal Cultural Heritage Management Plan
AEP	Annual Exceedance Probability
AH Act	<i>Aboriginal Heritage Act 1972</i>
ALARP	as low as reasonably possible
AMD	Acid Metalliferous Drainage
ANFO	Ammonium Nitrate Fuel Oil
ATSHIP Act	<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i>
AWT	Above Water Table
BAM Act	<i>Biosecurity and Agriculture Management Act 2007</i>
BC Act	<i>Biodiversity Conservation Act 2016</i>
BESS	Battery Energy Storage System
BIF	Banded Iron Formation
BoM	Bureau of Meteorology
BrIF	Brockman Iron Formation
BWT	Below Water Table
CEr	Clean Energy Regulator
CH ₄	Methane
CHMS	Cultural Heritage Management Systems
CLH	Common Law Holder
CO ₂	Carbon Dioxide
CO ₂ -e	carbon dioxide equivalent
CPI	Consumer Price Index for Perth, as calculated by the Australian Bureau of Statistics
CWB	Central Water Bores
DBCA	Department of Biodiversity, Conservation and Attractions
DCCEEW	Department of Climate Change, Energy, the Environment and Water
DG	Dangerous Goods
DG Safety Act	<i>Dangerous Goods Safety Act 2004</i>
DMA	Decision-making authorities
DMIRS	Department of Mines, Industry Regulation and Safety
DN	Decision Notice
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DWER	Department of Water and Environmental Regulation

Abbreviation	Description
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EP Act	<i>Environmental Protection Act 1986</i>
EPA Services	Environmental Protection Authority Services
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EPBC Regulations	<i>Environment Protection and Biodiversity Conservation Regulations 2000</i>
ERD	Environmental Review Document
ERWP	Environmental Review and Management Programme
ESA	Environmental Sensitive Area
ESG	Environmental, Social and Governance
EWR	environmental water requirements
GDE	Groundwater Dependent Ecosystems
GDV	Groundwater Dependent Vegetation
GEMP	Groundwater Extraction Management Plan
GHG	Greenhouse Gas
GHG EMP	Greenhouse Gas Environmental Management Plan
GL/a	Giga Liter per annum
GOS	Groundwater Operating Strategy
GST	Good and sale Tax
HCP	Healthy Country Plan
HR	Habitat Rating
HSB	Heritage Site Boundary
HSEC	Health, Safety, Environment and Communities
IBRA	Interim Biogeographic Regionalisation of Australia
ICOMOS	International Council on Monuments and Sites
ICROA	International Carbon Reduction and Offset Alliance
IHMP	Integrated Heritage Management Process
ILUA	Indigenous Land Use Agreement
IRP	Impact Reconciliation Procedure
JTSI	Department of Jobs, Tourism, Science and Innovations
KNP	Karijini National Park
kt	kilotonnes
LIC	Local Implementation Committee
LOM	Life of Mine
MAR	Mine Aquifer Recharge
MCP	Mine Closure Plan
Measurement Determination	National Greenhouse and Energy Reporting (Measurement) Determination 2008
MEZ	Mining Exclusion Zone
Mining Act	<i>Mining Act 1978</i>

Abbreviation	Description
ML	Mining Lease
MMIF	Marra Mamba Iron Formation
MNES	Matters of National Environmental Significance
MRZ	Mining Restriction Zone
MS	Ministerial Statement
Mt/a	Million tonnes per annum
N ₂ O	Nitrogen Oxide
NAC	Ngarlawangga Aboriginal Corporation
NAF	Non-acid forming
NDC	Nationally Determined Contributions
NDVI	Normalised Difference Vegetation Index
NGER Act	<i>National Greenhouse and Energy Reporting Act 2007</i>
Noise Regulations	<i>Environmental Protection (Noise) Regulations 1997</i>
NT Act	<i>Native Title Act 1993</i>
NTA	Native Title Agreements
NVCP	Native Vegetation Clearing Permit
NWQM	National Water Quality Management
P	Priority
PAF	Potential-acid forming
PBC	Pescribed Body Corporate
PCD	Proposal Content Document
PEC	Priority Ecological Communities
PEOF	Pilbara Environmental Offset Fund
PER	Public Environmental Review
PGDE	Potential Groundwater Dependent Ecosystem
PIL	Pilbara Bioregion
PMST	Protected Matters Search Tool
PoW	Programme of Work
PPV	Peak Particle Velocity
RFD	Regional Framework Deed
Rio Tinto	Rio Tinto Iron Ore Group
RISM	Residual Impact Significance Model
RiWI Act	<i>Rights in Water and Irrigation Act 1914</i>
RNTBC	Registered Native Title Bodies
ROM	Run-of-mine
RTIO	Rio Tinto Iron Ore
SCARD	Spontaneous Combustion and Acid Rock Drainage
SCHMP	Social and Cultural Heritage Management Plan
SRE	Short Range endemics

Abbreviation	Description
T & W	Thurantajinha and Wilga
TAP	Threat Abatement Plan
TCB	Turee Creek Borefield
TEC	Threatened Ecological Communities
TEK	Traditional Ecological Knowledge
TMM	total material moved
TSI	Torres Strait Islander
TSP	Total Suspended Particulates
UCL	Unallocated Crown Land
WA	Western Australia
WAM	West Australian Museum
WoNS	Weed of National Significance
WQPN	Water Quality Protection Notes
WRL	Waste Rock Landforms
YAC	Yinhawangka Aboriginal Corporation

1. INTRODUCTION

Robe River Mining Co. Pty. Ltd. (the Proponent) proposes to expand the West Angelas Iron Ore Project (the Proposal). The Proposal includes a proposed consolidation and modernisation of the approved Ministerial Statement (MS) for West Angelas Operations; MS 1113.

The Proposal is located approximately 130 km northwest of the township of Newman in the Pilbara Region of Western Australia (WA) (Figure 1-1). The Proposal is located within the Yinhawangka (WSD2017/003) and Ngarlawangga (WSD2016/007) Peoples Native Title Determination Areas.

1.1. Purpose and Scope

The purpose of this Environmental Review Document (ERD) is to provide sufficient information to allow for the assessment of the Proposal under Part IV of the *Environmental Protection Act 1986* (EP Act) (Section 3). This ERD has been prepared in accordance with the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual 2020* (EPA 2021a) and the *Instruction: How to Prepare an Environmental Review Document* (EPA 2021b) guidance and the Environmental Scoping Document (ESD) (Appendix A.1), which the Western Australian EPA approved on 17 February 2023.

Since the Proposal was referred (submitted 23 March 2021), additional technical studies have provided greater clarity on project design and environmental and social aspects. The Proponent subsequently submitted a request to change the relevant key characteristics of the Proposal under s.43A of the EP Act to the EPA and this ERD has been prepared to reflect the scope of the proposal as amended by that application.

This ERD presents detailed information on each environmental factor nominated by the EPA as a potential 'key' environmental factor that the Proposal implementation could potentially significantly impact.

The objectives of the ERD are to:

- Describe all operational components of the Proposal that have the potential to have a significant effect on the environment
- Describe the local and regional context and environmental values of the area within which the Proposal would be implemented, drawing upon proposal-specific biological and other technical studies
- Identify and assess the potential impacts of the Proposal implementation including consideration of the combined effects that implementation of the Approved Proposal and the Proposed Amendment may have on the environment
- Describe the mitigation strategies the Proponent would use to avoid, minimise, manage, rectify and offset adverse impacts.
- Identify whether there are any residual impacts after the application of the avoidance and minimisation elements of the mitigation hierarchy and assess whether these residual impacts are significant
- Determine whether the Proposal can deliver environmentally acceptable outcomes considering applicable legal requirements and WA EPA policy objectives.

This ERD also satisfies the requirements for an accredited assessment under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and includes an assessment of potential significant impacts of the Proposal on Matters of National Environmental Significance (MNES) (Section 13) and a checklist (Appendix A.2) of requirements outlined in Schedule 4 of the *Environment*

Protection and Biodiversity Conservation Regulations 2000 (EPBC Regulations) against the ESD (Appendix A.1).

The ERD considers all phases of Proposal implementation, including construction, commissioning, operation and closure. Cumulative impacts with other existing and reasonably foreseeable projects are also addressed. The potential impacts on key environmental factors are described in detail and assessed using relevant studies specific to the Proposal. This ERD summarises and describes the environmental studies conducted for the Proposal as relevant to the EIA. Copies of the technical reports used in preparing the ERD are provided as appendices.

1.2. Proponent

Robe River Mining Co. Pty. Ltd. (a joint venture in which the Rio Tinto Iron Ore Group (Rio Tinto (53%), Mitsui (33%) and Nippon Steel (14%) retain interests) is the Proponent for this Proposal. The Proponent details are provided in Table 1-1.

Table 1-1: Proponent Details

Item	Detail
Proponent	Robe River Mining Co. Pty. Ltd.
ACN	008 694 246
Address	152–158 St Georges Terrace, Perth WA 6000

The key contact for the Proposal is:

Elizabeth Mason

Senior Advisor, Environmental Approvals

+61 8 9327 2000

elizabeth.mason@riotinto.com

1.3. Proposal Terminology

The following terminology is used throughout this document:

Approved Proposal: Refers to operations approved under MS 1113 (including proposals approved by MS 514 and 970 and now superseded by MS 1113) and includes approved components yet to be implemented.

Approved Development Envelope: Refers to the extent of the existing Development Envelope approved under MS 1113 and EPBC Decision Notice 2018/8299, as shown in Figure 2-1.

Approved Conceptual Layout: Refers to the indicative location of key elements as approved under MS 1113 and shown in Figure 2-1.

Existing Operations: Refers to the existing iron ore operations currently being undertaken as approved under MS 1113.

The Proposal: The Proposal is the significant amendment to the Approved Proposal and includes the extension and development of new above and below water table (AWT/BWT) iron ore deposits and associated activities to extend the life of the Existing Operations. The Proposal is the subject of this assessment and includes the amendments proposed to the EPA in December 2022.

Extension Areas: Refers to the new development areas that are to be added to the Approved Development Envelope to become the Revised Development Envelope as shown in Figure 2-2.

Conceptual Footprint: Refers to the indicative direct disturbance footprint of the Proposal for the purpose of environmental impact assessment in this ERD. To provide for project flexibility, this footprint is indicative only and includes key elements such as miner pits, waste rock landforms (WRL) and infrastructure to a maximum extent of 5,350 ha. The final location of key elements and infrastructure may occur outside the Conceptual Footprint but will be contained within the Revised Development Envelope and within any approval limits. This flexibility within the Revised Development Envelope is part of this assessment, as the Proponent has allocated and undertaken survey work throughout the entire Revised Development Envelope to support this assessment.

Proposal Area (Proposed Action Area): Refers to the proposed Extension Areas currently outside of the Approved Development Envelope as shown in Figure 2-2 and areas of the Approved Development Envelope that are within the Proposed Conceptual Footprint.

Proposed Conceptual Layout: Refers to the indicative location of key Proposal elements, as shown in Figure 2-2.

Revised Proposal: The Revised Proposal incorporates both the Approved Proposal and the Proposal.

Revised Development Envelope: Refers to the combined development envelope of the Approved Proposal and the Proposal, as shown in Figure 2-2.

Mining Restriction Zone (MRZ): Refers to a demarcated zone where no mining excavation is permitted. Only low-impact activities associated with environmental monitoring, management and implementation of contingency actions (if required) will be undertaken in this zone. No more than 20% of the MRZ can be cleared for low-impact activities.

Mining Exclusion Zone (MEZ): Refers to an area within the Revised Development Envelope where no direct disturbance is permitted except for activities that support monitoring, management and implementation of contingency actions (if required).

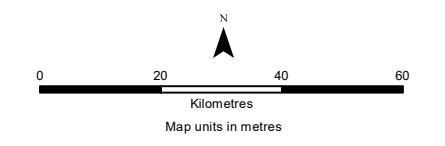
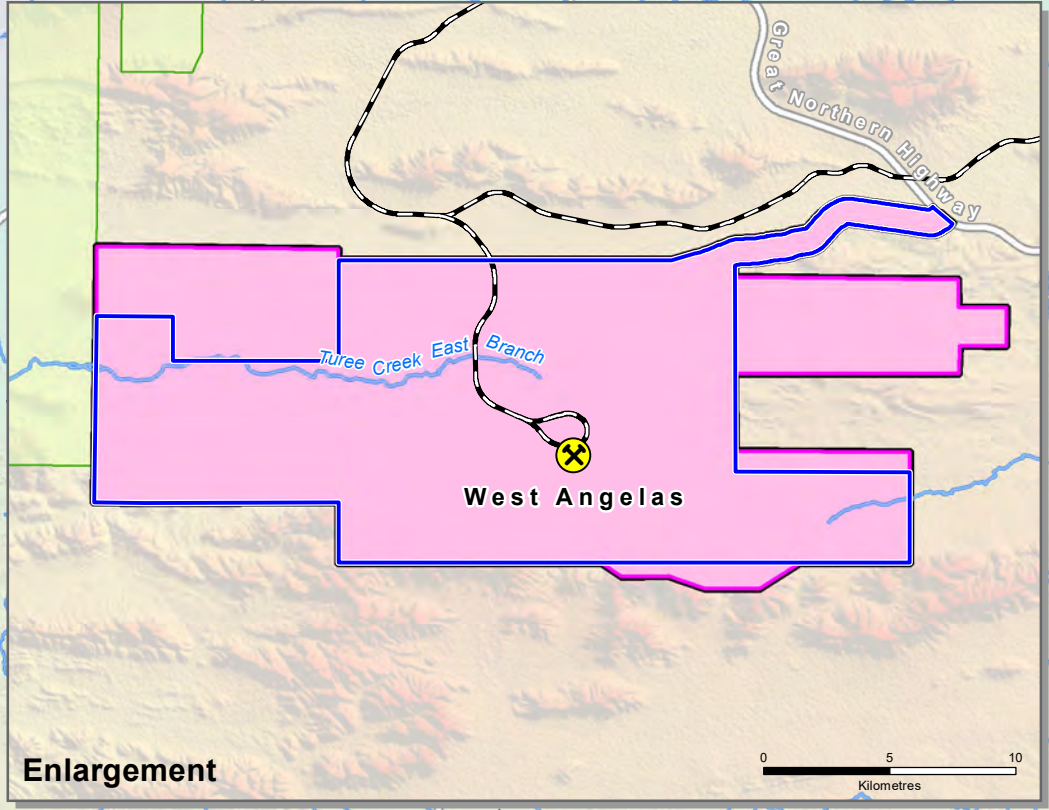
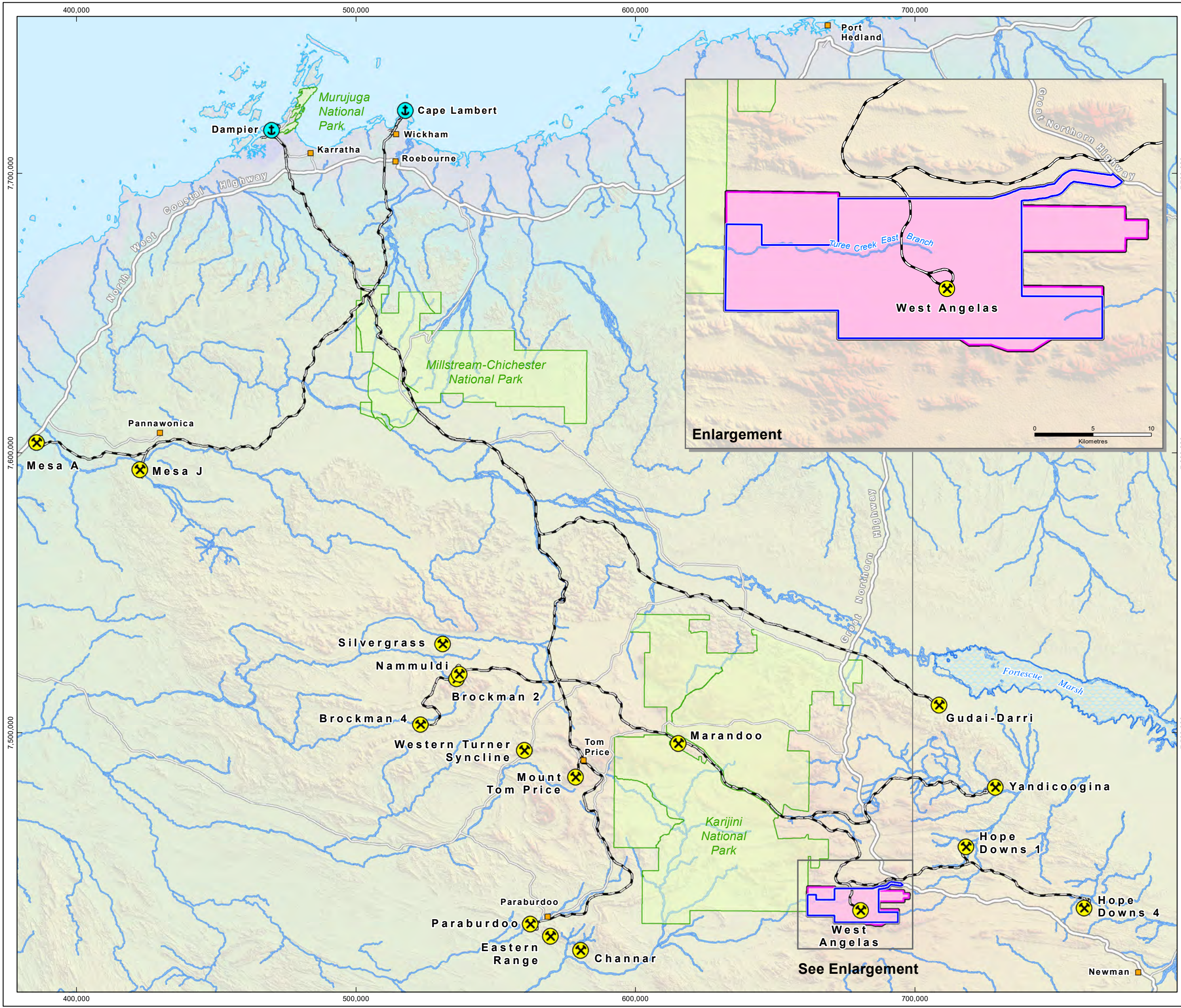
West Angelas Area: Includes the Revised Development Envelope and Survey Reference Areas (Deposit J and Mt Ella East) as shown on Figure 2-2.

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



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2. PROPOSAL

2.1. Proposal Content

The Proposal is located in the East Pilbara region of WA, approximately 130 km northwest of the township of Newman (Figure 1-1), and includes the development of new AWT and BWT mine pits (comprising four iron ore deposits: Western Hill, Deposit H, Deposit F North and Mt Ella East) and associated activities, which will extend the life of the existing West Angelas Iron Ore Project (Existing Operations).

In accordance with s.40AA of the EP Act, the Proposal represents a significant amendment to the Approved Proposal, and will be assessed in the context of the Existing Operations. Accordingly, this ERD details the combined effect that implementing the Approved Proposal and this Proposal may have on the environment.

Construction of the Proposal is planned to commence in 2025, with mining scheduled to start in 2026. Traditional open-cut mining by conventional drill and blast techniques will be used.

The Proponent proposes that subject to approval, a new consolidated MS for the Approved Proposal and this Proposal (collectively the 'Revised Proposal') will be published with implementation conditions that supersede those currently applicable to the Approved Proposal (MS 1113; Appendix A.3 Section 2.1.1).

2.1.1. Existing Operations

The Approved Proposal at West Angelas has an approved disturbance footprint of 12,205 ha within a 28,322 ha Approved Development Envelope.

The Approved Proposal is subject to the *Iron Ore (Robe River) Agreement Act 1964* (WA) and incorporates all activities approved under the current MS 1113 and earlier MS 514, MS 1015 and MS 970. This includes the following:

- Development of Deposits A and B and rail link to Cape Lambert (Figure 1-1) referred to the EPA under Part IV of the EP Act in 1997. The Minister approved the development in 1999 (MS 514)
- AWT mining of Deposit E and the discharge of surplus dewatering to the environment referred to the EPA in 2010 and were granted *Not Assessed*. A contemporised MS 970 was approved by the Minister in 2014, superseding the conditions of MS 514
- Development of Deposit A West and F referred to the EPA in 2014. The Minister approved the development in 2015 as an amendment to MS 970, subject to the conditions of MS 1015
- Development of Deposits C, D and G, referred to the EPA in 2017. The Minister approved the development in 2019, and it is subject to the conditions in MS 1113, which supersede the conditions of the previous Statements 970 and 1015.

The existing MS 1113, approved the following:

- Clearing of up to 12,205 ha within the existing 28,322 ha Approved Development Envelope
- Open cut AWT and BWT mining of iron ore from Deposits A, A West, B, C, D, E, F and G by conventional drill, blast, and load and haul techniques
- Ore processing in central processing facilities at approximately 35 million tonnes per annum (Mt/a) and overland transport of primary crushed ore, secondary crushing, screening and separating into lump and fines products
- Product stockpiling and train loadout
- Dewatering to allow BWT mining of pits
- Discharge of excess water to Turee Creek East in accordance with limitations as prescribed in MS 1113 (surface discharge extent will not extend within 2 km from Karijini National Park under natural no-flow conditions).

2.1.1.1. Shared Infrastructure

The Existing Operations at West Angelas include approved infrastructure that will be utilised for this Proposal, including but not limited to:

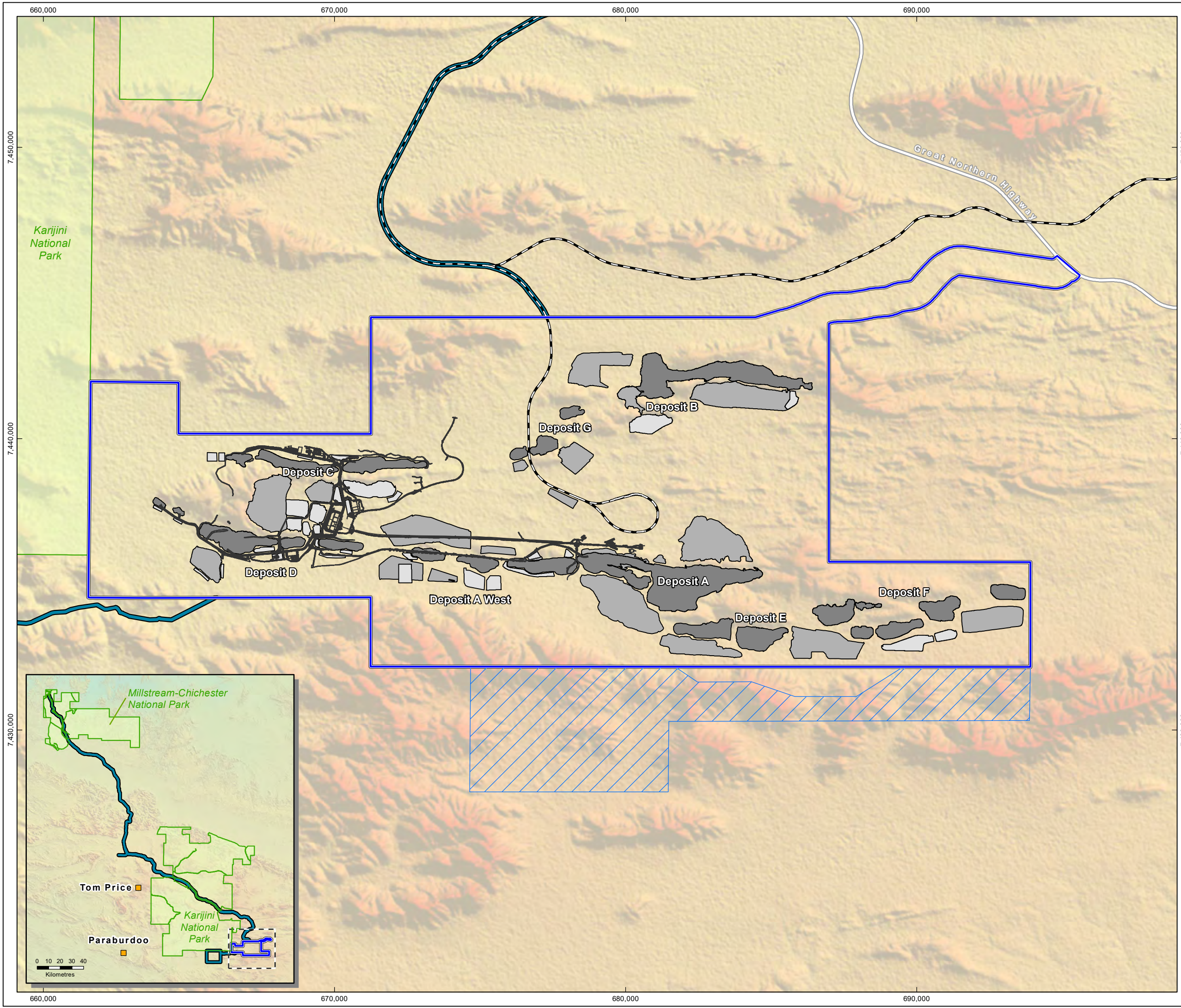
- Roads and haulage routes, including a private access road to the West Angelas Minesite off Great Northern Highway
- Administration buildings
- West Angelas Airport
- Dewatering and water supply borefields, including Turee Creek B Borefield and mine dewatering borefields
- Laydown yards
- Mobile and fixed plant equipment workshops (heavy and light vehicle)
- High voltage transmission lines to the site and reticulated power distribution network
- Processing facilities
- Surface water management infrastructure, including diversions to direct surface water flows around deposits
- Warehouses
- Wastewater treatment plants
- West Angelas and Wintamarra accommodation villages
- Linear infrastructure, including a 413 km rail network that transports processed ore from West Angelas to port facilities located at Cape Lambert
- Vehicle washdown areas
- Other supporting infrastructure.

The above infrastructure will continue to be operated in support of the development of the Proposal.

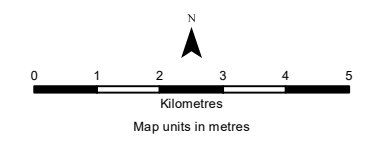
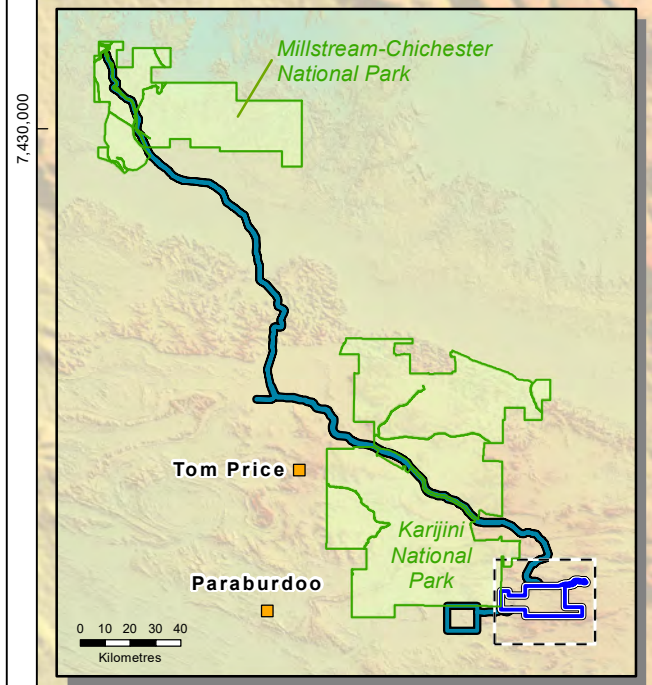
The approved conceptual layout as detailed in MS 1113 (pits and WRL) for the Approved Proposal at West Angelas, are shown in Figure 2-1.

Figure 2-1
Approved Conceptual
Layout within the Approved
Development Envelope

Drawn: GIS Team
Plan: PDE0186384v5
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



- Legend**
- Approved Development Envelope MS1113
 - Approved Development Envelope MS1113 Linear Infrastructure
 - Survey Reference Area
- Approved Conceptual Layout**
- Infrastructure
 - Pit
 - Waste Landform
 - Stockpile
- National Park
- Rio Tinto Railway
- Highway



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2.1.2. General Proposal Description

A summary of the Proposal and key elements which have the potential to have a significant effect on the environment are provided in Table 2-1. The Proposal's Revised Development Envelope is 36,779 ha. A total indicative disturbance of up to 5,350 ha is proposed in addition to the already approved 12,205 ha within the Revised Development Envelope (combined disturbance of 17,555 ha), as shown in Figure 2-2⁴.

The Proposal Content Document (PCD) is attached in Appendix A.4.

Table 2-1: General Proposal Description

General Proposal Description	
Proposal Title	West Angelas Revised Proposal
Proponent Name	Robe River Mining Co Pty Limited
Short Description	<p>The Proposal is located approximately 130 km northwest of Newman in the East Pilbara region of Western Australia. The Proposal is located within Yinhawangka and Ngarlawangga Peoples Native Title Determination Areas. The Proposal includes the development of AWT and BWT iron ore deposits and associated infrastructure including:</p> <ul style="list-style-type: none"> • Development of above and below water table mine pits at: • Associated activities which may include as relevant, but are not limited to, the following: <ul style="list-style-type: none"> ○ Mineral waste management: including WRL, 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 (ANFO) storage and laydown areas ○ Linear infrastructure including heavy and light vehicle access roads, rail and associated infrastructure, conveyors, utilities 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 below water table mining and associated infrastructure (including bores and pipelines) ○ Infrastructure for management and use of water from dewatering • Offices and accommodation villages • Renewable energy including renewable energy generation, energy storage and associated ancillary infrastructure

⁴ The change to the area of the proposed Revised Development Envelope between referral (39,862 ha) and ESD (41,484 ha) was due to an increase in the Approved Development Envelope, approved via S45C of the State EP Act post referral and prior to ESD lodgement in relation to the Managed Aquifer Recharge area. Subsequently, the extension areas for the Proposal were modified via a Section 43A (of the State EP Act) after consultation with Traditional Owners such that the Revised Development Envelope is 36,779 ha. Referred Development Envelope under EPBC Act was 39,851 ha, amended to 36,779 ha via an application under Section 156A of the EPBC Act.

2.1.3. Clearing Limits

Clearing of up to 12,205 ha of native vegetation is approved under existing MS 1113. This Proposal is seeking approval for 5,350 ha of additional clearing to support the proposed mining of the additional (Proposal) Deposits.

Table 2-2 presents the approved clearing and the additional clearing for the Proposal.

Table 2-2: Clearing to support this Proposal

Element	Approved Limit	This Proposal	Revised Proposal
Total Clearing	12,205 ha	5,350 ha	17,555 ha
Revised Development Envelope	28,322 ha	8,457 ha ⁵	36,779 ha

2.1.4. Proposal Elements

The Proposal will involve clearing an additional 5,350 ha of native vegetation (in addition to the 12,205 ha currently authorised under MS 1113) within a Revised Development Envelope of 36,779 ha (Figure 2-2 and Table 2-3).

⁵ Additional Development Envelope; some elements of the Proposal are located outside of the Proposal Development Envelope, within current Approved Development Envelope

Table 2-3: Proposal Elements that have the Potential to have a Significant Effect on the Environment

Element	Location	Approved Proposal Extent (MS 1113)	Proposal	Revised Proposal
Physical Elements				
Mine and associated infrastructure	Figure 2-2	<p>Clearing of no more than 12,205 ha within a 28,322 ha Mine Development Envelope including:</p> <ul style="list-style-type: none"> No clearing within Ghost Bat Cave AA1, WA-13, WA-21 and WA-23 Exclusion Zones No clearing within the West Angelas Cracking Clay Priority Ecological Community (PEC-2015-5) No more than 20 ha of clearing to other representations of the West Angelas Cracking Clay Priority Ecological Community No more than 25 ha of clearing of riparian vegetation No clearing of Hilltop, Hillslope, Ridge or Cliff habitat for the Managed Aquifer Recharge Scheme infrastructure No clearing of: <ul style="list-style-type: none"> Water features - WMAR-01 and WMAR-03 Caves - CMAR-02, CMAR-03 and CMAR-04 Clearing of no more than 0.6 ha of Major Drainage habitat for the Managed Aquifer Recharge scheme infrastructure Below water table pits are to be backfilled to a level to prevent the formation of permanent pit lakes 	<p>Clearing up to an additional 5,350 ha within a 36,779 ha Revised Development Envelope:</p> <ul style="list-style-type: none"> No direct impacts to Deposit H Waterhole No more than 2 ha of other representations of West Angelas Cracking Clay Priority Ecological Community (Section 8) No more than 35 ha of clearing of riparian vegetation (Section 8) No direct disturbance to Ghost bat roosts listed in Table 9-22 (Section 9) 	<p>Clearing no more than 17,555 ha within a 36,779 ha Revised Development Envelope, including:</p> <ul style="list-style-type: none"> No clearing within Ghost Bat Cave AA1, WA-13, WA-21 and WA-23 Exclusion Zones No direct disturbance to Ghost bat roosts listed in Table 9-21 (Section 9) No clearing within the West Angelas Cracking Clay Priority Ecological Community (PEC-2015-5) No more than 22 ha of clearing to other representations of West Angelas Cracking Clay Priority Ecological Community No more than 60 ha of clearing of riparian vegetation No clearing of Hilltop, Hillslope, Ridge or Cliff habitat for the Managed Aquifer Recharge Scheme infrastructure No clearing of: <ul style="list-style-type: none"> Water features - WMAR-01 and WMAR-03 Caves - CMAR-02, CMAR-03 and CMAR-04 Clearing of no more than 0.6 ha of Major Drainage habitat for the Managed Aquifer Recharge scheme infrastructure

Element	Location	Approved Proposal Extent (MS 1113)	Proposal	Revised Proposal
				<ul style="list-style-type: none"> No direct impacts to Deposit H Waterhole Below water table pits are to be backfilled to a level to prevent the formation of permanent pit lakes
Linear Infrastructure	Figure 2-2	<p>A 413 km rail network transports processed ore from West Angelas to port facilities located at Cape Lambert</p> <p>Clearing no more than 1,500 ha within a 19,400 ha Linear Infrastructure Development Envelope, including:</p> <ul style="list-style-type: none"> Five existing sidings (Spoonbill, Bellbird, Rosella, Brockman Refuge and Emu) and potential additional sidings to support the rail network Turee Creek B Borefield, pipeline, powerline, access roads and other associated infrastructure 	Not applicable	<p>No change</p> <p>A 413 km rail network transports processed ore from West Angelas to port facilities located at Cape Lambert</p> <p>Clearing no more than 1,500 ha within a 19,400 ha Linear Infrastructure Development Envelope, including:</p> <ul style="list-style-type: none"> Five existing sidings (Spoonbill, Bellbird, Rosella, Brockman Refuge and Emu) and potential additional sidings to support the rail network Turee Creek B Borefield, pipeline, powerline, access roads and other associated infrastructure
Operational Elements				
Surplus water management	NA	<p>Dewatering water will be used on-site in the first instance to supply water for operational purposes</p> <p>Surplus dewatering water, exceeding the operational requirement, is discharged to a local ephemeral tributary of Turee Creek East</p> <p>The surface discharge extent will not extend within 2 km of the boundary of Karijini National Park under natural no-flow conditions</p>	<p>Additions:</p> <ul style="list-style-type: none"> Option for temporary storage of surplus water in disused mine pits and potential Infiltration to the aquifer Use in Managed Aquifer Recharge Project Provision of surplus water for use by others 	<p>Dewatering water will be used on-site in the first instance to supply water for operational purposes. Use of surplus water may include:</p>

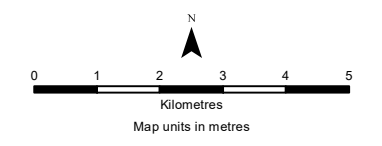
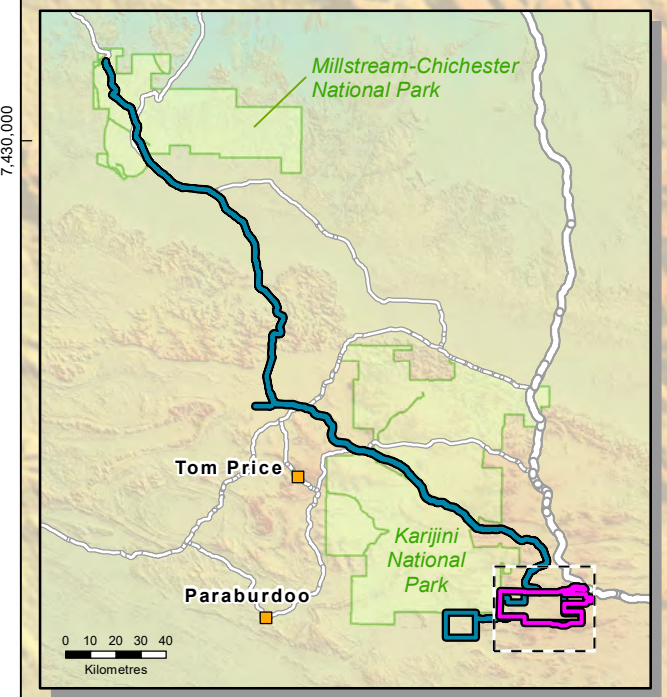
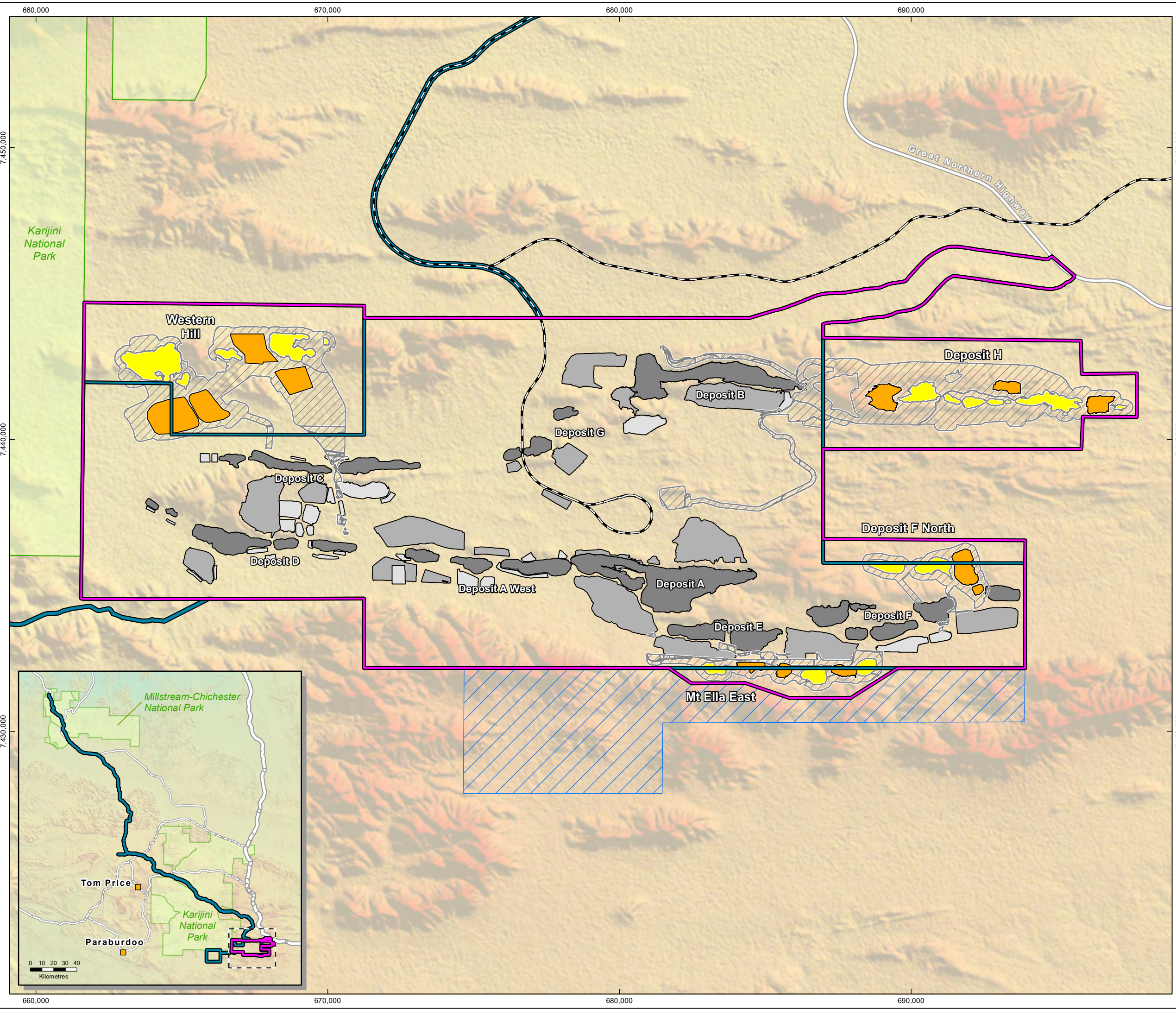
Element	Location	Approved Proposal Extent (MS 1113)	Proposal	Revised Proposal
				<ul style="list-style-type: none"> • Use in processing • On-site other use • Options for temporary storage in disused mine pits • Infiltration to the aquifer • Use in Managed Aquifer Recharge Project • Provision to other users <p>Surplus dewatering water exceeding the operational requirement is discharged to a local ephemeral tributary of Turee Creek East</p> <p>The surface discharge extent will not extend within 2 km of the boundary of Karijini National Park under natural no-flow conditions</p>
Proposal Elements with Greenhouse Gas Emissions				
Annual average emissions				
Scope 1	Diesel and land clearing – 54,550 t CO ₂ -e pa			
Scope 2	Electricity – 8,985 t CO ₂ -e pa			
Scope 3	8.9 Mt CO ₂ -e pa			
Rehabilitation and Closure				
<p>The key closure outcome is to rehabilitate the site to create a safe, stable, non-polluting landscape consistent with the post-mining land use and maintain environmental and cultural heritage values</p> <p>Rehabilitation and closure activities will be carried out in accordance with the approved Mine Closure Plan (MCP)</p>				
Other Elements that Affect the Extent of Effects on the Environment				
Proposal Time	Maximum project life	The operational phase is estimated at ~ 15 years (not including construction and closure implementation phases)		

Figure 2-2
Revised Development Envelope
and Indicative Location
of Key Proposal Elements

Drawn: GIS Team
Plan: PDE0186387v7
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Approved Development Envelope 1113 - Linear Infrastructure
- Survey Reference
- Conceptual Footprint**
 - Conceptual Pit
 - Conceptual Waste Landform
 - Conceptual Associated Mine Disturbance
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - Stockpile
- National Park
- Rio Tinto Railway
- Highway
- Major Road



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2.1.5. Detailed Proposal Description

2.1.5.1. Native Vegetation Clearing and Topsoil Removal

Clearing up to 5,350 ha of additional native vegetation is proposed within the 36,779 ha Revised Development Envelope. Clearing vegetation occurs through all phases of the Proposal (construction / implementation, operation and closure) due to the long timeframe of iron ore mining operations.

Topsoil and subsoil will be recovered as part of clearing activities. Topsoil is essential in successful rehabilitation relative to subsoil or overburden material. It contains a natural seed bank and typically contains significant organic material and nutrients. Topsoil layers in the Pilbara, including in the Revised Development Envelope, are highly variable in thickness, ranging from minimal soil development on rocky areas to approximately 300 mm in valley areas. Stripped topsoil and subsoil will be stored, when necessary in out-of-pit stockpiles for later use in rehabilitated areas (following existing management systems).

2.1.5.2. Mining

The Proposal includes the development of open-cut AWT and BWT pits as outlined in Section 2.1.4.

Mining is anticipated to involve conventional drill, blast, load and haul techniques whereby the blasted material will be excavated and loaded into haul trucks (i.e., bulk mining methods). Mining equipment would include excavators, haul trucks, drill rigs, bulldozers, water trucks, service trucks and graders. Ore from the pits would be transferred by truck, road train or conveyor to run-of-mine (ROM) stockpile pads for dry crushing and processing at existing operations. Resource definition and development activities to support mining are included within the scope of mining the deposits.

In line with relevant Australian standards, explosives magazines would store explosives for open pit blasting activities.

Approved and proposed AWT and BWT pits within the Revised Development Envelope are detailed in Table 2-4 and shown in Figure 2-2

Table 2-4: Approved and Proposed Pits within the Revised Development Envelope

Type	Approved Pits/Deposits	Proposed Pits/Deposits
AWT Only	N/A	Western Hill, Mt Ella East
AWT and BWT	Deposits A, B, C, D, E, F, G	Deposit H and F North

2.1.5.3. Waste Rock Management

Waste rock material generated by the Proposal will be stored in designated WRL (WRLs), to be located out-of-pit, as shown on Figure 2-2. Waste rock will also be used to construct land bridges and dry waste fines material will also be stored in and out of pit (Section 2.1.5.6). Additionally, opportunities for progressive backfilling of pits will be investigated as mine planning becomes further advanced. Other waste rock management infrastructure includes low grade ore stockpiles, topsoil and subsoil stockpiles.

The ultimate design of permanent WRL will ensure landforms are geotechnically stable and safe over the long term. Permanent WRLs will be rehabilitated in line with closure requirements.

Several factors are taken into consideration for the locations of permanent WRLs; these include but are not limited to the following:

- Minimising the potential impact on known environmental and social values
- Waste rock characterization, including erosion and acid and/or metalliferous drainage (AMD) potential
- Minimising the economic haul distance
- Avoiding the areas with potential future economic resource potential
- Allowing for future battering to achieve ultimate WRL stability at closure
- Allowing for contingency mine pit cutbacks in the event pit wall stability is compromised.

2.1.5.4. Mineral Waste Management

Rio Tinto operations in the Pilbara manage and reduce the risk of AMD by implementing provisions included in the MCP (Appendix A.5).

Most rock types at the West Angelas Mine generally have a low AMD risk. Consistent with existing operations, most rock types associated with the Proposal deposits are classified as Non-acid forming (NAF) or Uncertain and have a low AMD risk. Lithologies with moderate AMD risk may occur; however, most lithologies are expected to pose a low AMD risk and not require active management during operations and closure.

If potential acid-forming (PAF) materials are encountered, management will include encapsulation within ex-pit WRLs in the first instance. Other opportunities, such as in-pit and BWT dumping, will be investigated if they become available. Further detailed designs will be undertaken to support subsequent revisions of the MCP (Appendix A.5).

NAF mineral waste may be utilised to construct ROM pads and/or land bridges. Alternatively, mineralised stockpiles (in and ex pit) may be used temporarily or permanently to store materials that do not meet current product strategy specifications. This material may be processed where strategies change over time.

2.1.5.5. Linear Infrastructure

Ore will be transported to existing processing facilities at West Angelas via existing and proposed conveyor, haul trucks and/or road trains. The Proposal includes utilisation of existing infrastructure linking the Proposal to the Existing Operations. New infrastructure is required to connect the new pits to the existing infrastructure, including, but not limited to:

- Heavy vehicle and light vehicle access roads
- Overland conveying systems
- Powerline realignments and associated power distribution network
- Water supply pipelines
- Communications infrastructure
- Other linear infrastructure as required.

2.1.5.6. Processing Facilities

The Proposal utilises existing ore handling and processing infrastructure at the West Angelas Operations. In addition to utilising existing ore handling and processing infrastructure, the Proposal may include the construction of the following facilities:

- Primary crushing at deposits to allow conveying of ore to the central processing plant
- ROM pads and blending stockpiles
- Concentrators
- Modifications to the existing processing facilities
- In-pit waste fines storage.

2.1.5.7. Non-mineral Waste Management

The Proponent has existing systems and procedures at the site to collect and recycle waste streams, such as hydrocarbon wastes (oil, drums, rags, filters, etc.), tyres, batteries, scrap metal and conveyor belting. These existing systems will be used for the Proposal. Hazardous wastes will be collected and removed for treatment by licensed contractors.

2.1.5.8. Water Management Strategy

Rio Tinto's overarching water management strategy and surplus use hierarchy is outlined in Figure 2-3. The water management hierarchy requires surplus water to be used preferentially for:

- Required mitigation demand, then
- Operational use, then
- Storage for later operational use (e.g., in completed pits or suitable formations), then
- Controlled discharge of surplus water is the last management option.

Existing Operations currently manage water according to the water management hierarchy and discharge surplus water to Turee Creek East in accordance with MS 1113. The Proposal includes BWT mining at Deposit H and Deposit F North, which will require dewatering to access ore safely.

Predicted dewatering volumes for the Existing Operations and the Proposal will initially exceed operational water demand; however, as mining progresses into later years of the Life of Mine (LOM), water demand exceeds dewatering volumes. The water management strategy will be applied to the Proposal to ensure water is used appropriately.

Water is currently managed via a hub-based approach, with all mining areas being connected by pipelines as appropriate to enable flexibility in water management across the Revised Development Envelope. This flexibility will reduce the requirement for surplus water discharge and result in better environmental outcomes.

The key elements of the water management strategy are:

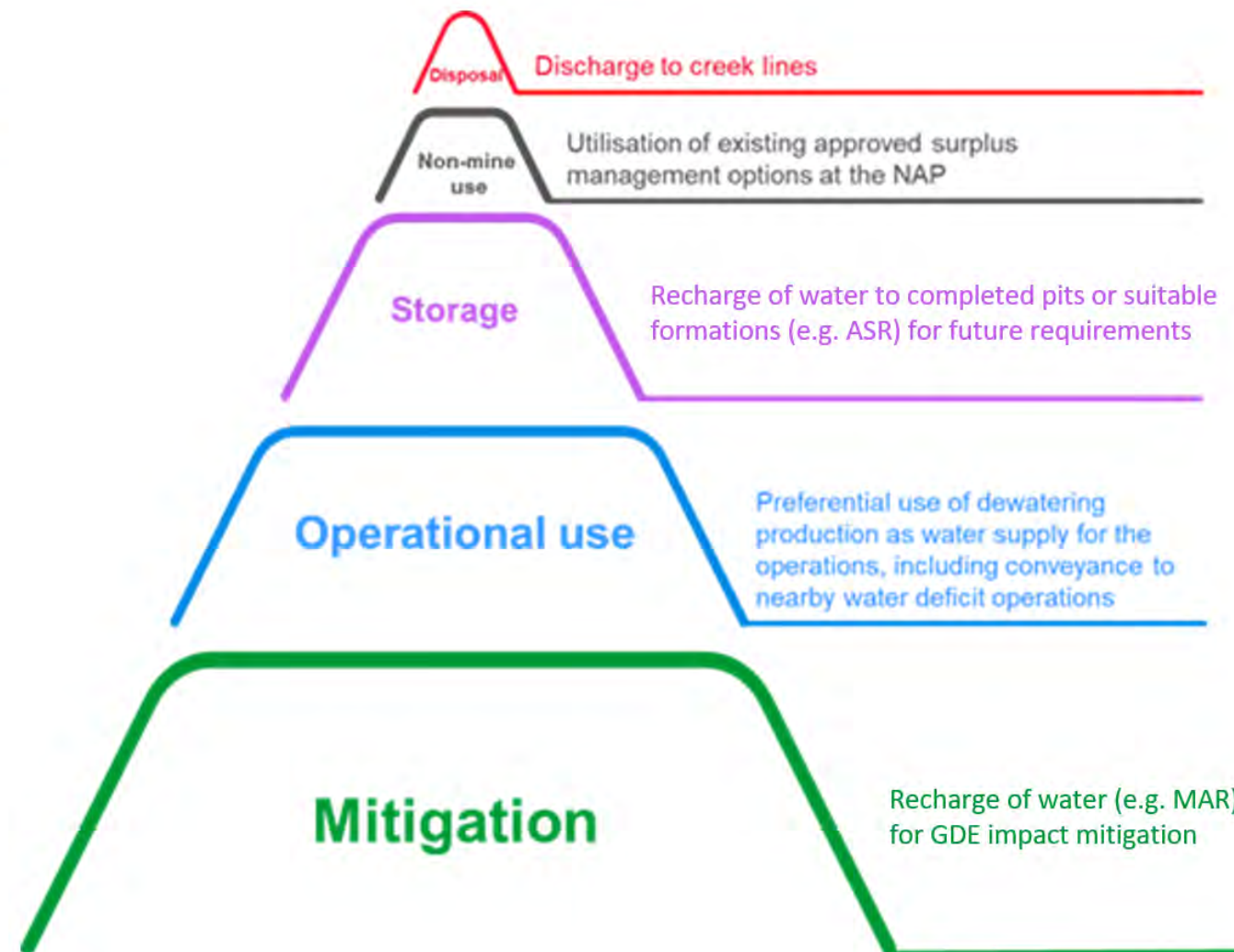
- Reduce surpluses where practicable with mine scheduling and efficient dewatering design
- Water supply to the West Angelas Mine Aquifer Recharge (MAR) Scheme
- Preferential use of water for operational purposes such as processing and dust suppression
- Include flexibility to transfer water between mining areas to meet operational demands
- Preferential temporary storage within completed mine pits for later operational use minimises surplus water discharge to the environment
- Utilise the existing Turee Creek East discharge points for periodic discharge. Periodic discharge to Turee Creek East is anticipated to be required until around 2030.

This water management strategy includes the following mitigation measures:

- Avoids discharge to creeks not previously used for discharge
- Utilises existing discharge locations
- Avoids continuous discharge to Turee Creek East
- Minimises water losses during the surplus period through use of pit voids for storage where appropriate.

Overarching strategy

- Management of operational water surplus and deficits
- Reduce surpluses where possible with mine scheduling and efficient dewatering
- Adopt a hierarchy of use
- Protection of heritage and environmental values.
- Minimise closure obligations, including meeting stakeholder expectations around impact mitigation



2.1.5.9. Surface Water Management

The Proposal's deposits are located within two regional catchments: Turee Creek East and Weeli Wolli Creek. The Western Hill and Mount Ella East deposits are located within the Turee Creek East catchment, whilst Deposits F North and H are in the far upper reaches of the Weeli Wolli Creek catchment. Mine development as part of the Existing Operations has resulted in hydrological changes through reduction of flows and catchment diversions; however, catchment connectivity has been retained with general east-west water movement across the site to Turee Creek East, which delivers ephemeral surface flows to Karijini National Park to the west (Figure 2-7).

Most infrastructure will be located outside the creeks' floodplains within the Revised Development Envelope. The Proposal includes a number of diversions to sub-catchments and minor creeklines for the purposes of directing natural catchment runoff away from disturbed areas, including mining areas and WRL. This is a recommended practice (e.g. DOW 2010) and avoids the need to control, treat and discharge large volumes of potentially affected stormwater runoff.

Diversion of surface water flows to an ephemeral creekline at Deposit H is proposed to maintain flows to culturally significant Deposit H Waterhole and will be designed and constructed in consultation with Traditional Owners. At closure, operational diversions will either be removed or replaced with permanent surface water diversions. This will be determined in consultation with the Traditional Owners.

Surface water management infrastructure will be designed to minimise erosion and downstream sedimentation risks.

2.1.5.10. Support Facilities

The Proposal will largely utilise existing supporting facilities at the existing West Angelas operations, which may be upgraded as required. The Proposal includes, but is not limited to, the following additional support infrastructure and facilities as required:

- Heavy and light vehicle workshops
- Fixed plant workshops
- Hydrocarbon storage
- Refuelling facilities
- Oily water treatment facilities
- Park-up/lay down areas
- Administration and crib facilities
- Waste management facilities
- Emergency fire services.

2.1.5.11. Power Supply

Power will be supplied by existing 33 kV transmission lines and additional substations. Transformers and switchgear equipment will be required to support new crush, convey and dewatering infrastructures. Overhead power lines will be extended and re-aligned to support mine operations. Diesel generators may be required to power dewatering bores. Power may also be supplied through renewables, including the construction of new renewable (solar) power projects and associated power supply infrastructure.

2.1.5.12. Railway Corridor

No change to the rail network or its operation is required for the Proposal, and the West Angelas Iron Ore Project Linear Infrastructure Development Envelope as outlined in MS 1113 remains unchanged.

2.1.5.13. Accommodation

The operational workforce will be accommodated in existing West Angelas accommodation villages. Temporary construction accommodation may be required to accommodate the construction workforce and will be located in disturbed areas, where possible, to minimise the clearing of native vegetation and fauna habitat.

2.1.6. Proposal Exclusions

The scope of the Proposal subject to assessment under Part IV of the EP Act excludes:

- Low impact activities that are required to refine the Proposal and inform the Part IV assessment, including but not limited to drilling and associated activities for resource evaluation, geotechnical assessment and hydrogeological investigations. These activities will be subject to the relevant provisions under Part V of the EP Act and the *Rights in Water and Irrigation Act 1914* (RiWI Act)
- The existing accommodation camp and associated activities
- Activities that are part of, or are required to support the existing approved mining operations at West Angelas, as approved under MS 1113 and EPBC 2018/8299.

Current operational activities are authorised via statutory environmental approvals under Part IV and Part V of the EP Act (MS 1113), the RiWI Act, and EPBC 2018/8299. The Proponent notes that whilst the Proposal is under assessment, additional approvals or amendments to existing approvals that do not relate to the implementation of this Proposal may be required to support the continuation of Existing Operations. Therefore, the above exclusions are not limited to only those activities already approved but also to activities authorised by existing approvals as they may be amended (including under s45C of the EP Act).

2.1.7. Approach to Impact Assessment

The Proponent has defined the Revised Development Envelope, which contains all of the Proposal's construction and operational activities and the full scope of predicted direct impacts.

A Conceptual Footprint has been created, representing the approximate location of the Proposal's maximum amount of disturbance. The Proposal's final footprint will be restricted to within the Revised Development Envelope.

Iron ore mines can operate over many years, and pits, WRLs and infrastructure requirements can change over time as they are subject to market influences/conditions, the overarching portfolios of other mines, the desired ore blend, business requirements, legal agreements, customer demand and the need for flexibility to take into account environmental and heritage information for adaptive management and optimal environmental and social outcomes. Also, as new technology and advances occur, changes may be required to enable improved mining and infrastructure practices.

In order to allow for a full environmental impact assessment (EIA) of the Proposal and enable the flexibility to implement the Proposal, the entire Revised Development Envelope has been assessed for mining activities and surveys undertaken following EPA guidance. Where significant environmental or cultural heritage areas are present within the Revised Development Envelope, MRZ and/or MEZs have achieved the EPA's objectives, including outcome or management-based conditions or management plans.

Therefore, the activities of this Proposal can occur at any location within the Revised Development Envelope up to the authorised extents, subject to the proposed MRZs and/or MEZs and other disturbance or other limits as proposed in conditions or management plans.

2.1.7.1. Mining Exclusion Zones (MEZ) and Mining Restriction Zones (MRZ)

MEZs are defined as areas within the Revised Development Envelope where no direct disturbance is permitted except for activities that support monitoring, management and implementation of contingency actions (if required) including as outlined in an approved Environmental Management Plan (EMP).

MRZs are defined as areas within the Revised Development Envelope where no mining excavation is permitted. Only low impact activities may be implemented with disturbance up to 20% of the MRZ surface affected, which support monitoring, management and implementation of contingency actions (if required) including as outlined in an approved EMP.

The Proponent has established MEZs and MRZs around all category 2, 3 and apartment block caves, and retained category 4 caves throughout the Revised Development Envelope to ensure these Ghost Bat roosts are protected from direct impacts from the Proposal. The proposed MEZ areas immediately surround the protected cave and a MRZ is located on the outside of the MEZ as additional protection.

MEZs and MRZs have been established around 17 of the 21 caves identified during recent surveys, with the potential to be impacted by the Proposal. In addition, 20 previously identified caves are currently protected within the Approved Proposal. In total 37 of the 41 caves within the Revised Development Envelope will be retained and protected.

MEZ and MRZ form part of the PCD (Appendix A.4) and are shown on Figure 2-4.

2.2. Proposal Alternatives

2.2.1. Justification of the Proposal

The Proponent supplies the global market with iron ore from the Pilbara and progressively seeks to develop resources within tenure, environmental and social constraints. The Proposal is required as part of the long-term plan to sustain iron ore production from Rio Tinto's Pilbara operations.

The Proposal is the most suitable option to sustain the current iron ore production from the existing West Angelas operations whilst also optimising the use of existing processing facilities and accommodation. Implementation of the Proposal will extend the life of the existing operations for approximately 15 years.

The Proposal will result in economic benefits for Australia and WA through:

- Contribution to the value of mineral exports
- Royalties and taxation payments
- Development and ongoing sustaining capital investment
- Sustaining direct and indirect employment opportunities in the region
- Sustaining demand for goods and services supporting the national, state and local economy.

The ongoing activities of the Proponent, and more broadly Rio Tinto, in the Pilbara will continue to support social and economic development projects, including:

- Continued education, training, employment and business opportunities for local people, including local Aboriginal people
- Continued funding for various regional organisations, including sporting and cultural groups.

The Proposal will continue to use Rio Tinto's existing infrastructure, including ports and railway, power, communications and road networks. This will reduce the extent of new infrastructure required and result in a smaller disturbance footprint than would otherwise be required for a greenfield project of this scale.

2.2.2. Consideration of Alternatives

The location of the economic orebodies defines the location of the Proposal. No alternative iron ore deposits have been identified as suitable for development within the timeframe required to maintain the type of iron ore product and the efficiency of the Approved Proposal, including associated infrastructure.

However, the Proposal design and scope have been optimised to minimise environmental and social impacts through various considerations such as design, layout, sequence, technologies and mitigation strategies. These considerations are described throughout this ERD. The approach to avoiding and mitigating impacts through developing the final project scope, Revised Development Envelope and Conceptual Footprint is described below.

2.2.2.1. Modifications to Project Scope

Western Hill

Mining at the Western Hill deposit within this Proposal has been restricted to AWT only in recognition of the value of groundwater within Karijini National Park. BWT ore is known to be present at Western Hill; however, to avoid potential impacts on groundwater near Karijini National Park, AWT mining is only proposed at this site in this Proposal.

Mt Ella Songline and Deposit J

Social Surroundings consultation undertaken with Yinhawangka and Ngarlawangga People in 2021 and 2022 has separately identified that the Mt Ella hill range is of important cultural significance with an ethnographic feature known as a Songline running along the mountain range. It was identified that this Songline feature extended beyond the Mt Ella area and is important to the wider Traditional Owner community.

Deposit J interacts with the identified Songline and hence has been removed from the scope of this Proposal (Figure 2-4). The Revised Development Envelope was amended via a Section 43A application based on advice from Yinhawangka People concerning the Social Surroundings EPA factor.

The consultation will continue regarding the ethnographic cultural value, boundary, and management for the Songline running along the Mt Ella hill range. It is plausible that amendments to mine plans, including pit design changes, alternate access routes or removal of deposits and amendments to the Revised Development Envelope, may occur because of this ongoing consultation throughout the life of the Proposal.

Mt Ella Marnta

Social Surroundings consultation undertaken in 2021 and 2022 has identified that the Mt Ella marnta (hill range and Mt Ella) is of important significance with a Songline running along the mountain range that is important to Ngarlawangga people and the neighbouring Traditional Owner groups. Ngarlawangga People advised that no proposed mining activity will be acceptable within the Mt Ella marnta and that this should be removed from mine plans and the Proposal's Revised Development Envelope. Following advice from Ngarlawangga People, the two most eastern pits at Mt Ella East have been removed from the Proposal (Figure 2-4). The Revised Development Envelope was amended to exclude the Mt Ella marnta area via a Section 43A application. Consultation with the Ngarlawangga People about the management of the marnta is ongoing.

Significant Biological Values

Mine planning is iterative, with environmental and heritage constraints being considered from pre-feasibility until final design. Mine planning starts with fully developing mineral resources and waste rock placement in the nearest suitable landform. The mine plan is overlaid on the environmental and heritage constraints mapping to refine the plan. This process is repeated as resource definition, environmental and heritage investigations, and feasibility studies progress.

Several pit designs, WRL designs, and locations were evaluated for the mine planning process. The Proposal has been designed to avoid and minimise direct and indirect impacts of the following values:

- Category 2 Ghost Bat roosts – mine design was amended during the design phase to avoid direct impacts to caves CWAN-04, 06 and 07
- Important habitat for significant terrestrial fauna and MNES species (specifically for Ghost Bat, Pilbara Leaf-nosed Bat, Northern Quoll and Pilbara Olive Python) through the introduction of a habitat MRZ at Western Hill Priority flora species – mine design amendments resulted in reduced impacts to P2 and P3 species.

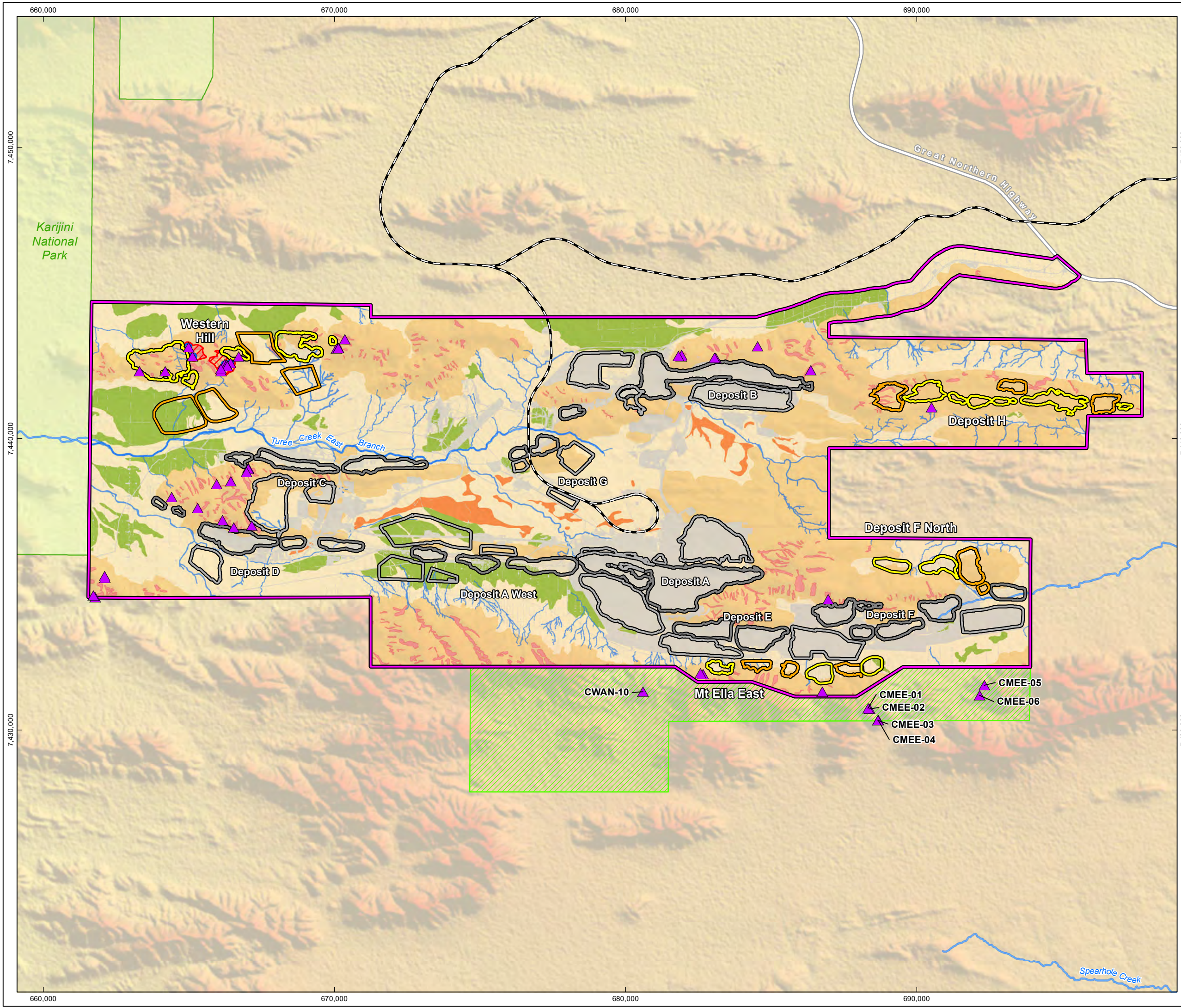
Closure and Rehabilitation

Yinhawangka and Ngarlawangga People have expressed their desire to see all pits backfilled and for WRL and other mining-related landforms to not remain within the landscape and the Proponent has been working with both groups on this topic. The Proponent has discussed that while mine design backfill opportunities and specific requests for bespoke backfilling will be considered, backfilling on a Pilbara-wide, entire mine scale will not be practicable. Options for bespoke backfilling at selected pits has been consulted with Traditional Owners.

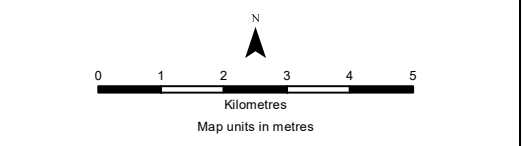
Table 2-5 details further alternatives and options for the Proposal.

Figure 2-4
Changes to the Development Envelope
to Avoid Significant Cultural and
Environmental Values

Drawn: A.D.
Plan: RTIO-0979085v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - Caves avoided as a result of amendment
 - Critical and Supporting Habitat avoided as a result of amendment
 - Mining Exclusion Zone
 - Mining Restriction Zone
 - Critical Fauna Habitat**
 - Gorge/Gully
 - Hillcrest and Hillslope
 - Other Fauna Habitat**
 - Cracking Clay
 - Drainage Line
 - Footslopes and Plains
 - Mixed Acacia
 - Disturbed
 - National Park
 - Rio Tinto Railway
 - Highway
 - Major Creek



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Table 2-5: Consideration of Alternatives

Change Made and Reference Number in Figure 2-4	Outcome Achieved
<p>1. Reduce the Revised Development Envelope by 4,705 ha (decreasing from 41,484 ha to 36,779 ha; 11%)⁶.</p> <p>Reduce clearing related to the Proposal from 7,200 to 5,350 ha (approximately 25%)</p>	<p>Flora and Vegetation</p> <ul style="list-style-type: none"> • A decrease in the extent of the proposed clearing of native vegetation of 1,850 ha • Reduction in the extent of impact on Priority flora species • Reduction of impact to high local significance vegetation communities, including 108 ha of riparian vegetation and 1,700 of vegetation type H15 <p>Terrestrial Fauna (and corresponding MNES)</p> <ul style="list-style-type: none"> • A decrease in the clearing of terrestrial fauna habitat of 1,850 ha • Avoidance of approximately 3,269 ha of critical Gorge/Gully and Hillslope/Hillcrest (breeding, denning and roosting) habitat for significant fauna species (Northern Quoll, Ghost Bat and Pilbara Olive Python), which is being removed from the originally referred development envelope • Avoidance of approximately 1,363 ha of supporting (foraging and dispersal) habitat for MNES species, which is being removed from the originally referred development envelope • Avoidance of seven caves (one category 2, one category 3 and five category 4 Ghost Bat roosts) located within the Mount Ella East deposits and Deposit J, which are being removed from the originally referred development envelope <p>Social Surroundings</p> <ul style="list-style-type: none"> • Avoidance of potential impacts to the 'Range' cultural heritage value from the removal of the two eastern most proposed pits and associated waste landforms at Mt Ella East and corresponding amendment the Revised Development Envelope in this area • Minimisation of impacts to the 'Range' cultural heritage value from the redesign of retained pits and associated waste landforms at the Mount Ella East deposit to limit their southern extent and corresponding amendment the Revised Development Envelope in this area • Avoidance of potential impacts to the 'Range' cultural heritage value from the removal of proposed development at Deposit J, and corresponding amendment the Revised Development Envelope in this area

⁶ Note: **Referral under the State EP Act** - the Revised Development Envelope change between referral (39,862 ha) and ESD (41,484 ha) was due to an increase in the existing Approved

Change Made and Reference Number in Figure 2-4	Outcome Achieved
2. Limit mining to AWT only at Western Hill	<ul style="list-style-type: none"> • Avoid the need to dewater pits and manage and/or discharge surplus water at Western Hill • Mining has been limited to AWT at Western Hill Deposit for this Proposal in recognition of values associated with groundwater within Karijini National Park
3. Complete or partial backfilling of mine pits at the end of the mining (entire Revised Development Envelope)	Reduce number, size and volume of permanent WRL's at closure. This minimises long term changes to visual amenity and surface runoff. Backfill of BWT pits to prevent the formation of pit lakes will be undertaken as required by MS 1113.
4. Alternative surplus water management options proposed: Temporary in-pit storage (entire Revised Development Envelope)	In consideration of Traditional Owner views, no pit-lakes will be formed within the Revised Development Envelope due to this Proposal. Maximise operational use of surplus mine dewatering in accordance with the water use hierarchy and minimise impact on the environment.
5. 17 Ghost Bat cave MEZ and associated MRZ established	Protection of all category 2, 3 and apartment block caves, and retained category 4 caves (not identified to be impacted) throughout the Revised Development Envelope to ensure these Ghost Bat roosts are protected from direct impacts from the Proposal.
6. Two critical habitat MRZs established around category 2 and apartment block caves and critical adjacent supporting habitat in the Western Hill area	Protection of critical adjacent supporting habitat in the Western Hill area.

Development Envelope, approved via S45C (of the State EP Act) post referral approved on 25 May 2021 and prior to ESD lodgement. The Development Envelope was subsequently amended via S43A application to 36,779 ha in relation to feedback from Traditional Owners. **Referral under the Cth EPBC Act** – referred Development Envelope was 39,581 ha and was subsequently amended via S156A application under the EPBC Act to 36,779 ha.

2.3. Local and Regional Context

2.3.1. Bioregion

The Proposal is located within the Pilbara Bioregion (PIL) under the Interim Biogeographic Regionalisation of Australia (IBRA). The Pilbara bioregion is divided into four sub-regions: Chichester (PIL1), Fortescue Plains (PIL2), Hamersley (PIL3) and Roebourne (PIL4). The Proposal is entirely within the Hamersley (PIL3) subregion (6,215,092 ha), which has significant mineral resources associated with the ranges and is described by Kendrick (2001) as:

“Mountainous area of Proterozoic sedimentary ranges and plateaus, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine-textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges. The climate is semi-desert tropical, an average of 300 mm rainfall, usually in summer cyclonic or thunderstorm events. Winter rain is not uncommon. Drainage into either the Fortescue River (to the north), the Ashburton River to the south, or the Robe River to the west”.

2.3.2. Climate

The climate of the Hamersley subregion in which the Proposal is located is classified as semi-desert tropical, with an average rainfall of 300 mm, typically attributed to summer cyclonic or thunderstorm events (Kendrick 2001). The Newman Airport Bureau of Meteorology (BoM) weather station (Station ID 007176) is approximately 109 km southeast of the Revised Development Envelope (Biologic 2021c). It provides information on the long-term climate patterns in the area and is expected to be representative of the climate within the Revised Development Envelope. Summer sees average maximum and minimum temperatures of 39.3 °C and 24.1 °C, respectively Figure 2-5) (BoM 2022). The mean annual rainfall (1996 to 2022) measured at Newman Airport is 315.3 mm, with monthly averages ranging from 4.7 mm in September to 72.3 mm in February, highlighting the highly variable rainfall of the region (BoM 2022 (Figure 2-5).

Rainfall is also highly seasonal, with approximately 75% of the annual total occurring between December and April. Rainfall is typically associated with tropical low-pressure systems and thunderstorm activity from the monsoonal troughs in northern Australia during summer. While winters are typically dry, mild unseasonal rainfall can occur owing to tropical cloud bands that intermittently affect the area. The daily rainfall data analysis indicates infrequent rain events and low rainfall totals.

Climate Change

For the period 1970–2016, the following climate trends have been identified for the central Pilbara area in which the Proposal is located (BoM 2022):

- Annual mean temperature has increased 0.2°C per decade, largely during winter and spring months, and annual maximum temperature has increased by 0.4°C per decade
- Annual rainfall has increased 10–20 mm per decade, and rainfall patterns have shifted to become more summer-dominated
- Annual pan evaporation has decreased 2.5–5 mm per decade.

Climate projections show very high confidence for substantial temperature increases to continue in the Pilbara, with the north-west of Western Australia warming more than elsewhere in Australia (DPIRD 2021).

Annual average temperature in the Pilbara is projected to increase:

- By 2030: a rise of 0.6–1.5°C for all emission scenarios
- By 2090: a rise of 1.5–3.1°C for medium and 3.1–5.6°C for high emission trajectories.

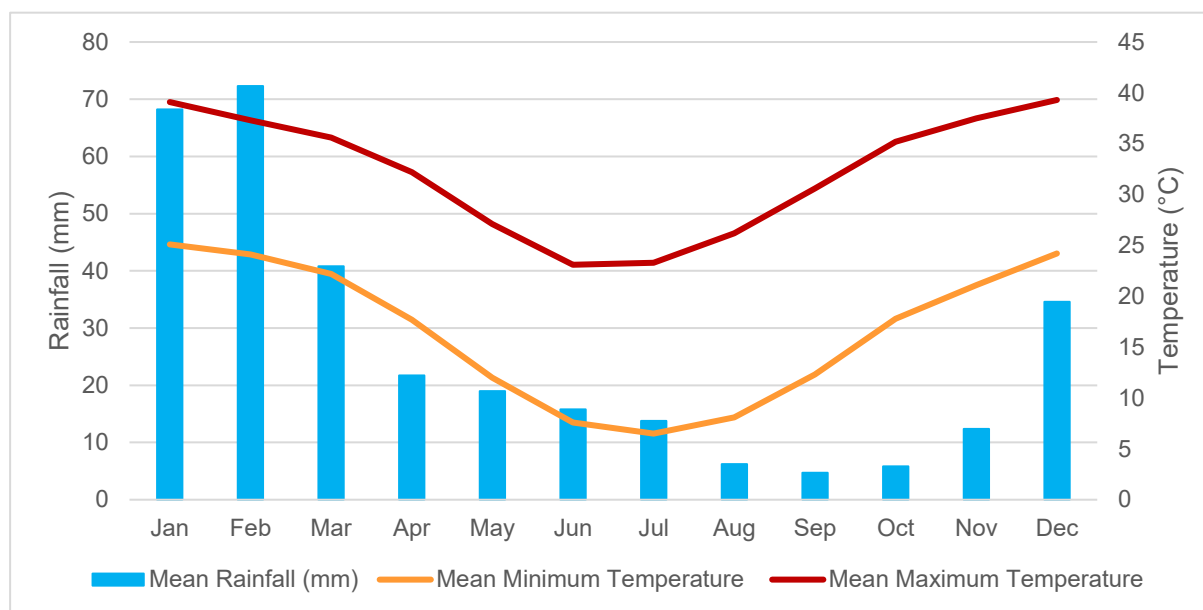


Figure 2-5: Newman Airport Average Monthly Climate Data from 1996 – 2022 (BoM Station 007176) (BoM 2022)

Annual rainfall is projected to remain largely unchanged to 2090 and there is high confidence that natural rainfall variability will remain the primary driver of rainfall changes to 2030. There is medium confidence that tropical cyclones will become less frequent in future but will increase in intensity. There is high confidence that potential evaporation will increase, but only medium confidence in the magnitude of the change (DPIRD 2021).

2.3.3. Geology

The Proposal lies in the southern section of the Pilbara Craton and consists of mountainous areas of Proterozoic sedimentary ranges and plateaux, dissected by gorges of basalts, shales and dolerite (Kendrick 2003). The cratonic basement comprises Archean granite-greenstone and is overlain by the Archean-Proterozoic rocks of the Hamersley Basin. These rocks can be divided into three stratigraphic groups: the Fortescue, Hamersley and Turee Creek Groups, with the Hamersley Group forming most of the outcropping. The Hamersley Group is a thick sedimentary sequence comprising banded iron formations (BIF), shales and dolomites, with minor felsic volcanic and extensive dolerite dykes and sills. The group contains the Brockman Iron Formation (BrIF) and the Marra Mamba Iron Formation (MMIF), which together host most of the known major iron ore deposits in the Pilbara.

The BrIF is the main Hamersley Group formation within the West Angelas region, along with Mount McRae Shale, Mount Sylvia Formation, Wittenoom Formation and MMIF. Areas of the BrIF occur in the Western Hill and Mount Ella East deposits.

The lower relief of the Marra Mamba Formation comprises BIF rich rocks. It contains significant proportions of shale, chert and dolomites of the Mount Newman, MacLeod and Nammuldi Members. Weathering of the Marra Mamba Formation has also produced a significant hydrated/mineralised zone (goethite-martite hardcap) over the bedrock. Marra Mamba Formation is a feature of Deposit F North and Deposit H.

Tertiary and quaternary detrital (colluvium/alluvium) cover the lower slopes and valley floors, occasionally featuring secondary deposits such as pisolite/channel iron deposit and calcrete deposited in areas near the historic (and in some cases present) water table.

2.3.4. Topography

The Proposal sits within the Hamersley Ranges east of Karijini National Park. Two main landscape features dominate regional topography: the Hamersley Range north of the Revised Development Envelope and the lower areas of flats and undulating plains. The top of the Hamersley Range plateau is a series of rounded hills and narrower ridges, reaching 1,245 m above sea level at its highest point. The plateau forms the watershed between the Fortescue River to the north and the Ashburton River to the south. Numerous rivers and streams have dissected the plateau, forming gorges, broader scree, and rubble-filled valleys (Copp 2005). A ridgeline is present south of Mt Ella East, representing a catchment boundary and is of cultural heritage significance.

2.3.5. Land Systems

Land systems of the Western Australian rangelands have been mapped and described by the Department of Primary Industries and Regional Development (DPIRD), outlining the distributions and providing comprehensive descriptions of biophysical resources, including soil and vegetation condition.

The Proposal intersects six land systems, of which the Newman Land System covers most of the Revised Development Envelope (approximately 35%) (Table 2-6 and Figure 2-8).

Table 2-6: Description of Land Systems Associated with the Revised Development Envelope

Land System	Description	Extent in Pilbara Region		Extent in Revised Development Envelope*	
		ha	%	ha*	%
Boolgeeda	Stony lower slopes and plains below hill systems and supporting hard and soft spinifex grasslands or mulga shrublands.	961,847	5	12,561	34
Egerton	Highly dissected hardpan plains supporting mulga shrublands and hard spinifex hummock grasslands.	66,849	<1	652	1.8
Elimunna	Stony plains on basalt supporting sparse acacia and cassia shrublands and patchy tussock grasslands.	62,851	<1	202	0.5
Jamindie	Stony hardpan plains and rises supporting grooved mulga shrublands, occasionally with spinifex understorey.	192,160	1	73	0.2
Newman	Rugged, jaspilite plateaux, ridges and mountains supporting hard spinifex grasslands.	1,994,339	11	13,007	35
Platform	Dissected slopes and raised plains supporting hard spinifex grasslands.	236,389	1	3,396	9.2
Rocklea	Basalt hills, plateaux, lower slopes and minor stony plains supporting hard (and occasionally soft spinifex) grasslands.	2,880,024	16	6,032	16
Wannamunna	Hardpan plains and internal drainage tracts supporting mulga shrublands and woodlands and occasionally eucalypt woodlands.	63,004	<1	856	2.3

Land System	Description	Extent in Pilbara Region		Extent in Revised Development Envelope*	
		ha	%	ha*	%
Total		7,501,131	-	36,779	100

Source: van Vreeswyk et al. 2004 *Area has been rounded up to nearest ha

2.3.6. Surface Water Hydrology

Regionally, the majority of the existing approved West Angelas deposits (Deposits A, A west, B, E and the F1 and F2 orebodies of Deposit F) are located within the upper reaches of the Turee Creek Catchment, immediately west of the regional catchment divide separating Ashburton River Catchment from the Fortescue River Catchment (Figure 2-7).

Deposits associated with the Proposal are located across two regional catchments – Turee Creek East and Weeli Wollli Creek. Western Hill and Mount Ella East are located within the Turee Creek East catchment, while Deposits F North and H are in the far upper reaches of the Weeli Wollli Creek catchment. There are no permanent pools/permanent water bodies located within the Revised Development Envelope or immediate surrounds.

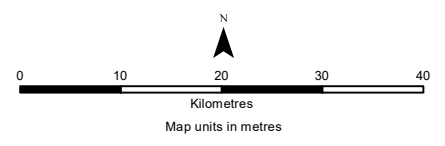
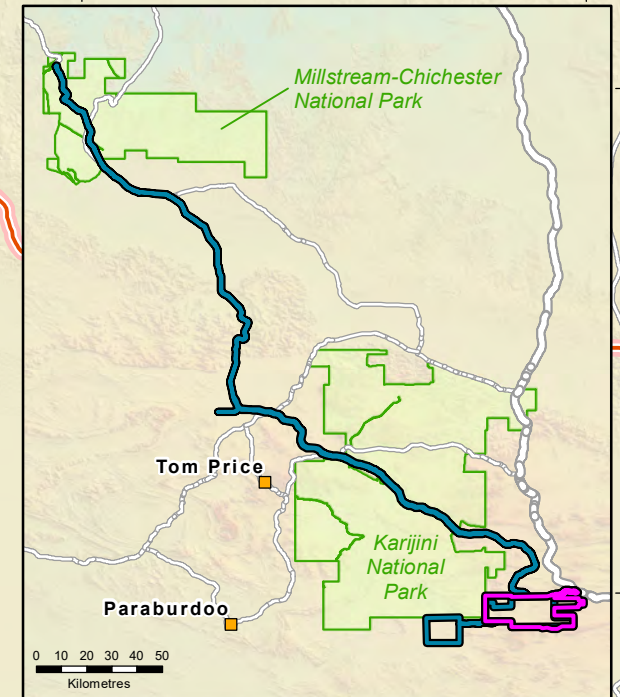
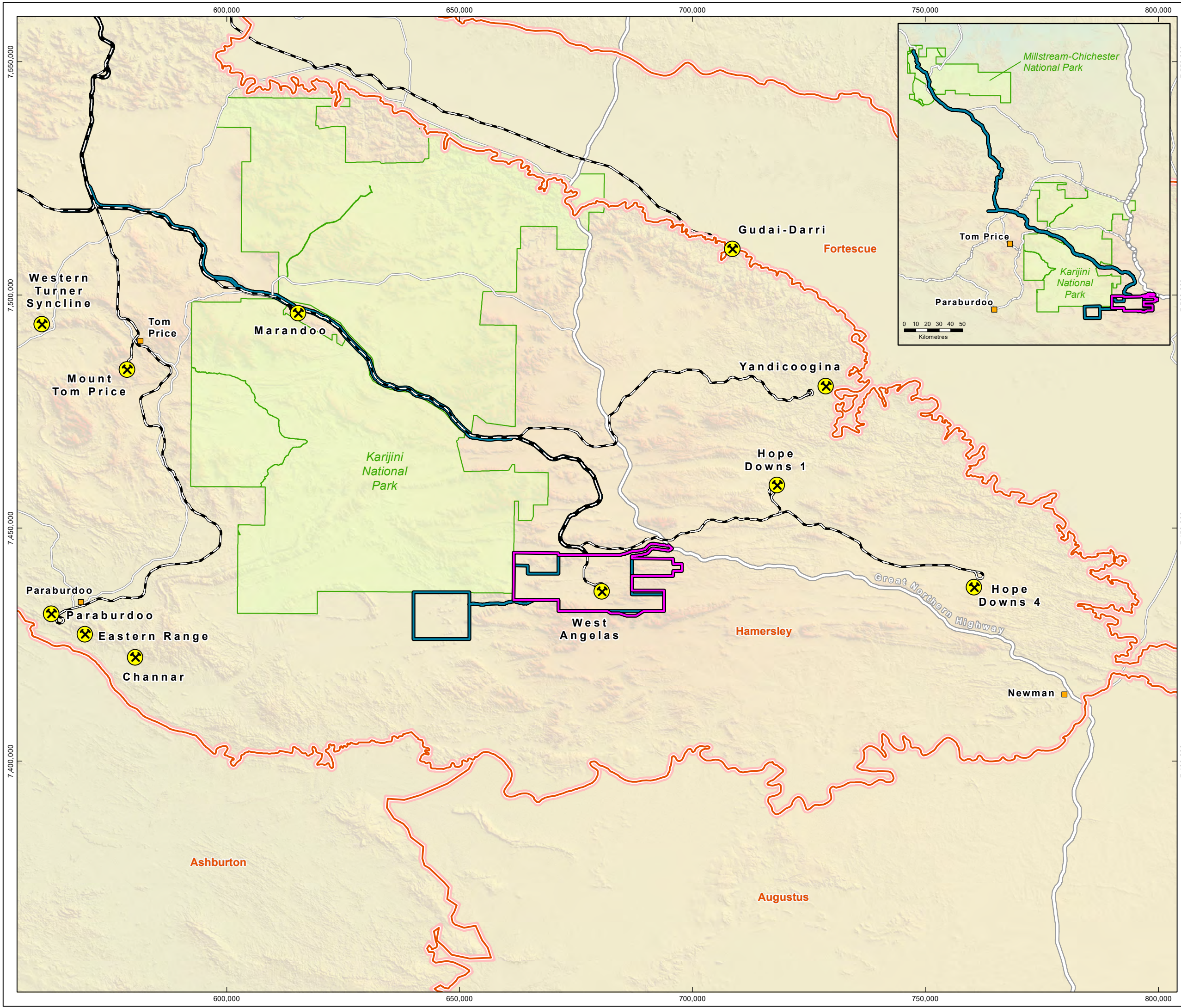
West Angelas has undergone incremental hydrological changes since mine development, interrupting some tributary catchments, restriction of flows by linear infrastructure, and diversion of minor sub-catchments to allow mining at Deposits B and F. However, overall catchment connectivity has been retained with a general east-west water movement across the site to Turee Creek East, which delivers ephemeral flow to Karijini National Park west of Deposits C and D.

Figure 2-6
IBRA Subregions
and Major Towns

Drawn: GIS Team
Plan: PDE0186388v5
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:750,000 @A3
GIS.Team@riotinto.com

Legend

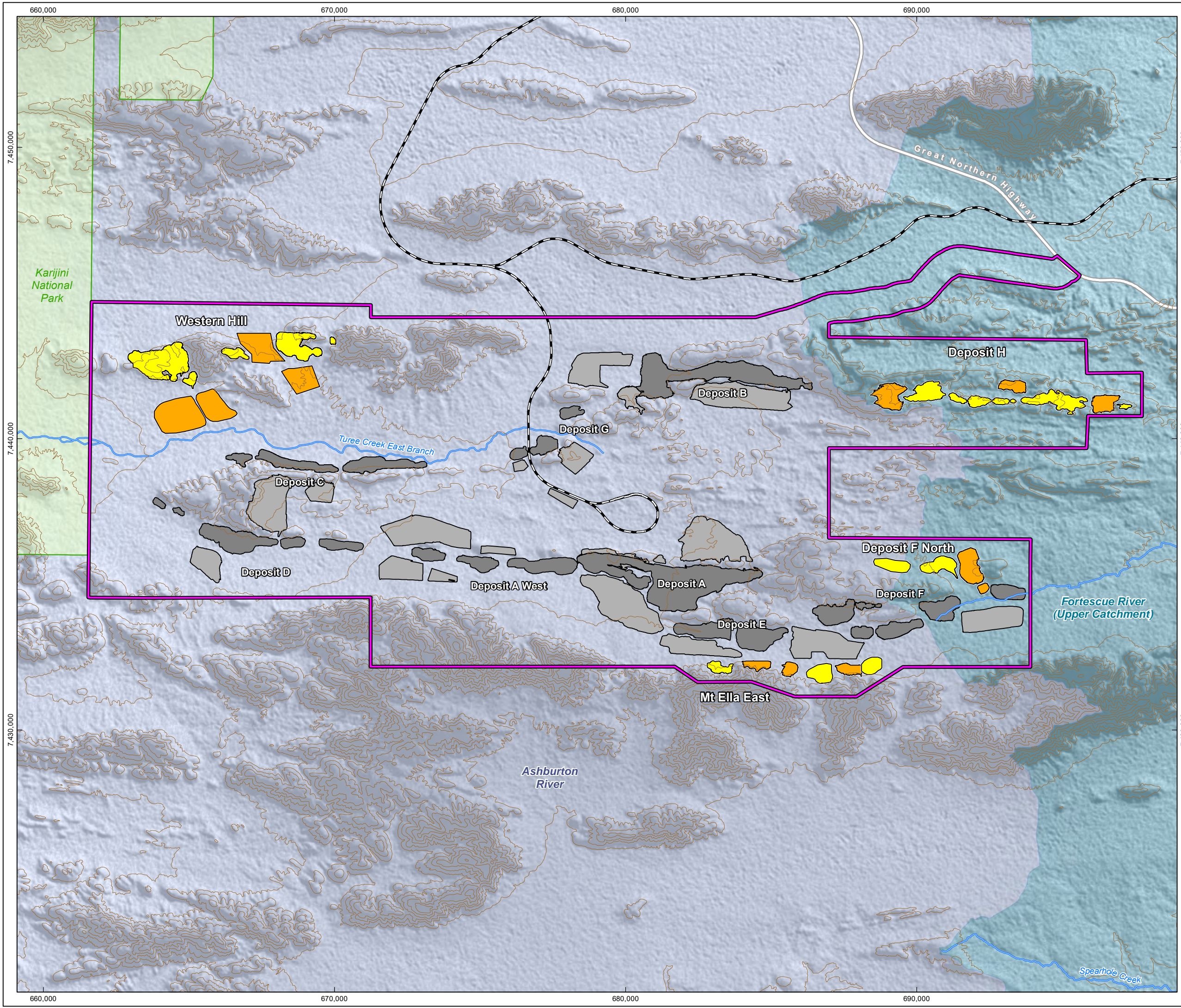
- Rio Tinto Mine
- Town
- Revised Development Envelope
- Ministerial Statement Boundary 1113
- IBRA Subregion
- National Park
- Rio Tinto Railway
- Highway
- Major Road



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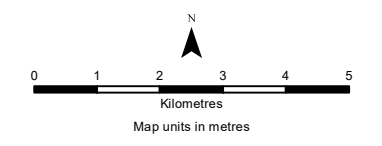
Figure 2-7
Key Topographic Features,
Creeks and
Conservation Reserves

Drawn: GIS Team
Plan: PDE0186389v7
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

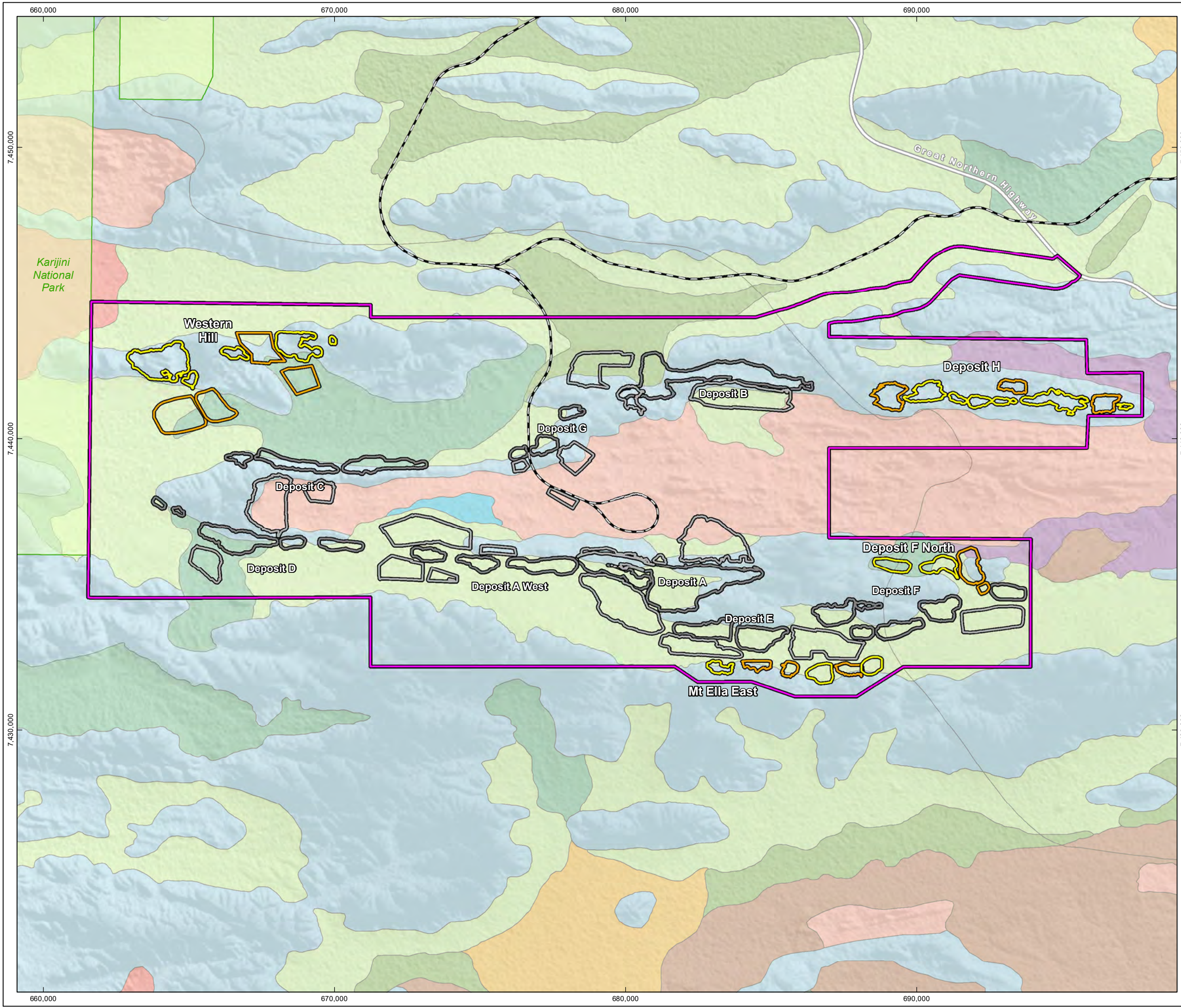
- Revised Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Catchment Boundary**
 - Ashburton River
 - Fortescue River (Upper Catchment)
- 10m Contour
- Rio Tinto Railway
- Highway
- Major Creek
- National Park



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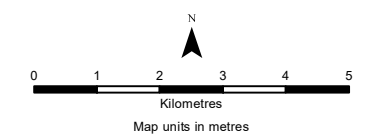
Figure 2-8
Land System Distribution
of the Proposal

Drawn: GIS Team
Plan: RTIO-0210189v3
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Land System**
 - Boolgeeda Land System
 - Egerton Land System
 - Elimunna Land System
 - Jamindie Land System
 - Newman Land System
 - Pindering Land System
 - Platform Land System
 - Rocklea Land System
 - Spearhole Land System
 - Wannamunna Land System
- National Park
- Rio Tinto Railway
- Highway



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2.3.7. Social Setting

The Revised Development Envelope is predominantly located within the Shire of East Pilbara, with a small portion of the westernmost extent of the Proposal extending into the Shire of Ashburton. In the 2021 Australian Bureau of Statistics (ABS) Census, the Shire of East Pilbara had an estimated population of approximately 11,000 (ABS 2022). The Shire of Ashburton had an approximate population of 7,500 people. Iron ore mining and oil and gas production are the main industries, alongside large pastoral leases and cattle stations.

The Revised Development Envelope extends into a western area of Yinhawangka lands and a north-eastern portion of Ngarlawangga lands. The Ngarlawangga section covers 26.6 km² (31.5%) of and relates to the eastern portions of the Revised Development Envelope, including Deposit H and Deposit F North areas. The Yinhawangka section covers 58.0 km² (68.5%) of the Revised Development Envelope and relates to the Western Hill portion and Deposit H, Deposit F North and Mt Ella East regions of the Revised Development Envelope. Neighbouring native title areas include those of the Banjima, Nyiyaparli, and Martu peoples.

Key values identified include numerous recorded heritage sites and objects readily recognisable as having archaeological and anthropological value. Other less visible social, cultural and heritage values exist in the area that are more complex, relating to interdependent connections between land, place and cultural practice, such as hunting, resource collection, learning, stories, rituals and religion. Social, cultural and heritage values are often associated with ridge lines and water, including major drainage lines, springs, pools, rock holes and soaks. However, social, cultural and heritage values can occur throughout the landscape, for example, in areas supporting medicinal or food plants or are preferred hunting grounds or campsites.

2.3.8. Land Use and Existing Development

Current land use in the region is dominated by iron ore mining, with several other iron ore mines located nearby and within the wider region. Additional land use includes pastoral grazing. Turee Creek Pastoral Station is the nearest pastoral lease to West Angelas, located south of the Revised Development Envelope. No pastoral leases overlie the Revised Development Envelope. Other land uses in the region include:

- Public and private infrastructure (including roads and railways)
- Unallocated Crown Land (UCL).

2.3.9. Conservation Reserves and Environmentally Sensitive Areas

The Revised Development Envelope's western boundary joins Karijini National Park, Western Australia's second-largest National Park, protecting more than 627,000 ha of land within the Hamersley subregion of the Pilbara bioregion (Figure 2-2).

The original boundary (1977) of the Hamersley Range National Park (now included within the Karijini National Park) was listed on the Register of the National Estate and therefore considered an Environmentally Sensitive Area (ESA) (Biota 2020) (Figure 2-9).

2.3.10. Existing and Reasonably Foreseeable Projects within the Hamersley Subregion

There are several existing and reasonably foreseeable projects, all mining, within 100 km of the Proposal and, more broadly, within the Hamersley subregion of the Pilbara bioregion. The projects within the Hamersley Subregion have similar physical features and, therefore, similar fauna and flora assemblages which are comparable to the Proposal. Projects within the Hamersley Subregion and within 100 km from the Proposal are listed in Table 2-7 and shown on Figure 2-10.

Table 2-7: Existing and Reasonably Foreseeable Projects within the Hamersley Subregion (within 100 km of the Proposal)

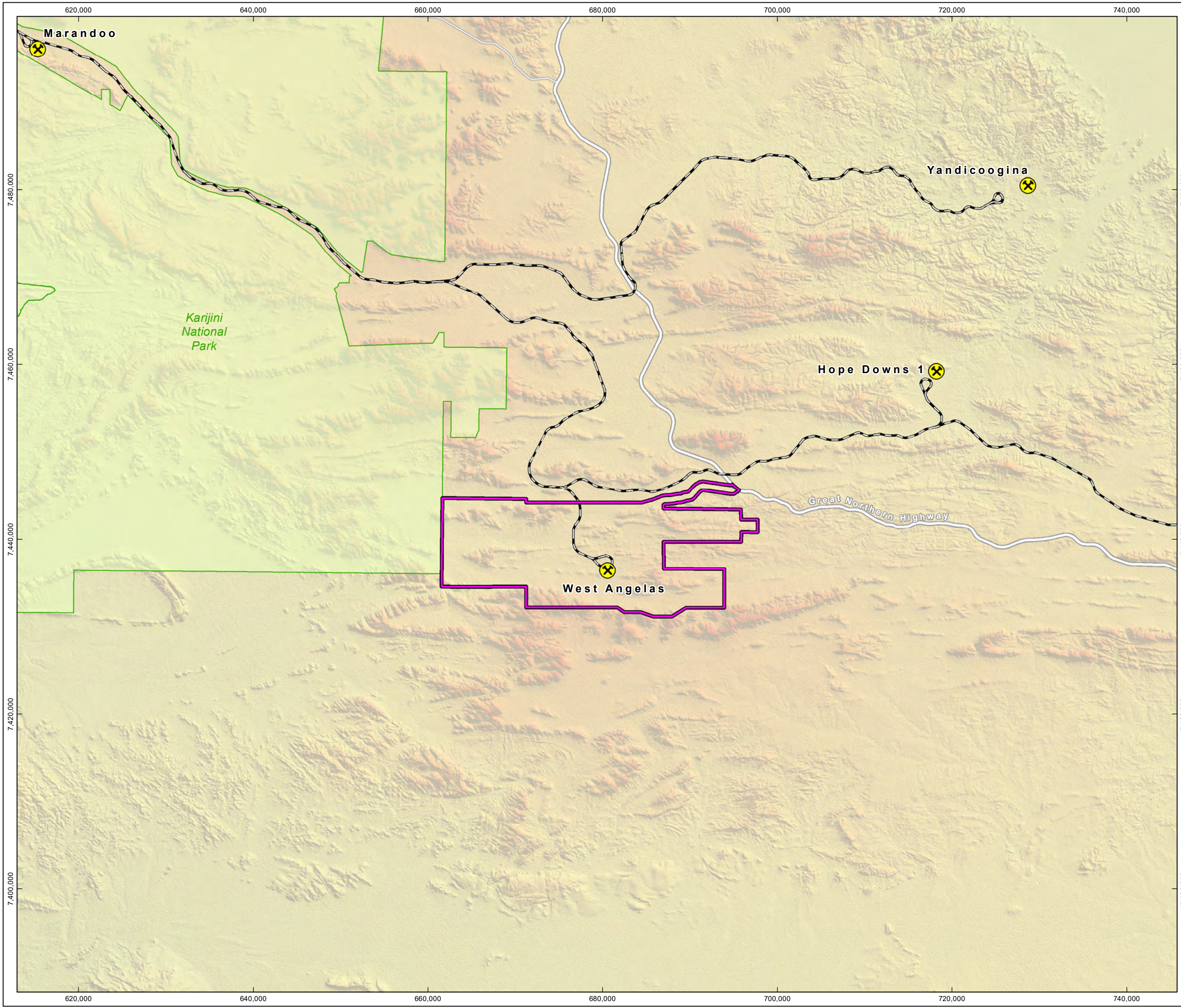
Project Name	Status	Location
Approved Projects*		
West Angelas Iron Ore Mine Existing Operations (Deposits A, B, C, D E, F and G)	Operational	The approved footprint is within the Revised Development Envelope
Hope Downs Iron Ore Mine - Hamersley Hope Management Services Pty Ltd (2000)	Operational	Adjacent to the Revised Development Envelope approximately 2 km to the northeast
Pilbara Expansion Strategic Proposal: Jinidi Iron Ore Mine – BHP Billiton Iron Ore Pty Ltd (2012)	Approved	20 km
Mining Area C Southern Flank – BHP Billiton Iron Ore Pty Ltd (2020)	Operational	25 km
Yandicoogina Iron Ore Project Expansion - Hamersley Iron Pty Ltd (2011)	Operational	35 km
Hope Downs 4 Iron Ore Mine - Hamersley Hope Management Services Pty Ltd (2013)	Operational	40 km
Gudia-Darri Iron Ore Mine and Infrastructure Project - Mount Bruce Mining Pty Ltd (2015)	Construction commenced	40 km
Marandoo Iron Ore Project – Hamersley Iron Pty Ltd (2015)	Operational	65 km
Revised Iron Valley Iron Ore Project – BC Pilbara Iron Ore Pty Ltd (2016)	Operational	81 km
Turee Syncline Iron Ore Project	Approved	100 km
Greater Paraburdoo Iron Ore Hub Proposal - Hamersley Iron Pty Ltd (2020)	Approved*	100 km
Reasonably Foreseeable Projects**		
Hope Downs 2 – Hamersley HMS Pty Ltd (2021)	Under Assessment	Adjacent to the Revised Development Envelope approximately 1 km

**Includes projects that have been approved but are yet to be implemented*

***Defined as projects that have not yet been approved but have currently been referred*

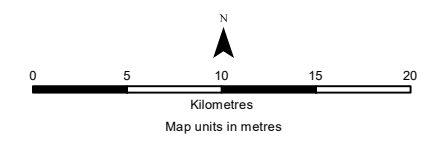
Figure 2-9
Conservation Reserves
Nearby to the Proposal

Drawn: GIS Team
Plan: RTIO-0210194v3
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:400,000 @A3
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Legend

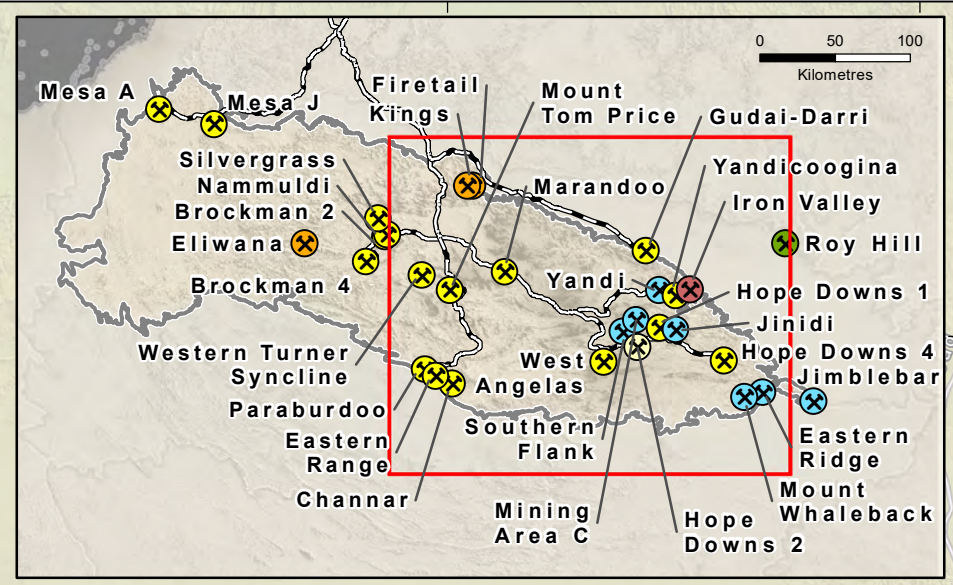
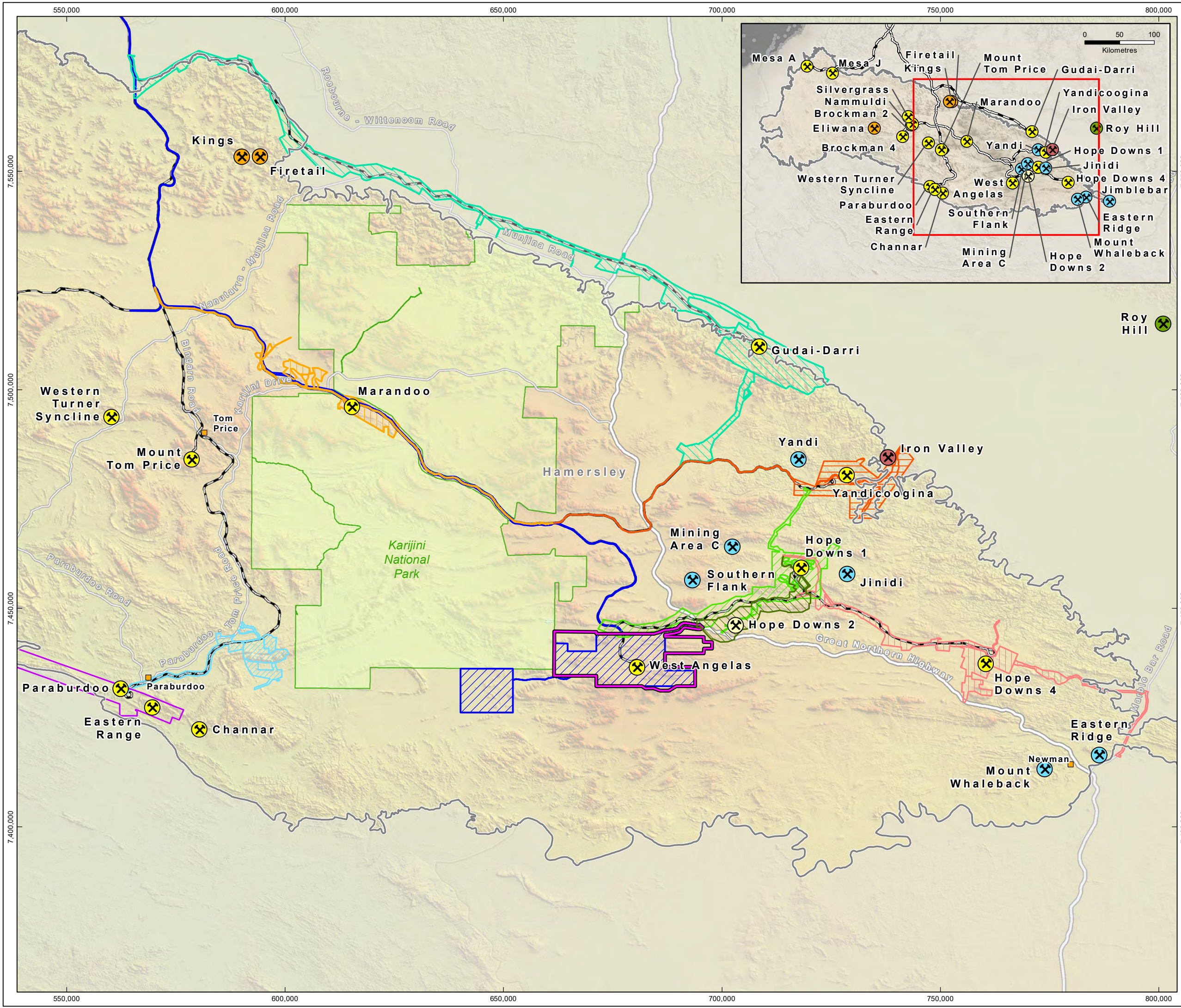
- Rio Tinto Mine
- Revised Development Envelope
- National Park
- Rio Tinto Railway
- Highway
- Major Road



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Figure 2-10
Existing and Reasonably
Foreseeable Projects Within the
Hamersley Subregion

Drawn: A.D.
Plan: RTIO-0210195v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:800,000 @A3
GIS.Team@riotinto.com



Legend

- Rio Tinto Mine
- Rio Tinto Mine (Proposed)
- BHP Mine
- FMG Mine
- Iron Valley Mine
- Roy Hill Mine
- Town
- Revised Development Envelope

Approved Projects

- Hope Downs Iron Ore Mine - Hamersley Hope Management Services Pty Ltd (2000)
- Hope Downs 4 Iron Ore Mine - Hamersley Hope Management Services Pty Ltd (2013)
- Greater Paraburdoo Iron Ore Hub Proposal - Hamersley Iron Pty Ltd (2020)
- Koodaideri Iron Ore Mine and Infrastructure Project - Mount Bruce Mining Pty Ltd (2015)
- Marandoo Iron Ore Project – Hamersley Iron Pty Ltd (2015)
- Turee Syncline Iron Ore Project
- West Angelas Iron Ore Mine Existing Operations (Deposits A, B, C, D, E, F and G)
- Yandicoogina Iron Ore Project Expansion - Hamersley Iron Pty Ltd (2011)

Reasonably Foreseeable Projects

- Hope Downs 2 – Hamersley HMS Pty Ltd (2021)

Other Symbols

- Hamersley Subregion
- Other Subregion
- National Park
- Rio Tinto Railway
- Highway
- Major Road

Scale
0 5 10 15 20 25
Kilometres
Map units in metres

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3. LEGISLATIVE CONTEXT

3.1. Environmental Impact Assessment Process

The Proposal is subject to assessment under the Commonwealth EPBC Act and Western Australian EP Act. The Proposal will undergo an accredited assessment in which the Commonwealth will rely on the assessment outcomes prepared by the WA EPA to inform its own consideration of the Proposal under the EPBC Act.

This ERD content, format and environmental assessment have considered the following EPA guidance:

- Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures (GoWA 2021) (Administrative Procedures)
- Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual (EPA 2021a) (Procedures Manual)
- Statement of Environmental Principles, Factors and Objectives and Aims of EIA (EPA 2021c)
- Instructions – How to identify the content of a Proposal (EPA 2021d)
- Instructions – How to prepare an Environmental Review Document (EPA 2021b)
- Instructions – Environmental outcomes and outcomes-based conditions (EPA 2021g)
- Instructions for preparing data packages for the Index of Biodiversity Surveys for Assessments (IBSA) (EPA 2021e)
- Instructions on how to prepare EP Act Part IV Environmental Management Plans (EMPs) (EPA 2021f)
- Interim Guidance - Taking Decision Making Processes into Account in EIA (EPA 2021h)
- Interim Guidance – Environmental outcomes and outcomes-based conditions (EPA 2021i).

3.1.1. *Environmental Protection Act 1986*

WA's primary environmental legislation governing environmental protection and impact assessment is the EP Act. Part IV, Division 1 of the EP Act, provides for the referral and assessment of proposals that may significantly impact the environment. The Environmental Protection Authority Services (EPA Services) division within the Department of Water and Environmental Regulation (DWER) administers the impact assessment process in accordance with the relevant policies and guidelines, including those listed above.

The Proposal was referred to the EPA on 25 March 2021. On 22 April 2021, the EPA determined that the Proposal would be assessed under Part IV of the EP Act. The level of assessment was set at Public Environmental Review (PER) – an 8-week public review period.

The EPA identified the key environmental factors as:

- Social Surroundings (Section 6)
- Inland Waters (Section 7)
- Flora and Vegetation (Section 8)
- Terrestrial Fauna (Section 9)
- Subterranean Fauna (Section 10)
- Greenhouse Gas Emissions (Section 11).

No new environmental impacts have emerged during the assessment, so no additional key environmental factors have been identified. The Proponent prepared an ESD to define the ERD's form, content, timing and procedure (Appendix A.1), and the EPA approved the ESD on 17 February 2023.

The ERD has been prepared in accordance with the ESD (Appendix A.1) and the EPA guidance listed above to meet the requirements of s 40(2)(b) of the EP Act. This ERD is now published for eight weeks, during which time the public is invited to comment on the ERD. Refer to the **Invitation to make a submission** section at the beginning of this document for guidance on how to make a submission and the closing date for submissions.

After the public review period, the EPA will assess the Proposal, considering the ERD, any submissions received, and the Proponent's responses to any submissions received. The EPA also considers relevant policies and guidelines and may seek advice from relevant government agencies. The EPA will prepare an assessment report recommending whether the Proposal should be approved and, if recommending approval, any implementation conditions that should apply. The EPA Report and Recommendations (EPA Report) will be made public. After the appeal period has concluded, the EPA Report will be provided to the Minister for the Environment, who will determine any appeals and decide whether the Proposal may be implemented and, if so, any implementation conditions and procedures which will apply.

3.1.2. Environment Protection and Biodiversity Conservation Act 1999

The EPBC Act is the primary Commonwealth environmental legislation protecting MNES. It is administered by the Commonwealth Department of Climate Change, Energy, the Environment and Water (DCCEEW).

Referral of the Proposal/Proposed Action to DCCEEW under the EPBC Act occurred in March 2021. On 1 June 2021, DCCEEW (previously Department of Agriculture, Water and the Environment [DAWE]) determined that the Proposed Action is a Controlled Action under s 75 of the EPBC Act (EPBC 2021/8923), with listed threatened species and communities (sections 18 and 18a) and listed migratory species (sections 20 & 20A) as the controlling provisions. DCCEEW agreed that the EPA could assess the proposal as an accredited assessment. The Proponent subsequently prepared an ESD that sets out the matters to be addressed in the ERD, including relevant MNES (EPBC Regulations 2000; EPA 2020b).

MNES with the potential to be significantly impacted by the Proposed Action include the following fauna species:

- Northern Quoll (*Dasyurus hallucatus*) - Endangered
- Ghost Bat (*Macroderma gigas*) - Vulnerable
- Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) - Vulnerable
- Pilbara Olive Python (*Liasis olivaceus*) - Vulnerable
- Grey Falcon (*Falco hypoleucos*) - Vulnerable
- Night Parrot (*Pezoporus occidentalis*) - Endangered
- Fork-tailed Swift (*Apus pacificus*) - Migratory.

The assessment of the significance of potential impacts from the Proposed Action on MNES has been carried out as per relevant EPBC Act guidance and addressed specifically in Section 13 of this ERD.

3.1.2.1. Accredited Assessment

The EPA assesses the Proposal as an accredited assessment on behalf of the Commonwealth under s 87 of the EPBC Act. This agreed approach provides for a single environmental assessment process conducted by the State, in consultation with DCCEEW. After its assessment, the EPA will provide its Assessment Report to DCCEEW, to allow that agency to consider the Proposal's potential impacts on MNES.

The Commonwealth Minister for the Environment will make a decision on whether to approve the proposal based on DCCEEW's final advice. If approved, an EPBC Act Decision Notice will be issued, including implementation conditions to be applied to the various stages of the Proposal.

3.1.3. State Agreement

The Proposal is located within an area administered under the *Iron Ore (Robe River) Agreement Act 1964* (Robe River State Agreement). A State Agreement is a legal contract between the Western Australian Government and a Proponent of a major project within State boundaries. A State Agreement details the rights, obligations, terms and conditions for developing a specific project. Elements of the Proposal outside the State Agreement tenure are supported by various tenures granted and managed under the *Mining Act 1978* (Mining Act) and *Land Administration Act 1997*.

The Robe River State Agreement also includes provisions for Proposal expenditure to prioritise local (Western Australian) vendors. Any services, materials, plant, equipment, supplies, and other procurement matters intended to be sourced outside Western Australia will need to be considered during the Proposal studies and suitably justified. Compliance reporting against this obligation is also required during Proposal implementation.

3.2. Other Approvals and Regulations

3.2.1. Native Title

The Proposal is located within the boundaries of the recognised Native Title determination areas of two Traditional Owner groups of the Pilbara region: Yinhawangka People Part A and B Native Title determination (WCD2017/003) and Ngarlawangga People Native Title determination (WCD2016/007) (refer to Section 6 for further details). Rio Tinto and the Proponent have negotiated and executed claim-wide land use agreements with both Traditional Owner groups. These agreements are subject to modernisation and improvement processes in consultation with the respective Traditional Owner group.














The Proposal is located within two Indigenous Land Use Agreement (ILUA) areas registered with the National Native Title Tribunal. These voluntary agreements between the Proponent and the Yinhawangka and Ngarlawangga peoples provide guidelines for communication and participation between the Traditional Owner groups and the Proponent regarding cultural heritage management,

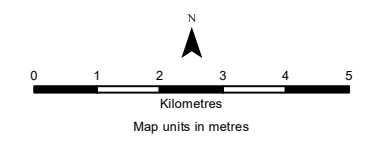
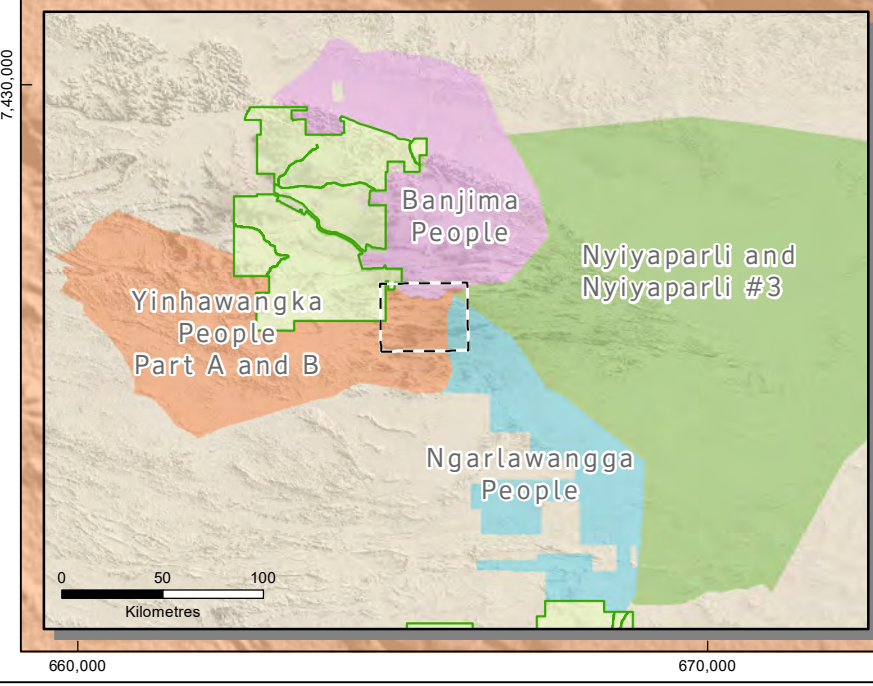
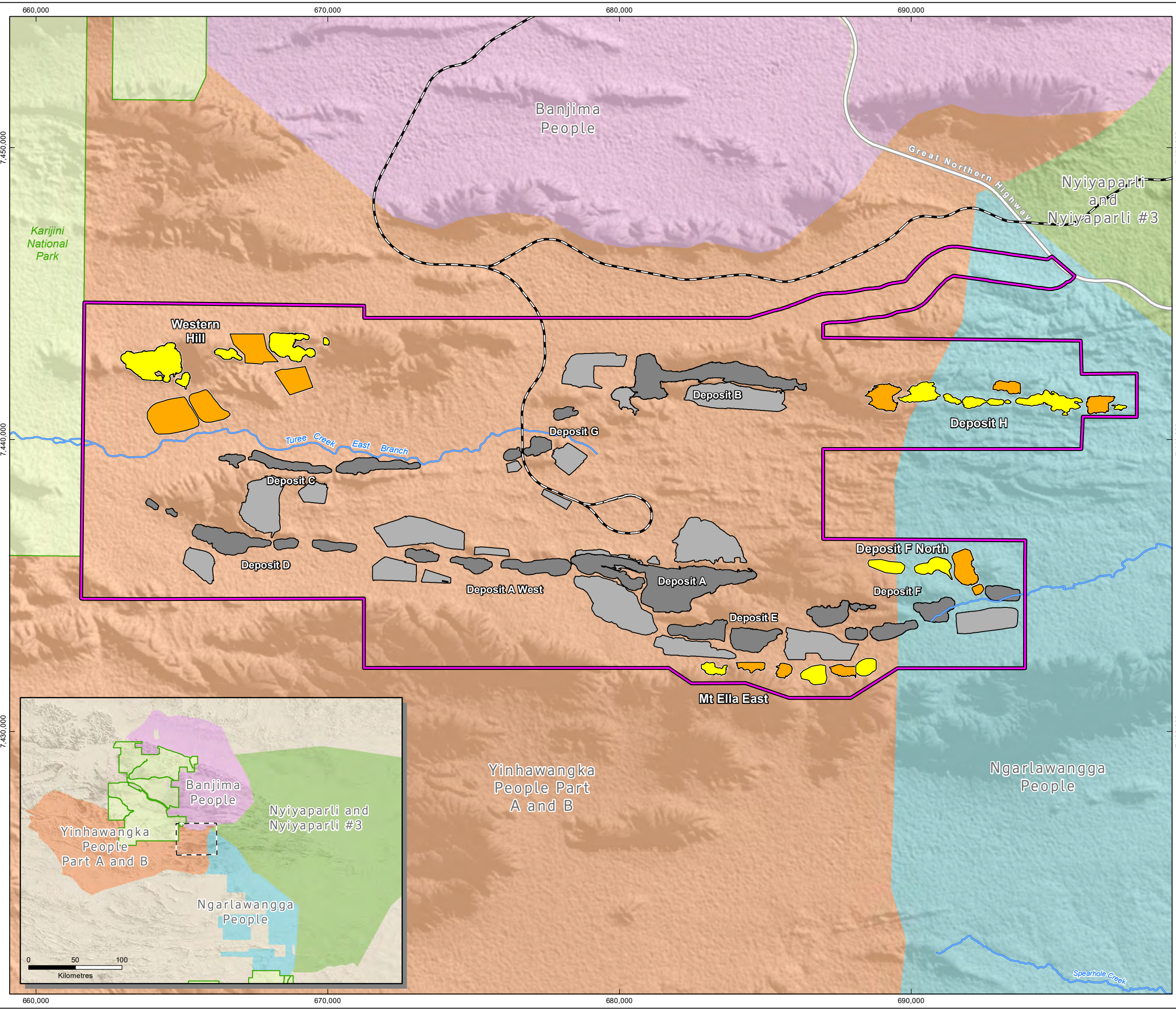
environmental management, LOM planning, land access, employment and training, business development and cultural awareness training.

Figure 3-1
Native Title Determination
Areas

Drawn: A.D.
Plan: RTIO-0210544v3
Date: March 2023
Proj: GDA 1984 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

-  Revised Development Envelope
 - Proposed Conceptual Layout**
 -  Pit
 -  Waste Landform
 - Approved Conceptual Layout**
 -  Pit
 -  Waste Landform
 - Native Title Determination Area**
 -  Banjima People
 -  Ngarlawangga People
 -  Niyaparli and Niyaparli #3
 -  Yinhawangka People Part A and B
-
-  National Park
 -  Rio Tinto Railway
 -  Highway
 -  Major Creek



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3.2.2. Land Tenure

The Proposal and Existing Operations at West Angelas are associated with the State Agreement Mineral Lease (ML) 248SA granted pursuant to the Robe River State Agreement. ML248SA is considered appropriate tenure for all current and proposed mining and mining-related infrastructure.

Some of the deposits associated with the Proposal are located on Exploration Licences (47/797, 47/986 and 47/1050) held under the Mining Act. These Exploration Licences would be converted to appropriate tenure to support the development of the Proposal. Additional tenure will be required for infrastructure, including corridors for services and transportation of the ore from Western Hill and Deposit H.

Land subject to third-party interests within the Revised Development Envelope will be subject to the grant of additional tenure or subject to access agreements as appropriate before ground-disturbing activities in these areas.

The infrastructure at West Angelas, located outside of ML 248SA, is supported by other tenures (General Purpose Leases and Miscellaneous Licences) that have been granted under the Mining Act in accordance with the Robe River State Agreement.

Land tenure is presented in Table 3-1 and Figure 3-2.

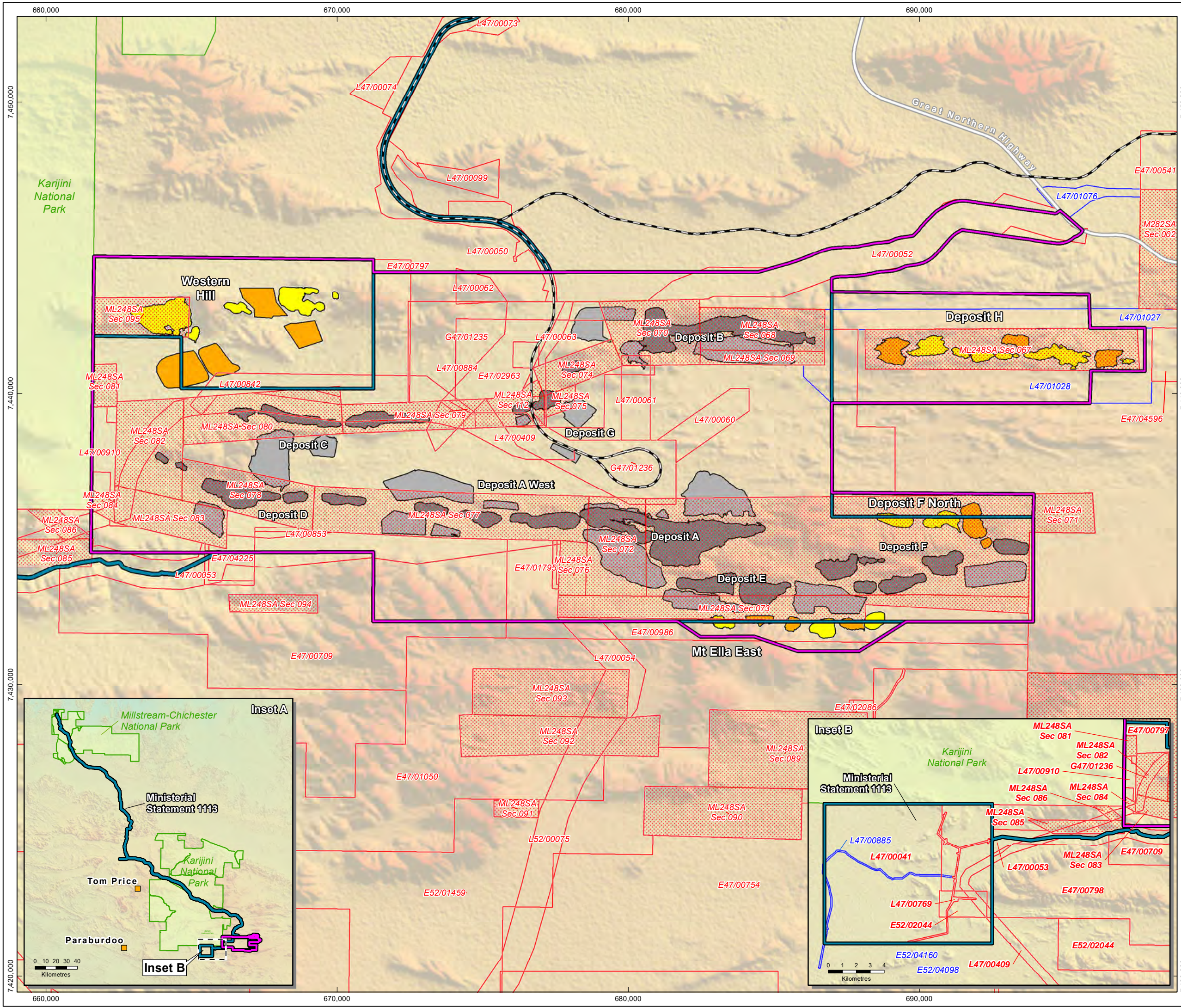
Table 3-1: Summary of Tenement Information

Tenement	Status	Holder
General Purpose Lease		
G47/01235	Live	<ul style="list-style-type: none"> Robe River Mining Co Pty Ltd Cape Lambert Iron Associates
G47/01236	Live	<ul style="list-style-type: none"> Mitsui Iron Ore Development Pty Ltd North Mining Limited Pannawonica Iron Associates
Miscellaneous Licences		
L47/00041	Live	<ul style="list-style-type: none"> Robe River Mining Co Pty Ltd Cape Lambert Iron Associates Mitsui Iron Ore Development Pty Ltd North Mining Limited Pannawonica Iron Associates
L47/00050	Live	
L47/00052	Live	
L47/00053	Live	
L47/00054	Live	
L47/00060	Live	
L47/00061	Live	
L47/0062	Live	
L47/00063	Live	
L47/00409	Live	
L47/00769	Live	
L47/00842	Live	
L47/00853	Live	
L47/00884	Live	

Tenement	Status	Holder
L47/00885	Pending	
L47/00910	Live	
L47/01027	Pending	
Mineral Lease		
ML248SA	Live	<ul style="list-style-type: none">• Robe River Mining Co Pty Ltd

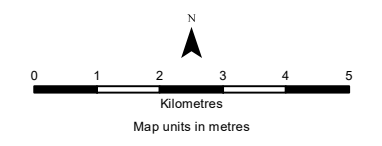
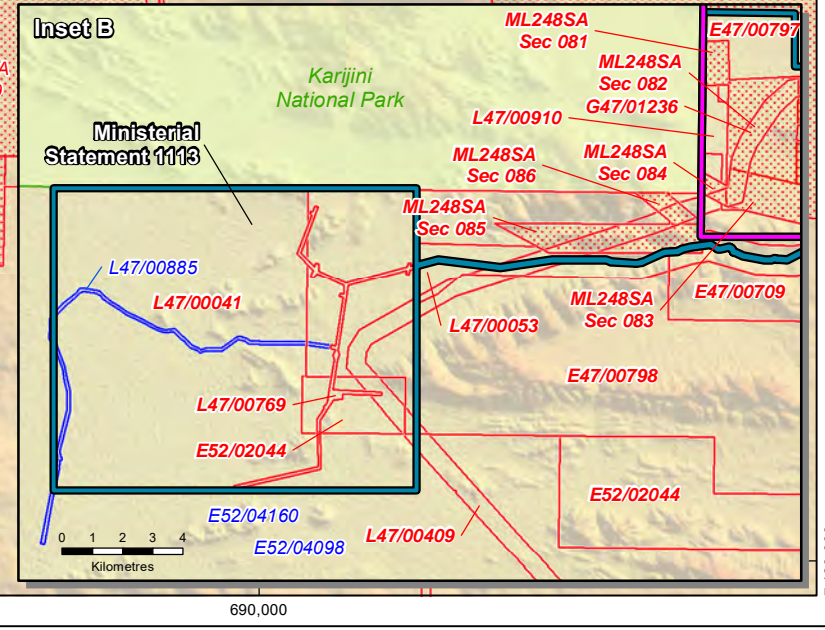
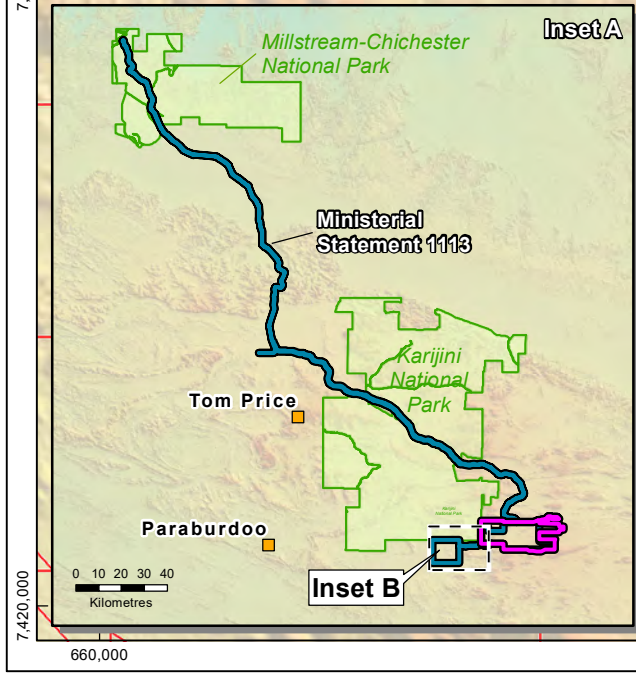
Figure 3-2
Land Tenure

Drawn: GIS Team
Plan: PDE0186391v5
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Ministerial Statement Boundary 1113
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Rio Tinto Mining Act Tenure**
 - Live Mining Lease
 - Live Other
 - Pending
- Town
- National Park
- Rio Tinto Railway
- Highway



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3.2.3. Decision-making Authorities and Other Approvals

In addition to the EPA assessment of the Proposal under Part IV of the EP Act, numerous other environment-related assessments and authorisations will be required before the Proposal can be implemented. These, along with the authorities identified as decision-making authorities (DMAs) for this Proposal, are listed in Table 3-2. Project implementation in relation to certain factors may be delegated to DMA's as appropriate and managed in accordance with the relevant EPA objective for that factor. Where the Proponent considers this appropriate, it is specified in Table 3-2.

Table 3-2: Decision-making Authorities Identified for the Proposal and Other Approvals Required

Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-Making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
Minister for Water, DWER	RiWI Act	<p>Section 26D licence required to construct dewatering and water supply bores</p> <p>Section 5C licence is required for the abstraction of groundwater</p>	<p>Yes</p> <p>EPA Inland Waters factor and objective considered in decision-making.</p> <p>RiWI Act processes regulate the extraction of water associated with mine dewatering, but not disposal.</p> <p>The licence application is advertised for public comment when a significant impact on the water resource is expected, or the request is to take more than 1 giga litre per annum (GL/a).</p> <p>Assessments of licence applications to take groundwater include consideration of environmental and social impacts, including effects on:</p> <ul style="list-style-type: none"> • Groundwater resource - availability, allocation and quality • Groundwater dependent ecosystems • Other groundwater users. <p>Hydrogeological studies are required to inform the assessment, including the potential impacts of taking water.</p> <p>Licence conditions will usually include requirements to undertake and report groundwater volume and quality monitoring to ensure detrimental impacts on the environment, other users and the groundwater resource are no more than predicted.</p> <p>Surface water impacts may be considered in the assessment but are not essential.</p> <p>Impacts on stygofauna are not further assessed (although related results may be included in groundwater monitoring reporting required by the licence).</p>
Minister for Water, DWER	RiWI Act	<p>Groundwater – Operating Strategy required to manage significant volumes of water proposed to be taken from several sources and multiple bores</p>	<p>Yes</p> <p>EPA Inland Waters factor and objective considered in decision-making.</p> <p>The Groundwater Operating Strategy supplements a section 5C licence detailing how the licensee will manage its operations to address broader management issues associated with taking and using water (DWER 2020b). The operating strategy must include:</p>

Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-Making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
			<ul style="list-style-type: none"> • Details of the water source to be used • Land use, water abstraction regime and methods and infrastructure used to abstract and distribute water • Monitoring and reporting requirements • Methods to manage impacts on the aquifer, the environment and other water users • Contingency plans • Water efficiency measures.
Minister for Water, DWER	RiWI Act	Section 11/17/21A Permit required to interfere or obstruct bed or banks (i.e., floodway creek crossing)	<p>Yes</p> <p>EPA Inland Waters factor and objective considered in decision-making.</p> <p>Permit applications consider the effect of the alteration to existing surface water catchments, surface water flow paths and sheetflows. Key principles considered include (DoW 2012):</p> <ul style="list-style-type: none"> • Avoiding interference or obstruction of water, bed or banks, wherever practicable • Discouraging dams where viable alternatives exist • Reduce watercourse crossings to a minimum and consolidate crossings with other infrastructure, where practicable • Avoid permanent pools, bends or high velocity sections of watercourses • Minimise disturbance to riparian vegetation, riparian zones and floodplains • Mitigate risks or impacts from site disturbance including erosion, sedimentation, weed introduction, vegetation clearing, loss of habitat and change to ecological values • Prevent the discharge of pollutants and materials into watercourses • Rehabilitate or revegetate the site following construction to maintain or improve riparian zone function.

Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-Making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
Chief Executive Officer, DWER	EP Act Part V	<p>Works Approval* and Licence</p> <p>Activities and prescribed premise categories applicable to the Proposal include, but are not limited to:</p> <ul style="list-style-type: none"> 5 – Processing of ore 6 – Mine dewatering 12 – Screening, etc. of materials 64 – Class II Putrescible landfill 73 – Bulk storage of chemicals etc 	<p>Yes</p> <p>EPA factors and objectives considered in decision-making:</p> <ul style="list-style-type: none"> • Inland Waters – refer above • Flora and Vegetation and Terrestrial Fauna – To protect flora and vegetation/terrestrial fauna so that biological diversity and ecological integrity are maintained • Terrestrial Environmental Quality – To maintain the quality of land and soils so that environmental values are protected • Air Quality – To maintain air quality and minimise emissions so that environmental values are protected • Social surroundings – To protect social surroundings from significant harm • Human Health – To protect human health from harm. <p>Works approvals and licences regulate industrial emissions and discharges to air, land or water and apply to ‘prescribed premises’ categories defined in Schedule 1 of the Environmental Protection Regulations.</p> <p>Applications are open for public comment, and the public and licence holder have the right to appeal decisions. DWER will seek comment and advice from people and public authorities deemed to be interested during the assessment.</p> <p>Assessments consider the risk to the environment, public health and amenity and the controls proposed to mitigate these risks.</p> <p>Compliance monitoring and reporting are included in standard conditions of approval.</p>
Chief Dangerous Goods Officer, Department of Mines, Industry Regulation and Safety (DMIRS)	<i>Dangerous Goods Safety Act 2004 (DG Safety Act)</i>	<p>Dangerous Goods (DG) Licence is required for the storage and handling of hazardous materials during construction</p>	<p>Yes</p> <p>Dangerous goods licence applications require risk assessments demonstrating the dangerous goods site can be operated with minimal risk to people, property and the environment.</p> <p>DMIRS will notify DWER of all new licence applications or amendments to existing licences, resulting in additional environmental assessment and approval (i.e., under the EP Act).</p>

Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-Making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
Minister for Aboriginal Affairs, Department of Planning, Lands and Heritage (DPLH)	<i>Aboriginal Heritage Act 1972 (AH Act)</i>	<p>Section 16 Authorisation is required to enter, excavate, examine or remove anything on an Aboriginal site.</p> <p>Section 18 Notices from the Minister is required where the impact on an Aboriginal site is unavoidable.</p>	<p>Yes</p> <p>s.16 and 18 authorisations are predominately related to authorisations to impact heritage sites. However the EPA Social Surroundings factor and objective is considered in decision-making.</p> <p>The AH Act makes it an offence to impact Aboriginal heritage places and objects and requires approval for direct impacts to those and, therefore, in some respects, considers matters relevant to the environmental factor of Social Surroundings. However, the act does not expressly deal with Aboriginal use and enjoyment of cultural landscapes and 'Country' or indirect impacts on Aboriginal sites.</p>
Minister for Environment and Chief Executive Officer, Department of Biodiversity, Conservation and Attractions (DBCA)	<i>Biodiversity Conservation Act 2016 (BC Act)</i>	<p>Section 40 Authorisation is required from the Minister to take and/or disturb threatened flora and/or fauna species</p>	<p>Yes</p> <p>EPA factors and objectives considered in decision-making:</p> <ul style="list-style-type: none"> • Flora and Vegetation – refer above • Terrestrial Fauna – refer above. <p>Authorisation to take threatened species is always required irrespective of any approval granted or exemption under the EP Act.</p> <p>The BC Act provides the ability to impose conditions on authorisations to take threatened species that mitigate or offset the impact of such actions.</p> <p>There is no provision for public comment or appeal with respect to the issue of an authorisation to take threatened species.</p>
Minister for Mines and Petroleum, DMIRS	<p><i>Mines Safety and Inspection Act 1994</i></p> <p><i>Mines Safety and Inspection Regulations 1995</i></p>	<p>A Project Management Plan imposes a general duty of care and provisions to maintain safe and healthy workplaces at mining operations and protect people at work from hazards</p>	<p>No</p> <p>A Project Management Plan is concerned with occupational health and safety.</p>
Minister for Mines and Petroleum, DMIRS	<i>Mining Act 1978</i>	<p>A Mining Proposal is required for any mining-related disturbance within tenements</p>	<p>Yes</p>

Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-Making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
		(i.e., all works apart from road intersection works) outside of the State Agreement area	<p>DMIRS has developed its own environmental objectives, which approximate EPA factor objectives for Terrestrial Fauna, Flora and Vegetation, Inland Water and Terrestrial Environmental Quality.</p> <p>Mining Proposals address all Proposal elements and activities and consider the likely environmental impacts within an 'Environmental Group Site' (a grouping of mining tenements that make up a mining operation). DMIRSs aims to focus its assessment on factors not regulated elsewhere (e.g., key environmental factors assessed under Part IV of the EP Act). Environmental factors assessed include:</p> <ul style="list-style-type: none"> • Land and soils (including subsurface materials) – geochemical and physical characteristics • Biodiversity (e.g., flora, vegetation, terrestrial fauna) • Water resources (surface water and groundwater) • Rehabilitation and mine closure – a mining proposal must contain a MCP. <p>Stakeholder engagement will occur during preparation, but there is no provision for public comment or appeal on a mining proposal. Approved mining proposals will typically be made available to the public on the DMIRS website.</p> <p>Approval of a mining proposal will usually include environmental monitoring and reporting requirements.</p>
Minister for Mines and Petroleum, DMIRS	<i>Mining Act 1978</i>	MCP (for areas administered under the Mining Act tenure) is required to address mine closure and rehabilitation	<p>No (State Agreement Tenure)</p> <p>As mentioned above, environmental objectives defined by DMIRS approximate EPA objectives.</p> <p>A preliminary MCP (Appendix A.5) is provided with this ERD.</p> <p>MCPs address all requirements applicable to mine rehabilitation and closure, including:</p>

Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-Making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
			<ul style="list-style-type: none"> • Baseline and closure date that informs successful rehabilitation, environmental closure risks, monitoring and performance and closure objectives • Post-mining land use • Closure risk, outcomes and completion criteria • Implementation • Monitoring and maintenance. <p>Other than the preliminary MCP provided in Appendix A.5, there is no provision for public comment or appeal on an MCP (although stakeholder engagement will be undertaken to support the development of the MCP and ongoing revision during LOM). MCPs are reviewed every three years to ensure continual improvement and coverage of knowledge gaps identified in previous iterations.</p> <p>DMIRS is an advisory body related to the mine closure plan (MCP) in relation to MCP's on State Agreement tenure.</p>
Minister for Mines and Petroleum, DMIRS	<i>Mining Act 1978</i>	Programme of Work (PoW) Application is required to undertake ground disturbing activities with mechanised equipment on mining tenement (i.e., Exploration activities)	Yes PoW includes requirements to rehabilitate disturbed areas.
Local Government – Shire of Ashburton	<i>Building Act 2011</i> <i>Planning and Development Act 2005</i> <i>Health Act 1911</i>	Building and Health approvals is required	No
Minister for State Department, Jobs, Tourism, Science and innovations (JTSI)	<i>State Agreement: Iron Ore (Robe River) Agreement Act 1964 (WA)</i>	State Agreement is required to be administered by JTSI on behalf of the Western Australian Government	Yes The department administers State Agreements on behalf of the Western Australian Government. Development Proposals are required to be lodged under State Agreement.

Decision-making Authority	Legislation or Agreement Regulating the Activity	Approval Required	Can the Statutory Decision-Making Process Regulate Impacts on the Environment? (Yes/No and Summary of Reasons)
			The State Agreement details the rights, obligations, terms, and conditions for the project's development.

**The term 'works approval' will be replaced by 'controlled work' under Stage 3 of EP Act amendments introduced under the Environmental Protection Amendment Act 2020, with a proclamation estimated to occur in late 2022.*

4. STAKEHOLDER ENGAGEMENT

The Proponent recognises the value of building positive relationships with key stakeholders and the communities in which they are active. The Proponent seeks to build sustainable partnerships with business partners, governments, non-government organisations, host communities and other stakeholders to support mutually beneficial outcomes. The Proponent strives to engage early, openly, honestly and regularly with the communities impacted by their operations and considers the communities' views in their decision-making with respect to key planning, operational and closure aspects.

Ongoing consultation has been an important part of the Proponent's approach to continued operations at West Angelas. This has involved:

- Identification of stakeholders associated with the Proposal
- Delineation of a plan of communications and engagement with stakeholders
- Incorporation of stakeholder feedback into project planning
- In undertaking consultation, the Proponent has incorporated feedback from stakeholders into its planning to ensure the Proposal can be implemented in a manner that does not compromise the environmental and social values of the area or the interests of key stakeholders.

4.1. Stakeholders Identification

Relevant key stakeholders identified and consulted with for the Proposal, including DMAs, other relevant state government agencies and local government authorities, local communities and environmental non-government organisations, are listed in Table 4-1.

Table 4-1: Key Stakeholders for the Proposal

Stakeholder Sector	Organisation	Key Interest
Government of Western Australia	Environmental Protection Authority	<ul style="list-style-type: none"> • Assess EIAs under Part IV (EP Act)
	Department of Planning, Lands and Heritage	<ul style="list-style-type: none"> • Administers AH Act • Native Title requirements • Heritage, cultural, ethnographic and archaeological sites
	Department of Mines, Industry Regulation and Safety	<ul style="list-style-type: none"> • Administers Part V (works approvals and prescribed premises licences) of the EP Act. • Administers Mining Act and regulations • Tenement conditions • Mining proposals and programs of work • Mine closure • Mining rehabilitation fund • Rehabilitation standards • Safety in resource sector
	Department of Water and Environmental Regulation	<ul style="list-style-type: none"> • Administers RiWI Act • Provision of licences to abstract water • Groundwater quality and quantity

Stakeholder Sector	Organisation	Key Interest
	<p>Department of Jobs, Tourism, Science and Innovation</p>	<ul style="list-style-type: none"> • Administers State Agreement Acts • Major Projects • Future Battery Mineral Strategy • Jobs • Renewable energy initiatives
	<ul style="list-style-type: none"> • Department of Primary Industries and Regional Development • Department of Communities 	<ul style="list-style-type: none"> • Regional and community development • Administers the <i>Biosecurity and Agriculture Management Act 2007</i> (obligations with respect to declared pest species)
	<p>Department of Biodiversity, Conservation and Attractions</p>	<ul style="list-style-type: none"> • Administers BC Act • Flora, fauna and habitat conservation • Interest in projects that are located on DBCA-managed land • Baseline surveys and licences to take flora and fauna
	<p>Department of Fire and Emergency Services</p>	<ul style="list-style-type: none"> • Fire breaks • Provision of emergency services
<p>Australian Government</p>	<ul style="list-style-type: none"> • Department of Climate Change, Energy, the Environment and Water • Department of the Prime Minister and Cabinet • National Indigenous Australians Agency 	<ul style="list-style-type: none"> • MNES • Native Title and Aboriginal Heritage • Community Development Program
<p>Local Government Authorities and community</p>	<ul style="list-style-type: none"> • Shire of East Pilbara • Shire of Ashburton 	<ul style="list-style-type: none"> • Rates • Local economy • Benefits to local economy and community • Safety of locals and passers-by • Use of public roads and infrastructure • Compliance with building, health, sewage and other • Local government regulation

Stakeholder Sector	Organisation	Key Interest
Traditional Owner Groups	<ul style="list-style-type: none"> • Yinhawangka People • Ngarlawangga People 	<ul style="list-style-type: none"> • Access to and use of Traditional Owner land • Social and cultural heritage values • Native Title rights • Potential socio-economic opportunities resulting from the Proposal • Potential impacts to sites and social and cultural heritage values of significance/heritage protection • Change of rights to land access • Land access agreement • Operational interactions (e.g., traffic, road condition, noise, and other amenity issues)
Pastoralists	Turee Creek Station	<ul style="list-style-type: none"> • Downstream impacts to access and use of pastoral land • Business and other economic opportunities associated with the Proposal • Operational interactions (e.g., traffic, road condition, noise and other amenity issues) • Firebreaks • Provision of emergency service • Water use and management, impacts on other users

4.2. Stakeholder Engagement Process

A stakeholder consultation program was developed specifically for the Proposal to undertake effective consultation, focusing on the principles outlined in Table 4-2.

Table 4-2: Principles of Stakeholder Engagement

Principles	Requirements
Communication	Communication must be open, accessible, clearly defined, two-way and appropriate
Transparency	The process and outcomes of community and stakeholder engagement should wherever possible, be made open and transparent, agreed upon and documented
Collaboration	The process and outcomes of community and stakeholder engagement should wherever possible, be made open and transparent, agreed upon and documented
Inclusiveness	The process and outcomes of community and stakeholder engagement should, wherever possible, be made open, transparent, agreed upon and documented
Integrity	Community and stakeholder engagement should establish and foster mutual trust and respect

The overarching objectives of the consultation program included the following:

- Ensure stakeholders understand the nature of the proposed project, including likely impacts and benefits that may be derived from the Proposal
- Communicate the project vision to promote confidence in Rio Tinto as an organisation, and the proposed project, by ensuring open and transparent communication of the project's development process, impacts and risk management
- Enable individuals, groups and agencies with interest in the proposed project to have access to up-to-date relevant information
- Establish opportunities for two-way feedback to engage stakeholders and maximise project outcomes through obtaining local knowledge and expertise
- Provide a means through which stakeholders can raise concerns and issues and Rio Tinto with the means to respond to these
- Assess stakeholder issues and concerns so that proposed impacts can be minimised to as low as reasonably practicable and in-line with stakeholder expectations, where possible.

The proponent will continue to build enduring relationships with its neighbours that are characterised by collaboration and mutual respect, which it aims to foster through the following Rio Tinto principles:

- Respect for cultural differences – Wherever we operate, we do our best to accommodate our neighbours' different cultures, lifestyles, heritage and preferences. We are committed to continually reviewing and improving our approach
- Open and honest dialogue – Providing regular opportunities and various mechanisms for engagement is critical to understanding the issues important to our neighbours and our neighbours' understanding of what is important to us
- Active local and regional partnerships – Rio Tinto is dedicated to active partnerships based on mutual commitment, trust and openness. In doing so, we support community-based projects that sustainably make a difference and assist regional development, training, employment, and small business opportunities
- Strong and transparent governance – Our work with communities is closely coordinated via our Agreement structures and takes account of peoples' perceptions of the effects and consequences of our activities. Good performance requires all of us to accept responsibility for community relationships
- Long term commitment to sustainability – We detail local arrangements in our planning and report to stakeholders regularly to ensure programmes remain relevant and deliver outcomes throughout the life cycles of Rio Tinto's activities.

4.3. Stakeholder Engagement Summary and Outcomes

An engagement and consultation database has been established to collate and record stakeholder engagement and ensure that issues raised are addressed and tracked. Consultation activities undertaken to date and feedback received from stakeholders are provided in Appendix A.6. Consultation relevant to closure planning for the Proposal is reflected within the MCP (Appendix A.5).

4.3.1. Traditional Owner Groups

The Proponent has consulted with the Yinhawangka People and Ngarlawangga People relating to the Proposal. This consultation has included the protection and management of cultural heritage sites.

Ongoing engagement with each Traditional Owner group is maintained through formal and informal engagement frameworks, including six-monthly Local Implementation Committee (LIC) and Heritage and Communities meetings attended by Traditional Owner representatives, heritage and approvals, specific engagement and consultation between the Proponent and the Traditional Owner representatives, and other meetings as required.

The Proponent and each Traditional Owners group have agreed on heritage-specific engagement processes, including a Heritage Protocol, which provides archaeological and ethnographic surveys, associated consultation and meetings and Social and Cultural Heritage Management Plans (SCHMP). This is the framework for the Proponent and the Traditional Owner groups to work together to manage and maintain the social and cultural values of the areas in which the Proponent operates on their country.

Through ongoing engagement and consultation with the Traditional Owner groups, review of the Register of Aboriginal Sites managed by DPLH, and archaeological and ethnographic surveys undertaken to date within the Revised Development Envelope, the Proponent has established an initial understanding of the cultural heritage values of the land the subject of the Proposal.

Consultation undertaken to date has been considered in current study programs and impact assessments and is captured in Appendix A.6. Importantly, the significant body of consultation has gone some way to assist Traditional Owners in having a deeper understanding of the Proposal and providing the Proponent with a deeper appreciation of the Traditional Owners connection to Country including concerns and priorities.

The Proponent recognises that ongoing consultation with Traditional Owners is required throughout the Proposal LOM. As the Proposal progresses, the Proponent looks forward to continued collaboration with the Yinhawangka and Ngarlawangga People.

4.3.2. Pastoral Stations

The Proponent has undertaken regular and ongoing consultation with Turee Creek Pastoral Station since 2019. The Turee Creek Pastoral Station have raised queries regarding mining activities that involves dewatering (Deposit J – now excluded from the scope of the Proposal) and have raised queries around management of dust at the Existing Operations.

The Turee Creek Pastoral Station have queried what we would do in the situation if the monitoring bores in L47/041 (station bores Blair's & Mudlark) began to show a decline in the water table and have also queried whether Rio Tinto could investigate direction lighting to try and reduce light pollution. This is also an increasing discussion point for pastoralists in the Pilbara.

4.3.3. Government and Special Interest Groups

Consultation with several State and Commonwealth Departments and Agencies commenced in 2020, with consultation continuing during 2021 and 2022. A pre-referral consultation with EPA Services (DWER) in relation to the Proposed Action was held on 12 May 2020.

To date there have been several opportunities for public involvement in the impact assessment process. Opportunities for formal involvement to date have included:

- Comment on the level of assessment appropriate for the project under Part IV of the EP Act (2 - 9 April 2021). Three public submissions were received requesting assessment by Public Environmental Review process
- Comment on Controlled Action Status of the Proposal under the EPBC Act (3 – 13 May 2021). No public submissions were received from DCCEEW.

The Proponent is committed to continuing consultation with DMAs (DWER, DBCA, DMIRS) and other stakeholders throughout all stages of the environmental assessment process and post-assessment.

4.3.4. Ongoing Stakeholder Consultation

Stakeholder consultation will continue throughout the approvals process, construction, operation, and closure stages. This will include the following levels of engagement:

- Information: The Proponent will continue to publish and distribute information to stakeholders
- Consultation: The opportunity for a two-way exchange of information
- Participation: Active, multi-directional interaction and more intensive forms of consultation
- Negotiation: Face-to-face discussion with the intent of reaching agreement on a specific issue.

This ERD provides stakeholders with a formal opportunity to provide feedback and comment on the Proposal, which will be responded to in the Response to Submissions in the final ERD. If approved, Rio Tinto will continue to implement a Community and Stakeholder Consultation Program during the construction and operations phase of the project. The purpose of this program would be to ensure stakeholders are well informed of Proposal development and to identify, monitor and manage relevant issues raised by stakeholders and the community as a result of the Proposal.

5. ENVIRONMENTAL PRINCIPLES

Section 4A of the EP Act identifies the object and principles of the Act, which is to protect the Environment of the State, having regard to a list of specific principles. These principles are the highest order the EPA must have regarded as a condition of the valid exercise of its powers when assessing and reporting on proposals under the EP Act.

The Proponent has considered these principles concerning the development and implementation of the Proposal. Table 5-1 outlines how the principles relate to the Proposal.

Table 5-1: EP Act Principles

Principle	Consideration
<p>The Precautionary Principle</p> <p>Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation</p> <p>In application of this precautionary principle, decisions should be guided by:</p> <ul style="list-style-type: none"> • Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment • An assessment of the risk-weighted consequences of various options 	<p>The Proponent has conducted numerous studies to understand the social and environmental values within the Revised Development Envelope and the potential risks to these from the Proposal. These studies have informed the detailed design of the Proposal, and modifications to the Proposal have been made to avoid and minimise impacts, where practicable. All applicable studies have been conducted to conform with EPA’s Environmental Factor Guidelines, technical guidance documents, and other best practice guidelines to ensure the robust collection of data to make predictions on the effect or impact of the Proposal on environmental and social values. Scientific certainty around environmental values is improved via the number and nature of studies undertaken for the Existing Operations since 1998, and other studies across the Pilbara for the broader Rio Tinto Group at surrounding operations and from publicly available information from other proponents.</p> <p>The impact assessment has addressed any uncertainties within the studies using conservative assumptions, scenario modelling and proposed outcome-based conditions. Uncertainties that have been addressed throughout the ERD include:</p> <ul style="list-style-type: none"> • The Revised Development Envelope supports several significant values, including critical (high significance) habitat for Northern Quoll, Ghost Bat and Pilbara Olive Python and supporting habitat for Pilbara Leaf-nosed bat (Section 9 and Section 13) • The Proposal will impact some Priority flora species; however, no flora species or ecological communities listed as Threatened are present within the Revised Development Envelope (Section 8) <p>The Proponent has determined key mitigation measures to address scientific uncertainties and avoid or minimise impacts; which include:</p>

Principle	Consideration
	<ul style="list-style-type: none"> • Mining of the Western Hill deposits will be limited to AWT to avoid the need to abstract groundwater (for mine pit dewatering) close to Karijini National Park (Section 7) • Surface water management to minimise erosion and downstream sedimentation risk (Section 7) • Water will only be discharged to the environment where the water quality is compatible with the receiving environment and only at existing discharge points and when surplus only after water-re-use options have been implemented (Section 7) • Restore vegetation using recovered topsoil and seed of local provenance to promote successful rehabilitation (Section 8) • Minimise direct and indirect impacts to significant vegetation (PECs) through the implementation of upper clearing limits (Section 8) • Minimise direct and indirect impacts to high significance fauna habitat through the implementation of upper clearing limits (Section 9) • Avoid significant Ghost Bat caves (category 2 and apartment blocks) and water features (Deposit H Waterhole) through the implementation of MEZ and/or MRZ (Section 9). <p>The Proponent will monitor all significant environmental values, as detailed in the EMP, to provide assurance that anticipated environmental outcomes are achieved and that mitigation measures are effective.</p> <p>The Proponent has consulted and continues to engage extensively with the Traditional Owner groups whose lands intersect the Revised Development Envelope or are neighbouring the Revised Development Envelope. These groups are interested in the Proposal and potential impacts on social and cultural heritage values from the Proposal.</p> <p>The Proponent has applied the mitigation hierarchy to avoid, minimise and mitigate environmental, social and cultural heritage impacts to as low as reasonably practicable. The environmental risks associated with the Proposal have been assessed and are detailed in this ERD.</p>
<p>The Principle of Intergenerational Equity</p> <p>The present generation should ensure that the health, diversity and productivity of the environment are maintained and enhanced for the benefit of future generations</p>	<p>The Proposal has been designed to meet the EPA's objectives for the identified environmental factors, with mitigation measures to reduce residual environmental impacts and offsets proposed to compensate for any significant residual impacts. The maintenance of biological diversity and natural resources and the reduction in greenhouse gas emissions are of particular importance in relation to this principle.</p> <p>The Proponent understands that greenhouse gas emissions pose a risk to the global environment and future generations and has prepared a Greenhouse Gas Management Plan (GHG EMP; Appendix A.7) that outlines the projects emissions targets and processes and initiatives to reduce emissions over time, consistent with the net-zero by 2050 commitment of the Commonwealth and West Australian Governments. The Proponent has also set medium term (2 – 10 year) targets for GHG emission reductions against a 2018 baseline as outlined in the GHG EMP (Appendix A.7):</p>

Principle	Consideration
	<ul style="list-style-type: none"> • Reduce Scope 1 & Scope 2 emissions by 15% by 2025 • Reduce Scope 1 & Scope 2 emissions by 50% by 2030. <p>The Proponent commits to providing offsets as a contingency if emission reduction targets are not met over the LoM.</p> <p>The Proponent has and will continue to work collaboratively with Traditional Owner groups to ensure the maintenance of Indigenous social and cultural heritage values and the future enjoyment of the land.</p> <p>The Proponent has amended the Proposal to reduce potential risk to identified environmental and cultural heritage values (outlined under Precautionary Principle) and will further protect environmental values by implementing MEZ and MRZ to protect 37 Ghost Bat caves.</p> <p>The Proponent will implement offsets for significant residual impacts that cannot be completely avoided by the Proposal including: vegetation in 'good to excellent' condition; and fauna habitat of high significance (Gorge/Gully and Hillslope/Hillcrest) and moderate significance (Drainage Line, Foothills and Plain, Mixed Acacia Woodlands and Cracking Clays) in relation to conservation listed species, including Northern Quoll, Ghost Bat, Pilbara leaf-nosed Bat and Pilbara Olive Python (Section 12 and 13).</p> <p>This assessment demonstrates that the Proposal can be implemented to avoid significant impacts on the health, diversity or productivity of the environment for the benefit of future generations.</p>
<p>The Principle of the Conservation of Biological Diversity and Ecological Integrity</p> <p>Conservation of biological diversity and ecological integrity should be a fundamental consideration.</p>	<p>The Proponent has considered the relevant environmental factors and has modified the mine and infrastructure design to avoid and minimise impacts to significant environmental values associated with Flora and Vegetation, Terrestrial Fauna and Subterranean Fauna, where practicable. This includes:</p> <ul style="list-style-type: none"> • The total clearing required for the Proposal was revised from 7,200 ha to 5,350 ha • Avoid direct disturbance to 37 Ghost Bat Caves and protection via Mining Exclusion / Restriction Zones • Avoid direct disturbance to Deposit H Waterhole and filling regime as a result of changes to catchments from mining • Minimise impacts to critical and supporting habitat for MNES species. <p>The Proponent will implement an EMP (Appendix A.8) to manage potential impacts to environmental values within the Revised Development Envelope and implement an MCP to effectively close and rehabilitate disturbances and landforms associated with the Proposal (Appendix A.5).</p> <p>The Proponent will implement offsets for significant residual impacts to vegetation in Good to Excellent condition, and high and moderate value fauna habitat for Northern Quoll, Ghost Bats, Pilbara Leaf-nosed Bat and Pilbara Olive Python.</p> <p>The conservation of biological diversity and ecological integrity has been a fundamental consideration in developing the Proposal and applying the mitigation hierarchy.</p>

Principle	Consideration
<p>Principles Relating to Improved Valuation, Pricing and Incentive Mechanisms</p> <ul style="list-style-type: none"> • Environmental Factors should be included in the valuation of assets and services • The polluter pays principles — those who generate pollution and waste should bear the cost of containment, avoidance or abatement • The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes • Environmental goals, having been established, should be pursued in the most cost-effective way, by establishing incentive structure, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems 	<p>The Proponent acknowledges the need for improved valuation, pricing and incentive mechanisms and endeavours to pursue these principles when practicable. For example:</p> <ul style="list-style-type: none"> • Detailed flora, vegetation, and terrestrial fauna field surveys have been undertaken to identify and confirm the relative environmental values within the Revised Development Envelope. Environmental factors have been considered in determining the mine design and location of the infrastructure • Emissions and discharges will be minimised as far as practicable through design and administrative controls such as Management Plans and Procedures • Potential impacts on the identified ecological attributes within the Revised Development Envelope have been a fundamental design consideration. The Conceptual Footprint has been modified to reduce impacts to significant environmental values • The Proponent has proposed management actions to mitigate and manage the Proposal related impacts to flora and vegetation, terrestrial fauna, subterranean fauna, inland waters, social surroundings and greenhouse gas emissions • Offsets have been proposed for significant residual impacts to vegetation in Good to Excellent condition, and high value fauna habitat for Northern Quoll, Ghost Bats, Pilbara Leaf-nosed Bat and Pilbara Olive Python • The Proponent will bear all costs of monitoring, mitigation provisions, offsets and closure, which has been included in the financial provisioning for the Proposal. The Proponent has prepared a MCP for the Proposal (Appendix A.5). This will be further developed through ongoing consultation.
<p>The Principle of Waste Minimisation</p> <p>All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment</p>	<p>The Proponent has considered the principle of waste minimisation, including the destination and use of removed materials. Waste will be minimised during construction, operation and closure by adopting the hierarchy of waste controls: avoid, reduce, reuse, recycle and safe disposal. Key measures for waste minimisation in this Proposal include:</p> <ul style="list-style-type: none"> • Strategic management of surplus water via surplus use hierarchy to minimise the overall loss of water from this system in accordance with RTIO water strategy (Section 7) • Mineral Waste Management Plan to ensure waste material is adequately geochemically characterised and appropriately managed • Waste to be collected and removed for treatment by licensed contractors as appropriate. <p>The Proponent has committed to a low carbon future, with the production of essential materials aligned with proactive climate action and goals of the Paris Agreement and targets to achieve reduced emissions intensity by 15% by 2025, 50% by 2030 and net-zero emissions by 2050.</p>

6. SOCIAL SURROUNDINGS

6.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021c) lists the following as their objective for Social Surroundings:

To protect social surroundings from significant harm

Social surroundings under the EP Act refers to “the social surroundings of a person are their aesthetic, cultural, economic and social surroundings to the extent that those surroundings directly affect or are affected by a person’s physical or biological surroundings.”

As such, there is a specific focus on a clear linkage between the Proposal’s potential impact on the physical and biological surroundings and the subsequent impact on a person’s aesthetic, cultural, economic or social surroundings. This must be considered in the context of ‘significance’ as defined in relation to significant proposals in subsection 37B(1) of the EP Act.

6.2. Relevant Legislation, Policy and Guidance

Legislation, policy and guidance relevant to Social Surroundings is discussed in Sections 6.2.1 to 6.2.3.

6.2.1. Applicable Legislation

Relevant legislation is described in Table 6-2, with more specific details provided below.

6.2.1.1. Environmental Protection Act 1986

Under the Environmental Protection (EP) Act, Social Surroundings is considered a part of the environment that may require consideration for the purpose of EIA, as it is included in the EP Act definition of environment:

Environment, subject to subsection (2), means living things, their physical, biological and social surroundings, and interactions between all of these.

The meaning of social surroundings is further explained in the EP Act as follows:

“In the case of humans, the reference to social surroundings in the definition of the environment in subsection (1), is a reference to the aesthetic, cultural, economic and other social surroundings to the extent that they directly affect or are affected by physical or biological surroundings.”

This means that for social surroundings to be considered in an EIA there must be a clear link between a proposal’s impact on the physical or biological surroundings and the subsequent impact on a person’s aesthetic, cultural, economic or other social surroundings. Further, as stated in the *Environmental Factor Guideline: Social Surroundings* (EPA 2023a), this must be read in the context of ‘significance’ as defined in relation to significant proposals in subsection 37B(1) of the EP Act. That is, for the EPA to consider Social Surroundings as a factor in an EIA, the proposal’s effect (i.e., impact) on social surroundings, via its effect on the physical or biological environment, must be significant.

6.2.1.2. Native Title

The Commonwealth *Native Title Act 1993* (NT Act) recognises under common law the rights and interests of Aboriginal and Torres Strait Islander people in land and waters according to their traditional Laws, lore and customs. Native Title includes areas where title holders have exclusive rights and interests, as well as areas where non-exclusive rights and interests exist. The Proposal intersects non-exclusive areas of the relevant native title determinations. The exercise of native title rights and interests

are subject to and exercisable in accordance with the laws of the State and Commonwealth. Traditional Owner (or Common Law Holder [CLH]) rights recognised under the NT Act within non-exclusive areas include, generally, the right to (on or within the area):

- Possess, occupy, use and enjoy the area as against the whole world (Area A only with respect to Yinhawangka native title determination [see below])
- Access, live, camp, erect shelters, move about
- Hunt and fish, gather and take traditional resources (other than minerals, petroleum and gas), fauna, flora, soil, sand, stone and/or flint, clay, gravel, ochre, access and take water, take and trade in shells
- Occupy, use, enjoy, be present on or within the area
- Speak for and make decisions about the use of the area by members of the Aboriginal society to which the native title claim group belong
- Invite and permit others to have access to and participate in or carry out activities
- Speak authoritatively about the area among other Aboriginal people and to control access to and use of the area by other Aboriginal people
- Engage in cultural activities, conduct and participate in ceremonies and meetings, conduct burials, and transmit knowledge
- Visit, care for, maintain and protect places of importance and maintain, conserve and protect significant places and objects
- Manufacture traditional items from resources of the area, trade resources from the area.

The Revised Development Envelope is on land subject to two Native Title Determinations (Section 6.2.1.2) including:

- Ngarlawangga People Native Title Determination (WCD2016/007), which covers 26.6 km² (31.5%) of the Revised Development Envelope and incorporates the eastern portions of Deposit H and Deposit F North (the Ngarlawangga section). Ngarlawangga Aboriginal Corporation (NAC) holds determined native title rights on behalf of the Ngarlawangga People
- Yinhawangka People Native Title Determination (WCD2017/003), which covers 57.97 km² (68.5%) of the Revised Development Envelope and incorporates the Western Hill and Mt Ella East deposits in addition to the western portions of Deposit H and Deposit F North (the Yinhawangka section). Yinhawangka Aboriginal Corporation (YAC) holds determined native title rights on behalf of the Yinhawangka People.

NAC and YAC are Registered Native Title Bodies Corporate (RNTBCs) established following each native title determination, in accordance with the NT Act, to manage and protect native title holders' rights and interests.

These two Traditional Owner groups hold non-exclusive native title rights in their respective determination areas, recognised by the Federal Court. Each group has a demonstrated long history of land use and cultural association within the Proposal area and its near surrounds, which continues into the present. This includes an ongoing responsibility to protect and care for their respective areas of Country, which applies to the whole of their Country, as well as being part of a reciprocal responsibility shared more broadly with neighbouring Traditional Owner groups.

The Revised Development Envelope extends along the eastern boundary of Yinhawangka lands, intersecting with the north-western boundary of Ngarlawangga lands (Table 6-1; Figure 6-1).

Neighbouring native title areas include those of the:

- Banjima People Native Title Determination (WCD2014/001)
- Nyiyaparli People Native Title Determination (WCD2018/008)
- Nharnuwangaa People Native Title Determination (WCD2000/001)
- Martu and Ngurrara Native Title Determination (WCD2002/002).

Table 6-1: Proposal Deposit Locations

Deposit	Native Title Boundary Locations
Western Hill	Yinhawangka Country
Deposit H	Yinhawangka, and Ngarlawangga Country
Deposit F North	Yinhawangka, and Ngarlawangga Country
Mt Ella East	Yinhawangka Country

The Proponent has negotiated and executed Native Title Agreements with the Ngarlawangga and Yinhawangka Traditional Owner groups in respect of the use of the land within the Revised Development Envelope, and more broadly. Yinhawangka executed a Claim Wide Participation Agreement in 2013, and Indigenous Land Use Agreement which was registered with the National Native Title Tribunal in 2013. Ngarlawangga executed a Northern Claim Area Participation Agreement in 2011, and Indigenous Land Use Agreement in 2012. These Agreements are part of an agreement modernisation process with Traditional Owners, which is ongoing at the time of writing.

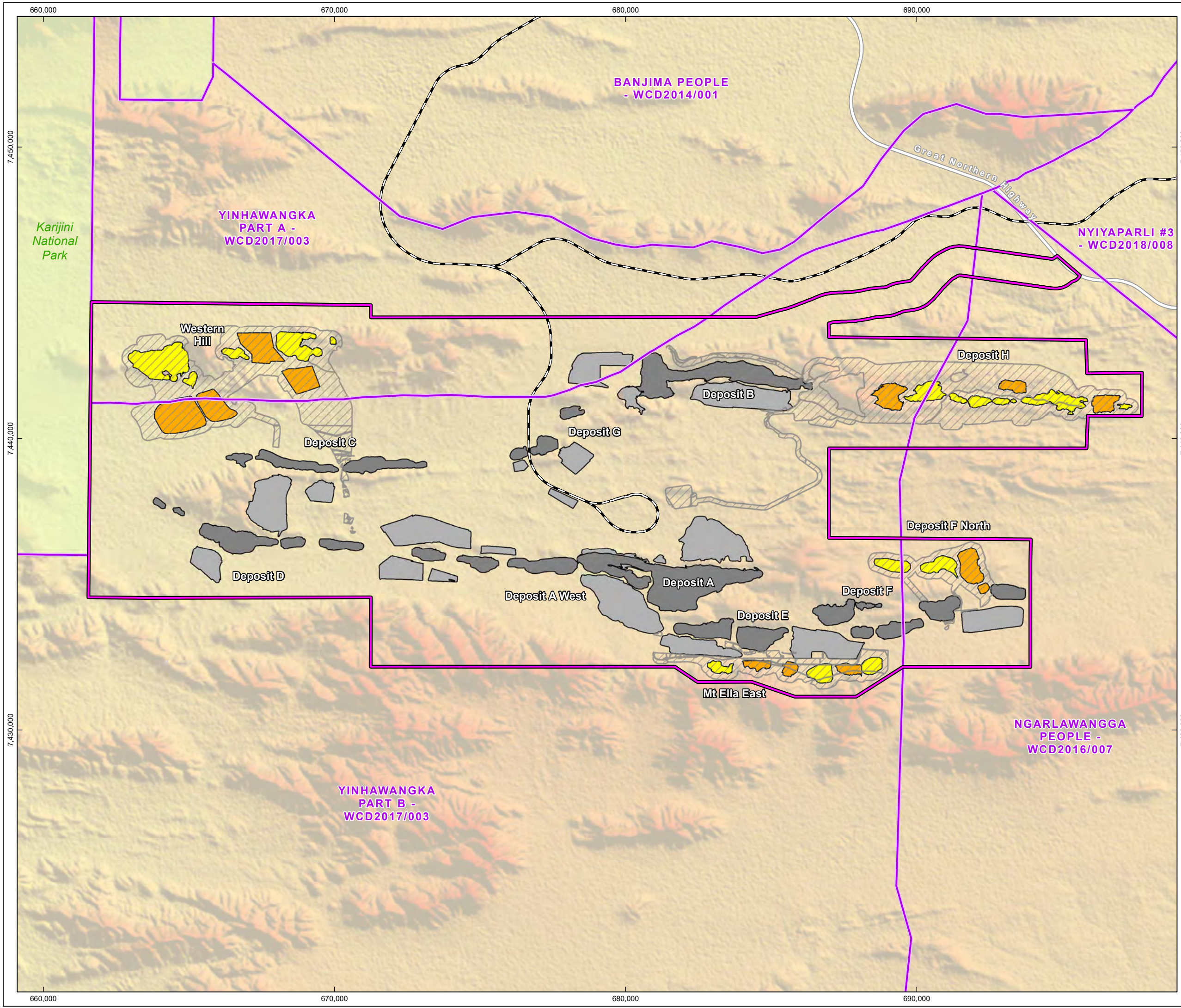
These Agreements recognise Rio Tinto’s support of Native Title rights. In return for access to land, the Agreements provide a range of benefits and set out a number of obligations for both Traditional Owners and Rio Tinto. The Agreements also detail frameworks through which the Proponent and the Traditional Owner groups work together to manage interaction between cultural values and the Proponents’ activities in the areas in which the Proponent operates. Ongoing engagement with the groups is maintained through formal and informal engagement frameworks including consultation, monitoring and review processes as discussed in Section 6.3.1. Indigenous Land Use Agreement (ILUAs) between the Proponent and the Traditional Owner groups have also been registered addressing the Future Acts provisions of the NT Act.

In addition to the above Agreements Yinhawangka and Ngarlawangga opted into the Regional Framework Deed (RFD) in 2013 and 2011, respectively. The RFD establishes a series of mutual commitments between Rio Tinto and the relevant Pilbara Traditional Owner groups (known as Opt-In Groups), with the intention of providing a series of non-monetary benefits across seven regional standards including:

- Employment and training
- Cultural heritage management
- Business development and contracting
- Life of mine planning
- Environmental management
- Cultural awareness training
- Land access.

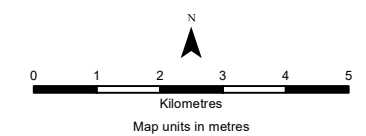
Figure 6-1
Native Title Determination
relevant to the Revised
Development Envelope

Drawn: GIS Team
Plan: PDE0186404v4
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Conceptual Footprint
- Proposed Conceptual Layout
 - Pit
 - Waste Landform
- Approved Conceptual Layout
 - Pit
 - Waste Landform
- Native Title Determination Area
- National Park
- Rio Tinto Railway
- Highway



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6.2.2. Interaction Between State Aboriginal Heritage Legislation and the EP Act

The EP Act and State Aboriginal heritage legislation (which includes the recent *Aboriginal Cultural Heritage Act 2021* [ACH Act] which, at the time of preparation, is to be repealed and replaced by a reinstated *Aboriginal Heritage Act 1972* [AH Act]) have the legal capacity to consider aspects of Aboriginal heritage.

Under the EP Act, the EPA is required to consider social surroundings, include impacts to Aboriginal cultural heritage values, to the extent to which they directly affect or are affected by physical or biological surroundings (EPA 2023a). State Aboriginal heritage legislation is about valuing and protecting Aboriginal cultural heritage and managing activities that may harm that heritage, recognising the special interest Aboriginal people have in protecting, conserving, preserving and managing Aboriginal cultural heritage.

State Aboriginal heritage legislation protects all Aboriginal heritage sites in Western Australia (WA), whether or not they are registered with the Department of Planning, Lands and Heritage (DPLH).

6.2.2.1. Applicable Legislation

Table 6-2 lists the legislation for Social Surroundings that have been considered in this section.

Table 6-2: Relevant Legislation for Social Surroundings

Document	Description
<i>Environmental Protection Act 1986</i> (WA) (EP Act)	An Act to provide for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection, enhancement and management of the environment and for matters incidental to or connected with the foregoing.
<i>Aboriginal Heritage Act 1972</i> (WA) (AH Act) to be reinstated pending repeal of the <i>Aboriginal Cultural Heritage Act 2021</i> , below	An Act to make provision for preservation on behalf of the community of places and objects customarily used by or traditional to the original inhabitants of Australia or their descendants.
<i>Aboriginal Cultural Heritage Act 2021</i> (WA) (ACH Act) Temporarily replacing the AH Act; however, is to be repealed.	An Act to make provision for the protection and management on behalf of the community of Aboriginal cultural heritage, which is more broadly defined than under the AH Act.
<i>Aboriginal and Torres Strait Islander Heritage Protection Act 1984</i> (Cth) (ATSIHP Act)	An Act to preserve and protect places, areas and objects of significance to Indigenous people, and for related purposes.
<i>Native Title Act 1993</i> (Cth) (NT Act)	An Act that recognises the common law of Indigenous Australians, based on their own laws and customs in relation to the lands and waters.
<i>Environment Protection and Biodiversity Conservation Act 1999</i> (Cth) (EPBC Act)	An Act for protecting the environment, including MNES - which can include cultural heritage; providing for, protecting and conserving cultural heritage; and promoting a co-operative approach to management of the environment, involving governments, the community, landholders and Aboriginal (and Torres Strait Islander [TSI]) peoples; to recognise the role of Aboriginal (and TSI) peoples in conservation and ecologically sustainable use of biodiversity; and to promote the use of Aboriginal (and TSI) peoples knowledge of biodiversity, with knowledge-owners involvement and cooperation.
<i>Heritage Act 2018</i> (WA)	An Act concerned with the understanding, appreciation, importance, identification, documentation and conservation, use, development and reuse of historic heritage

Document	Description
	(focussed on the built environment and historic elements of Western Australian heritage).
<i>Land Administration Act 1997 (WA)</i>	The State's principal legislation dealing with administration of all Crown land. The Minister for Lands is responsible for the Act which is administered by the Department of Planning, Lands and Heritage. The Act establishes the Pastoral Lands Board which has responsibility for administering pastoral leases. Pastoral leases provide a right to graze authorised livestock on Crown land that has been set aside for this purpose.
<i>Conservation and Land Management Act 1984 (WA)</i>	An Act to establish the Conservation and Parks Commission which is vested with responsibility for management of the conservation estate including national parks such as Karijini National Park. The Act provides for conservation, protection and management of biodiversity and biodiversity components within the estate and enables joint management with Traditional Owners.
<i>Mining Act 1978 (WA)</i>	An Act which manages mining tenure, Mining Proposals, exploration and Mine Closure Plans. A Mining Proposal is required for any mining-related disturbance within tenements (i.e., all works apart from road intersection works) outside of the State Agreement area. DMIRS is an advisory body related to the mine closure plan (MCP) in relation to MCP's on State Agreement tenure.
<i>Iron Ore (Robe River) Agreement Act 1964 (Robe River State Agreement)</i>	A State Agreement is a legal contract between the Western Australian Government and a Proponent of a major project within State boundaries. A State Agreement details the rights, obligations, terms and conditions for developing a specific project.

6.2.3. Policy and Guidance

Table 6-3 lists the policy and guidance for Social Surroundings that have been considered in this section, and the manner in which they have been addressed.

Table 6-3: Relevant Policy and Guidance for Social Surroundings

EPA, other State or Commonwealth and Industry or Proponent Policy or Guidance, if Relevant	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021a)	The EPA objective for Social Surroundings forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Social Surroundings (EPA 2023a)	<p>Considered in:</p> <ul style="list-style-type: none"> • Planning and design of relevant surveys, consultation and investigations undertaken to date • Consultation with Traditional Owners • Consultation with pastoral and community stakeholders • Preliminary assessment of potential impacts • Project design and refinement • Development of mitigation measures.

EPA, other State or Commonwealth and Industry or Proponent Policy or Guidance, if Relevant	Explain How the Policy and Guidance has been Considered
Interim Technical Guidance – Environmental impact assessment of Social Surroundings – Aboriginal cultural heritage (EPA 2023b)	Considered in: <ul style="list-style-type: none"> • Planning and design of relevant surveys, consultation and investigations undertaken to date.
Instructions on how to prepare an Environmental Review Document (EPA 2021e)	Considered during the development of this document.
Instructions on how to prepare <i>Environmental Protection Act 1986</i> Part IV Environmental Management Plans (EPA 2021h)	This document forms the basis of the headings and content provided in this ERD.
Other State or Commonwealth	
Statutory Guidelines for Mine Closure Plans (MCP) (DMIRS 2020b)	The MCP has been prepared in accordance with the guidance and recognises the importance of Social Surroundings and related consultation in informing closure strategies (Appendix A.5:).
Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	
Department of Planning, Lands and Heritage and Department of Premier and Cabinet Due Diligence Guidelines, Version 3.0 (DAA and DPC 2013)	Considered with respect to guidance on raising awareness of how proposed activities could adversely impact Aboriginal heritage sites.
Engage Early Guidance for proponents on best practice Indigenous engagement for environmental assessments under the EPBC Act (DoE 2016a)	Used as guidance during engagement.
Other Industry or Proponent	
ESG: Change for the Better (MCA 2021)	Considered with respect to industry-standard policies, strategies and partnerships that support and improve the mining industry in its environmental, social and governance (ESG) performance, including Indigenous partnerships.
Integrated Mine Closure Good Practice Guide (ICMM 2019)	Considered with respect to engagement and participation of stakeholders most affected by the Proposal, through the LOM including closure.
Communities and Social Performance Standard (Rio Tinto 2022c)	The Standard the Proponent expects of itself in regard to its performance in relation to, and management of, Health, Safety, Environment and Communities (HSEC) and Human Rights risks and opportunities associated with the proposed activities which could adversely impact the social surroundings of Traditional Owners and local communities.
Communities and Social Performance Commitments Disclosure Interim Report (Rio Tinto 2021a)	Considered with respect to commitments the Proponent has made regarding partnerships and engagement with Traditional Owner groups within the Pilbara.
The Burra Charter the Australia International Council on Monuments and Sites (ICOMOS) Charter for Places of Cultural Significance, (ICOMOS 2013)	Used as Guidance for Heritage Surveys Considered with respect to the practice of cultural heritage management and guidance on the Burra Charter and its application.

EPA, other State or Commonwealth and Industry or Proponent Policy or Guidance, if Relevant	Explain How the Policy and Guidance has been Considered
Cultural Heritage Management System (CHMS)	<p>Policies, procedures, instructions and frameworks for heritage related items including;</p> <ul style="list-style-type: none"> • Identification and management of heritage sites and places • Consultation processes with Traditional Owners • Protection and/or management, e.g. exclusion/restriction zones or application of legislative guidelines as specified above.

6.3. Receiving Environment – Consultation and Studies

The Proponent has undertaken dedicated consultation focussed on the Social Surroundings key environmental factor to inform this assessment. Key parties consulted with are outlined in Table 6-4. The Proponent's approach to undertaking Social Surroundings consultation for Traditional Owners is outlined in Section 6.3.1 and Appendix B.1: and for key non-Traditional Owner stakeholders reflected in Section 4.

Consultation with respect to the Proposal more broadly, including with other stakeholders, is listed in Section 4 (Stakeholder Engagement).

Table 6-4: Key Stakeholders for Social Surroundings Consultation

Traditional Owner Group	Prescribed Body Corporate	Pastoral Station	Community	Other relevant parties
Ngarlawangga Traditional Owners	NAC	Turee Creek Pastoral Station	Community, including the Shire of East Pilbara, Shire of Ashburton	DBCA – (Manager of Karijini National Park)
Yinhawangka Traditional Owners	YAC			

6.3.1. Traditional Owner Social Surroundings Consultation Program

An outline of the Social Surroundings consultation program for Traditional Owners is shown in Appendix B.1. Important context and key issues, concerns and values identified during the implementation of this program are detailed in Section 6.5.

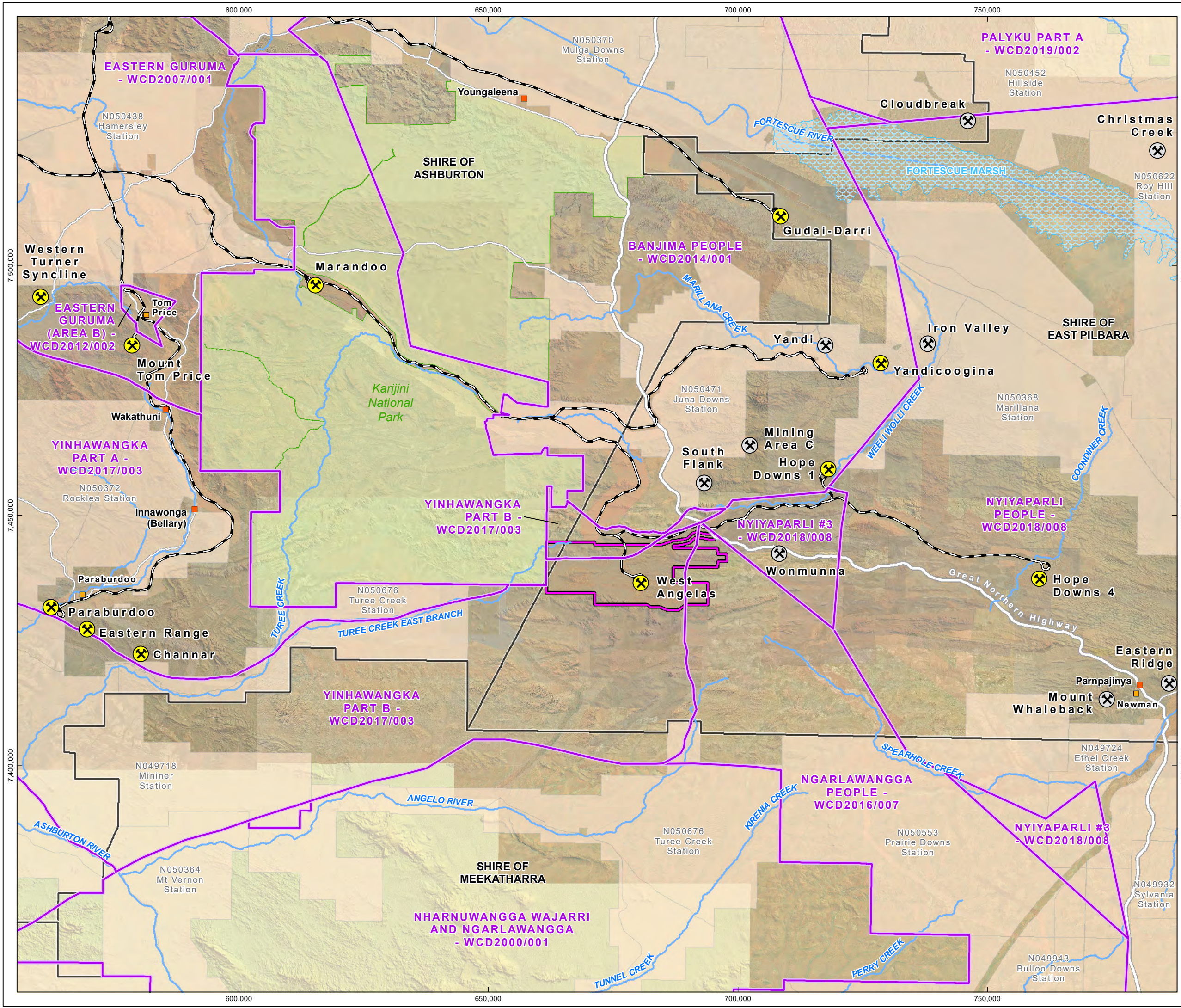
Social Surroundings consultation and fieldwork is also ongoing during the assessment phase and expected to continue under the provisions of the SCHMP developed for the Proposal.

Note that key concerns identified from Non-Traditional Owner Social Surroundings consultation are provided in Section 6.5.

At each stage of consultation, the Proponent has aimed to transparently present information to the Traditional Owner groups on all Proposal aspects based on the state of knowledge at the time. This includes presenting Proposal design options and study findings and providing updates and further information in response to concerns or queries raised during or following previous consultation, while acknowledging that some issues and concerns will need to be an ongoing consultation focus through the life of the Proposal. Recognising that Traditional Owners have been asked to consider a large volume of often new and challenging information, the Proponent has, at each stage, attempted to build on the last consultation forum, be targeted, reflect and address Traditional Owners recommendations (Appendix B.2:e and B.3:c) and responses on their key concerns, or acknowledge or incorporate information they have provided and to present information in ways to support lay people's understanding without minimising key detail, for example through the use of 3D models, graphics and photos. Specific important sites or features (for example, Deposit H Waterhole, or the Range to the south of the existing West Angelas operations) were given extra attention within presentations as appropriate.

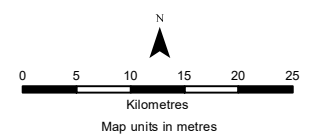
Figure 6-2
Social Setting and Land Use
within and around the Revised
Development Envelope

Drawn: GIS Team
Plan: RTIO-0977403v1
Date: February 2023
Proj: GDA 1984 MGA Zone 50
Scale: 1:700,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Native Title Determination Area
- LGA Boundary
- Pastoral Lease
- National Park
- Marsh
- Rio Tinto Mine
- Competitor Mine
- Town
- Aboriginal Community
- Rio Tinto Railway
- Highway
- Major Road
- Major Creek



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6.3.2. Social Surroundings Studies and Consultations

Outcomes from the Social Surroundings consultation were used to inform the studies listed in Table 6-5. For more details, key study/survey reports are provided in Appendix B.2: to B.3:.

Table 6-5: Summary of Technical Studies for the Social Surroundings Factor

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Final Report of Ngarlawangga Aboriginal Corporation WAN Social Surroundings Consultations (Herrmann and Millett 2022) Prepared for Ngarlawangga Aboriginal Corporation Appendix B.2a (Confidential)	Area: Ngarlawangga Native Title Determination Area Type: On-Country and offsite consultation with Traditional Owners regarding potential impacts of the Proposal on Social Surroundings Timing: 2022	No specific guidance is available for Social Surroundings consultation however, the consultation process has been consistent with 'Engage Early Guidance for proponents on best practice Indigenous engagement for environmental assessments under the EPBC Act (DoE 2016a)' and in alignment with agreements between the Proponent and relevant Native Title groups.
Final Report of a Social Surroundings Assessment for West Angelas Revised Proposal (Yinhawangka CLH and Archae-aus 2022). Prepared for Yinhawangka Aboriginal Corporation on behalf of Rio Tinto. Appendix B.3a (Confidential)	Area: Yinhawangka Native Title Determination Area Type: Consultation including on-country assessment Timing: 2022	
Interim Report of Ngarlawangga Aboriginal Corporation Social Surroundings Mt Ella Consultation (Herrmann 2022b) Prepared for Ngarlawangga Aboriginal Corporation	Area: Ngarlawangga Native Title Determination Area Type: Consultation including on-country assessment Timing: 2022	
Preliminary Advice of a Social Surroundings Assessment for West Angelas Revised Proposal, Western Australia (Archae-aus 2022a) Prepared for Yinhawangka Aboriginal Corporation on behalf of Rio Tinto	Area: Yinhawangka Native Title Determination Area Type: Consultation Workshop Timing: 2022	
Summary Report of Ngarlawangga Aboriginal Corporation Social Surroundings Phase 1 Scoping Consultation (Herrmann 2021)	Area: Ngarlawangga Native Title Determination Area Type: Consultation including on-country assessment	

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Prepared for Ngarlawangga Aboriginal Corporation	Timing: 2021	
<p>Trip 1 Field Report on Yinhawangka cultural values to inform a Social Surroundings assessment of the Beyond 2020 Proposal at Greater West Angelas, Western Australia. Trip 1 of 3 (Archae-aus 2021a)</p> <p>Prepared for Yinhawangka Aboriginal Corporation on behalf of Rio Tinto</p>	<p>Area: Yinhawangka Native Title Determination Area</p> <p>Type: Consultation including on-country assessment</p> <p>Timing: 2021</p>	
<p>Trip Report on Yinhawangka cultural values to inform a Social Surroundings assessment of the Beyond 2020 Proposal at Greater West Angelas, Western Australia. Trip 2 of 3 (Archae-aus 2021b)</p> <p>Prepared for Yinhawangka Aboriginal Corporation on behalf of Rio Tinto</p>	<p>Area: Yinhawangka Native Title Determination Area</p> <p>Type: Consultation including on-country assessment</p> <p>Timing: 2021</p>	
<p>Trip Report of a Social Surroundings Assessment of the Beyond 2020 Proposal and Deposits G and A West at Greater West Angelas, Western Australia. Trip 3 of 3 (Archae-aus 2021c)</p> <p>Prepared for Yinhawangka Aboriginal Corporation on behalf of Rio Tinto</p>	<p>Area: Yinhawangka Native Title Determination Area</p> <p>Type: Consultation including on-country assessment</p> <p>Timing: 2021</p>	
<p>Trip Report of a Social Surroundings Assessment of the Beyond 2020 Proposal and Deposits G and A West at Greater West Angelas, Western Australia. Trip 4 (Archae-aus 2022b)</p> <p>Prepared for Yinhawangka Aboriginal Corporation on behalf of Rio Tinto</p>	<p>Area: Yinhawangka Native Title Determination Area</p> <p>Type: Consultation including on-country assessment</p> <p>Timing: 2022</p>	

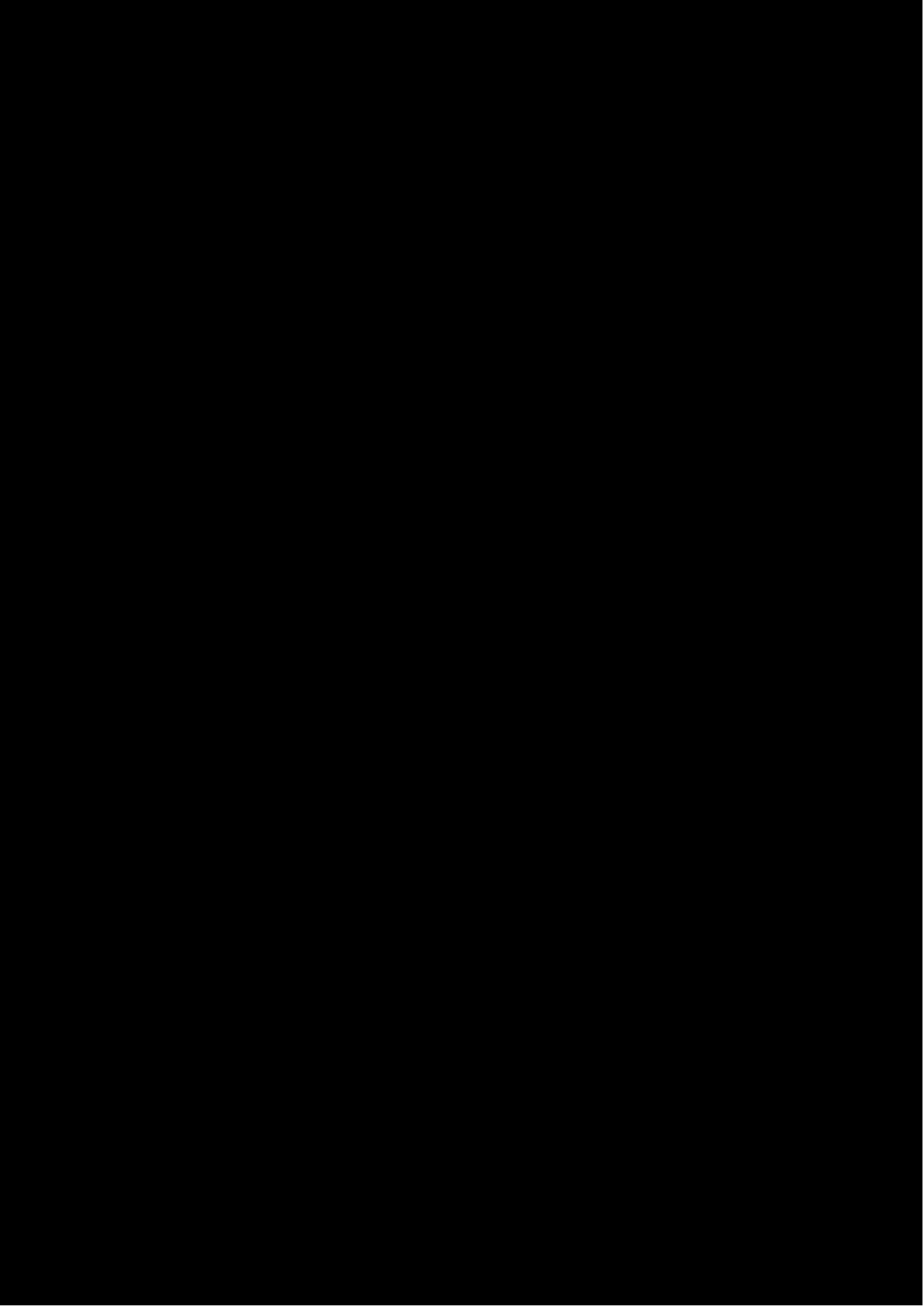
Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
<p>West Angelas Social Surrounds (Trip 2) Consultation with Ngarlawangga Traditional Owners, Rio Tinto, Yamatji Marlpa Aboriginal Corporation, and Ngarlawangga Aboriginal Corporation; for the West Angelas Revised Proposal (Preston 2021)</p> <p>Prepared by Preston Consulting for Ngarlawangga</p>	<p>Area: Ngarlawangga Native Title Determination Area</p> <p>Type: Consultation including on-country assessment</p> <p>Timing: 2021</p>	
<p>Summary Report of Ngarlawangga – Rio Tinto Iron Ore Social Surroundings Consultations regarding the West Angelas Proposal (Stevens 2023a)</p> <p>Prepared by Stevens Heritage Services for Ngarlawangga Aboriginal Corporation and Rio Tinto Iron Ore</p>	<p>Area: Ngarlawangga Native Title Determination Area</p> <p>Type: Summary of consultation including on-country assessment</p> <p>Timing: 2023</p>	
<p>Ngarlawangga – Rio Tinto Iron Ore Social Surroundings Consultations Regarding the West Angelas Proposal. Summary Report No. 2. (Stevens 2023b)</p> <p>Prepared by Stevens Heritage Services for Ngarlawangga Aboriginal Corporation and Rio Tinto Iron Ore</p> <p>Appendix B.2.b (Confidential)</p>	<p>Area: Ngarlawangga Native Title Determination Area</p> <p>Type: Summary of consultation including on-country assessment</p> <p>Timing: 2023</p>	
<p>West Angelas Beyond 2020 Proposal Visual Impact Assessment (Rio Tinto 2021)</p> <p>Prepared for Rio Tinto</p> <p>Appendix B.5a</p>	<p>Area: Observer locations surrounding the Revised Development Envelope</p> <p>Type: Viewshed analysis and analysis of photomontages</p> <p>Timing: 2021</p>	<p>No specific guidance is available with respect to visual impact assessment in Australia. Study based on qualitative analysis of rendered images of proposed pits and WRLs on photomontages created through GIS and design software applications.</p>
<p>West Angelas 3D Model Revision 2.0</p> <p>Prepared by Sentient for Rio Tinto</p>	<p>Area: West Angelas Operations and West Angelas Revised Proposal area</p> <p>Type: Digital View analysis tool</p> <p>Year: 2022</p>	<p>No specific guidance is available with respect to the application of 3D models and interactive tools to inform Social Surroundings assessment. 3D modelling created through GIS and design software applications.</p>

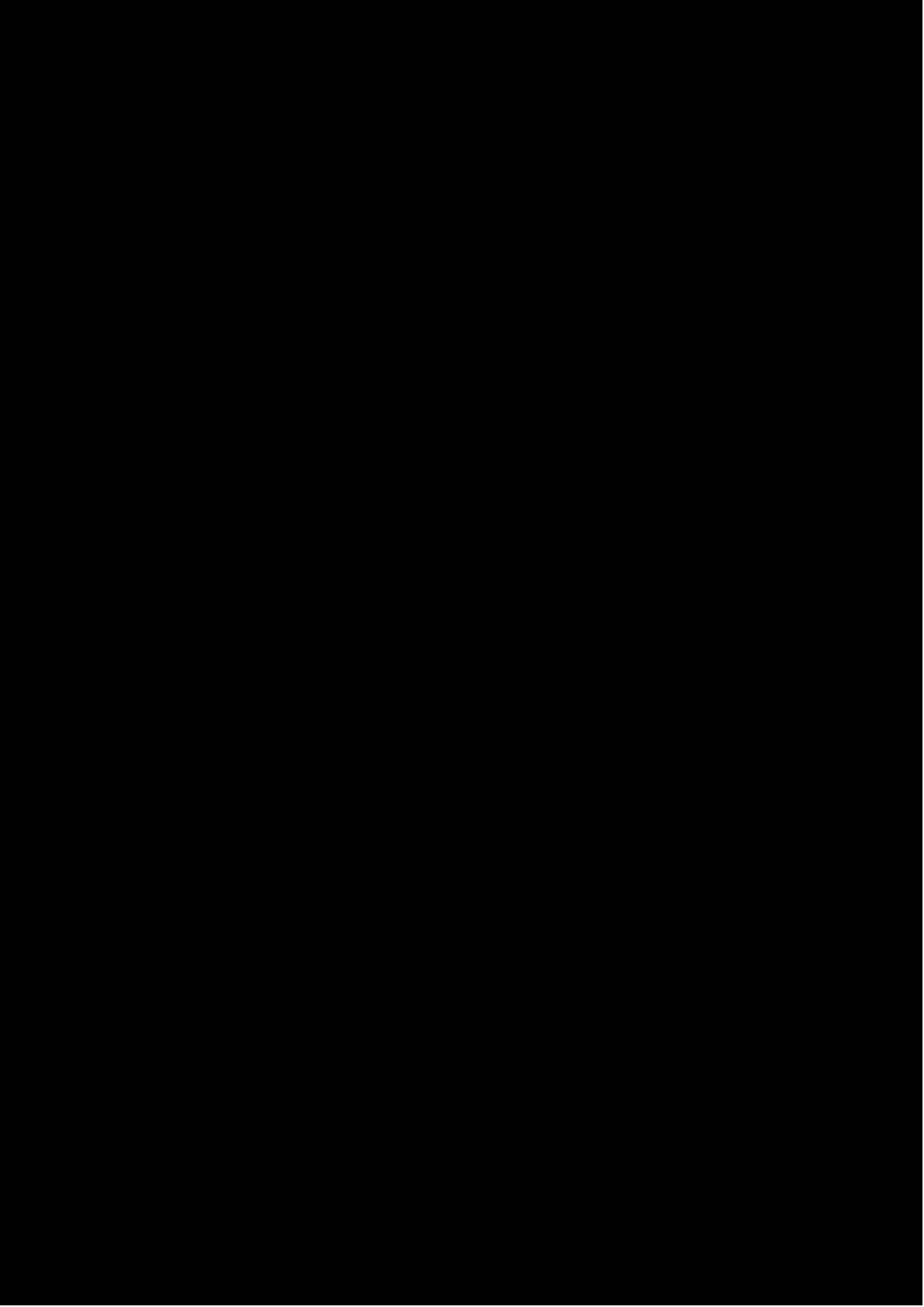
Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
<p>West Angelas 3D Model Revision 1.0 Prepared by Sentient for Rio Tinto Interactive screen-based tool - example (screenshot) provided in Appendix B1b</p>	<p>Area: West Angelas Operations and West Angelas Revised Proposal area Type: Digital View analysis tool Year: 2021</p>	
<p>West Angelas Deposit H Waterhole Interactive Communication Tool Prepared by Sentient for Rio Tinto Interactive screen-based tool - example (screenshot) provided in Appendix B1b</p>	<p>Area: Deposit H West Angelas Revised Proposal area Type: Digital View analysis tool Year: 2021</p>	
<p>West Angelas Revised Proposal: Air Quality Assessment (ETA 2022) Prepared for Rio Tinto Appendix B.5b</p>	<p>Area: Receptor locations within and surrounding the Revised Development Envelope (Figure 6-3) Type: Predictive dust modelling and assessment. Ground-level concentrations of particulates (Total Suspended Particulates [TSP], PM₁₀ and PM_{2.5}), dust deposition predicted at a range of receptors were compared with relevant air quality assessment criteria. The assessment was based on the predicted year of maximum total tonnage mining throughput (Year 10) and high tonnage throughput (Year 2) emissions. Two emissions scenarios were used: The Proposal in isolation The Proposal along with surrounding operations Timing: 2022</p>	<p>No specific guidance is available with respect to air quality assessment in Western Australia; however, modelling was undertaken using the WRF/CALMET/CALPUFF suite, and in accordance with air quality guidance notes (DoE 2006), which incorporated site-specific meteorological data, and emissions information estimates for the Proposal based on equipment design specifications specific to the Proposal. Emission rates were estimated using recognised and accepted methods of emissions estimation, which included published emission factors from the NPI Emission Estimation Technique Manual for Mining (EA 2012, cited in ETA 2022).</p>
<p>West Angelas Revised Proposal Noise and Vibration Impact Assessment (Wood 2022) Prepared for Rio Tinto Appendix B.5c</p>	<p>Area: Receptor locations within and surrounding the Revised Development Envelope (Figure 6-4) Type: Predictive noise modelling and assessment at a range of receptors against criteria derived from the <i>Environmental Protection (Noise) Regulations 1997 (WA)</i> (Noise Regulations) and other guidance. Timing: 2022</p>	<p>Consistent with the <i>Draft Guideline on Environmental Noise for Prescribed Premises</i> (DWER 2021):</p> <ul style="list-style-type: none"> • The algorithm (CONCAWE) for industrial noise simulation was used to predict the sound levels at each of the noise sensitive receivers • The noise predictive model utilised SoundPlan software.

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
<p>Report of an Yinhawangka Ethnobotanical Survey of the Deposits C and D at West Angelas (Stevens et al 2019)</p> <p>Prepared for Rio Tinto Iron Ore and Yinhawangka Aboriginal Corporation*</p>	<p>Area: West Angelas Deposit C & D</p> <p>Type: Consultation including on-country assessment</p> <p>Timing: 2019</p>	<p>No specific guidance is available for ethnobotanical consultation however, the consultation process has been consistent with best practice.</p>
<p>Ngarlawangga Traditional Ecological Knowledge (TEK) – Ethnobotanical Survey 1 August 2021 – Interim Report (Long & Associates 2021)</p> <p>Prepared for Ngarlawangga Aboriginal Corporation</p> <p>(Confidential)</p>	<p>Area: Ngarlawangga Native Title Determination Area</p> <p>Type: Consultation including on-country assessment</p> <p>Timing: 2021</p>	
<p>Heritage site investigations (various)</p>	<p>Refer to Appendix B.4</p>	<p>All archaeological and ethnographic heritage surveys undertaken have been in accordance with requirements of relevant legislation, principally the <i>Aboriginal Heritage Act 1972</i> including (for those undertaken since 2013) the Aboriginal Heritage Due Diligence Guidelines (DAA and DPC 2013), but also other heritage legislation, and in alignment with agreements between the Proponent and relevant Native Title Groups.</p>

*While relevant as a baseline information source, this study was undertaken prior to West Angelas Revised Proposal referral

**The Final Social Surroundings assessments reports have been provided as per noted appendix number all other reports acknowledged above are supplementary, and have not been provided but have been summarised in this section.





6.3.2.1. Cultural Heritage Management

Respect for archaeological and ethnographic cultural heritage is integral to the way the Proponent conducts business and ensures cultural heritage is managed and protected in consultation with relevant communities. This includes ensuring tangible cultural heritage features and an understanding of intangible cultural values are appropriately documented to assist with the management of known heritage values. The Proponent developed and implemented a fit for purpose Cultural Heritage Management System (CHMS) which is applicable to all of its business units and managed operations located across Australia over all phases of their lifecycle, from exploration through post closure. The Proponent's Australian businesses require a fit for purpose CHMS appropriate to each business's level of risk exposure and in accordance with statutory and legal requirements. The CHMS outlines key process steps for planning, implementation, operation and monitoring and is coordinated by a large number of cultural heritage Subject Matter Experts (SMEs) within the business. It is not a standalone system, rather a number of integrated processes with a shared purpose to minimise significant harm to cultural heritage. The CHMS interacts with a range of other processes, activities, and systems with the aim to protect the value and integrity of cultural heritage places within the lands on which the Proponent operates, wherever possible.

The CHMS allows for identification of heritage constraints to development or expansion plans by the Proponent which can either be avoided through the design process, or which need to be removed through a salvage and mitigation program including the Integrated Heritage Management Process (IHMP).

The Proponent's CHMS comprises the following elements:

1. Legal and agreement requirements (Element 2)
2. Cultural heritage surveys and assessments (Element 3)
3. Accountabilities (Element 5)
4. Cultural heritage procedures awareness induction (Element 6)
5. Contractor management requirements (Element 7)
6. Community and stakeholder consultation (Element 9)
7. Heritage ground disturbance authorisation procedure (Element 10)
8. Cultural heritage management procedures and plans (Element 10)
9. Incident investigation procedure (Element 14)
10. Heritage information and document management (Element 15)
11. Geographic information system and data management (Element 15); and
12. Monitoring and review procedure (Element 16).

The IHMP was introduced in a direct response to the Proponent reviewing cultural heritage management practices and includes ensuring earlier consultation in the planning phases occurs, assessing heritage sites within proposed impact areas and assessing each on the basis of cultural significance which is informed through consultation with Traditional Owners. Under the IHMP any requests to disturb sites undergoes a stringent review and approval process. The IHMP process also includes integration of heritage considerations into mine planning and development studies. The aim is to ensure that Traditional Owners are actively involved in the management of the cultural heritage aspects of mine design.

6.3.2.2. Cultural Heritage Survey Assessment

The Proponent works with appointed qualified archaeologists, anthropologists and land-connected peoples to identify and record archaeological and ethnographical sites and places including the recording of oral history and cultural information. The heritage consultants conducting these surveys and works are appointed and selected by the Traditional Owner groups and their representatives.

Archaeological and ethnographic baseline surveys (otherwise known as avoidance level surveys) have been undertaken across approximately 40% of the Revised Development Envelope, and approximately 87% of the Conceptual Footprint as detailed in Appendix B.4 and seen in Figure 6 5.

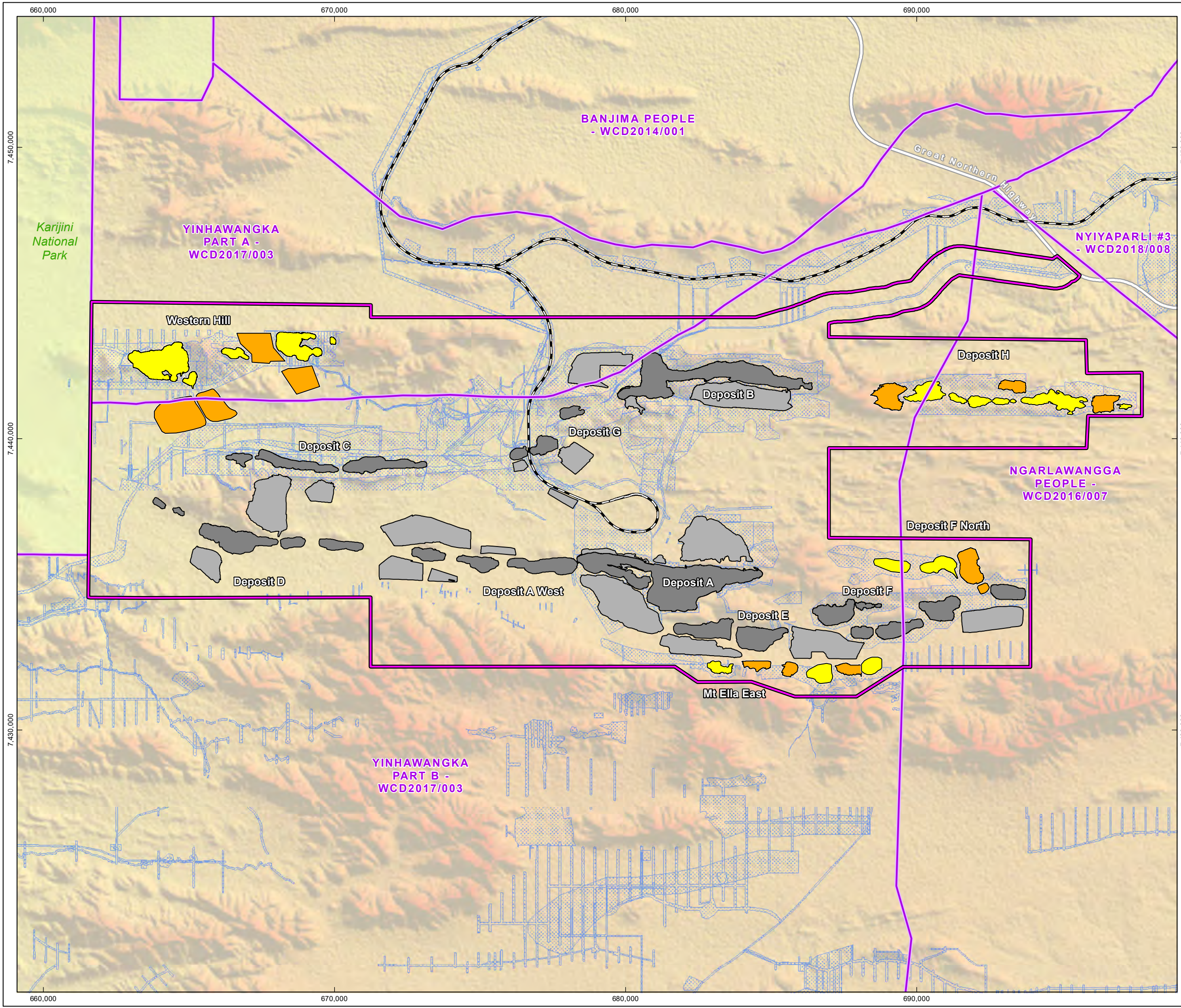
Due to the size of the Revised Development Envelope in relation to the Conceptual Footprint, the focus will be prioritised to the Conceptual Footprint with archaeological and ethnographic baseline surveys being completed to identify heritage sites and places within that area prior to development and ground disturbance work, as well as areas identified by Traditional Owners as requiring specific assessment with regard to this Proposal. Archaeological and ethnographic surveys and consultations are ongoing and will continue through the life of the Proposal to identify and manage heritage values. Appendix B.4a provides a summary of surveys and infield consultation undertaken within the Development Envelope to date.

Where a heritage site or place is considered at potential risk of impact or harm by the Proposal, or as requested by Traditional Owners, Level 1 archaeological and ethnographic surveys (otherwise known as site identification and assessment surveys) will be completed to better understand the site and its significance to inform ongoing consultation and potential management options. Sites considered at risk include any that directly interact with the Conceptual Footprint, those within 40 m of active mine pits that may be at risk of disturbance from flyrock, or sites located within 70 m of mine pits which may be sensitive to vibrational impacts from blasting impacts; noting that ongoing design work aims to avoid and minimise any disturbance to such sites.

Level 2 surveys may be undertaken for specific sites such as, rock art sites and rock shelters to provide targeted archaeological information to support informed assessment of the site with Traditional Owners.

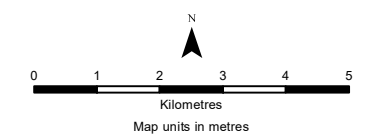
Figure 6-5
Archaeological and Ethnographic
Heritage Survey Assessments within
the Revised Development Envelope

Drawn: GIS Team
Plan: RTIO-0977657v1
Date: February 2023
Proj: GDA 1984 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Native Title Determination Area
- Heritage Survey Area
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- National Park
- Rio Tinto Railway
- Highway



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6.4. Receiving Environment – Land Use

The Revised Development Envelope covers 36,779 ha in the East Pilbara region of Western Australia, about 100 km northwest of Newman (population approximately 7,000). The Proposal is located partially within the upper reaches of the Weeli Wolli Creek, part of the Upper Fortescue River catchment, and partly within the Turee Creek East catchment, which is in the upper reaches of the Ashburton River Catchment.

The majority of the Proposal is within the sparsely populated Shire of East Pilbara, home to approximately 11,000 residents in an area of around 372 km² (ABS 2022, Shire of East Pilbara 2022). Newman is the administrative centre and largest town in the shire. Site access to the Proposal is via the Great Northern Highway. A small portion of the Western Hill development area is intersected by the Shire of Ashburton (Figure 6-2).

Other than Newman, the nearest town centres from the Proposal are:

- Tom Price, approximately 100 km northwest
- Paraburdoo, approximately 100 km west.

The nearest Aboriginal communities from the Proposal are:

- Parnpajinya, part of the Newman townsite
- Youngaleena, approximately 90 km north
- Innawonga (Bellary), approximately 80 km west
- Wakathuni, approximately 100 km west-northwest.

An approximately one-kilometre section of the Great Northern Highway is located inside the eastern boundary of the Revised Development Envelope. The highway, forms part of the National Highway Network and is the region's major arterial road, feeding access to many parts of the Pilbara including townships, nearby tourism attractions and many other private mine sites. Most other public roads outside town areas are unsealed, reflecting the 'remote' and sparsely populated character of the region.

6.4.1. Traditional Owners

The long history of Aboriginal land use within the Revised Development Envelope continues into the present as evidenced by the Ngarlawangga and Yinhawangka Native Title determinations (Section 6.2.1.2, Figure 6-1).

6.4.2. Pastoral Stations

No pastoral leases intersect the Revised Development Envelope.

6.4.2.1. Turee Creek Pastoral Station

Turee Creek Pastoral Station is the nearest pastoral lease to West Angelas, located to the west and south of the Revised Development Envelope. Turee Creek Pastoral Station is a third-party privately owned station, with a pastoral lease that operates as a cattle station. The station is located 140 km southwest of Newman and 100 km southeast of Paraburdoo and occupies an area of 2,777 km². The Maguire family own and operate the Station. The station's closest boundary is approximately 20 km southwest of the Revised Development Envelope, with the homestead located 48 km south.

Northern areas of Turee Creek Pastoral Station are located within the Turee Creek Catchment, part of the Ashburton River Catchment, on the Turee Creek East branch, receiving flows from Karijini National Park and the Western Hill area of the Proposal, which is located in the upper reaches of the catchment.

The Angelo River and Kirenia Creek, also part of the Ashburton River Catchment, flow through southern areas of the station but are not expected to be affected by the Proposal.

6.4.3. Mining

The area surrounding the Revised Development Envelope has been targeted more recently, relative to the pastoral industry, for its mineral resources. Current mining projects in the region, in addition to the Proposal, include:

- Rio Tinto – West Angelas operations immediately adjacent (encompassed within Revised Development Envelope)
- Rio Tinto – Hope Downs 1 Iron Ore Mine (including Baby Hope), 22 km east
- Rio Tinto – Hope Downs 4 Iron Ore Mine, approximately 60 km east
- Rio Tinto – Yandicoogina Iron Ore Mine, approximately 50 km northeast
- Rio Tinto – Gudai-Darri Iron Ore Mine, approximately 65 km north
- Rio Tinto – Marandoo Iron Ore Mine, approximately 65 km northwest
- Mineral Resources – Wonmunna Iron Ore Mine, approximately 40km east
- BHP – Mining Area C South Flank Iron Ore Mine, approximately 35 km northeast
- BHP – Yandi Iron Ore Mine, approximately 50 km northeast
- BCI Minerals – Iron Valley Iron Ore Mine, approximately 65 km northeast.

The Proposal and proposed Hope Downs 2 operations are adjacent, generally located on the western and eastern sides of the Great Northern Highway, respectively – except where the proposals' development envelopes overlap where they coincide with an approximate one-kilometre section of the highway (Figure 6-2).

6.4.4. Tourism

Tourism is also an important part of the regional economy, with the Shire of East Pilbara in the North-West Tourism region, which draws on its significant natural features and cultural heritage, including Indigenous culture, gorges, landscapes, waterfalls and other attractions (Shire of East Pilbara 2020).

6.4.5. Conservation Estate

The western boundary of the Development Envelope abuts Karijini National Park, an important part of the Western Australian conservation estate, that extends over more than 600,000 ha in the Hamersley Range in the Pilbara region. The park is relatively undisturbed compared with the surrounding major land uses of mining and pastoralism. The park is a popular tourist destination, best known for its gorges. It also features waterfalls, plateaus and broad grasslands, and has some of the oldest rock formations exposed on the Australian continent. This area is highly valued by Traditional Owner groups in the region.

6.5. Receiving Environment – Ngarlawangga and Yinhawangka Social Surroundings Values

The following sections provide an overview of the Social Surroundings values identified during consultations with Ngarlawangga and Yinhawangka Traditional Owners, with a particular focus on those which have potential to be affected by physical or biological changes attributable to the Proposal.

It should be noted that Traditional Owners have reserved the right to withhold restricted cultural knowledge in accordance with Traditional Owner Laws, lore and customs (noting the inclusion of *lore* is representative of Ngarlawangga viewpoint only when utilised through the document). Therefore, some descriptions and understanding by the Proponent (and wider public) of elements of social surroundings

values must remain limited or non-specific through cultural necessity and out of respect for those Laws, lores and customs.

Social Surroundings fieldwork and consultation occurred throughout March 2021 to June 2022 with both Yinhawangka and Ngarlawangga Traditional Owner groups, was undertaken in the context of the Proponent's original (i.e. since superseded) West Angelas Significant Amendment Development Envelope that was inclusive of a broader Development Envelope which included the larger Mt Ella East deposit, and an additional mining deposit with associated access and infrastructure components known as Deposit J (refer to Figure 2-4 in Section 2).

Based on the outcomes of the Social Surroundings fieldwork, discussions and ongoing consultation with both Traditional Owner groups, Deposit J has been entirely removed from this Proposal, and Mt Ella East has been substantially amended and reduced in size post July 2022 (See Section 1). Social Surroundings discussions and consultation continued from July 2022 based on the amended Proposal footprint

The Traditional Owner Social Surroundings have been grouped into themes to assist with implementing management actions. Ngarlawangga have further grouped the themes into categories of 'Amenity' and 'Cultural Heritage', reflecting EPA Social Surroundings guidance (EPA 2023a, EPA2023b). Yinhawangka do not observe these categories.

Traditional Owners' concerns, recommendations and requests should be understood in the context of the original Proposal footprint, recognising that the Revised Development Envelope no longer includes Deposit J and the larger Mt Ella East Deposits. However, for transparency, the views held by the Traditional Owners at the time of original fieldwork and consultation are still included throughout the chapter.

Some of the values, concerns comments, requests and recommendations which emerged from the Social Surroundings Assessment are not considered directly relevant to EIA under the EP Act (i.e. not relevant to physical or biological changes to the environment and the effect they have on social surroundings); however, they often contain elements recognised by the Proponent and Traditional Owners as important to integrate into the SCHMPs with respect to:

- Traditional Owner involvement in Proposal activities and engagement processes over the life of the Proposal
- The transition from mining to post-closure land use
- Some elements may also be more appropriate to be managed in accordance with, or integrated into, other Agreements or existing consultation forums between the Traditional Owners and the Proponent.

Recommendations and requests raised by Traditional Owners in relation to all themes and values identified in social surroundings consultation are provided in Appendix B.2e and B.3e.

6.5.1. Organising Values, Themes and Categories

During consultations, Traditional Owners shared with the Proponent, information that they deemed relevant to their Country and the Proposal. The Proponent has organised this information into themes; Yinhawangka People have emphasised the interconnectedness of *People, Culture and Country*, whereas the Proponent was guided by Ngarlawangga to contemplate two categories that reflect EPA guidance to inform the assessment (Table 6-6 and Table 6-7 and summarised in Sections 6.5.3 and 6.5.4):

- Amenity (enjoyment of Country, access and native title); discussed further in Section 6.5.1.1
- Cultural heritage (cultural practises, traditional Law, customary lore, sites, places, songs, stories and beliefs discussed further in Section 6.5.1.2).

Yinhawangka advised that such categorisation is not considered to be an appropriate way to communicate their holistic worldview.

6.5.1.1. Amenity (Enjoyment of Country, Access and Native Title)

Amenity for Traditional Owners has the same meaning as for any person, as defined by the EPA – i.e. the qualities, attributes and characteristics of a place that make a positive contribution to quality of life (EPA 2023a). The values referred to here also reflect the holistic sense of place Traditional Owners are understood to attach to the broad dimensions of areas under their guardianship – e.g. land, waters and sky. Amenity values include visual amenity as well as the people’s ability to live and recreate within their surroundings without any unreasonable interference with their health, welfare, convenience and comfort (Stevens 2023b). Emissions such as noise, odour and dust all have the potential to interfere with people’s health, welfare, convenience and comfort.

Amenity for Traditional Owners relates to access and enjoyment of Country as significant elements of their social surroundings (R. Stevens pers comm. 2022). Cultural heritage, including the ability to visit Country, exercise native title rights, take bush resources, camp and hunt, perform ritual and visit sites and special places - is intrinsically linked to amenity. So is the concept of healthy country, which includes the aesthetics of landscape and the ability to be in pleasant surroundings, unimpeded as much as possible by unsightly, unnatural or imposing changes to the landscape or infrastructure.

Due to their interconnected nature, a range of concerns raised by Traditional Owners, and a range of Proposal aspects relevant to amenity are also relevant to cultural heritage, and vice versa (see Table 6-6 and Table 6-7).

6.5.1.2. Cultural Heritage (Cultural Practises, Traditional Law, Customary Lore, Sites, Places, Songs, Stories and Beliefs) -

Cultural heritage is what one generation hands down to the next (Stevens 2023b). Cultural heritage is not restricted to place-based heritage sites and objects, the focus of Aboriginal heritage legislation (Section 6.2.2), rather these are a sub-set. More broadly, it includes valuing spiritual belief and customs, protecting places and objects, local ecological knowledge, stories and myths, historical accounts and legends, heroes and heroines, songs and poems, traditional foods, plants and resources, dance, art, games and sport, cultural norms, traditional dress, and language. Heritage is centred on communities and their way of life. It includes native title rights such as hunting, collecting resources, access to Country and ritual activity as well as responsibilities to *Care for Country*, recreation areas, aesthetics of landscape and place, and of teaching younger generations about culture and tradition.

6.5.1.3. Yinhawangka Guidance Regarding Categorisation of Social Surroundings Values

Although amenity and cultural heritage are recognised by the EPA with respect to aspects of Social Surroundings and Yinhawangka People have values associated with these (Sections 6.5.1.1 and 6.5.1.2) including the ability to visit Country, take bush resources and protect places and objects, they have advised the Proponent they do not wish to separate amenity and cultural heritage. Rather, Yinhawangka CLHs emphasise the interconnectedness of People, Culture and Country and any such categorisation is not considered to be an appropriate way to communicate their holistic worldview, and; therefore, these categories do not apply for Yinhawangka. To support the Social Surroundings assessment, Yinhawangka People values have been loosely defined by themes, to assist assessment and with management objectives. Supporting their worldview, Yinhawangka CLHs have also provided additional information on their cultural context and vision for the future (Section 6.5.4).

Out of respect for the Yinhawangka concern regarding categorisation of their values, the Social Surroundings impact assessment sections (6.7 to 6.12) do not overtly refer to amenity and cultural heritage 'categories'. Instead, amenity and cultural heritage can be considered to be integral elements of the values expressed in this chapter and the themes used to organise the assessment. As such, while Yinhawangka do not agree with categorisation of their values, they do endorse for the purpose of EIA the organisation of values into multiple interconnected themes (Section 6.5.1.5), that are shared with Ngarlawangga.

Amenity and cultural heritage (as categories) have been used in descriptions of the Ngarlawangga 'receiving environment', consistent with Ngarlawangga consultation and review.

6.5.1.4. Ngarlawangga

Ngarlawangga assert that all their recommendations provide in Social Surroundings consultation reporting are in service to the following set of cultural values that underpin Social Surroundings and of utmost importance to the Ngarlawangga community (Herrmann and Millett 2022):

1. **Connection to Country and the maintenance of access:** associated with Ngarlawangga ability to maintain their cultural practices and ensure that all other cultural values are cared for and maintained.
2. **Country:** representing a physical space used and enjoyed by Ngarlawangga People but also something much deeper with intrinsic and spiritual value.
3. **Respect and preservation of water:** a vital component of the landscape that gives life to people, plants, and animals. It is also a sacred spiritual entity that is governed by traditional laws and customs, which require strict cultural protocols.
4. **Maintenance of obligations to Country and kin:** this value is connected to the laws and customs of the Ngarlawangga People and its origins in the land.
5. **Protection of cultural sites/places and cultural heritage:** includes the importance of maintaining and protecting cultural knowledge and places that include Ngarlawangga stories, songs, and practices.
6. **Country must be healthy and cared for:** vital to the maintenance of Ngarlawangga People's health and happiness and their responsibilities to Country and kin.
7. **Plants and Animals:** seen as both material components in the landscape, relied on for survival and the maintenance of cultural practice, but also containing their own intrinsic value and right to exist.
8. **The use and enjoyment of Country:** representing Country as both a place where Ngarlawangga People derive their livelihoods but also a place that brings Ngarlawangga people aesthetic enjoyment and physical and spiritual nourishment.
9. **Family:** valued as having a basis in the land in which Ngarlawangga live and care for. Country is considered family and is a place where kin dwell.
10. **Ngarlawangga People should be happy and healthy:** an important value that is derived from customary obligations.
11. **Maintain and follow laws, customs, and rules for interacting with Country:** this value is vested in the obligations of country but also in the desire to ensure that Ngarlawangga culture and practices prevail forward for the next generation. This value also speaks to the importance of non-Ngarlawangga People, who require permission and protocol from the traditional custodians to visit and work on Ngarlawangga Country.

Table 6-6 summarises the Social Surroundings values and themes identified by Ngarlawangga Traditional Owners as indicated above and as defined in their Social Surroundings reporting (Herrmann

and Millett 2022), and their relationship with the Social Surroundings Traditional Owner common themes. The recorded common themes have been listed in approximate order, in that most pertinent detail is generally provided and assessed in matching subsequent sections under the theme mentioned first. However, given all values and themes are inextricably linked in line with the Ngarlawangga worldview, there is a crossover and interconnection between all the themes.

Table 6-6: Ngarlawangga Social Surroundings Values and Themes

Themes	Values	Relevant Common Themes Established in this ERD
Cultural heritage	Protection of cultural sites/places and cultural heritage	Cultural heritage: Care for Country:
	The Range	Cultural heritage: special places
	Country must be healthy and cared for	Cultural heritage: plants and animals
	Ngarlawangga People should be happy and healthy	Cultural heritage: mine design, closure and rehabilitation
	Maintain and follow laws, customs and rules for interacting with Country ('Respect for Country and Traditional Owner culture')	Amenity: enjoyment of Country, access and native title
Maintenance of obligations to Country and kin		
Water	Country	Amenity: enjoyment of Country, access and native title: water
	Family	Cultural heritage: Care for Country
	Respect and preservation of water	Cultural heritage: special places
	Country must be healthy and cared for	Cultural heritage: plants and animals
	Ngarlawangga People should be happy and healthy	
	Maintain and follow laws, customs and rules for interacting with country ("Respect for Country and Traditional Owner culture")	Cultural heritage: mine design, closure and rehabilitation
	Maintenance of obligations to Country and kin	
Water available for life in pools after it rains		
Water remains beneath the land		
Water used, not wasted		
Pollution (dust, chemical, noise, waste)	Country must be healthy and cared for	Amenity: enjoyment of Country, access and native title: water
	Respect and preservation of water	Cultural heritage: Care for Country
Ngarlawangga People should be happy and healthy		
Destruction of physical	Country	Cultural heritage: Care for Country

Themes	Values	Relevant Common Themes Established in this ERD
environment and rehabilitation	Family The use and enjoyment of Country Protection of cultural sites/places and cultural heritage Country must be healthy and cared for Ngarlawangga People should be happy and healthy Maintain and follow laws, customs and rules for interacting with Country (“Respect for Country and Traditional Owner culture”)	Amenity: enjoyment of Country, access and native title: water
		Amenity: enjoyment of Country, access and native title: mine design, closure and rehabilitation
Access	Country Family Connection to country and the maintenance of access The use and enjoyment of Country Ngarlawangga People should be happy and healthy Maintain and follow laws, customs and rules for interacting with Country (“Respect for Country and Traditional Owner culture”) Protection of cultural sites/places and cultural heritage Key locations required to be accessed - known sites provided in Section 6.5.3, additional sites may be identified	Amenity: enjoyment of Country, access and native title: access
		Cultural heritage: Care for Country
		Cultural heritage: special places
		Amenity: enjoyment of Country, access and native title: mine design, closure and rehabilitation
Flora and fauna	Country Family Flora and fauna The use and enjoyment of Country Protection of cultural sites/places and cultural heritage Country must be healthy and cared for Ngarlawangga People should be happy and healthy	Cultural heritage: Plants and animals
		Cultural heritage: Care for Country
		Cultural heritage: special places
		Amenity: enjoyment of Country, access and native title: water
		Amenity: enjoyment of Country, access and native title: access
		Amenity: enjoyment of Country, access and native title: mine design, closure and rehabilitation

6.5.1.5. Yinhawangka

Table 6-7 summarises the Social Surroundings values and themes identified by Yinhawangka CLH as defined in the relevant Social Surroundings assessment report (Yinhawangka CLH and Archae-aus 2022) and their relationship with the Social Surroundings Traditional Owner common themes. This report’s key focus is on recommendations arising from the Social Surroundings assessment, as such the values shown have largely been derived from the recommendations, an approach supported by the Yinhawangka.

Table 6-7: Yinhawangka Social Surroundings Values and Themes

Themes	Values (based on recommendations)	Relevant Common Themes Established in this ERD
Protection of Country	Protect Country in and around the Revised Development Envelope	Care for Country
	Landscape integrity - mine pit backfilling	Special places
	Rockshelter and other heritage sites protection	Plants and animals
	Sinkhole water quality and quantity	Enjoyment of country, access and native title: water
	Yinhawangka monitoring and management of Country	Enjoyment of country, access and native title: access
	Western Pebble-mound Mouse protection	Mine design, closure and rehabilitation
	Rehabilitation integrity – topsoil vitality, local and culturally appropriate plants	
	Native bees and honey	
Connection to Country	Yinhawangka CLH require access, and support for access, in and around the Revised Development Envelope	Enjoyment of country, access and native title: access
	Manage and share knowledge of places between Yinhawangka CLH and others	Enjoyment of Country, access and native title: water
	Key locations required to be accessed - known sites provided in Section 6.5.4, additional sites may be identified	Enjoyment of Country, access and native title: mine design, closure and rehabilitation
	Revitalise women’s connection to significant places	Care for Country
	Respect for Country and culture by Proponent personnel	
	Yinhawangka CLH should be offered a welcoming experience at Proposal facilities	Special places
Cultural mapping and correct place names		
Caring for country	Yinhawangka CLH should manage important cultural places, with support	Care for Country

Themes	Values (based on recommendations)	Relevant Common Themes Established in this ERD
	<p>Cultural gender requirements are important (e.g. for surveys and assessments)</p> <p>Water-related decisions led by Yinhawangka CLH</p> <p>Yinhawangka CLH involvement in mine planning, supported by independent evaluation</p> <p>Two-way knowledge exchange (Western and Yinhawangka science and records) and Yinhawangka-led ecological studies</p> <p>Lessons-learnt from other mines</p> <p>Regular review of activities on Country</p>	<p>Enjoyment of Country, access and native title: water</p> <p>Enjoyment of Country, access and native title: access</p> <p>Enjoyment of Country, access and native title: mine design, closure and rehabilitation</p>
Sustainable future	<p>Holistic vision for the future of Country – meet Healthy Country Plan targets</p> <p>Consider long-term benefits, impacts and possibilities</p>	<p>Care for Country</p> <p>Enjoyment of Country, access and native title: access</p> <p>Enjoyment of Country, access and native title: mine design, closure and rehabilitation</p>
Partnership and agreement	<p>Prioritise a genuine partnership approach to mine planning, management, and closure</p>	<p>Care for Country</p> <p>Enjoyment of Country, access and native title: access</p> <p>Enjoyment of Country, access and native title: water</p> <p>Enjoyment of Country, access and native title: mine design, closure and rehabilitation</p>

6.5.1.6. Country

'Country' is a critical concept underpinning an understanding of Traditional Owner worldview and social surroundings. All of the values considered in this section relate in some way to protecting and caring for Country. The following is largely derived from Social Surroundings reports prepared by Herrmann (2022a), Herrmann and Millett (2022) and Yinhawangka CLH and Archae-aus (2022) for the Ngarlawangga and Yinhawangka peoples, respectively.

The importance of 'Caring for Country' is paramount for Aboriginal Traditional Owners. It symbolises who they are, informs how they should live, and provides for their existence in the past, present and for future generations. The NT Act (and AH Act) recognises this through rights to manage cultural heritage, maintain Traditional Owner sense of well-being and protect social and cultural values.

Caring for Country is an Indigenous cultural-ecological ethos founded on relationships of cultural respect (R. Stevens pers. comm. 2022). These relationships are embedded in a set of rights and responsibilities created in the distant past, commonly known as the Dreaming. The Dreaming - when all plants, animals, humans, waters and landscape features were created by powerful spirits as they travelled through Country - established the rules for existence and relationships between entities. Yet the Dreaming is not just in the past. Considered to be alive and sentient, Country is home to powerful spirits and mythic beings including ancestors who must be respected, honoured and cared for. Country possesses, imparts and shapes knowledge through a myriad of social and cultural relationships held in language, lore, religion and stories. 'Healthy Country' is the result of strong relationships.

6.5.1.7. Responsibilities Beyond Country

It is notable that the Revised Development Envelope extends across two native title boundaries (Section 6.2.1.2).

Native title law requires defined lines on a map, whereas significant cultural values, cultural responsibilities, meeting places, dominant landscape features and resources extend across and along delineated Native Title boundaries. This also speaks to a group's responsibilities extending beyond their boundaries when decisions regarding impacts may have flow on consequences to neighbouring groups. An example of which is the Range (Section 6.5.5), important to both Ngarlawangga and Yinhawangka (and other groups).

6.5.1.8. Historical Context – Post-Contact Period

The Revised Development Envelope is at the periphery of pastoral station activity, being located southwest of Marillana, southeast of Juna Downs, and north of Turee Creek homesteads.

From the 1860s, pastoralists were granted leases along the Fortescue River bringing European settlers to the eastern Pilbara (Niyaparli Community et al. 2015). Along with other Aboriginal groups in the Pilbara Ngarlawangga and Yinhawangka People were initially forced into indentured labour, becoming stockmen and domestic servants on these stations (Niyaparli Community et al. 2015). Oral histories and archaeological features document how they utilised and adapted new routines to ensure that their obligations to Country and the performance of ceremony continued (Niyaparli Community et al. 2015).

Following years of struggles and a Pilbara-wide strike in 1946 to 1949, Aboriginal stockmen finally received equal wages in 1968. Unfortunately, this resulted in many families being evicted from stations. Yinhawangka and Ngarlawangga families relocated to larger towns including Newman, Port Hedland, Roebourne, Marble Bar and Onslow. These families continued to visit their lands where possible and maintained their traditions and language until the Homelands Movement of the 1980s saw communities such as Bellary and Wakathuni established in the area (Section 6.4). Many Traditional Owners now live and work on their Country while others visit regularly to maintain the relationships needed for Healthy Country.

6.5.2. Ngarlawangga Amenity – Enjoyment of Country, Access and Native Title

6.5.2.1. Water

Water is sacred to Ngarlawangga, it is not just of ‘special significance’. Water is at the core of Ngarlawangga spiritual connection to Country. For the Ngarlawangga People, water is a manifestation of the creation being/s that created the land and waters of this Country. Water possesses strong life force and has sustained human, animal and plant life in this place for eternity. Removing or disturbing the water within the landscape threatens to remove the life force, the spiritual life, from this Country, as such water has cultural and social value as much as ecological value (Stevens 2023b).

All extraction, use and impacts on water on Ngarlawangga Country is a compromise for Ngarlawangga People.

Water and water management are consistent concerns raised in Social Surroundings consultations due to water’s sacred nature, importance in keeping Country healthy and supporting life for people and animals (Herrmann and Millett 2022). Water possesses the highest cultural value to Ngarlawangga (Herrmann and Millett 2022). It is essential for life and always connected to a spiritual hierarchy, ‘groundwater’ and ‘surface water’ are considered equally significant and sacred. Water – rivers, creeks and waterholes – sustain life, flowing through and sustaining the people and animals who share the landscape in a hot and arid environment. Flora and fauna utilised and appreciated by Ngarlawangga are concentrated at and near waterbodies and creeklines are often well-known travel routes that provide shade, resources and camping places (Stevens 2023b). Removal of water from Country for mining purposes threatens to undermine Ngarlawangga rights and responsibilities (recognised under Native Title 6.2.1.2) to manage and enjoy that Country for current, future and past generations. Below some sentiments shared by Ngarlawangga People during consultation emphasise this importance:

1. *Water is like the veins in your body, it’s under your skin* - Ngarlawangga participant
2. *Water is the most important thing.... water is sacred. Some water you can’t swim in, some waterholes you don’t drink out of them. Out of respect, we don’t mess with the water –* Ngarlawangga participants
3. *All water is sacred* – Ngarlawangga participant

Anxiety amongst Ngarlawangga People regarding water extends to concerns about dewatering, and the potential impact on surrounding water sources (e.g., aquifer depletion, contamination) and subsequent effects on plants and animals (loss of habitat, sustenance), and spiritual consequences. Ngarlawangga have expressed the desire to be more informed about these processes, including the volume of water proposed to be abstracted, contamination risks, and the expected time for recovery of the aquifer.

Concerns have also been raised by Ngarlawangga throughout consultation regarding the reliance on water for dust suppression, which related to pumping of water to waste rather than respect, with investigations requested into alternative methods, that are not water reliant. Ngarlawangga wish to minimise the use of water for dust control and be consulted on other options and technological opportunities to reduce a reliance on water for dust suppression, and until an alternative solution is confirmed they would like the Proponent to continue monitoring dust quality and quantity and be kept appraised of the results.

Acknowledging that groundwater is proposed to be abstracted, Ngarlawangga have discussed whether excess water that may otherwise be discharged (or ‘wasted’) could be utilised to create plant and animal refuge habitats to offset the loss of habitat in disturbance areas, while noting that no additional discharge is currently within the scope of this proposal.

Ngarlawangga are concerned about sediment and pollutants including dust and chemicals from drilling and blasting entering waterways and waterholes. This is a significant issue, previously observed at other existing mining operations within the Pilbara.

The protection and management of the Deposit H Waterhole site complex (which includes a large portion of the downstream creek), and Turtle Pool are of particular priority to Ngarlawangga, however, potential impacts to all surface water and groundwater generally also concern them. This concern does not only involve the potential for ecological, physical and chemical changes to water, but the potential for illness or punishment associated with Traditional Owner spiritual beliefs tied to water. A Ngarlawangga general position is that direct impact to waterholes should be avoided altogether and that detrimental impacts to the groundwater and the surface water catchments that may feed them be minimised or avoided. The Revised Development Envelope across Ngarlawangga Country is at the head of the Weeli Wollie Creek catchment. As such, there is a cultural expectation that anything that happens on Ngarlawangga Country does not lead to impacts to water within neighbouring and other downstream areas.

Turtle Pool

As detailed in Inland Waters (Section 7), Turtle Pool is a semi-permanent ephemeral surface/groundwater water feature located approximately 700 m east of Deposit H, outside of the Revised Development Envelope, in a tributary of Weeli Wollie Creek. The pool is of high significance to the Ngarlawangga People.

Although acknowledging that studies were ongoing during consultation to confirm whether Turtle Pool was groundwater connected, the Proponent initially advised during early phases of Social Surroundings consultations that existing studies indicated both the Deposit H Waterhole and Turtle Pool are not connected to the groundwater of the Deposit H aquifer (i.e. they are solely surface water fed), and therefore the waterhole and pool would not be impacted by abstraction of groundwater related to the Proposal.

Ngarlawangga stated that they did not want dewatering activities to impact Turtle Pool and that extraction of the aquifer for production was not something they were comfortable with, and they required further information from the Proponent on its intended dewatering activities.

In contrast to the preliminary assessments, subsequent hydrogeological studies conducted by the Proponent determined that Turtle Pool is actually likely to be partly groundwater fed and connected to the Deposit H aquifer. Investigations into the hydrological regime of Turtle Pool are ongoing at this time. The Proponent communicated this information to Ngarlawangga in April 2023 and due to the significance that had been conveyed for these two features, the Proponent committed that no abstraction via dewatering bores to access BWT ore will occur without Ngarlawangga agreement. Rather, the Proponent will consider sump pumping as a method to target BWT ore at Deposit H and will continue consultation on this mining process with Ngarlawangga. An alternative water supply source within the Revised Proposal Development Envelope is proposed with operational water demands for Deposit H to be supplied from other deposits at West Angelas (refer to Inland Waters Section 7).

Deposit H Site Complex

As detailed in Inland Waters (Section 7), a creekline in one of the Deposit H sub catchments includes a small surface water-fed ephemeral pool known as Deposit H Waterhole (WB-WAH1) located at the base of a gorge, which is significant to the Ngarlawangga People and is within the Proposal area.

Ngarlawangga People have expressed that they are particularly concerned with degradation to the surface water-dependent ecosystems at the Deposit H site complex. In particular, there are concerns that proposed pits and WRLs at Deposit H will remove a substantial proportion of the catchment, which would then have a detrimental impact on the health of the waterhole and downstream areas, and change the general Ngarlawangga amenity (enjoyment of place) of the area. Modelling to date has shown that maximum pit designs will retain sufficient catchment to maintain the hydrological regime (filling and overflow) of the Deposit H Waterhole (Section 7). Ngarlawangga expect and are concerned that this change will impact downstream ecology. Ngarlawangga have asked that there are no significant impacts to the entirety to the site complex, and particularly the amenity and ecological vitality (understood to encompass healthy ecosystem processes, biodiversity, habitats and water) within the gully downstream

of the waterhole. The Proponent has agreed it will not impact the catchment of the Deposit H Waterhole without written agreement from Ngarlawangga. Investigations are ongoing with respect to catchment and ecological impacts of various mine designs and the Proponent commits to ongoing consultation with Ngarlawangga regarding these matters.

6.5.2.2. Access

Ngarlawangga enjoy accessing Country to exercise their native title rights, for example for hunting, camping, gathering bush resources, attending ritual and ceremonial activities, visiting special places and sites, and for teaching culture (Stevens 2023b). Access to Country also means to simply enjoy the landscape. Access to Country is integral to what it means to be Ngarlawangga, being present on Country is important and at the core of Ngarlawangga cultural identity. Ngarlawangga have referred often to concerns around access to visit, interact and enjoy Country in terms of resources, cultural activities, beliefs as well as with respect to ambience.

Access concerns raised during social surroundings consultation have broadly centred on two key matters (Herrmann and Millett 2022):

- Restrictions on access to Country for native title purposes and social and cultural activities. This related to both existing restrictions due to existing projects as well as the potential to continue and extend restrictions due to the Proposal
- Access by non-Traditional Owners to Country, particularly areas of high cultural importance and places believed to be spiritually dangerous.

Ngarlawangga have native title rights in accordance with their determination (Section 3.2.1). This includes rights to access Country and exercise traditional rights on that Country, so they can enjoy, conduct cultural activities, monitor and protect their Country. While access more broadly is understood to be throughout their Native Title determination area of the Revised Development Envelope, Ngarlawangga requested facilitation of access (non-prevention of access, or 'no worse off access) throughout life of Proposal to:

- The Deposit H Waterhole site complex
- Turtle Pool
- The Range
- WAN-22-100-EX.

Ngarlawangga have suggested a low impact private access track from the north to the cultural areas near Deposit H could be created so Ngarlawangga People would not have to use the current access which transects existing operational areas. This is anticipated to avoid a need to seek Proponent permission to access and allow for unescorted access.

Ngarlawangga participants reported that they are often confronted with physical (e.g., locked gates) and organisational barriers while attempting to travel on their Country in the vicinity of existing mining operations. Ngarlawangga acknowledge there are health and safety reasons behind these restrictions; however, they also feel that more could be done to work constructively with Traditional Owners to maintain and facilitate connection and access to Country. These access restrictions were reported to be creating a high level of anxiety and consternation among Ngarlawangga People (Herrmann and Millett 2022).

Ngarlawangga also raised concerns about Proponent workforce accessing Country without permission and going to restricted sites, governed by strict cultural protocols (such as gender restrictions) and to places that are believed to be dangerous to people without cultural authority to visit these sites. This concern was highlighted during social surroundings consultation fieldwork as it appeared culturally significant pools had been visited in recent years for monitoring, without any known consultation with

Ngarlawangga People or NAC's consent. This was advised as disrespectful, with a lack of regard for cultural protocols. Ngarlawangga people also expressed concern for the safety of personnel accessing places that might be spiritually dangerous:

I am concerned about your employees going near places they shouldn't be. We have some dangerous places near here – Ngarlawangga participant.

Ngarlawangga advised that to avoid misunderstandings and keep staff safe they should be consulted when non-Ngarlawangga people require access to some areas of their Country. The Proponent was also advised that Ngarlawangga People should accompany Proponent personnel (e.g., when undertaking monitoring activities) whenever possible to make sure they do not go to places that may be culturally sensitive or problematic, and potentially to assist and complement the activity:

In the future notify our elders and corporation and we can come with you, to protect you and Country and keep you safe – Ngarlawangga participant.

6.5.2.3. Amenity

Ngarlawangga concerns regarding broader effects on Country from physical impacts through clearing and the development of mining landforms and infrastructure extends to concern over impacts to resource availability and visual amenity. Moreover, these changes are visibly unpleasant and jarring, and understanding that these impacts during and post mining would leave a landscape that was not recognisable to ancestors past nor potentially recognised as what was lost by future generations, represents a broader sense of loss of connection to Country. This, combined with a reduced enjoyment of Country as time spent in a landscape so changed, is painful.

Ngarlawangga indicated general impacts to amenity (and cultural heritage and other values) are often felt due to their Country being in a landscape often dominated by mining exploration and operations. This is also accompanied by a sense of loss regarding effects on or loss of pleasant places to enjoy cultural activities, restricted ability to access Country free of dust and noise, disturbance of heritage sites and places, or the presence of mining personnel, infrastructure, vehicles, and altered visual landscapes due to the presence of drilling patterns, pits, WRLs and other sub-structure. Mining exploration and operations have an end date with many impacts 'temporary' against the limitless timescale of Ngarlawangga Country. However, this does not change the felt experience of impacts which affect how people feel about Country and how they are able to interact, use and enjoy Country in the here and now.

Ngarlawangga suggested sensitive receptors (locations) that were used in modelling associated with dust, noise and vibration impacts on visual and general amenity, including Deposit H Waterhole site complex and Turtle Pool (along with Ghost Bat caves [Section 6.5.3]).

Concerns over amenity impacts also extended to waste and litter. There was some unease over the potential for Proponent employees to create effigies in the landscape such as 'boot trees' and 'hard hat mounds', as previously observed in other Pilbara mining areas. As one Ngarlawangga participant noted, such effigies were disrespectful and aesthetically polluting.

Ngarlawangga are particularly concerned with the scale of physical landscape changes represented by the Proposal. Several Ngarlawangga members have responded emotionally when discussing these changes during Social Surroundings consultation speaking to the depth of feeling for Country held by Traditional Owners (Herrmann and Millett 2022):

The Country is alive... I get sad when I see those big holes cut out of the ground. It's like a part of me is cut up, like my guts are cut out – Ngarlawangga participant.

Special importance regarding potential impacts on visual amenity and aesthetics was placed on the Deposit H Waterhole. The waterhole's beautiful setting, associated with enjoying the country that Traditional Owners have custodian responsibility for, was collectively acknowledged by Ngarlawangga People. Proponent presentations showing Ngarlawangga landscape changes around the waterhole

created a sense of sadness in the group and elicited discussion of the need for the Proponent to rehabilitate and manage the impacts of the area.

6.5.2.4. Mine Design, Closure and Rehabilitation

Ngarlawangga have a stated desire for their Country to be rehabilitated to its *original state* wherever possible, otherwise as close as possible or at the very least to a state that can sustain life and bring back flora and fauna species (Herrmann and Millett (2022)). If stockpiles and WRLs present at the existing operations cannot be utilised to back fill pits, as is their preference, Ngarlawangga have suggested pits should be progressively backfilled during the life of the mine, instead of creating new stockpiles and WRLs, and leaving pits open.

Other regular and ongoing discussion points during social surroundings consultation included:

- Rehabilitation of WRLs
- Progressive backfilling and backfilling of pits at closure.

The Proponent has advised that it will not undertake comprehensive and complete backfilling of pits and removal of WRLs; however, opportunistic backfilling would be considered in mine design and pit sequencing. This will be continually reviewed and communicated to Traditional Owners through LoM Planning and other consultation forums. The Proponent acknowledges that some pit and waste locations may be specifically identified and requested for backfilling where possible and commits to specifically addressing the viability of backfilling these locations during mine design consultation and LoM Planning forums.

Ngarlawangga also expressed concern regarding the proposed mine design for areas in proximity to Deposit H Waterhole, in particular in relation to any potential risks to the catchments and to Turtle Pool associated with pollution (i.e., sediment, chemical, explosive) spreading through the catchments into and beyond the waterholes. To address these concerns, Ngarlawangga representatives met with the blast management team in October 2022 to discuss concerns about potential impacts to Deposit H Waterhole. Consultation and mine design optionality is ongoing to further understand potential direct and indirect impacts and risks and appropriate management options.

Ngarlawangga also want to:

- Achieve natural-looking rehabilitation on Country post mining, incorporating tree logs, large rocks, and native plant species, curved (rather than straight) edged landscapes, and revegetated areas that blend back into the surrounding landscape
- Stop the erosion of the topsoil (Section 6.5.3) and manage topsoil to maintain and improve its vitality so that it provides a viable seed bank
- Encourage native plants and animals back into the area.

Ngarlawangga participants observed rehabilitation works being undertaken at West Angelas during the Social Surroundings fieldwork and requested pictures and videos of rehabilitation efforts undertaken by the Proponent other than at the existing West Angelas operation which was provided in September 2022. They also expressed an interest in meeting and discussing with the Proponent regarding how they may work collaboratively to effect better rehabilitation outcomes and fulfil a desire to be active agents in the rehabilitation of mine sites on their Country. This includes the potential to create culturally appropriate employment with Ngarlawangga People as part of Proposal rehabilitation, along with other environmental management, activities.

6.5.3. Ngarlawangga Cultural Heritage (Cultural Practises, Traditional Law, Customary Lore, Sites, Places, Songs, Stories and Beliefs)

6.5.3.1. Care For Country

While acknowledging the collaborative efforts of the Proponent and the benefits that mining brings to Ngarlawangga People, it needs to be understood that impacts to Country through mining including landscapes that are unable to be returned to their natural state, are multi-generation compromises for the Ngarlawangga People. Ngarlawangga People however understand that these impacts are an unavoidable consequence of mining.

As traditional custodians, and as a way to maintain connection, a part of caring for and keeping Country healthy, Ngarlawangga have consistently expressed interest in being involved in Proposal processes throughout all phases from design to closure - such as field surveys, ongoing environmental monitoring and management. These might involve joint application of scientific and traditional methods, or as part of a team guided by other experts and specialists.

Ngarlawangga are concerned with the physical impacts to Country through clearing and the development of mining pits, WRLs, stockpiles and infrastructure and associated subsequent effects such as residue seepage, noise and dust pollution. Traditional Owners are particularly concerned with the scale of landscape changes, vegetation loss and overall cumulative impacts. They question the need for additional clearing to accommodate additional stockpiles and WRLs given the existing West Angelas operation contains existing disturbed areas that could be potentially used for these purposes to minimise the creation of new disturbances.

6.5.3.2. Plants and Animals

The Revised Development Envelope includes plants and animal species that are not only used and important for food or medicine but that hold other cultural significance with respect to stories, ceremonial uses, for clothing, for shelters and toolmaking. As cultural custodians of their lands Ngarlawangga are concerned with not only plants and animals that have specific cultural associations, but their Care for Country ethos means that they are culturally responsible for maintaining healthy Country, meaning they are obliged to care for all plants and animals that occur on Country.

Key concerns raised by Ngarlawangga with respect to plants and animals relate to:

- Collecting bush medicines
- Collecting food – plants and hunting (for example, bush tucker and hunting goannas, kangaroos, emus, bush turkey, fish and other species)
- Collecting resources
- Caring for Country
- Maintaining pools and waterholes which support the plants and animals (such as turtles, hence Turtle Pool) of the area
- Rehabilitation to resemble natural habitat which will help establish micro-climates and niche environments for plants and animals.

Ngarlawangga share their Country with plants and animals essential for cultural and economic practices and are part of the cultural landscape (Herrmann and Millett 2022).

Ngarlawangga have concerns about the potential for adverse impacts to plants and animals, (including culturally important species) due to mining activities resulting in interference with migration pathways, consequent loss of, or significant reduction in, local populations, and the need to access these resources from neighbouring Countries, which could potentially impact social relationships and create cultural obligations.

We rely on the bushmeat during ceremony. If there is no meat on our Country we have to go into other people's Country and ask permission, then we owe them or have to pay them back –
Ngarlawangga participant

Ngarlawangga have anecdotally observed a decline in kangaroos and emus in the region as they are harder to find when hunting.

While species listed under legislation such as Western Pebble-mound Mouse (which does hold special cultural significance) and Ghost Bat (refer to Section 9 [Terrestrial Fauna] and Section 13 [MNES]), respectively) are important to them, Ngarlawangga have queried the prioritisation of monitoring and research of such species over other species that may be more culturally important, for example bush tucker (plants and animals used for food and medicine).

Ngarlawangga reflections on the impacts of mining on Western Pebble-mound Mouse, indicate their unease about the potential for ground disturbance activities to destroy their mound dens and kill individuals directly (along with other small, slow moving, ground-dwelling animals).

Ngarlawangga participants wished to know what the Proponent intends to do to protect and minimise damage to the listed species.

If plants are endangered, then they are important to us too – Ngarlawangga participant

A specific concern expressed was the loss of native honeybee species and honey-trees (Snappy Gum, *Eucalyptus leucophloia*) in the region that was thought to be related to water loss and habitat reduction from existing mining operations. The bees are considered critical to the survival of plants and animals in their Country and to Pilbara ecosystems generally (Herrmann and Millett 2022; Stevens 2023b). Another species, the White Cypress Pine (*Callitris columellaris*), has very high cultural significance and Ngarlawangga have concerns about any potential indirect impacts to this species.

Ngarlawangga also raised concerns regarding the potential for impacts on denser vegetation and old trees associated with Deposit H and Turtle Pool waterhole gullies, considered by Ngarlawangga as important fauna refugia in contrast to the surrounding landscape where dense shade and water is scarce (Stevens 2023b).

The weeds Buffel Grass (*Cenchrus ciliaris*) and Caltrop (*Tribulus terrestris*) have been observed by Ngarlawangga at the West Angelas accommodation village, with concerns raised regarding the potential for these species to spread (Stevens 2023b).

Ngarlawangga social surroundings participants have discussed the need to record and map their own Traditional Ecological Knowledge (TEK), key species and cultural values so potential impacts could be better understood and addressed. NAC with the support of the Proponent has begun to record the TEK associated with flora in the Revised Development Envelope and surrounding region. Ngarlawangga wish to continue to develop these TEK projects and consider it essential that this knowledge be incorporated into mine design and rehabilitation.

Along with associated impacts to amenity (Section 6.7.2.3), Ngarlawangga concerns exist about the potential effect from dust, light and noise on animal habitats and suggested locations to use in any modelling and potential monitoring include Ghost Bat CWAN-07 and CWAN-09 (along with Deposit H Waterhole and Turtle Pool). Special Places

Although in effect all areas of the Revised Development Envelope are potential Ngarlawangga cultural and social areas, being as they are *Country*, there are numerous specific cultural sites, places, and traditional Songlines in and around the Development Envelope that are of elevated importance (Figure 6-5). See confidential Appendix B.4 – note for cultural and protective reasons, some places, sites and features are not mapped, described or be made available to the public domain.

Special places identified during Social Surroundings consultations (that may have also been identified in heritage surveys) of particular and profound importance for Ngarlawangga people include (Herrmann and Millett 2022; Stevens 2023b) (Figure 6-5 Appendix B.4a):

- **The Range** which was identified as an extremely important cultural area and is considered to be of the highest cultural significance for Ngarlawangga people (see further discussion below) – this area is also encompassed by the unnamed range to the south of the Proposal, discussed below under the Yinhawangka section.
- **Deposit H Waterhole (refer to Section 7), rock art and creek line (Deposit H Waterhole site complex)** which includes significant water and rock art motifs. Ngarlawangga have provided the Proponent with a boundary for the place which encompasses currently identified heritage and cultural values along with the aesthetic value of the adjacent gully and the vitality of its flora and fauna.
- **Turtle Pool**, identified as a significant place of high social, cultural, heritage and aesthetic value to Ngarlawangga People. Turtle Pool itself is located outside, but adjacent to, the Development Envelope. However, Ngarlawangga have provided the Proponent with a heritage site boundary which encompasses the pool and several other cultural features, this boundary intersects the Revised Development Envelope.
- **WAN-22-100-EX** – A restricted **additional place of high cultural significance** to Ngarlawangga (and Yinhawangka and other groups) has also been identified, the details of which or not appropriate for public review. Relevant details as permitted by Ngarlawangga are provided within the Ngarlawangga SCHMP. This additional location is located outside of, but nearby, the Revised Development Envelope. A large buffer (preliminary mining exclusion zone) that does intersect the Revised Development Envelope has been provided by NAC while further recording continues. WAN-22-100-EX does not have groundwater dependent values.

Several other sites within the Revised Development Envelope, including rock shelters and scarred trees, were identified as of high social, cultural and heritage significance for Ngarlawangga (Herrmann and Millett 2022). These sites carry aesthetic importance not easily translated into the English vernacular.

Heritage surveys to date within the Ngarlawangga Native Title Determination Area of Ministerial Statement 1113 have identified 54⁷ heritage places (archaeological and/or ethnographic) sites or places (including artefact scatters, quarries, rock shelters, scarred trees, rock art and places with other cultural values). The Ngarlawangga sections of the Proposal contain an additional 46 heritage places, of which 39 heritage places intersect the Conceptual Footprint (Appendix B.4.a). As surveys continue, additional sites are likely to be identified. Places potentially identified in heritage surveys that contain painted rock art, which are very uncommon in the region, permanent/semi-permanent water sources and places with ceremonial significance have particular significance. Archaeological and ethnographic heritage surveys, as well as heritage specific engagement and consultation is ongoing with the Ngarlawangga to inform the Proponent's understanding of their heritage sites and places within the Revised Development Envelope, the significance of these sites, and the development of additional impact avoidance, minimisation and management options.

Lack of access to, and loss or impacts of, sites and places leads to an erosion of cultural knowledge – through consultation, Ngarlawangga have noted that a priority is to record knowledge and sites and preserve and protect cultural knowledge and places (Stevens 2023b).

⁷ All Ngarlawangga site numbers and site type information used within this document and Appendices are current as of October 2023

6.5.4. Yinhawangka

Yinhawangka Country is centred around the Ashburton River system encompassing Angelo River, Ashburton River, Hardey River, Kunderong Range, Mount Vernon Station, Rocklea Station and Turee Creek (Scambary 2013; Sharp and Thieberger 1992; Sharp 1992; Thieberger 1993; Wilson 1980). They share boundaries and close cultural, linguistic and familial ties with neighbouring Banjima, Nyiyaparli, Ngarlawangga, and Eastern Guruma peoples (Scambary 2013). For Yinhawangka People, as for all Traditional Owners throughout Australia, connection to Country is fundamental to culture, health, and identity. Stevens (2019) notes that the elements of Country, from trees to rocks to water to weather to Yinhawangka CLH themselves (and all of the relationships between them enacted across space and through time) were, and still are, created by ontological beings. These beings are generally conceived as Ancestors who remain extant and active in Country today. In this way, Country is in a constant process of re-creation. As Stanner (1987) observed: "One cannot 'fix' The Dreaming in time: it was, and is, everywhen". The Ancestors continue to bring all things into existence and to bestow Country, with all of its interconnected elements, upon people and upon all those others (living and non-living) who share in it.

Radcliffe-Brown's (1913) research with the Kariyarra found that Pilbara language groups were divided into exogamous patrilineal local clans with territorial and totemic associations. Descent may be patrilineal and/or matrilineal but there may be considerable flexibility (now and in the past) as to exactly which genetic line an individual chooses to identify with (e.g., the father's line; the mother's line; or both). The extended family group has always been important. Wilson (1961) observes:

Rarely, if ever, did the tribes, individually or collectively, act as a corporate unit even though the members acknowledged a cultural affinity.

Identity within a language group is based on genealogy, now formalised through Native Title Determination. The Yinhawangka Native Title claim is based on genealogical descent from three apical ancestors Minatangunha, Jardunha, and Thurantajinha and Wilga (T & W).

A history of the native title claim itself illustrates Yinhawangka People's connection to, and knowledge of, Country (Jones v Western Australia 2017). The Yinhawangka Native Title holders' Connection Material included a Connection Report (Sackett 2010), genealogies for the descendants of Jardunha, Minatangunha and Thurantajinha (Sackett and Norris 2011); and a Yinhawangka Connection DVD (McDonald 2011).

In 2016, Yinhawangka Elders made numerous witness statements to the Federal Court. The various Connection Material, submissions and statements were deemed by the Court "to evidence the Yinhawangka People's maintenance of connection according to traditional laws and customs in the Determination Area" (Jones v Western Australia 2017). Yinhawangka People affirmed their belief that ancestral beings created the features of the landscape and laid down the laws and customs when the world was 'soft'. These laws and customs connect Yinhawangka People to their Country today.

According to the Federal Court, the joint submissions identified the continuity of Yinhawangka traditional laws and customs, the recognition of the traditional Country of the Yinhawangka People, and the descent of contemporary Yinhawangka People from recognised Yinhawangka Ancestors. Membership under Native Title requires descent from a Yinhawangka Ancestor, self-identification as a Yinhawangka person, and acceptance of that identity by other members of the Yinhawangka People in accordance with their traditional laws and customs. It follows that Yinhawangka People consulted for the West Angelas social surroundings assessment are the appropriate people to speak for the Revised Development Envelope, and in fact many of the older Yinhawangka People who were consulted for this Proposal were those who provided Witness Statements as cultural experts to the Federal Court in support of the Yinhawangka Determination (Jones v Western Australia 2017). The determination also noted that traditional decision-making is consensual, although not necessarily unanimous.

Four Yinhawangka field trips were commissioned as part of the social surroundings assessment. The first two were attended by Yinhawangka CLH's, while the third field trip for the Yinhawangka assessment had a component where Yinhawangka and Ngarlawangga men came together to discuss aspects of the Proposal which have implications for both Native Title determination areas. There was also an Yinhawangka-only component of field trip three with men and women. The fourth field trip brought Yinhawangka, Ngarlawangga and Martu men together to discuss shared cultural knowledge that was relevant to critical aspects of the Proposal and its impact on their respective and shared values on-Country. There is a requirement for further discussion between the groups to agree on the management of any shared values.

Heritage surveys, while usually directed at prescribed questions about the use of specific land areas, provide some insights into Yinhawangka values and aspirations for the Revised Development Envelope, particularly as they have consistently involved the Yinhawangka People, resulting in confirmation of some of these values and aspirations on many occasions.

Most surveys at West Angelas have been archaeological surveys, which have led to the identification of hundreds of artefact scatters, as well as rockshelters; quarries; and modified (scarred) trees (Jackson and Ibbitson 2008; Jackson 2013; Stevens 2011). Some scatters may indicate former habitation or 'public' areas, while others may have been associated with sacred or private activities. Ethnographic surveys at West Angelas have confirmed the importance of intangible values and places. Common themes on ethnographic surveys include management of archaeological sites in the path of mining proposals, traditional ecological plant knowledge for food and medicines and significant spiritual places (Williams 2011; Stevens 2011; Venz and Grove 2003). Stevens et al.'s (2019) ethnobotanical survey report reveals an extensive plant knowledge held by Yinhawangka women. Yinhawangka men have recently identified sites associated with men's business (Trip 4, closed report (2022)).

6.5.4.1. Water

The Proponent commissioned an ethnographic study of Yinhawangka water values in 2021 at Western Range, approximately 120 km to the west of the Proposal. Local surface water catchments and features are shown in Figure 6-6. The following information was documented as a result of that study (Archaeus 2022c).

The significance of water in Yinhawangka culture cannot be overstated. In what would otherwise be an inhospitable environment, water provides the fundamental basis for all aspects of life throughout Yinhawangka Country. For Yinhawangka People, water is life. During the 2021 consultation, the Yinhawangka representatives expressed a commonly held understanding of Country in which the whole landscape is an expression of water. It is in the plants, the animals, the people.

Water is life – Yinhawangka Participant

The cultural significance of water is also derived from its centrality in Yinhawangka spirituality. Yinhawangka People understand that river systems, creeks, pools, and aquifers were all created by the movements of supernatural serpent like creatures known as *Warlu* or *Thurru*. Through their connections to these creation narratives, all aspects of hydrological systems present within Yinhawangka Country continue to be understood as spiritually significant by Yinhawangka People. According to Yinhawangka beliefs, *Warlu* continues to reside in certain permanent pools. The Yinhawangka Healthy Country Plan confirms that all aspects of life in such dry Country depend on water (YAC 2016). Traditional Owner rituals, stories and prescribed cultural activities are essential for protecting and maintaining the quantity and quality of water on Yinhawangka Country and the life that depends on it.

The presence of *Warlu* not only affords these places the upmost cultural significance, it also demands the performance of specific rituals to safely navigate them. These rituals continue to be practiced by Yinhawangka People while visiting Yinda (important places). During the 2021 consultation, Elders explained that these rituals are about connecting with the Yinda.

Although certain waterholes may be viewed as particularly significant based on the ongoing presence of the Warlu, for Yinhawangka People this does not detract from the general significance of all waters. This was made abundantly clear by the reactions of the Yinhawangka representatives when they were asked for input regarding the prioritisation of places for investigation. In response, the Yinhawangka representatives explained that all of the waterholes in Yinhawangka Country are important, and they did not want to risk diminishing the significance of some waterholes by placing them in a hierarchy of significance.

Landforms associated with the movement of water across the landscape are also attributed with an additional level of significance through their ongoing occupation and use. For many generations, rivers and creeklines have provided sustenance to Yinhawangka People and enabled access to broader Yinhawangka Country. According to the Yinhawangka representatives, creek lines and gullies were used as pathways across the landscape by the 'Old People'. Through their repeated occupation and use by multiple generations of Yinhawangka People, they have become highly emotive places, embodied with stories, meaning, and a shared history that connects Yinhawangka People to their Country and ancestors.

There are few known water places on Yinhawangka Country in the Revised Development Envelope. However, additional water sources may yet be identified during ongoing consultation during either pre-approval or post-approval stages of the Proposal.

Yinhawangka have a range of concerns with respect to water, including:

- Potential impacts on waterholes, creeks and related ecosystems in general
- A lack of trust regarding hydrological and hydrogeological information and modelling presented by mining companies, due to their experiences at existing mining operations such as at Paraburdoo and Eastern Range (both within Yinhawangka Country)
- Dewatering, and its potential impact on surrounding water sources, plants and animals, and spiritual consequences
- A requirement for more information on groundwater abstraction volumes and aquifer recovery
- The reliance on water for dust suppression (a low value use of a very valuable and culturally important resource and element of Country), and a request for investigations into alternative methods that require less water
- Proponent to continue monitoring dust quality and quantity and keep Yinhawangka apprised of the results through a proposed water committee
- The potential for sediment and entering waterways and waterholes.

6.5.4.2. Access

Yinhawangka concerns regarding access include (Archae-aus 2022):

- Restrictions on access to Country for native title purposes and social and cultural activities
- Unauthorised access by non-Traditional Owners to Country and places of significance.

Yinhawangka also have native title rights (Section 6.2.1.2) such as with respect to rights to access Country and exercise traditional rights there. Yinhawangka requested facilitation of access (non-prevention of access, or 'no worse off' access) throughout life of Proposal to:

- The unnamed range to the south of existing West Angelas operations (RTIO database: THE RANGE [No DPLH Place ID])
- Western Hill Site Complex (RTIO database: WESTERNHILLCPLX [No DPLH Place ID])
- Archaeological Site (RTIO database: WA-16-61SS [No DPLH Place ID]) (in vicinity to Deposit J, site now outside the Revised Proposal Development Envelope)
- Mt Ella Site Complex (RTIO database: WA-18-ETH-01 [No DPLH Place ID])
- Rockshelter with handprint (RTIO database: YINHARR-39 [DPLH Place ID 20444]) (within existing West Angelas MS 1113, but outside the Revised Proposal Development Envelope)
- Rockshelter with engravings (RTIO database: WA-16-45-ENG [No DPLH Place ID]) (within existing West Angelas MS 1113, but outside the Revised Proposal Development Envelope)
- The Sinkhole (RTIO database: Yinta) (approximately 12.5 km south-west of the the Revised Proposal Development Envelope)..

A revitalisation of women's connections to significant places is also important to Yinhawangka, who wish to develop this through YAC under the leadership and guidance of Yinhawangka women with Proponent facilitation assistance. Furthermore, Yinhawangka advised that gender-restricted locations should be identified and incorporated into access protocols and inform culturally appropriate management, informed by cultural protocol 'code of conduct' material Yinhawangka wish to develop and incorporate into mine personnel training. Alongside these improvements, Yinhawangka wish to hold annual community days on site for CLHs, ensure Proposal facilities offer a welcoming experience for Traditional Owners when accessing their Country within and around the Revised Development Envelope, and that the sharing of language and imagery is undertaken under a collaboratively developed communications strategy. Yinhawangka also recommend associated cultural mapping and place-naming for incorporation and sharing with the Proponent as appropriate.

6.5.4.3. Mining Operations

Yinhawangka feedback and concerns during mining operations included:

- Physical impacts through clearing and the development of mining landforms and infrastructure will affect aesthetics
- A general sense that culture is being eroded by the presence of mining operations across their Country
- Advice on waste and litter
- The need for greater education and cultural awareness of those living, working and passing through their Country
- Desire to be active agents in the management and rehabilitation of their Country. Including the potential to create employment and training opportunities tied to (but not limited to) mining operations, rehabilitation and other environmental management activities
- Scale of physical landscape changes.

Yinhawangka People also expressed their concerns about pits being left open on their Country after mining throughout the Social Surroundings consultations:

On Yinhawangka Country, when you make a hole, you gotta fill it in otherwise you gurrbalgu – (make trouble for yourself) – Yinhawangka participant

6.5.4.4. Mine Design, Closure and Rehabilitation

Yinhawangka want their Country to be restored to its original state wherever possible (Yinhawangka CLH and Archae-aus 2022). Yinhawangka also want, and regularly raised during Social Surrounding consultation, pits to be backfilled - utilising materials from the existing operations or progressively during the life of the Proposal to minimise creation of new WRLs and extent of disturbance during the LoM and at closure. Yinhawangka want to see more natural-looking rehabilitation, stop topsoil erosion and manage topsoil condition, and encourage native plants and animals back into the area.

Yinhawangka have specifically advised that due to the location of the Mount Ella East pits and their proximity to the Range that it is a requirement of consent that these pits at Mount Ella East shall be backfilled to the original ground surface, using the waste material from the proposed pits and existing WRLs. Furthermore, Yinhawangka have asked that, where possible, waste from the proposed pits should be dumped on top of existing WRLs, to minimise the overall number and footprint of the landforms. As stated above, Yinhawangka do not support pits being left open on their Country after mining.

Put the (waste dump) back in the hole! – Yinhawangka participant.

The Proponent has advised Yinhawangka CLH that it will not undertake backfilling of pits and removal of WRLs; however, opportunistic backfilling would be considered in mine design and pit sequencing and would be continually reviewed and communicated to Traditional Owners through LoM Planning and other consultation forums. The Proponent acknowledges that some pit and waste locations may be specifically identified and requested for backfilling, and commits to addressing the viability of backfilling these locations during mine design consultation and LoM Planning forums.

Yinhawangka have requested to visit Rio Tinto mines which have been or soon will be closed to hear the experience of those involved, including Traditional Owners whose countries the mines are on, and apply any lessons learnt at West Angelas and other mines on their Country..

6.5.4.5. Vision for the Future

Some of the most important Yinhawangka visions for the future are documented in the YAC Healthy Country Plan (HCP; YAC 2016), and to some extent more recent heritage reports. These documents largely address aspirations for Country.

The plan, developed with Yinhawangka CLH and YAC, identifies six main management targets for healthy Country:

- Yinda (Important places: water)
- Plants
- Animals
- Cultural sites
- Culture, Lore, Customs
- People on Country.

The HCP states that all six targets are largely achieved in land that is already in a protection regime, for example, Karijini National Park (YAC 2016). The targets are partly met on unallocated Crown land and, less so, on some pastoral stations. They are not met, or require serious remediation, on mine-sites and on Rocklea Station (north of Paraburdoo). The specific threats to the targets are multiple and overlapping. They include lack of effective governance, lack of management capacity, people living away from Country, climate change, roads and railways cutting through Country, overgrazing, inappropriate recreation activities in some places, unresolved Native Title, restricted access, loss of cultural knowledge, mine dewatering and bore fields, invasive plants, herbivores and carnivores, wrong

fire regimes, various social concerns, and mining as a whole. Conversations with YAC staff and recent heritage reports reveal many of these concerns continue to be seen as problems by Yinhawangka People.

However, the HCP also demonstrates Yinhawangka are keenly aware of local solutions to these threats even if the threats are largely the result of external historical and on-going economic and political forces (YAC 2016). Six strategies for solving these problems are identified, as follows:

- Developing capacity in governance and native title
- Managing relationships and partnerships through ILUAs and joint management agreements
- Developing capacity in land management through a Ranger program
- A cultural heritage program engaging Yinhawangka youth
- Managing invasive species
- A burning program to achieve less harmful fires and improve natural and cultural values.

The plan acknowledges that these strategies would require developing and extending the capacities of YAC and Yinhawangka CLH into environmental and heritage protection through a culturally appropriate management structure. This work is on-going.

The Yinhawangka Strategic Plan (YAC 2017) also indicates priorities for YAC in the areas of education, land, culture, health, economic development, and governance. These priorities align with the HCP and confirm overarching Yinhawangka aspirations to manage their Country.

6.5.4.6. Yinhawangka Themes

While Yinhawangka do not agree with categorisation of their values, they do endorse the organisation of values into multiple interconnected themes as described in the following three sections.

Care For Country

Yinhawangka are concerned with the physical impacts to Country through clearing and the development of mining pits, WRLs, stockpiles and infrastructure and subsequent effects such as residue seepage, noise and dust pollution. They also share concerns regarding the scale of landscape changes, cumulative impacts and vegetation loss, and wish to minimise creation of new disturbance. A key element of concern for Yinhawangka is the permanent alteration of landforms and creation of permanent pit voids and WRLs when pits are not backfilled.

Plants and Animals

In addition to plants and animals that have specific identified cultural associations, Yinhawangka are also concerned about the preservation of all plants and animals that occur on Country, including those essential for cultural and economic practices and part of the cultural landscape (Yinhawangka CLH and Archae-aus 2022).

During consultations, Yinhawangka raised similar concerns to Ngarlawangga with respect to plants and animals including shared concerns about the collection of bush medicines, bush tucker, and natural resources used for cultural practices. They noted their responsibilities with regard to caring for Country obligations, including the protection of local waterholes and appropriate design of rehabilitated areas that support the return of flora and fauna post mining through the creation of quality habitats for species that previously inhabited the affected areas.

Yinhawangka People also highlighted concerns about mining activities impacting migration pathways and adversely effecting local plant and animal individuals and populations. The existing prioritisation of monitoring and research of listed (i.e. as threatened) species over other plant and animal species important for cultural practices was also raised, with Yinhawangka noting it was harder to find kangaroos

and emus when hunting. Indirect impacts on animal habitats from dust, light, vibration and noise are a Yinhawangka concern.

Yinhawangka discussed the significance of the Western Pebble-mound Mouse and wish to know how potential impacts to this species will be managed and desired involvement in future mapping and monitoring activities to protect the species. Further, the loss of native honeybee species and honey-trees was also a noted concern (Yinhawangka CLH and Archae-aus 2022).

Yinhawangka recognise a need to record and map their own TEK, key species and cultural values to inform Proposal environmental and social surroundings management. Yinhawangka aim to have plants and animals (and other natural features) within the Revised Development Envelope recorded based on two-way knowledge exchange between Western and Yinhawangka science.

Special Places

As explained above, sites and places as described here generally represent only a narrow subset of cultural heritage as it should be understood, all locations on Country can be considered potential social and cultural areas. There are numerous Yinhawangka cultural sites and places of elevated importance, and traditional Songlines in and around the Revised Development Envelope (Figure 6-5).

Special places identified during social surroundings consultation (that may have also been identified in heritage surveys) of particular importance for Yinhawangka People are listed below (Figure 6-5):

- The unnamed range to the south of the existing West Angelas operations (RTIO database: THE RANGE [No DPLH Place ID])
- The range interacts with the Mt Ella East Development Envelope, however, the cultural boundary of the Range as identified by Yinhawangka has been avoided in this Proposal following removal of Deposit J and amendment to Mt Ella East Conceptual Footprint.
- Western Hill Site Complex (RTIO database: WESTERNHILLCPLX [No DPLH Place ID])
- Archaeological Site (RTIO database: WA-16-61SS [No DPLH Place ID]) (in vicinity of Deposit J, site now outside the Revised Proposal Development Envelope)
- Mt Ella East Site Complex (RTIO database: WA-18-ETH-01 [No DPLH Place ID])
- Rockshelter with handprint (RTIO database: YINHARR-39 [DPLH Place ID 20444]) (within existing West Angelas MS 1113, but outside the Revised Proposal Development Envelope)
- Rockshelter with engravings (RTIO database: WA-16-45-ENG [No DPLH Place ID]) (within existing West Angelas MS 1113, but outside the Revised Proposal Development Envelope) T
- The Sinkhole (RTIO database: Yinta) (approximately 12.5 km south-west of the WAN RP Development Envelope). A significant place for Yinhawangka People and visited as part of Social Surroundings Assessment fieldwork by Yinhawangka CLHs. This place is geographically separated from the Revised Development Proposal (particularly following the removal of Deposit J from the Proposal) and is not considered at risk from the Proposal. No further discussion on this place is required as part of Social Surroundings or the Yinhawangka Social Cultural Heritage Management Plan (SCHMP).

As aforementioned (Section 6.5.3), WAN-22-100-EX an additional place of high cultural significance to Yinhawangka (along with Ngarlawangga and other groups) has also been identified, outside the Revised Development Envelope, with details withheld from public review (see Section 6.5.3.3).

Heritage surveys to date, within the Yinhawangka Native Title Determination Area of Ministerial Statement MS 1113 have identified 345⁸ heritage places (including artefact scatters, quarries, rock shelters, scarred trees, rock art and places with other cultural values). The Yinhawangka sections of the Proposal contain an additional 85 heritage places inclusive of the above places of elevated importance, of which 52 heritage places intersect with the Conceptual Footprint (Appendix B.4.b). Additional sites are likely to be identified as ongoing surveys and heritage specific engagement and consultation are conducted.

The Governor (*Illingurra*), a prominent hill approximately 15 km northwest of the Revised Development Envelope, is a place of cultural importance for Yinhawangka People.

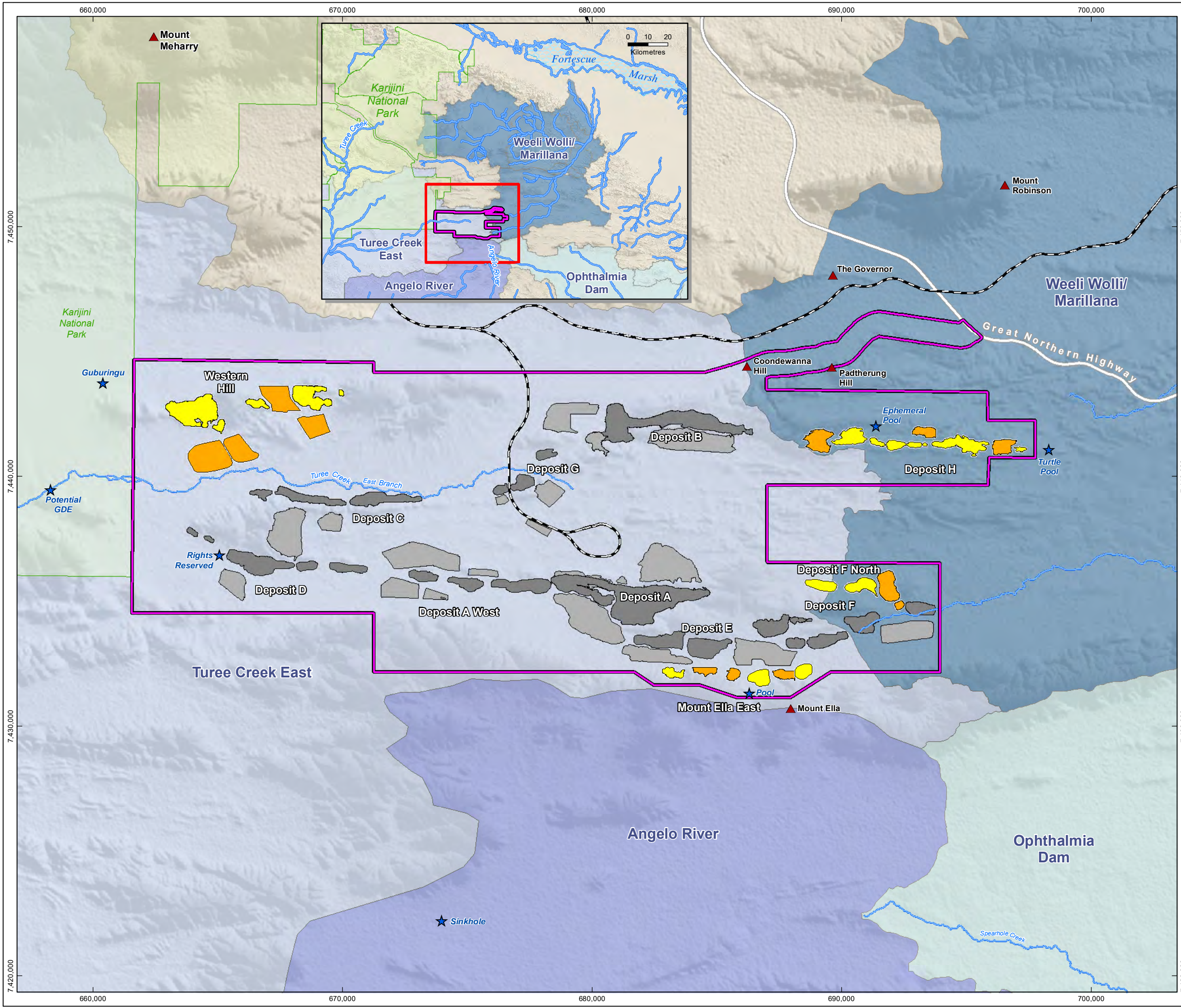
Yinhawangka have recommended that support be provided to manage important cultural places, and that CLH participation in heritage surveys is enhanced through specific induction measures and considers cultural and gender-specific requirements.

⁸ All Yinhawangka site numbers and site type information used within this document and Appendixes is current as of October 2023

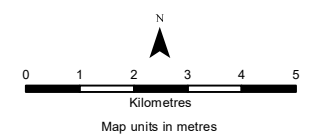
Figure 6-6
Surface Water Catchments and Features, and Major Natural Landforms within and around the Revised Development Envelope

Drawn: A.D.
Plan: RTIO-0977659v1
Date: February 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:140,000 @A3
GIS.Team@riotinto.com



- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Waste Landform
 -
 - ★ Sensitive Receptor
 - Major Creek
 - Marsh
 - Sub Catchment**
 - Angelo River
 - Ophthalmia Dam
 - Weeli Wolli/Marillana
 - Turee Creek East
 -
 - National Park
 - ▲ Mountain
 - Rio Tinto Railway
 - Highway



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6.5.5. The Range – Ngarlawangga and Yinhawangka Shared Area of Extreme Cultural Sensitivity

'The Range' (south of the existing West Angelas Operations) was identified during social surroundings consultation as an extremely important cultural landscape (Herrmann and Millett 2022; Yinhawangka CLH and Archae-aus 2022). The Range intersects both Ngarlawangga and Yinhawangka Native Title determination areas and is located at the southern edge of the Mt Ella East Development Envelope.

Traditional Owners have supplied cultural boundaries for 'the Range', as well as providing direction on ongoing consultation and management of the area and a requirement for the area to be excluded from any new direct impacts, noting that the area has historic impacts from roads, tracks, drill lines and pads and communications infrastructure.

You see some of these areas are very sacred... that is a very important area - Ngarlawangga participant

This big (hill) here is not just for us. It's for all the Indigenous people across Australia - Yinhawangka participant

The Range is part of a cultural landscape that represents significant social, community and cultural knowledge and practice. The Range is vital to Ngarlawangga and Yinhawangka People as recognised by the value they place on it, noting all participants at consultations asserted that this area must not be impacted by mining activity (Herrmann and Millett 2022; Yinhawangka CLH and Archae-aus 2022).

Cultural knowledge associated with the values and landscape features of the Range is governed by strict cultural protocols including gender and status considerations (Herrmann 2022). Because of this, Traditional Owner participants have requested that specific details of the cultural landscape not be reported in the ERD. Furthermore, Traditional Owners have requested that the mapping of the whole cultural landscape is not provided to the Proponent (or public), only the elements that intersect the Revised Development Envelope and require exclusion.

Ngarlawangga and Yinhawangka have asserted that to address impacts to their social surroundings adequately, elements of the Range cultural landscape should be excluded, rehabilitated where necessary, and protected from current and proposed mining activity, including exploration activity.

Exploration drilling has been conducted on sensitive parts of the Range, in accordance with appropriate approvals. It has been asserted by Ngarlawangga participants that this should not have happened; however, no blame was attributed to either Ngarlawangga or the Proponent during consultations, rather, it was agreed there is a need to 'get it right' going forward. Ngarlawangga have requested the Proponent complete rehabilitation of these drill lines with opportunity for Ngarlawangga representatives to monitor and inspect these works upon completion. Yinhawangka have also requested all disturbances in the Range (with the exception of the Angelo River access road) to be rehabilitated, and that the rehabilitation operations be undertaken by Yinhawangka businesses and people.

Ngarlawangga and Yinhawangka participants have asserted that if further damage were to occur to the most sensitive parts of the Range, then there would be very real consequences for them and their neighbours:

If Rio destroys those named places we will be punished physically, mentally, and spiritually. But also, our neighbours will get angry, punish us, and hold us responsible. This fills us with anxiety, sad feelings, and shame – Ngarlawangga participant

If we let this [mining in the Range] go [ahead], we might go off [experience mental health episode] and end up here [points to the ground]. – Yinhawangka participant.

Ngarlawangga and Yinhawangka participants support the continued maintenance and use of an existing mining access track running north-south through the Mt Ella Range (Angelo River access road), allowing access to Traditional Owners and the Proponent (Herrmann and Millett 2022; Yinhawangka CLH and

Archae-aus 2022). It was discussed during Ngarlawangga consultation that this track was a traditional thoroughfare for Aboriginal people (Herrmann and Millett 2022).

6.6. Receiving Environment – Other Social Surroundings Values

Consultation with community and agency stakeholders (i.e., not representing Traditional Owners) regarding all aspects of the Proposal is outlined in Table 6-8 and Section 4.

Turee Creek Pastoral Station boundary is approximately 20 km south and west of the Revised Development Envelope, with the homestead as the nearest residence approximately 50 km south. Initial concerns in relation to the Proposal raised by Turee Creek Pastoral Station were addressed during the consultation process however, consultation regarding water management is ongoing. Removal of Deposit J from the Revised Development Envelope has removed the closest disturbance to Turee Creek Pastoral Station.

Matters raised during consultation with community and agency stakeholders pertinent to Social Surroundings are provided in Table 6-8, including any key concerns relating to potential impacts to Karijini National Park (Section 6.6.1). Noting that the approximately 70 km distance from the Proposal to the Karijini National Park tourism hotspots such as the Dales Gorge reduces public interactions with the Revised Development Envelope and limits potential impacts to visual amenity.

Table 6-8: Social Surroundings Consultation (Non-Traditional Owners)

Stakeholder	Date	Issues Raised by Stakeholder	Proponent Response
Commonwealth Government	29 Oct 2021	No Social Surroundings concerns raised	N/A
State Government EPA Services	12 May 2020 (and ongoing consultation at regular EPAS/RTIO meetings)	No Social Surroundings concerns raised	N/A
State Government Department of Biodiversity Conservation and Attractions	30 Sep 2021	<ul style="list-style-type: none"> Project overview including changes to groundwater and surface water regimes adjacent to Karijini National Park No ongoing concerns were raised	Presented and discussed modelling indicating no drawdown and minimal impact to receptors in KNP as a result of water abstraction and altered surface water flows
Local Government	Shire of East Pilbara <ul style="list-style-type: none"> - Aug 2018 - Oct 2018 - Jun 2022 - Oct 2022 Shire of Ashburton <ul style="list-style-type: none"> - Sep 2022 - Jul 2023 	No Social Surroundings concerns raised Shire of Ashburton was advised about the VIA in Oct 2022 for KNP and confirmed the Shire does not hold any concerns over the visible impact from the operations in relation to areas heavily frequented by tourists. The Shire understands the southeast section of KNP is not heavily visited and there is limited access to the area.	N/A
Turee Creek Pastoral Station	Nov 2020	Concern from Turee Creek regarding any mining activities that involves dewatering (a common concern for Pilbara pastoralists, given potential effect on water supplies) The concerns raised represent a continuation of similar concerns raised over a number of years previous with respect to the Approved Proposal As Turee Creek homestead is on the Angelo River downstream of the Proposal, the Proponent must remain mindful of potential impacts upstream Turee Creek expressed ongoing and explicit concern regarding any water extraction, or mining and exploration, that would affect	High level update provided regarding Proposal

Stakeholder	Date	Issues Raised by Stakeholder	Proponent Response
		<p>the river catchment for the Angelo, Ashburton or Turee river systems and highlighted the 'catchment' for these water flows far exceeds the riverbed extent</p> <p>As Turee Creek operations are solely reliant on water and built around the Angelo, Turee and Ashburton river systems the Proponent must remain mindful and proactive about any impacts upstream</p> <p>Turee Creek expressed concern about contingencies if monitoring bores showed a decline in the water table at station bores Blair's and Mudlark. Station management are wary due to a related issue at Nyirrimpa spring</p> <p>Turee Creek inquired about investigations into directional lighting and efforts to reduce light pollution (also a common concern for Pilbara pastoralists)</p>	
	Feb 2021	No new concerns raised (regarding Turee Creek); however, existing concerns about potential impacts to the creek system and waterways remain	More detail provided regarding Proposal
	Oct 2021	<p>Comments provided regarding WAN RP Draft ESD</p> <p>Turee Creek Station requested visibility of specific low impact activities that are excluded from the scope of the ESD</p> <p>Additional concerns related primarily to potential impacts to water</p> <p>Turee Creek Station considers that preliminary key environmental factors should be more data driven and include specific, measurable information</p>	Met to discuss comments/responses to draft ESD
Turee Creek Pastoral Station	Mar 2022	<p>No specific objections or concerns raised in relation to the West Angelas Revised Proposal</p> <p>Turee Creek raised concerns they considered were not being heard or addressed, that the catchment questions were not being met and that the Proponent was failing to provide the information requested regarding the broader river catchment zones and the effect on groundwater</p>	High level update on Proposal

Stakeholder	Date	Issues Raised by Stakeholder	Proponent Response
		<p>Turee Creek continued to express concerns and highlight the sole reliance of operations on water, and the ability to source water given its scarcity</p> <p>Turee Creek again highlighted all operations on Turee Creek as a pastoral operation revolve around the river systems as they are, including paddock layout, watering points and stock numbers. Any impact will have a direct and immediate impact to the viability of the pastoral operations.</p>	
	Jul 2022	Acknowledgement of removal of Deposit J	More detailed update provided regarding amendments to Proposal including removal of Deposit J
	Dec 2022	Confirmation of removal of Deposit J. Update of Proposal and Part IV timeline provided	Detail provided about Proposal process and required input from TCPS
	May 2023	Update on West Angelas Revised Proposal	Detail provided about Proposal process and required input from TCPS

6.6.1. Turee Creek Pastoral Station

Joseph James Maguire and Claude Lorraine Piesse took up the original Turee Creek Pastoral Station lease in the late 1800s, with the station under the stewardship of the Maguire family since (Claude Piesse relinquishing his stake due to injury in World War 1) (B. Maguire pers comm. 2023). The current owners, Bruce and Suzanne Maguire, have a strong sense of responsibility and love for the land, based on a philosophy of acting beyond their own interests to preserve an environment and cultural legacy for future generations. The Maguires have emphasised their deep respect for the Traditional Owners (i.e. Yinhawangka) on whose land their station operates and with whom a strong and harmonious relationship has been fostered historically and into the present. The family value and are proud of this connection and their commitment to the land, evidenced by their dedication to safeguarding Turee Creek's heritage and advocacy for sustainable water and land management.

The Maguire family advised the Proponent they share Traditional Owner concerns regarding potential threats posed by mining to the station's (being a part of the Traditional Owners' country's) heritage and its environmental integrity.

Foremost of these concerns relate to groundwater and its relationship with the natural springs and waterholes that occur in the area. The family is wary of the Proponent's understanding of the local and regional groundwater regime, which they view as being necessarily limited due to it having been developed only recently, in contrast to their innate understanding developed through the family's century-plus connection to the land. This acute on-ground connection has imparted a heightened awareness of the crucial role water plays in sustaining local ecology and cultural heritage. The Revised Development Envelope and the Western Hill deposits of the Proposal interact with the surface water flows of the Turee Creek East Branch creekline which flows into Karijini National Park and then downstream through the station. The Turee Creek owners have concerns regarding the potential for the addition of any impacts, or that the scale or extent of existing impacts represented by the Approved Proposal (Section 7) will be increased as a result of the Proposal.

6.6.2. Karijini National Park

The western boundary of the Revised Development Envelope abuts Karijini National Park, which in that area is within the traditional lands of Yinhawangka People, and connected to the Proposal hydrologically by both the Turee Creek East Branch creekline and the Wittenoom Formation, which is the regional groundwater aquifer in the area. Important heritage places (e.g., *Guburingu*) and high social values exist within the national park. A potential groundwater dependent ecosystem (GDE) also occurs within and approximately 7 km downstream within the Karijini National Park boundary (Section 7). The closest development associated with the Proposal is the Western Hill Deposit which is located on the eastern boundary of the southern portion of the Karijini National Park. All remaining deposits are located further south and east of Western Hill (Figure 6-7). Mt Meharry (Figure 6-7) is approximately 13 km north of the Revised Development Envelope within Karijini National Park and is regularly visited by tourists as the highest point in the State. Views from Mt Meharry take in existing mines, including the existing West Angelas operations and BHP Area C Southern Flank operations (Rio Tinto 2021b). Views for these locations are otherwise generally of surrounding national park and/or pastoral station landscapes composed of essentially intact native vegetation and surrounding flatlands and ranges, with disturbance from existing mines visible but not prominent.

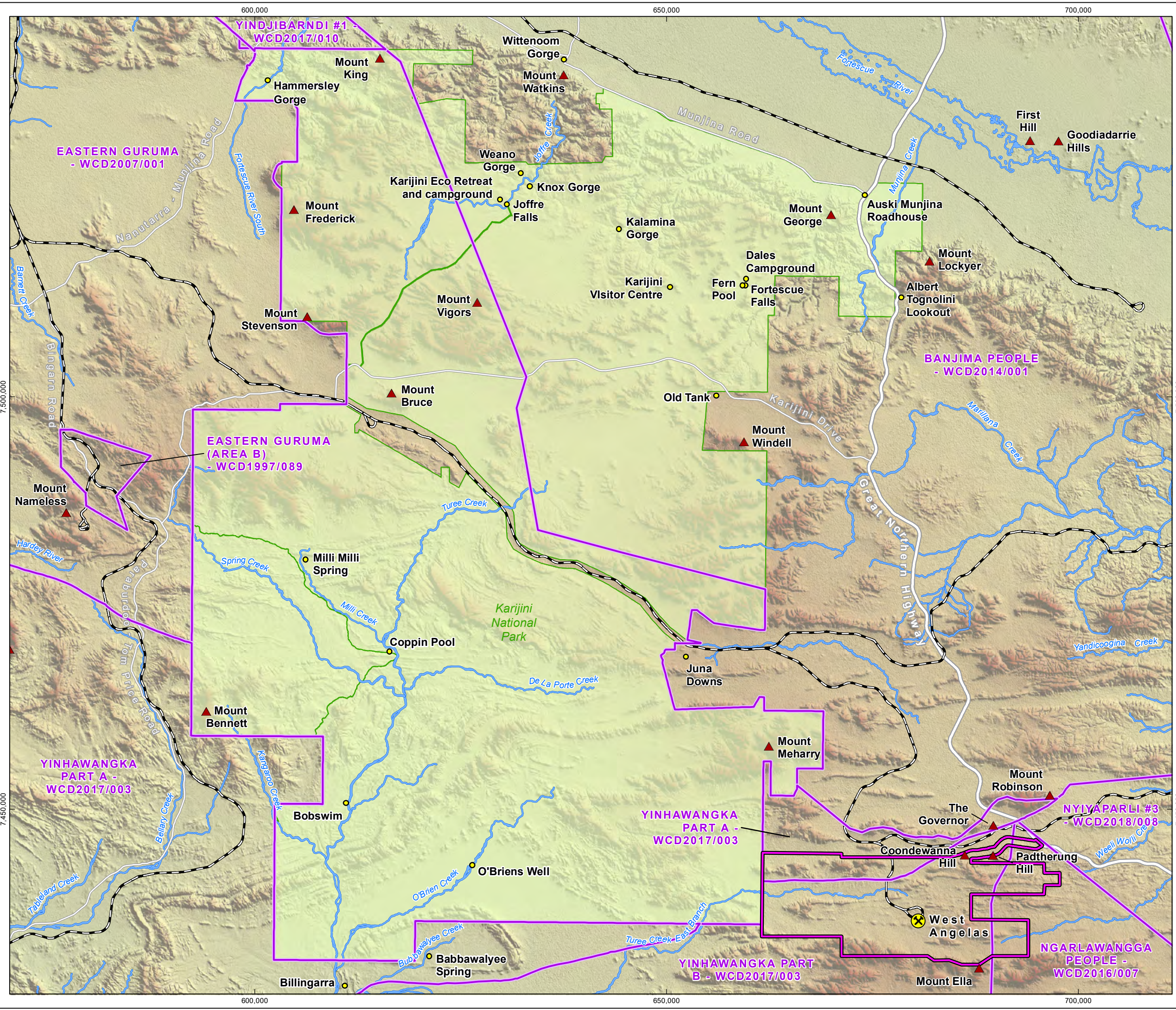
Most other tourist locations within Karijini National Park are located within the northern part of the park, typically more than 70 km from the Proposal. Consultation has occurred with the Shire of Ashburton in relation to the Western Hill Deposit location within its jurisdictional boundary and any potential amenity impact to areas heavily frequented by tourists, along with providing a copy of the Visual Impact Assessment that was created for this Proposal. It was agreed that due to the location of Western Hill - remote from the heavily frequented tourist areas of Karijini National Park - that this would not be an issue.

Surplus water from dewatering at the existing West Angelas operation is discharged into a tributary of Turee Creek East, which then flows westwards through Karijini National Park. Under the conditions of approval for the existing operation (MS 1113), the extent of discharge of excess water to Turee Creek East must not extend within 2 km from the national park boundary under natural no-flow conditions.

BWT ore is known to be present at Western Hill; however, in acknowledgement of the significant value of Karijini National Park, mining will be limited to above watertable (AWT) only at this site for this Proposal, noting a small volume of groundwater abstraction for operational supply is proposed (refer to Section 7). Modelled groundwater drawdown from existing approved operations (Deposits C and D) was identified as having the potential to extend to the west and into Karijini National Park. To ensure drawdown does not extend into Karijini National Park, the Proponent has constructed a managed aquifer recharge (MAR) scheme located between the existing mining areas and the national park and the scheme is managed via an approved Groundwater Environmental Management Plan.

Figure 6-7
Karijini National Park and
Surrounds

Drawn: GIS Team
Plan: RTIO-0978265v1
Date: February 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:425,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Native Title Determination Area
- National Park
- Rio Tinto Mine
- Landmark
- Elevation Point
- Rio Tinto Railway
- Highway
- Major Creek

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6.6.3. Local Amenity

As the region is sparsely populated and as no town sites or communities are located in the immediate vicinity of the Proposal, the consideration of amenity is largely restricted to the effect on users of higher nearby viewpoints.

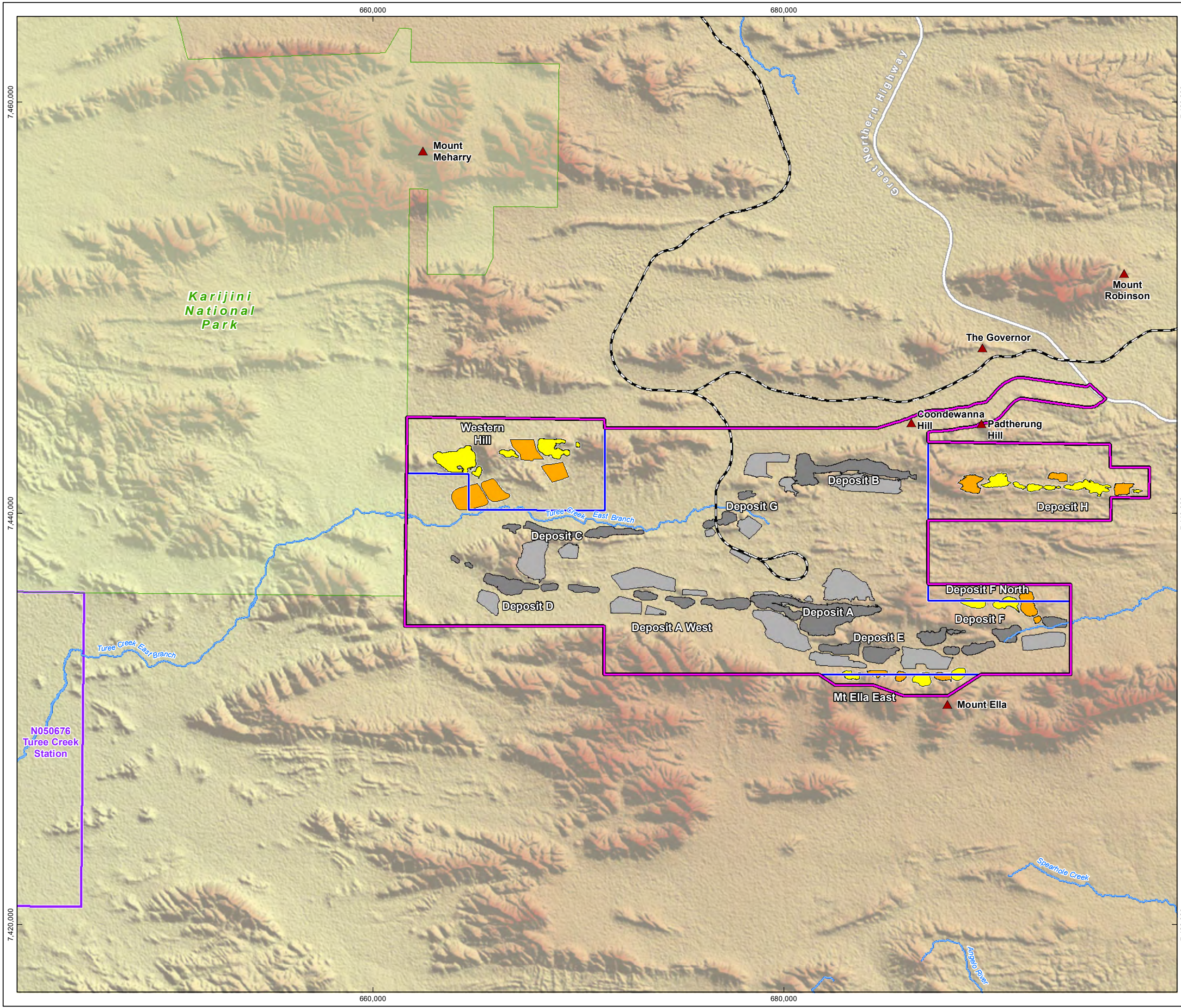
Although not raised by community or agency stakeholders as significant concerns, outside Karijini National Park, two prominent high points occur in the vicinity, and with clear views, of the Revised Development Envelope area (Figure 6-8), including:

1. Mt Robinson, approximately 7.5 km north of the Revised Development Envelope – the peak is accessible from the Mt Robinson rest area, utilised by travellers along the Great Northern Highway (actual visitation numbers to the peak is not known but expected to be relatively low).
2. The Governor (*Illingurra*), approximately 5 km north of the Revised Development Envelope, is a known site of cultural and heritage significance for the Yinhawangka People. There are publicly accessible tracks in the vicinity of this landform but none that provide direct access to the peak.

Although to some degree naturally dusty due to the effects of bushfires and wind erosion (EPA 2007a), limited information on ambient dust levels exists for the eastern Pilbara. The Proposal is located near the existing and operational West Angelas mine, which utilises water carts for dust suppression measures on transport corridors. Nonetheless the West Angelas operation emits fugitive dust emissions.

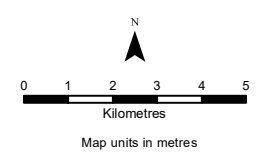
Figure 6-8
Prominent Viewpoints near
the Revised Development
Envelope

Drawn: GIS Team
Plan: RTIO-0978270v1
Date: February 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:170,000 @A3
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Legend

- Revised Development Envelope
- Approved Development Envelope
- Mountain
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- National Park
- Pastoral Station
- Major Creek
- Rio Tinto Railway
- Highway



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6.7. Potential Environmental Impacts

Proposal disturbance of up to 5,350 ha from vegetation clearing, mine pit excavation and infrastructure placement will directly and indirectly impact Social Surrounding values, including a number of sites and places of cultural significance for Traditional Owners. The combined extent of this Proposal with the existing approved West Angelas operation will result in clearing of up to 17,555 ha within a 36,779 ha Revised Development Envelope.

The Social Surroundings of the Proposal may be affected by clearing, blasting and excavation for mining, placement of mineral waste management infrastructure, transport infrastructure, surface water management infrastructure, renewables infrastructure⁹, abstraction of groundwater for water supply, vehicle and rail movements, fencing, gates and other restrictions on access and the presence of workforce personnel. These effects may be short-term, may last for the duration of Proposal operations (approximately 20 years), may gradually decrease as rehabilitation outcomes are achieved, or may be permanent.

6.7.1. Overview

6.7.1.1. Direct Impacts – Ngarlawangga and Yinhawangka Social Surroundings

Potential direct impacts of the Proposal to Ngarlawangga and Yinhawangka Traditional Owner Social Surroundings have been identified as:

- Direct disturbance of Country (including water, waterholes, creeklines, aquifers, camping sites, hunting grounds, other important cultural places and heritage sites, plants and animals and their habitat, physical changes to landscape, and interference with cultural obligations and spiritual beliefs tied to Country)
- Restriction of access to Country (including waterholes, creeklines, camping sites, hunting grounds, and important cultural sites and places affecting the ability of Traditional Owners to exercise Native Title rights and undertake cultural activities and obligations) – in addition to temporary impacts, this includes permanent restrictions with respect to sections of land where access will be prohibited post mining (i.e. areas within abandonment bunds), and where rehabilitation activities will not be undertaken (i.e. pit voids)
- Permanent changes to local landforms and installation of infrastructure which may result in altered visual landscapes and amenity (social and cultural dimensions, use, experience, and enjoyment of Country) within Country, and interference with cultural obligations and spiritual beliefs tied to Country.

6.7.1.2. Indirect Impacts – Ngarlawangga and Yinhawangka Social Surroundings

Potential indirect impacts of the Proposal to Ngarlawangga and Yinhawangka Social Surroundings can be the result of changes to the physical and biological attributes of the environment affecting related values. These include:

⁹ Consultation with Yinhawangka CLHs on renewable energy and associated infrastructure within the West Angelas Revised Proposal Development Envelope has not yet occurred. The Proponent commits to undertaking consultation with Yinhawangka CLHs in the event that the Proponent decides to pursue renewable energy options on Yinhawangka Country and recognises that Yinhawangka CLHs reserve the right to object to any such proposals.

- Alteration of amenity and sense of place (social and cultural dimensions, use, experience and enjoyment of Country) due to dust, noise, vibration, light and waste/litter and increase in human presence and activity
- Indirect impact to cultural heritage, including interference with cultural obligations and spiritual beliefs tied to water, as a result of altered hydrological regimes
- Indirect disturbance of cultural sites and places as a result of active mining
- Alteration to groundwater and surface water regimes impacting Traditional Owner amenity and sense of place (physical changes to aquifers and creeks, and interference with cultural obligations and spiritual beliefs tied to water)
- Disturbance, or reduced presence of plants and animals which are traditionally used, or which have cultural associations due to dust, noise and vibration.

The Proponent acknowledges that both Yinhawangka and Ngarlawangga perceive any impacts felt as a result of the Proposal as direct, rather than distinguishing between direct or indirect.

6.7.1.3. Indirect Impacts – Turee Creek Pastoral Station

Potential indirect impacts of the Proposal to Turee Creek Pastoral Station have been identified as:

- Alterations to surface water and groundwater hydrological regimes, affecting surface water and groundwater dependent values
- Changes to local landforms and installation of infrastructure which may result in altered visual landscapes and amenity
- Changes to the physical (including noise and dust levels) and biological attributes of the environment which may impact amenity.

6.7.1.4. Indirect Impacts – Karijini National Park and Nearby High Viewpoints

Potential indirect impacts of the Proposal to Karijini National Park have been identified as:

- Alterations to surface water and groundwater hydrological regimes, affecting surface water and groundwater dependent values.

Potential indirect impacts of the Proposal to Karijini National Park, Mt Robinson and The Governor (*Illingurra*) include:

- Changes to local landforms and installation of infrastructure which may result in altered visual landscapes and amenity
- Impacts to amenity due to dust and noise.

6.7.1.5. Indirect Impacts – General Public

Potential indirect impacts of the Proposal to the general public have been identified as:

- Changes to local landforms and installation of infrastructure which may result in altered visual landscapes and amenity.

6.7.2. Ngarlawangga and Yinhawangka

6.7.2.1. Water

Ngarlawangga

Sump pumping is proposed within the Deposit H pit as a method to access BWT ore which will minimise impacts to groundwater and result in local impact to groundwater, such that the groundwater at Turtle

Pool will not be impacted (Section 7). Consultation on this proposed mining process will be ongoing with Ngarlawangga.

The hydrology of both Deposit H Waterhole and Turtle Pool indicates they are dependent on rainfall and surface flows for replenishment, with observation of the pools becoming full following rain events and dry following prolonged periods of no rainfall (Section 7 [Inland Waters]). However, Turtle Pool is also likely to be groundwater fed and connected to the Deposit H aquifer and investigations to confirm this are ongoing. LiDAR undertaken to compare Deposit H aquifer heights to the two pools has established that the Turtle Pool is the same height above sea level as the aquifer (approximately 735 mAHD [metres Average Height Datum]) and is therefore likely to be connected to groundwater. Deposit H Waterhole is confirmed as ephemeral by this same process as it is located at approximately 757 mAHD, 22 m above the height of the Deposit H aquifer.

The conceptualisation of the Deposit H local groundwater suggests the aquifer is bound in all directions by impermeable unmineralised units of the Marra Mamba formation. Modelling of drawdown has been undertaken for both impermeable and permeable scenarios (IGS 2023) and results suggest that, if the surrounding stratigraphy is more permeable than anticipated, there will be drawdown observed in groundwater beneath Turtle Pool. A precautionary approach has been taken in relation to accessing BWT ore at Deposit H with localised sump pumping proposed instead of conventional dewatering using dewatering bores. This approach significantly reduces the volume of water abstracted, induces a negligible and localised cone of depression, and allows abstracted water to be retained within the pit to naturally infiltrate (refer to Inland Waters Section 7).

Turtle Pool is located outside of the Development Envelope and will not be directly impacted by the Proposal, although the heritage site boundary established around the pool intersects the Revised Development Envelope. The potential for indirect impacts on Turtle Pool are considered very low as a result of proposed BWT access strategy of sump pumping and commitment to no abstraction of groundwater for supply purposes.

Ngarlawangga indicated that they did not support drawdown of the aquifer at Deposit H but understood the requirement for water for operational purposes such as dust suppression. Ngarlawangga wanted the Proponent to review water supply options for Deposit H but also seek other methods for dust suppression to conserve water and limit Deposit H aquifer drawdown if no alternative water sources were viable. Ngarlawangga requested that should water be abstracted from the Deposit H aquifer that it be utilised locally at Deposit H for operational purposes such as dust suppression, and that water from Deposit H aquifer should not be extracted and discharged (i.e. as surplus), nor extracted and used elsewhere within the operation. However, groundwater abstraction for production use to allow BWT mining at Deposit H is no longer proposed. As Ngarlawangga have requested, alternative water supply for production at Deposit H will be sourced from other operational areas of West Angelas, and the Deposit H aquifer will not be depleted. As indicated, sump pumping for BWT mining at Deposit H is proposed instead of broadscale aquifer drawdown. Yinhawangka and Ngarlawangga have both requested ongoing consultation regarding ground water extraction, use and BWT mining.

Mine pits, WRLs and infrastructure proposed at Deposit H have the potential to affect the surface water quality, and recharge volumes, into the Deposit H Waterhole, with infrastructure the only proposed interaction with surface water for Turtle Pool. The Deposit H Waterhole volume is very small in relation to the volume of flow that reports to it with proposed pit, WRL and infrastructure designs impacting a significant portion of this catchment. Turtle Pool catchment infrastructure impacts will be designed to maintain all existing surface water volume and flows, with no impact predicted (see Section 7). If rainfall events transpire during construction of infrastructure there is potential for impacts to waterflow and volume to occur, but these will be temporary in nature.

Ngarlawangga are not supportive of any significant impact to the amenity and ecological vitality of the Deposit H Waterhole gully as a result of mining activities. Mining at Deposit H may remove up to 88% of the Deposit H Waterhole contributing catchment depending on development option, significantly

reducing runoff into the Deposit H Waterhole. In a 1:2-year event flow (32 mm of rainfall in 3 hours – which is a typical high intensity rainfall event that would generate flow to the pool and occur in most years), 12% catchment retention is expected to fill the pool and maintain ecosystem composition in the gully downstream of this; however, reduction in water volume is likely to result in a small to moderate decrease in vegetation abundance and density over time, as the vegetation occurring in the Deposit H Waterhole catchment is similar to that which occurs in other local catchments of variable, including smaller, size (Section 8). Pit design options including diversion drains are being explored at Deposit H with additional catchment retention up to 33%. These mine design and associated closure options, as well as the predicted impacts to amenity and ecological vitality as a result of catchment loss, are part of ongoing discussion with Ngarlawangga Traditional Owners and subject to further technical investigation.

There are no known GDEs or surface expressions of the Deposit F North aquifer. Groundwater abstraction to allow mining (both above and below water table) at Deposit F North will result in groundwater drawdown, but this will not result in a total depletion of the aquifer (Section 7).

Yinhawangka

No BWT mining will occur at Western Hill with pit floors to be above pre-mining water table heights, so no pit dewatering is required. Minor abstraction of groundwater for operational requirements is required at this deposit. A description of the groundwater abstraction strategy, mitigation and impact assessment in relation to Yinhawangka traditional lands within Karijini National Park showing negligible predicted impact, are provided in Section 7 and not discussed further here. The Turee Creek East catchment could be reduced by approximately 3%, depending on final mining footprints, resulting in a minor change to surface water flows in the Yinhawangka traditional lands within the national park, discussed in detail in Section 7.

Ngarlawangga and Yinhawangka

Existing infrastructure of major creek crossings will continue to be used, with no new creek crossings proposed, except for crossing points along ephemeral tributaries. Effects on surface water flows from creek crossing constructed to support the Proposal are expected to be negligible (Section 7). Any crossings that may be required will be built to ensure no significant disruption to flow regimes.

Stormwater controls at the existing West Angelas Mine are in place around all significant infrastructure, including mine pits, WRLs and workshops – the same control strategies and mechanisms will be employed across the Proposal area including at Deposit H.

Water use for dust suppression represents a potential cultural impact for Traditional Owners with respect to the ethnographic significance of water. Water extraction being recognised by Traditional Owners as an impact to the groundwater, signalling a preference for the Proponent to find alternative methods for dust suppression to reduce water use and to ensure that water is used respectfully, sparingly and efficiently. Water use will be continually reviewed and updated against dust suppression effectiveness and technological advancement, with resulting options considered in consultation with Traditional Owners over the life of the operation and as per their respective SCHMPs.

Sediment and pollutants including dust and chemicals from drilling and blasting, and from WRLs, entering waterways and waterholes is a concern for Traditional Owners. There is the potential for Potentially Acid Forming (PAF) material to be encountered during mining which if managed inappropriately, has the potential to impact surface and groundwater quality. It is noted that an Acid Mine Drainage (AMD) Risk Assessment undertaken in 2021 suggests all deposits are of low – moderate AMD Risk.

Further discussion of modelling and an assessment of hydrogeological and hydrological impacts and associated mitigation and management approach is provided in Section 7.

6.7.2.2. Access and Connection to Country

Traditional Owner access to most areas of the Revised Development Envelope during the construction, operation and rehabilitation of the Proposal will be further restricted from current access with effects on existing access permanent or temporary depending on the nature of the activity undertaken. The Proposal may alter access routes, but the Proponent will need to consider that identified locations are facilitated with access alternatives, while also ensuring that no prevention of access to these locations occurs.

A West Angelas LAP exists between the Proponent and YAC for the existing West Angelas Operations, this LAP is currently being reviewed to include the Proposal area, though the principles of the LAP will remain the same.

The Ngarlawangga West Angelas LAP is currently in development and will be inclusive of the existing operations and the Proposal.

The respective LAPs provide a summary of key activities, responsibilities and contact information to enable Traditional Owners safe access country associated with the existing West Angelas mining operation and the Proposal. Given the serious safety risks associated with mining, the LAPs include processes and timings that Traditional Owners have expressed concerns over, with respect to the limits on movement and access around parts of their Country, with those same necessary limits included as required to ensure the safety of all Traditional Owners within the Revised Development Envelope (and mining lease). However, the Proponent recognises the high level of concern this understandably generates and is committed to continuing to work with Traditional Owners to find ways to better facilitate less restricted access to as much of the Revised Development Envelope as can be achieved safely and practicably. The LAPs can specifically identify key cultural places that have been nominated by Ngarlawangga or Yinhawangka but are process documents to facilitate access more generally to the Revised Development Envelope (and mining lease) while ensuring the safety of Traditional Owners during visitation.

It should be noted that it is not the intention of the Proponent or the LAPs to create new access and new disturbance to all key cultural places and locations. Ongoing mine design consultation with Traditional Owners will incorporate access by design to ensure access requirements and non-prevention of access to places is considered and consulted during planning and operations, and that any alterations to access are no worse off.

Ongoing consultation with Traditional Owners on matters related to access is included in the SCHMPs. Part of this process is the investigation into specific opportunities to improve or create unescorted or easier access to locations which can be incorporated into the LAP such as the Ngarlawangga request to consider installing an access track from the north to the Deposit H Waterhole site complex that would remain outside the mining environment.

At closure, inadvertent access to pit voids will be restricted using physical barriers such as abandonment bunds. Strategies for managing safety risks will be developed as the site approaches closure and will consider the access requirements of Traditional Owner groups. However, access to some areas will be permanently affected by safety considerations, such as:

- Installation of abandonment bunds outside the potentially unstable pit edge zone, where required
- Flood management or surface water drainage and diversion structures.

Other aspects affecting access to Country within the Revised Development Envelope post-closure include the removal or retention of tracks and roads, fencing and other infrastructure that may be potential barriers to movement.

6.7.2.3. Amenity

The Proposal has the potential to impact the enjoyment and use of, and connection with, related intangible values tied to Country, and culturally important utilisation of places, plants and animals through the generation of airborne dust emissions, the emission of noise, vibration and light from mining and related activities and through changes to landscape, landforms and the atmosphere.

Mining operations generate dust, noise and non-natural visual changes in the environment. The creation of dust, noise and non-natural visual changes have the potential to impact the amenity of an area and the quality of enjoyment of place and the cultural landscape within and around the Development Envelope. Traditional Owners have expressed general concern regarding dust emissions, including with respect to their cumulative impact, as an eyesore impacting enjoyment of Country, potential impact on waterholes, vegetation and fauna health and availability, effect on cultural activities and the potential to diminish people's enjoyment of Country.

Landform Changes

Mining by its nature permanently alters natural landforms, particularly with respect to pit voids and waste rock landforms, and therefore the visual character and sense of place for not only the directly impacted area but the surrounding landscape. Mine pits and mineral waste management infrastructure including WRLs and landbridges will remain as permanent changes to the landscape and permanent changes to how that specific part of Country can be used and enjoyed. Permanent changes, even after rehabilitation, resonate through cultural understanding of Country, it is different to land that Ancestors walked, and future generations will not know what Country looked like before these changes. Consenting to these changes weighs heavily on the current Traditional Owners, and their enjoyment and desire to be on this part of Country will be impacted by the permanent changes to landscape and the knowledge of what was and what has changed.

Dust

Dust is an ongoing concern for both Yinhawangka and Ngarlawangga more generally as a result of nearby mining activities and for the Proposal. The visible presence of dust in the atmosphere across mining landscapes impacts the look and feel, the enjoyment and desire to visit, camp and be present on that part of Country. Concerns relating to flora and fauna health, and particularly fauna moving away from country as a result of dust, also impact the ability of Traditional Owners to use that landscape for cultural practices such as hunting and ceremonies.

Ngarlawangga assert that TSP and dust deposition modelling assessment criteria have limited application for measuring dust impacts to social surroundings values as relevant to them. Both the Proponent and Ngarlawangga acknowledge there is limited available research regarding potential dust impacts to flora and fauna and other social surroundings values within the Pilbara setting. There is also some Ngarlawangga skepticism around the datasets and criteria being used, based as they are on 'western' scientific measurables, whereas the 'felt' impact of dust on social surroundings values and places can be more intangible and personal in nature.

Dust has an impact to the use and enjoyment, and sense of place of Country, even if dust levels fall below assessment thresholds and criteria used in modelling. Ongoing consultation and involvement with Traditional Owners on dust monitoring and management is required, including recording Traditional Owner perspectives on dust levels, impacts and management.

Ngarlawangga have recommended the specific targeting of dust suppression and monitoring in the vicinity of Deposit H Waterhole site complex and Turtle Pool. Both groups would like to be consulted on:

- Technological dust suppression and dust creation reduction improvement opportunities
- Process driven dust creation reduction plans
- Alternative technologies that may reduce the reliance on water extraction and use in dust suppression.

Dust modelling assessed the predicted dust emissions of the Proposal, with TSP modelled at important cultural areas that were nominated by Yinhawangka or Ngarlawangga as locations chosen to represent broader locations of landscape value, or specific heritage sites (ETA 2022). TSP refers to the total amount of the dust particles suspended in air (regardless of size). These larger particles are primarily associated with amenity or visibility concerns and are likely to settle to the ground or other surfaces fairly quickly.

TSP modelling assessment criteria were based on protection, primarily, amenity impacts established by the EPA through its *Environmental Protection (Kwinana) (Atmospheric Wastes) Policy* (ETA 2022), which relates to the Environmental Protection (Kwinana) (Atmospheric Wastes) Regulations 1992 that stipulate a 24-hour TSP limit on the rural and residential zoned 'Area C' of 90 µg/m³.

No locally defined dust deposition standard in relation to amenity have been developed; therefore, the criteria (4g/m²/month total deposition rate) adopted is based on NSW and Victorian government guidelines to protect residential amenity (ETA 2022). Dust deposition criteria in relation to potential direct physical effects on vegetation (7g/m²) have been adopted from a mineral dust study by Farmer (1993, cited in ETA 2022).

Dust levels as TSP as well as dust deposition rates at most important cultural areas are predicted to be generally well below the defined assessment criteria during operation of the Proposal; however, the culturally important rockshelter YINHARR-39 is one of several sites which is predicted to experience exceedances of the TSP and dust deposition criteria due to the proximity to existing and future mining activities.

Figure 6-3 shows predicted TSP emissions at Year 2 and Year 10 for the range of sites (Table 6-9), against the assessment criteria (90 µg/m³). The table shows the maximum predicted 24-hour level reached and the number of days in the year above the assessment criteria. Table 6-10 shows the predicted maximum monthly dust deposition rates, with 4g/m²/month defined as the de facto trigger level for culturally important areas and 7g/m²/month adopted to determine the potential impact on vegetation, as indicated above.

Table 6-9: TSP Concentration at Key Sensitive Receptors – excluding Background (µg/m³)

Receptor	Maximum 24-hr Average (µg/m ³)		No of Days Above Assessment Criteria	
Assessment criteria	Kwinana EPP – 90 µg/m ³		Kwinana EPP – 90 µg/m ³	
Year of Operation	2	10	2	10
West Angelas Village	102	164	1	15
West Angelas (RTIO) Airport	85	121	0	3
Deposit H	56	21	0	0
Turtle Pool	68	12	0	0
Western Pebble-mound Mouse	58	20	0	0
Mt Ella East SE Con	88	20	0	0
Mt Ella East S Con	57	20	0	0

Receptor	Maximum 24-hr Average ($\mu\text{g}/\text{m}^3$)		No of Days Above Assessment Criteria	
WARE14-16-RS	52	24	0	0
DF-SH1	81	23	0	0
WA-19-ETH-01	59	28	0	0
WA-16-61-SS	67	27	0	0
YINHARR-18	94	37	2	0
YINHARR-19	82	33	0	0
RR21	78	71	0	0
WA-16-45-ENG	70	343	0	45
WA-16-51-ENG	148	455	2	123
WA-16-57-ENG	192	1093	21	353
WAN20-012	41	88	0	0
YINHARR-39	1365	129	216	6
WANETH06-2	84	174	0	3

Orange: above assessment criteria ($90 \mu\text{g}/\text{m}^3$)

Table 6-10: Maximum Monthly Deposition Rate ($\text{g}/\text{m}^2/\text{month}$)

Receptor	Year 2	Year 10
Bat Cave CWAN-09	4.5	0.1
Deposit H	2.1	0.1
Turtle Pool	0.1	0
Western Pebble-mound Mouse	2.4	0.1
Mt Ella East SE Con	0	0
Mt Ella East S Con	0	0
WARE14-16-RS	2.5	0.2
DF-SH1	0.2	0
WA-19-ETH-01	0.1	0.2
WA-16-61-SS	0.4	1
YINHARR-18	0.2	0.5
YINHARR-19	0.2	0.3
RR21	0.2	0.2
WA-16-45-ENG	0.2	0.2
WA-16-51-ENG	0.5	0.9
WA-16-57-ENG	0.3	0.5
WAN20-012	1.7	6.8

Receptor	Year 2	Year 10
YINHARR-39	0.2	0.2
WANETH06-2	0.2	0.2

Orange: trigger level for culturally important areas

Noise and Vibration

No specific concerns issues or, recommendations were raised by Ngarlawangga or Yinhawangka in relation to noise and vibration. However, the presence of mining-related noise and vibration is a felt impact to the enjoyment of Country and desire to be on the affected part of Country. More generally it was mentioned during consultations with both Traditional Owner groups that the potential noise and vibration impacts to the environment and in particular, the perception that fauna would move away from mining related noise, would impact how the land could be used culturally (hunting, resource gathering). Vibration effects including with respect to the effects of blasting on rock shelters, including those inhabited by fauna was also discussed.

A range of potential noise sensitive receptor locations were identified for incorporation into the noise and vibration modelling exercise that were nominated by Yinhawangka or Ngarlawangga as locations chosen to represent broader locations of landscape value, or specific heritage sites (Wood 2022). For the study, these were categorised as ‘sensitive premises’, ‘cultural value locations’ and ‘sensitive habitat’. Sensitive habitat relates to impacts on bats, primarily, so is not considered further here. Modelling was based on different operational ‘worst-case’ scenarios impacts during the life of the mining areas (years 2025, 2027, 2029 and 2034) when the highest intensity activities are the closest to sensitive receptors.

The Noise Regulations address noise management in WA and specify maximum noise levels (Assigned Levels) – the highest noise levels that can be received at noise-sensitive premises. No highly noise sensitive premises, as defined by the Noise Regulations (i.e., residential premises) occur in proximity to the Proposal. As such the noise assessment used applicable Assigned Levels for:

- ‘Other’ (approximately the equivalent of, for example, the area of a residential noise sensitive premise that is more than 15 m from the house – the former being the ‘not the highly sensitive area’ and the latter being the ‘highly sensitive’ part of the property) (LAS10 60 dB – level set for ‘cultural value locations’)
- ‘Industrial/utility’ (LAS10 65 dB – level set for ‘sensitive’ site) premises (Wood 2022).

Noise levels at the receptors are required to be adjusted if the noise exhibits intrusive or dominant characteristics (i.e., if the noise is impulsive, tonal, or modulating).

This modelling indicates no exceedance of noise limits would occur at any of the receptors (Table 6-11), However, the presence of mining-related noise (and vibration) in and of itself - regardless of regulatory receptor exceedances - is a felt impact with respect to Yinhawangka and Ngarlawangga enjoyment and use of Country.

Table 6-11: Noise Levels at Important Cultural Areas due to the Proposal

Receptors	Modelled Noise Level (dB[a])			
	[Assigned Threshold Level – LAS10 60dB]			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
Deposit H Waterhole	35.9	30.9	6.7	0.4
DF-SH1	10.0	26.7	23.8	31.5

Receptors	Modelled Noise Level (dB[a]) [Assigned Threshold Level – L _{AS10} 60dB]			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
	Mt Ella East S Con Pit	10.3	38.3	23.7
Mt Ella East SE Con Pit	19.6	29	28.3	29.5
RR21	22.4	14.7	15.1	22.5
Turtle Pool	17.9	12.4	5.9	3.2
WA-16-45-ENG	16.8	15.1	14.5	18.3
WA-16-57-ENG	28.3	27.1	18.1	28.5
WA-16-61-SS	0.7	39.2	50.0	40.2
WA-19-ETH-01	17.5	44.9	22.4	53.2
WAN20-012	49.3	39.9	27.3	45.4
WANETH06-2	22.8	20.0	24.3	32.7
WARE14-16-RS	57.8	58.5	26.8	15.4
YINHARR-18	6.6	40.3	47.8	48.3
YINHARR-19	17.7	26.8	30.6	28.5
YINHARR-39	1.7	47.5	27.4	58.6

Locations for vibration modelling were nominated by Yinhawangka and Ngarlawangga on their respective Country, chosen to represent broader locations of landscape value, or specific heritage sites. Vibration limits of 3 mm/s PPV (peak particle velocity) were modelled and assessed at cultural value locations, derived from German standards regarding vibration limits for structures. A model of 25 mm/s PPV was also assigned to these locations regarding cave structural integrity. The first model was chosen as an initial guide, as Australian standards do not specify an equivalent limit (Wood 2022).

The second model is consistent with the Proponent's blast management plans which are intended to manage the structural integrity of vibration sensitive locations such as rockshelters. Rio Tinto's blast management is based on Australian Standard AS 2187.2-2006 Explosives – Storage and Use – Use of Explosives – Victoria, referring to 'all blasting' limits, occupied sites, & frequency dependent 25 mm/s limits for human comfort', which is applied to blasting operations and the management of structural integrity of vibration sensitive locations such as rockshelters.

The Proponent also ensures that geotechnical assessments of vibration sensitive locations are completed to determine structural stability risk is undertaken prior to any blasting activities. Table 6-12 provides a breakdown of the minimum distances at which vibration levels fall below assessment levels.

It is not intended that the Proponent will consider management of cultural value locations to the 3 mm/s model. The Proponent will continue to use existing blast management processes to ensure structural integrity risk is managed for blasting activities.

The Proponent's blast management is targeted to within 350 m of blasting activity. However, where PPV predictions indicate that vibration will be greater than 25 mm/s at 350 m, then blast management occurs at greater distances.

Table 6-12: Distances at which vibration levels fall below assessment levels

Charge Mass (kg within 8 ms delay)	Minimum Distance (m)		
	Cultural Value Locations (3mm/s PPV)	Bat Disturbance (10mm/s PPV)	Cave Structural Integrity (25 mm/s PPV)
100	349	165	93
200	494	233	131
500	781	368	207
1,000	1,120	520	293
2,000	1,560	736	415
4,000	2,200	1,041	587
5,500	2,600	1,220	688

6.7.2.4. Care for Country: Plants and Animals

Concerns have been raised by both Ngarlawangga and Yinhawangka that Proposal activities have the potential to:

- Degrade culturally important plants
- Reduce the presence or abundance of animals and degrade habitat and food sources.

Broadly, both Ngarlawangga and Yinhawangka have expressed concerns about:

- Their ability to protect all animals and plants in accordance with their cultural responsibilities (i.e. Care for Country) should the Proposal proceed.
- The potential for particular animals and plants, highly valued as a source of food, medicines, resources, ritual or mythological or other cultural association, to be significantly reduced within and in proximity to the Revised Development Envelope.
- The potential for the use and enjoyment of Country to be impaired, and cultural knowledge and practices lost as a result of reductions in plant and animal numbers. If the vitality of sections of Country is reduced, affected areas to a degree become - culturally-speaking - 'sterile' until such time as impacts cease and rehabilitation is successful.

The Proponent acknowledges the potential for numerous culturally important plants and animals to occur within the Revised Development Envelope (particularly bush tucker species or those used in cultural practices, such as kangaroo, emu, native honey etc) that may not be afforded special protection under environmental legislation and; therefore, not typically the focus of environmental impact assessment processes unless identified as of significant value through other means. For example, in Social Surroundings consultation to date, Traditional Owners have referred to animals such as kangaroos, native bees, goanna, emu, fish, freshwater turtle alongside the EPBC Act-listed species Ghost Bat and DBCA Priority 4 species Western Pebble-mound Mouse (refer to Sections 9 and 13); confirming all have cultural importance and all have potential to be impacted by the Proposal.

As discussed in Section 9, direct disturbance, dust, noise and vibration from mining activities along with habitat degradation associated with altered surface water catchments and mining activities have the potential to impact fauna and fauna habitat. The mitigation and assessment of these impacts is discussed in further detail in that section.

Although ethnobotanical/Traditional Ecological Knowledge surveys with Ngarlawangga and Yinhawangka Traditional Owners at West Angelas have identified numerous plant species with cultural significance, value and use that occur within or in proximity to the Revised Development Envelope, few specific plant species of cultural importance have been raised as concerns in Social Surroundings consultation to date. However, a decline in native bee populations and honey-trees and has been communicated by both Yinhawangka and Ngarlawangga and therefore potential impacts to these attributable to the Proposal require attention.

In addition to direct impacts, the Proposal has the potential to disturb animals through blast vibrations, dust, light and noise from operations. As habitat, caves and rock shelters have the highest potential to be indirectly disturbed by mining, due to their position in the landscape and restricted size, and vibrations (and dust) from blasting have the potential to impact their structural integrity and habitat value. As well as potentially being of, as well as containing and protecting significant cultural and heritage values, caves and rock shelters often provide important habitat for listed significant species such as Ghost Bats. Blast management plans and geotechnical assessments will be prepared and undertaken for all sites and rock shelters identified as having heritage and/or ecological values that are identified as being potentially at risk from blasting impacts (vibration and flyrock), prior to blasting activities.

6.7.2.5. Care for Country: Special Places

Ngarlawangga

All of the important cultural sites and places identified by Ngarlawangga during consultation that require protection - the Range, Deposit H Waterhole and site complex, Turtle Pool and WAN-22-100-EX – are located outside of the Conceptual Footprint and will not be directly disturbed by the Proposal. While the dominant feature of the pool and specific features of WAN-22-100-EX are located outside of the Proposal area, the Turtle Pool and WAN-22-100-EX heritage site boundaries intersect the Proposal area. Disturbance within these site boundaries (or any other site boundaries) would require agreement from Ngarlawangga and appropriate heritage approvals as per the CHMS and relevant State Heritage legislation. It is not intended for the Range, Deposit H Waterhole and site complex, Turtle Pool and WAN-22-100-EX to be disturbed.

Of the 46 potential or known heritage sites identified within the Ngarlawangga portion of the Revised Development Envelope, 39 known rock shelter sites and artefact scatters, quarries and scarred trees are within the current proposed Conceptual Footprint, and therefore with high potential to be directly impacted, notwithstanding ongoing design work in progress that aims to avoid and minimise any disturbance to such sites. It is anticipated that additional heritage survey works to support the Proposal and other Proponent activities in the region will identify additional heritage sites that may potentially be directly impacted.

There are other Ngarlawangga sites and places in the broader landscape which have the potential to be indirectly impacted through dust, noise, vibration, changes to landforms and visual amenity, workforce visitation and changes to biological attributes.

A summary of the recorded archaeological and ethnographic sites within the Revised Development Envelope is provided in (Appendix B.4) showing the potential for direct disturbance.

Yinhawangka

All except two of the most significant important cultural sites and places nominated by Yinhawangka during Social Surroundings consultation are located outside of the Revised Development Envelope and will not be directly disturbed by the Proposal. The two areas within the Revised Development Envelope, the Western Hill site complex and Mt Ella site complex, are located within heritage site boundaries.

Disturbance within these site boundaries (or any other site boundaries) would require agreement from Yinhawangka and appropriate heritage approvals as per the CHMS and relevant State Heritage legislation. It is not intended for the Western Hill site complex and Mt Ella site complex to be disturbed.

Of the 85 potential or known heritage sites identified within the Yinhawangka portion of the Development Envelope, 52 known rock shelter sites and artefact scatters, quarries and scarred trees, are within the current proposed Conceptual Footprint, and therefore with high potential to be directly impacted notwithstanding ongoing design work in progress that aims to avoid and minimise any disturbance to such sites. It is anticipated that additional heritage survey works to support the Proposal and other Proponent activities in the region will identify additional heritage sites that may potentially be directly impacted.

There are other Yinhawangka sites and places in the broader landscape which have the potential to be indirectly impacted through dust, noise, vibration, changes to landforms and visual amenity, workforce visitation and changes to biological attributes.

A summary of the recorded archaeological and ethnographic sites within the Revised Development Envelope is provided in Appendix B.4: showing the potential for direct disturbance.

Ngarlawangga and Yinhawangka

As indicated above, the Range and WAN-22-100-EX occur outside the Development Envelope and will not be directly disturbed by the Proposal.

6.7.2.6. Mine Design, Closure and Rehabilitation

Mine design, closure and rehabilitation is addressed in Section 6.7.

6.7.3. Turee Creek Pastoral Station

A minor (insignificant) change to surface water flows to the Turee Creek East catchment is expected due to a reduced catchment associated with the Western Hill development, discussed in Section 7.

Discharge of surplus water will continue to an ephemeral tributary of Turee Creek East in accordance with existing approvals and management (MS1113:M5) under the Approved Proposal, as such there will be no change in relation potential impacts, although the timing may be extended due to mine life. The approved limit is for surface discharge extent (i.e. wetting front) not to extend to within 2 km of Karijini National Park under natural no-flow conditions. The outcome of the approval condition is to ensure there is no irreversible impact, as a result of the discharge of surplus water, to the health of riparian vegetation of Turee Creek East. Similarly, the GDE in the national park is not expected to be impacted due to the limited propagation of modelled drawdown at Western Hill in the direction of the park. By extension, no riparian vegetation or groundwater dependent values downstream within Turee Creek Pastoral Station are expected to be affected.

No visual impact is expected, the station's closest boundary is approximately 20 km southwest of the Revised Development Envelope, with the homestead located 48 km south.

6.7.4. Karijini National Park and Local Viewpoints

The Proposal has the potential to indirectly impact visual amenity for the general public, including from higher publicly accessible and frequently visited vantage points such as Mt Meharry within Karijini National Park, nearby parts of the national park itself, Mt Robinson and The Governor (Illingurra – noting this hill is not as readily accessible as the others). Great Northern Highway views are not expected to be affected at all by this Proposal (Rio Tinto 2021b); however, the Proponent notes that its neighbouring Hope Downs 2 proposal involves the potential realignment of the highway.

As discussed in Section 7 negligible impact is predicted within Karijini National Park associated with the minor groundwater abstraction required at Western Hill, the nearest deposit to the park, for operational water supply (not pit dewatering). The water supply bores will be more than 3 km from the park boundary.

There will be no additional surplus water discharge to Turee Creek East as a result of the Proposal – in accordance with the existing requirements of MS 1113. This includes the continuation of avoidance of the discharge footprint (wetting front) within 2 km of KNP as detailed in, discussed in Section 7.

As mentioned in Section 6.7.3 (and Section 7) Turee Creek East catchment surface water flows are expected to experience a minor (insignificant) change due to catchment reduction associated with the Western Hill development .

Dust modelling predicts dust deposition rates at the modelled location at the eastern edge of Karijini National Park nearest the Proposal to be lower than the assessment criteria of 4 g/m²/month. The effects of dust on the amenity of the areas of the park subject to highest tourist use are expected to therefore be negligible, although there remains the potential for those viewing from Mt Meharry or accessing nearby areas of the park to observe dust emitted by the Proposal.

6.8. Mitigation

6.8.1. Overview

The Proponent will apply the mitigation hierarchy to the Proposal to ensure it meets the EPA's objective in relation to Social Surroundings. General principles in this regard include:

- Avoid – the Proponent is to undertake engagement and consultation, including in-field consultation, with Traditional Owner groups, pastoralists and other key stakeholders including the public which will inform the Proposal design, with the aim of avoiding impacts to Social Surroundings, wherever practicable
- Minimise – the Proponent in consultation with Traditional Owners, pastoralists and other key stakeholders including the public will identify significant impacts to Social Surroundings values and seek to minimise direct and indirect impacts that may be a result of the implementation of the Proposal, wherever practicable
- Rehabilitate:
 - Rehabilitation and final landform design will consider Traditional Owner, pastoralists and other key stakeholder views
 - Rehabilitation activities will be undertaken progressively over the life of the mine and opportunities to involve Traditional Owner groups in the rehabilitation of their Country will be explored.

The Proponent will prepare and implement a MCP, in accordance with the *Statutory Guidelines for Mine Closure Plans* (DMIRS 2020b) for the Proposal.

SCHMPs have been jointly developed with each Traditional Owner group (Appendix B.2.d and B.3.b Ngarlawangga and Yinhawangka respectively). The SCHMPs address Traditional Owner concerns regarding impacts to Social Surroundings and facilitate Traditional Owner consultation and ongoing involvement with respect to concerns raised. Ongoing engagement and consultation with each Traditional Owner group will occur throughout the life of the mine to assess opportunities during mine and design and planning, and then in closure planning, to avoid and minimise impacts to cultural values, Country and special places, in particular where previously unknown important areas are identified.

The Proponent expects management of direct impacts to heritage sites where unavoidable will be addressed by relevant approvals and mechanisms under State Aboriginal heritage legislation in consultation with the relevant Traditional Owners. The Proponent will also consider Traditional Owner

concerns with regard to heritage management within broader and ongoing social surroundings consultation, under relevant SCHMPs or other ongoing and regular consultation arrangements, in accordance with leading practise.

Each SCHMP has been informed by consultation with each Traditional Owner group, have been prepared in collaboration with them, and have been subject to their review and agreement prior to final submission for approval by the EPA and subsequent implementation. The Proponent expects the implementation of SCHMPs to be a condition of approval under the EP Act.

The tables in Sections 6.8.2 to 6.8.3 below summarise how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during the Proposal design to develop appropriate strategies to address the key potential impacts on Social Surroundings. The management and mitigation measures and outcomes outlined in these tables may change subject to further consultation and reflect current understanding.

6.8.2. Ngarlawangga and Yinhawangka

6.8.2.1. Design Changes to Avoid or Reduce Impacts

Significant work has been undertaken to include Traditional Owner and pastoralists' feedback from Social Surroundings consultation in Proposal decisions and to refine the mine design. Traditional Owners from both groups have indicated appreciation for the efforts of the Proponent in this regard. Social Surroundings consultation continues and further design changes in response may occur. Key changes to the mine plan made to date are shown in Table 6-13.

Table 6-13: Design Changes to Avoid or Reduce Impacts

Native Title Area / Area	Design change
Ngarlawangga and Yinhawangka	The Revised Development Envelope has been changed to avoid impacts to important areas at Mt Ella East (the Range/part of the unnamed range to the south).
	Proposed eastern Mt Ella East Pits have been removed with the amendments to the Revised Development Envelope.
	The Range has been protected from direct impacts through the establishment of a Provisional Heritage Site Boundary (HSB), and to minimise potential indirect impacts.
Ngarlawangga	The Deposit H Waterhole site complex has been protected from direct impacts through the establishment of a HSB and commitment to no direct impacts as a result of this Proposal. Turtle Pool is outside of the Revised Development Envelope and will not be directly impacted by this Proposal.
	Deposit H pit designs and stockpile locations have been redesigned to avoid proximity to Deposit H Waterhole site complex HSB and commitment to no direct impacts as a result of this Proposal. Consultation and mine design optionality is ongoing to further understand potential direct and indirect impacts and risks and appropriate management options to further minimise impacts to the catchment and ecological vitality and amenity of the gully downstream of the waterhole.
	A total of 41 caves have been recorded within the Revised Development Envelope, 21 of which are located within the Proposal Area and 20 recorded within the Approved Development Envelope. Of the recorded caves, one (1) is located on Ngarlawangga Country. MEZs and/or MRZs have been established around none of the caves on Ngarlawangga Country. The MEZ/MRZ areas also incorporate 34 heritage sites, further reducing impacts at these areas and protecting areas that are culturally important such as native fauna habitat (refer to Section 6.5.3.2).
Yinhawangka	Western Hill Pit 2 (Central Pit) was redesigned to avoid direct impacts to the Western Hill heritage site complex and to minimise potential indirect impacts.

Native Title Area / Area	Design change
	<p>Mt Ella East Pit 2 was redesigned to avoid direct impacts to the Mt Ella Site Complex and the surrounding unnamed range to the south of the existing West Angelas operations, and to minimise potential indirect impacts. Commitment to not extend Mt Ella pits, dumps, stockpiles and associated infrastructure into the boundary of the unnamed range (delineated site) to the south of the existing West Angelas operations.</p> <p>Deposit J, including all associated pits, dumps, stockpiles and infrastructure, and the unnamed range to the south of the existing West Angelas operations, and encompassing the archaeological site WA-16-61SS, was included in the original referral, but has been removed from the Proposal and the Development Envelope has been amended to exclude these areas.</p> <p>A total of 41 caves have been recorded within the Revised Development Envelope, 21 of which are located within the Proposal Area and 20 recorded within the Approved Development Envelope. Of the recorded caves, 40 are located on Yinhawangka Country. MEZs and/or MRZs have been established around 18 of the caves on Yinhawangka Country. The MEZ/MRZ areas also incorporate 3 heritage sites, further reducing impacts at these areas and protecting areas that are culturally important such as native fauna habitat (refer to Section 9).</p>
Karijini National Park	Western Hill mining has been limited to AWT to avoid impacts to Karijini National Park

HSB: HSB is the heritage site boundary as determined by Traditional Owners. This boundary is then uploaded into the internal Rio Tinto system and while there may be some lag, this would be the boundary submitted to DPLH as the heritage site boundary. Rio Tinto internal Cultural Heritage Management Systems (CHMS) are used to avoid these boundaries and any impact to these would require approval under relevant heritage legislation. Any un-authorized impact is deemed as a heritage incident and would need to be notified to DPLH.

6.8.2.2. Water

Further mitigation relevant to water is described in Section 7.

Avoidance – Project Design

The Proponent has amended the mine design to avoid direct disturbance of the Deposit H Waterhole. Infrastructure interactions with upper catchment of Turtle Pool will have culverts/floodways which will be designed and installed to ensure existing flows to the pool are maintained.

Turtle Pool is located outside the Revised Development Envelope and will not be directly impacted by the Proposal. Groundwater levels will be monitored throughout the LoM to identify any potential impacts to Turtle Pool. The Proponent will implement contingency actions inclusive of reduced/ceased pumping and alternate water supply, if a decline of ground water levels is observed at Turtle Pool.

Any BWT mining as a result of aquifer drawdown will be backfilled to a level sufficient to prevent the formation of permanent pit lakes post-closure.

Minimisation – Project Design

The Conceptual Footprint has been optimised to reduce the total extent of disturbance and potential impact water catchments and water features.

Pit design options including diversion drains are being explored at Deposit H to retain additional catchment at Deposit H Waterhole. However, all pit designs and catchment impacts are committed to ensure the Deposit H waterhole will fill with sufficient volume of water to overflow and support the downstream ecosystem. It is expected that the reduced size of the surface water catchment reporting to these features, and particularly the gully vegetation downstream of the pool, will not have a significant impact on flora and vegetation or ecosystem composition, but it is likely to result in small to moderate decrease in vegetation abundance over time. These mine design options are part of ongoing discussion

with Ngarlawangga Traditional Owners. The Proponent will not undertake mining within the Deposit H Waterhole catchment without written agreement from NAC, which includes agreement on closure outcomes within the catchment area as per the Ngarlawangga SCHMP (Appendix B.2.d)

Ngarlawangga indicated that they did not support the drawdown of the aquifer at Deposit H, but understood the requirement for water for operational purposes such as dust suppression. Ngarlawangga wanted the Proponent to review water supply options for Deposit H, but also seek other methods for dust suppression to conserve water and limit Deposit H aquifer drawdown if no alternative water sources were viable. Ngarlawangga requested that should water be abstracted from the Deposit H aquifer that it is to be utilised in a localised manner at Deposit H for operational purposes such as dust suppression and that water from Deposit H aquifer should not be extracted and discharged (i.e. as surplus), nor extracted and used elsewhere within the operation. However, groundwater abstraction for production use to allow BWT mining at Deposit H is no longer proposed, with sump pumping for BWT mining proposed instead. As Ngarlawangga have requested, an alternative water supply for production at Deposit H will be sourced from elsewhere at West Angelas, and the Deposit H aquifer will not be depleted. Yinhawangka and Ngarlawangga have both requested ongoing consultation regarding ground water extraction, use and BWT mining.

A minimum post-development catchment area for Deposit H Waterhole will be maintained to ensure the pool is filled and flushed and maintaining ecosystem health and amenity in the downstream gully with monitoring of the Deposit H Pool and downstream gully to be undertaken in consultation with Ngarlawangga Traditional Owners as per the Ngarlawangga SCHMP (Appendix B.2.d).

Surface water management will be implemented to minimise disruption to natural flows, minimise erosion and sedimentation of surface water.

Where structures, including infrastructure, stockpiles and WRLs, are unavoidably located within ephemeral creek lines and floodplains, the Proponent will ensure such structures are appropriately armoured or otherwise protected to keep erosion risk as low reasonably practicable. Surface water drainage will be constructed to minimise natural flows entering disturbance areas, including pit voids, with operational diversion drains proposed, where required, to reduce operational risk and maintain flows to downstream areas. Surface water management infrastructure will be designed to minimise erosion and downstream sedimentation risks. At closure, operational diversion drains will either be removed or upgraded to meet landform stability and closure objective requirements. This will be determined in consultation with the Traditional Owners through MCP review process, mine design consultation and other relevant ongoing consultation forums under the SCHMPs or other processes.

Culvert design will ensure they are large enough to accommodate flows up to an Annual Exceedance Probability (AEP) of 1:10 or higher and are positioned so that disruptions to low flows are minimised.

Mine design is intended to limit pollution and sediment impacts will be mitigated through appropriate controls that are standard practice, such as sediment traps and settling ponds and armouring, as required, supported by ongoing monitoring. Potentially contaminating materials, including wastes, will be stored within appropriately contained areas.

If PAF materials are encountered, they will be encapsulated within WRLs and managed in accordance with the Proponent's SCARD management plan to ensure any impact to surface water or groundwater will be minimised and WRLs are stable and non-polluting.

Table 6-14: Application of the Mitigation Hierarchy for Impacts to Social Surroundings – Ngarlawangga and Yinhawangka: Water

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Impact to cultural heritage, including interference with cultural obligations and spiritual beliefs tied to water, as a result of altered hydro-logical regimes	Measures to Avoid			
	<p>Mining of ore reserves at Western Hill will be limited to AWT to avoid mine pit dewatering for this Proposal, owing to the proximity of Karijini National Park.</p> <p>A Groundwater Environmental Management Plan will be implemented to ensure no change to groundwater levels at the boundary of, or within Karijini National Park that are attributable to the Proposal.</p> <p>No additional surplus water discharge to Turee Creek East as a result of the Proposal. Continue to avoid discharge footprint (wetting front) within 2 km of KNP in accordance with requirements of MS 1113.</p>	Proposal specific.	Yes – DWER licensed discharge.	<p>The measure will ensure limited impacts on the aquifer Western Hill.</p> <p>Ongoing monitoring of groundwater levels across the area will be used to adapt the program as necessary to achieve the outcome.</p> <p>Controls are considered effective and have been utilised to date.</p>
	Direct impacts to the Deposit H Waterhole site complex will be avoided through implementation of heritage site boundaries.	Proposal specific.	Yes - DPLH for administration of AH Act approvals processes (for impact to heritage sites).	Heritage site boundaries and commitment to no direct impacts as a result of this Proposal and the location of the Conceptual Footprint will ensure important cultural areas will not be subject to direct disturbance.
	Infrastructure interactions with upper catchment of Turtle Pool will have culvert/floodway designed and installed to ensure existing flows to the pool are maintained.	Proposal specific.	No.	Impact restricted to minor disruption of regular surface water flows – design and maintenance parameters of such crossings are well understood and give a high level of certainty regarding the effect on water flows.
	No abstraction of groundwater for production supply or for local mining needs will occur at Deposit H.	Proposal specific.	No.	Established and proven practice.
	Measures to Minimise			

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>Groundwater is abstracted according to programs that have been modelled to ensure dewatering volumes are minimised while ensuring safe access to BWT mine pits. Ongoing groundwater level monitoring is used to verify the models and adjust dewatering programs as required.</p> <p>Operational water demand will be supplied from mine dewatering in the first instance (where feasible), reducing the requirement for water supply volumes.</p>	Proposal specific.	Yes - DWER – Groundwater abstraction licence.	The measure will minimise effect on aquifers in the Proposal area.
	The Conceptual Footprint has been designed to minimise impacts to watercourses within the Revised Development Envelope. The Proposal largely relies on existing infrastructure, including crossings.	Industry standard.	Yes - DWER RiWI Act bed and banks permit.	Limited impact to and disruption of surface water flows at local level and negligible impact at regional level are expected.
	Alternative water sources external to Deposit H aquifer be considered as part of mine designs. This mine design alternative is currently subject to further technical investigation and will be consulted with both Traditional Owner groups, understanding that water for production would need to be sourced from other aquifers at West Angelas operations.	Proposal specific.	Yes - DWER – Groundwater abstraction licence.	Relevant consultation will be included in the SCHMPs developed with each Traditional Owner group. The SCHMPs are expected to be required by ministerial condition.
	The Proponent will not undertake mining within catchment of Deposit H Waterhole without written agreement from NAC, which includes written agreement on closure outcomes within the catchment area.	Proposal specific.	No.	Commitment to reach agreement on impacts to Deposit H Waterhole catchment in order to reach agreement on indirect impacts to relevant values as a result of this Proposal. Commitment included in SCHMP developed with Ngarlawangga.
	Water use will be continually reviewed and updated against dust suppression effectiveness and technological advancement, with resulting options considered in consultation with Traditional	Proposal specific.	No.	Relevant consultation will be included in the SCHMPs developed with each Traditional Owner group. The SCHMPs are expected to be required by ministerial condition.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Owners over the life of the operation. Such reviews will include the implementation of trials on alternative techniques and strategies.			
	The Proponent will not extract groundwater from Deposit H Aquifer for production without written agreement from NAC. <u>BWT ore will be accessed via in pit sump pumping, with water discharged into backfilled areas of the pit to facilitate infiltration back into the aquifer.</u>	Industry standard.	No.	Established and proven practice.
	<p>Implement established procedures for the early identification of PAF materials to ensure adequate blending with NAF/high ANC materials, or encapsulation if required.</p> <p>Implement the Mineral Waste Management Plan to ensure mineral waste risks are identified, monitored and managed throughout all phases of the WAN RP.</p> <p>If PAF waste material is encountered at Western Hill the SCARD will be implemented to adequately manage the risk.</p> <p>PAF material will be encapsulated within NAF material within waste landforms to minimise potential for contaminated leachate.</p> <p>Pits will be backfilled to cover any exposed PAF material at closure to prevent further exposure and potential for generation of AMD.</p> <p>Update Groundwater Environmental Management Plan (Rio Tinto 2022) prior to commencement of mining at Western Hill and implement.</p>	Standard business practice at Rio Tinto iron ore mines in the Pilbara.	Yes - DMIRS MCP.	Consistent with the Proponent's industry standard established practices for managing AMD risk.
	All structures within creeklines and floodplains will be appropriately armoured or otherwise protected to ensure erosion risks are minimised.	Standard business practice – see Section 7.	No.	Refer to Section 7.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will not be stored within or near creeklines, or within floodplains.</p> <p>All personnel involved in the storage and handling of potentially contaminating materials will be appropriately trained and supported by adequate resources including signage, spill kits and PPE.</p> <p>Prioritise dust suppression and monitoring, particularly around Deposit H Waterhole and Turtle Pool as a recommendation from social surroundings consultation with Ngarlawangga Traditional Owners.</p>			<p>Hydraulic modelling demonstrated proposed diversions will maintain flows with minimal impacts.</p> <p>Minimum design requirements for linear infrastructure are standard practice and effective at reducing ponding and maintaining flow regimes downstream.</p>
	Measures to Rehabilitate			
	<p>Modelling will be used to ensure the integrity of legacy structures, such as WRL, is retained over the long term.</p> <p>All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure.</p> <p>Landforms will be stabilised and revegetated at closure to minimise sediment runoff.</p>	Industry standard.	Yes - DMIRS – MCP.	<p>This is a standard approach recommended in most mine closure planning guidelines, including DMIRS (2020a).</p> <p>Standard requirement enforced, for example, by the <i>Contaminated Sites Act 2003</i> and regulations.</p>
	BWT mine pits will be backfilled to a level where the formation of permanent post-closure pit lakes will be avoided.	Industry standard.	No.	Recommended approach to protect water quality from adverse outcomes in the long-term (e.g., Commonwealth of Australia 2015)
Alteration to groundwater and surface water regimes impacting Traditional	Measures to Avoid			
	Major infrastructure, including WRL, have been preferentially located outside of the floodplain of local creek lines and watercourses and outside ephemeral watercourses and their tributaries.	Standard practice.	No.	<p>Established and proven practice.</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement,</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Owner sense of place				DMIRS will act as an advisory body rather than a decision-making authority in this regard.
	Turtle Pool is outside the development Envelope and will not be impacted directly by the Proposal.	Proposal specific.	Yes – DPLH for administration of State Aboriginal heritage approvals processes (for impact to heritage sites).	The Rio Tinto Approvals Request system and CHMS is well-established and ensures clearing does not occur in heritage site boundaries. Heritage site boundaries and the location of the Development Envelope will ensure important cultural areas will not be subject to direct disturbance
	Catchment impacts will be limited to an extent that ensures water levels within Deposit H Waterhole are in accordance with pre mining water levels and vegetation in the downstream gully is not significantly impacted, taking into consideration natural variation as detailed in the West Angelas EMP (Appendix A.8).	Proposal specific.	No.	Established and proven practice.
	WRLs will be preferentially placed outside of the floodplain of local creek lines and watercourses.	Industry standard.	Yes - DMIRS – MCP.	The measure will avoid unnecessary interactions with high flow events.
	Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements and industry guidelines, including within secondary containment.	Standard practice.	Yes – DWER.	Established practice that can be adapted/expanded if regular post-flood inspections observe evidence of excessive erosion. Legislated requirement for some aspects; standard requirement of EP Act Part V licences for others.
	Abstraction of groundwater to allow dry mining of BWT ore will be minimised (sump pumping only) to ensure water level in Turtle Pool is in accordance with pre mining levels taking into consideration natural variation.	Proposal specific.	No.	Established and proven practice.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Minimise			
	Surface water diversion drains will be designed, constructed and maintained so as to minimise mobilisation and transport of sediment laden runoff to sensitive environmental receptors.	Industry standard.	No.	Standard practice as recommended by numerous guidelines, including DWER WQPN 52 (DoW 2010).
	The Proposal will avoid interactions with significant water features, where it is practicable to do so.	Proposal Specific.	No.	This will be enforced by implementing the Proponent's Approval Request System and the data will be stored within the Proponents GIS database.
	Minimise clearing within and preferentially locate noncritical infrastructure outside or Turee Creek East catchments directly adjacent to Karijini National Park at Western Hill.	Proposal Specific.	No.	Established and proven practice.
	<p>Pits will be isolated from significant creeklines and their floodplains to minimise interception of surface water catchment flows.</p> <p>Linear infrastructure will be designed to convey high frequency flood events (up to 1 in 10 AEP) through culverts or similar structures to avoid impediment of flows.</p> <p>Infrastructure may be designed to allow overtopping in lower frequency events to minimise upstream flooding and scouring downstream of culvert outlets.</p>	Industry Standard.	No.	Established standard practice (e.g., through application of the Main Roads WA [2006], Floodway Design Guide) that will be monitored to inform any required adaptations – upstream flooding during floods, and post-flood inspections to observe evidence of excessive erosion.
	Deposit H pit design and BWT mining will be agreed with Ngarlawangga Traditional Owners prior to implementation (see SCHMP, Appendix B.2.d).	Proposal Specific.	No.	Relevant consultation will be included in the SCHMPs developed with each Traditional Owner group. The SCHMPs are expected to be required by ministerial conditions.
	No abstraction of groundwater for dewatering will occur via bores at Deposit H. BWT ore will be accessed via in pit sump pumping, with water	Industry standard.	No.	Established and proven practice.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	discharged into backfilled areas of the pit to facilitate infiltration back into the aquifer.			
Measures to Rehabilitate				
	Reinstate surface drainage systems as far as practicable as the completion of mining unless otherwise agreed to.	Standard practice generally, with additional proposal-specific elements.	No.	Standard approach consistent with other MCPs.

6.8.2.3. Access and Connection to Country

Minimisation – Project Design

The Conceptual Footprint has been reduced to minimise impacts to access to important cultural areas.

Table 6-15: Application of the Mitigation Hierarchy for the Social Surroundings – Ngarlawangga and Yinhawangka: Access and Connection to Country

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
Restriction of access to Country	Measures to Avoid			
	N/A	N/A	N/A	N/A
	Measures to Minimise			
	The Conceptual Footprint has been reduced to minimise impacts to access to important cultural areas (including areas on which traditional practices are conducted and resources are collected).	Proposal specific	Yes – ILUAs administered under the NT Act	Ongoing engagement with Traditional Owners regarding access to Country will be addressed in the SCHMPs – expected to be required to be implemented under ministerial conditions
	The Proponent will continue to consult with Traditional Owners to confirm all areas required to remain accessible (within health and safety limitations) and investigate Mine Design and access design options to further minimise restrictions, ensure no worse off access and non-prevention of access on these areas and access generally.	Proposal specific	Yes – ILUAs administered under the NT Act	
	Traditional Owner access to sites that may be identified through ongoing surveys and consultation, will be facilitated throughout the life of the Proposal. Access track options are being investigated to provide Traditional Owners unrestricted access to the Deposit H Waterhole site complex.	Proposal specific	Yes – ILUAs administered under the NT Act	
Land Access Protocols will be updated or developed with Traditional Owners to facilitate and support access. The Proponent will maintain ongoing communication with Ngarlawangga and Yinhawangka to ensure that access to the places specified in the LAP is properly managed	Operations specific	Yes – ILUAs administered under the NT Act		

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	throughout the life of the Proposal. This will involve regular joint review of the LAP. Additional places, such as those identified in future surveys, will be included in the LAPs as required.			
	The Proponent will prepare SCHMPs with each Traditional Owner group that will address processes and/or arrangements to facilitate access within the Development Envelope. [SCHMP – will be co-designed with Traditional Owners to ensure each plan's aims, objectives and actions are agreed with each group prior to implementation.]	Proposal specific	EPA Ministerial Statement.	A ministerial condition requiring preparation and implementation of SCHMPs is expected. SCHMPs will be co-designed with Traditional Owners to ensure each plan's aims, objectives and actions are agreed with each group prior to implementation.
	The Proponent will consult with Traditional Owners regarding post-closure access in relation to final landform design.	Proposal Specific	No	Ministerial conditions requiring preparation and implementation of an MCP is expected. Statutory Guidelines for MCPs are available and are consistent with industry-leading practice. The MCP must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b). Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.
Measures to Rehabilitate				
	The MCP will be updated to reflect consultation with Traditional Owners on a regular basis to ensure its objectives remain relevant and are informed by stakeholder expectations, including post-closure access.	Operations specific	No	Ministerial conditions requiring preparation and implementation of an MCP is expected. Statutory Guidelines for MCPs are available and are consistent with industry-leading

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>Post-closure continued access to important cultural areas will be maintained in accordance with relevant health and safety requirements</p>	<p>Proposal specific</p>		<p>practice. The MCP must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>
	<p>The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020a), that will detail measures to manage public safety and post-closure access. The SCHMPs are also expected to include aspects of Traditional Owner consultation and engagement directly relevant to closure planning and implementation, including access.</p>	<p>Proposal specific</p>		

6.8.2.4. Amenity

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to Traditional Owner and wider community values in relation to impacts on amenity, as discussed below and in Table 6-16.

Avoid – Project Design

Amendments to the Revised Development Envelope and Conceptual Footprint are expected to avoid impacts to the amenity of some important cultural sites and places, including most of the unnamed range to the south of the existing West Angelas operations, and the Range.

Minimisation – Project Design

The Conceptual Footprint has been optimised to reduce the total extent of disturbance, and changes and heritage site boundaries at Western Hill, Deposit H and Mt Ella are expected to minimise adverse effects on amenity in relevant important cultural areas.

Dust suppression strategies for Deposit H Waterhole site complex to be considered in mine design as a targeted area.

Table 6-16: Application of the Mitigation Hierarchy for Social Surroundings – Ngarlawangga and Yinhawangka: Amenity

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
Changes to local landforms, installation of infrastructure which may result in altered visual landscapes	Measures to Avoid			
	N/A	N/A	N/A	N/A
	Measures to Minimise			
	The Proponent has refined its mine plan to minimise visual impact on landforms by removing Deposit J and significantly amending Mt Ella East sections of the Revised Development Envelope	Proposal specific	No	Project optimisation and reduction of clearing required will ensure impacts are minimised
	The Proponent is currently preparing SCHMPs with each Traditional Owner group that will include processes and/or arrangements to ensure consultation with each Traditional Owner group in respect of future mine designs, mine design changes, and LoM Planning consultations	Proposal specific	No	Ministerial conditions requiring preparation and implementation of SCHMPs are expected. SCHMPs will be co-designed with Traditional Owners to ensure each plan's aims, objectives and actions

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	<p>The Proponent is currently preparing SCHMPs with each Traditional Owner group that will include processes and/or arrangements to ensure consultation with each Traditional Owner group in respect to site closure planning and proposed closure outcomes, including with respect to final landforms</p>	<p>Proposal specific</p>	<p>No</p>	<p>Ministerial conditions requiring preparation and implementation of SCHMPs are expected.</p> <p>SCHMPs will be co-designed with Traditional Owners to ensure each plan's aims, objectives and actions are agreed with each group prior to implementation.</p> <p>Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>
Measures to Rehabilitate				
	<p>The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020 a), that will detail proposed closure landform designs and rehabilitation processes.</p>	<p>Industry Standard</p>	<p>No</p>	<p>Ministerial conditions requiring preparation and implementation of an MCP is expected.</p> <p>Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	Progressive backfilling opportunities will be investigated during the life of the operation, where practicable (e.g. when not limited by mine sequencing, pit designs and timing). Consultation with Traditional Owners on mine development will occur through LoM Planning consultation opportunities.	Industry standard	No	Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).
	The Proponent will consult with Traditional Owners on the proposed closure outcomes for the operation, including final landform design. Consultation on closure will be ongoing throughout the life of the operation.	Proposal specific	No	A ministerial condition requiring preparation and implementation of SCHMPs is expected. SCHMPs will be co-designed with Traditional Owners to ensure each plan's aims, objectives and actions are agreed with each group prior to implementation. The MCP must also detail all studies addressing knowledge gaps and related consultation on closure that affect post-mining land use and closure outcomes (DMIRS 2020b).
	The SCHMPs describe the agreed engagement framework with each Traditional Owner group in respect of consultation to inform closure planning.	Proposal specific	No	The SCHMPs describe the agreed engagement framework with each Traditional Owner group in respect of consultation to inform closure planning.
Alteration of the sense of place and amenity due to dust	Measures to Avoid			
	N/A.	N/A.	N/A.	N/A.
	Measures to Minimise			
	The Revised Development Envelope has been reduced and will minimise areas of potential disturbance and associated dust creation.	Proposal specific	No	High certainty that in areas removed from Development Envelope that dust emissions will not occur

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	<p>The Conceptual Footprint has been minimised through project optimisation to reduce the total extent of clearing.</p> <p>The Proponent will avoid unnecessary clearing (causing dust [and noise]) by ensuring that no ground disturbance occurs without prior assessment and authorisation.</p>	Proposal specific	No	<p>Clearing limits will be established through ministerial conditions.</p> <p>This will be enforced by implementing the Proponent's Approval Request System.</p>
	<p>Areas of focus for dust monitoring and/or management, and to inform dust minimisation options to include in design and operation of Proposal, based on dust modelling, include:</p> <ul style="list-style-type: none"> • Options to minimise dust accumulating in culturally important areas – minimisation / management options to be discussed further – e.g. increase dust suppression/ water carts near creeks/ creek crossings paving road sections • Vehicles will be required to travel at safe operating speeds on unsealed roads and will be restricted from accessing rehabilitated surfaces except for management purposes as per current practices • Options to minimise visual impacts from dust from specific locations 	Proposal specific	No	<p>Monitoring of dust management in relation to impacts on social surroundings will be undertaken through the SCHMPs. Traditional Owners will remain informed on results of, and have opportunities to be involved in, investigations into dust management strategies and dust monitoring throughout Proposal implementation</p>
	<p>The Proponent will implement dust management measures, such as dust suppression and sediment traps to minimise indirect impacts to important cultural sites and places and will continue to investigate and evaluate technological and process improvements and alternatives.</p>	Proposal specific	No	<p>High level of certainty that the measure minimises substantial impacts resulting from mining activities.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	Measures to Rehabilitate			
	Revegetation and rehabilitation to minimise ongoing erosion and creation of dust following operations. Self-sustaining ecosystems that are compatible with the surrounding environment are intended to be re-established.	Industry standard	No	<p>A ministerial condition requiring preparation and implementation of an MCP is expected.</p> <p>Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>
Alteration of the sense of place and amenity due to noise and vibration	Measures to Avoid			
	Refer to Section 6.8.2.4 (Special Places)			
	Measures to Minimise			
	<p>Vibration limits will apply to category 2 and 3 Ghost Bat caves (including within Ghost Bat apartment block caves) within the Revised Development Envelope to manage vibration impacts and maintain caves' structural integrity. as per Table 9-22 (Section 9) and the EMP.</p> <p>Noise limits will apply to retained category 2 Ghost Bat caves in the Proposal Area to as per Table 9-22 (Section 9) and the EMP. MRZ/MEZ buffers (Table 13 -17; Section 13) will minimise noise, vibration and light pollution received by the high significance habitat and structures within the area.</p>	Industry standard	No	Standard practice for plant and equipment

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	<p>Equipment design will be specified to be within Australian standard noise limits and/or fitted with noise mufflers in accordance with manufacturing specifications.</p> <p>The Proponent will implement noise management measures, such as plant and equipment modifications and installation of baffles to minimise indirect impacts to relevant places of social and cultural significance.</p>			

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	<p>The Proponent will implement vibration management measures, such as blast management plans to minimise indirect impacts to cultural sites and places of significance, including relevant rockshelter heritage sites and key caves identified as important bar roosting sites.</p> <p>Blast management plans will generally be inclusive of (but not limited to):</p> <ul style="list-style-type: none"> • Ensuring geotechnical sensitivity of rockshelter or vibration sensitive locations is assessed, with maximum PPV (vibration m/s) is recommended • Establishing vibration modelling and prediction to determine local vibration control program and site specific vibration data <p>Blast may then be designed on a 'scaled distance' blast vibration model to not exceed maximum PPV</p> <ul style="list-style-type: none"> • Vibration monitoring will then be undertaken verifying predicted and actual PPV • In addition, heritage site locations at risk of fly rock are considered, fly rock models will be used to influence blast designs • Undertake before and after blast photographic record 	<p>Industry standard</p>	<p>Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites)</p>	<p>Standard practice for blast management, with a high level of certainty that BMP measures minimise substantial impacts from blasting.</p> <p>Vibration limits for certain significant fauna habitats (roosts) are proposed (Chapter 9 and 13)</p> <p>All management of potential disturbance will be subject to AH Act approvals processes including implementation of CHMPs.</p>
<p>Measures to Rehabilitate</p>				

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	Vibration monitoring equipment will be removed once blasting activities have ceased within the set distance of the BMP	Industry standard	No	This will be enforced by implementing the Proponent's Approval Request System and IHMP
Alteration of the sense of place, and amenity due to waste/litter	Measures to Avoid			
	N/A	N/A	N/A	N/A
	Measures to Minimise			
	Management of all waste and litter and landfill is subject to standard site operating procedures, which require all waste and litter to be contained and disposed of appropriately.	Industry standard	Yes – DWER – EP Act Part V licensing manage landfills	Standard practice for waste and litter management.
	<p>The Proponent commits to ensuring waste management and site housekeeping actions are undertaken to minimise the visual impact of litter and waste.</p> <p>The Proponent will prepare SCHMPs with each Traditional Owner group that will include processes and/or arrangements to ensure ongoing consultation with each Traditional Owner group in respect of waste and litter management.</p>	Proposal specific	No	<p>Ministerial conditions requiring preparation and implementation of SCHMPs are expected.</p> <p>SCHMPs will be co-designed with Traditional Owners to ensure each plan's aims, objectives and actions are agreed with each group prior to implementation.</p>
SCHMP to include involvement of Traditional Owners in site observations to allow feedback on (among other things) waste/litter.	Proposal specific	No	<p>Ministerial conditions requiring preparation and implementation of SCHMPs are expected.</p> <p>SCHMPs will be co-designed with Traditional Owners to ensure each plan's aims, objectives and actions are agreed with each group prior to implementation.</p>	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	Measures to Rehabilitate			
	The Proponent will continue to implement standard environmental operating procedures to ensure all waste and litter is removed and correctly disposed of for closure.	Industry standard	Yes – DWER – EP Act Part V licensing manage landfills	Standard practice for waste and litter management.

6.8.2.5. Care for Country: Plants and Animals

Avoidance – Project Design

Pit designs at Deposit H have been amended to avoid direct impacts to the Deposit H Waterhole site complex.

Amendments to the Revised Development Envelope and Conceptual Footprint have avoided high significance habitats and habitat features, such as bat caves, and connecting habitat.

The application of MEZs/MRZs around Ghost Bat and Pilbara Leaf-nosed Bat caves (refer to Section 9) will avoid direct impacts within the Development Envelope to all plants and animals within these zones.

Minimisation – Project Design

The optimisation of the Conceptual Footprint, reducing the total extent of disturbance, and changes and MEZ at Western Hill, Deposit H and Mt Ella, are expected to minimise adverse indirect effects on plants and animals.

Pit design options including diversion drains are being explored at Deposit H to retain additional catchment at Deposit H Waterhole. However, all pit designs and catchments impacts are committed to ensure the Deposit H Waterhole will fill with sufficient volume of water to overflow and support the downstream ecosystem. It is expected that the reduced size of the surface water catchment reporting to these features, and particularly the gully vegetation downstream of the pool, will not have a significant impact on flora and vegetation or ecosystem composition, but it is likely to result in a small to moderate decrease in vegetation abundance and density over time. These mine design options are part of ongoing discussion with Ngarlawangga Traditional Owners.

Surface water management will be implemented to minimise disruption to natural flows, minimise erosion and sedimentation of surface and groundwater.

Blast management plans will be implemented, and geotechnical assessments undertaken, for important bat caves (i.e. 'category 2 and "apartment block" caves' – refer to Section 9) that are identified as being at risk from blasting impacts (vibration and flyrock), prior to blasting activities to ensure structural integrity is maintained.

Table 6-17 Application of the Mitigation Hierarchy for Social Surroundings – Plants and Animals

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
<p>Disturbance, or reduced presence, of plants and animals due to dust, light, noise and vibration</p>	<p>Measures to Avoid</p>			
	<p>Avoidance of 17 caves within the Proposal Area by implementing MEZ and MRZ. An additional 20 caves are currently protected under MS1113 Restriction and Exclusion areas, as discussed in Section 9.5.2</p>	<p>Proposal specific Implementation via the West Angelas EMP</p>	<p>No</p>	<p>Establishment of a MEZ avoids ground disturbance within the MEZ (except disturbance required for environmental monitoring purposes). Establishment of a MRZ avoids mining activities within the MRZ</p>
	<p>Measures to Minimise</p>			
	<p>Implement upper clearing limit for riparian vegetation for the Proposal of 35 ha, as detailed in the West Angelas EMP (Appendix A.8). Implement upper clearing limits for the regionally significant vegetation; West Angelas Cracking Clays Priority 1 PEC, as detailed in the West Angelas EMP (Appendix A.8). Limit clearing of high significance fauna habitat to:</p>	<p>Industry standard in line with EPA guidance and objectives</p>	<p>No</p>	<p>Clearing in approved ground disturbance areas will be enforced through a combination of the Proponent's Approval Request and GIS systems and as such is considered a highly effective control</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<ul style="list-style-type: none"> • 126 ha of Gorge/Gully habitat • 3,731 ha of Hillcrest/Hillslope habitat • Ensure clearing occurs only in approved areas through continued implementation of the Proponent's Approvals Request System • Utilise existing disturbed areas wherever practicable • Conduct a site induction program to provide information on vegetation protection and ground disturbance authorisation procedures • Implementation of dust suppression techniques such as sprayers on crushers and water trucks is expected to help minimise dust generation during construction and operation • Limiting the amount of disturbed land to as small as reasonable reducing the amount of dust producing surfaces • Continuation of fire management measures such as hot works permit system, vehicle movement (not leaving cleared tracks) and disposal of potential fire-starting waste [e.g. cigarette butts] is expected to minimise the risk of bushfires as a result of the Proposal • Firefighting equipment will be located around the site and in vehicles. Fire response procedures and personnel training will also be provided, including site inductions on fire prevention and management 			
	<p>The Proponent has refined its mine plan, with the Revised Development Envelope significantly reduced at Western Hill, Mt Ella East, and Deposit H to avoid impacts to culturally important sites and</p>	<p>Proposal specific</p>	<p>No</p>	<p>Clearing in approved ground disturbance areas will be enforced through a combination of the Proponent's Approval Request and GIS</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	places, which will minimise potential impacts to plants and animals occurring within these areas.			systems and as such is considered a highly effective control
	The Proponent will avoid unnecessary or unapproved clearing by ensuring that no ground disturbance occurs without prior assessment and authorisation by Rio Tinto management, and that records of vegetation removal are collected and retained and reported annually through the Impact Reconciliation Procedure Report	Industry standard	No	The use of upper clearing limits is a well-established management measure utilised in industry to ensure that Proposal impacts on high value habitat types are limited. These limits will be enforced through a combination of the Proponent's Approval Request and GIS systems and as such is considered a highly effective control.
	With respect to fauna, refer to Section 9, which includes: <ul style="list-style-type: none"> • Lighting in mining areas directed towards active mine areas to minimise light overspill. • Machinery fitted with noise mufflers • Dust suppression, minimising disturbance to habitats • Risk-based assessment on restricting dust-generating activities in high winds • Vehicle speed limits to minimise dust. 	Industry standard	No	The measures have been developed to meet current industry standards to manage light, noise and dust
	The implementation of MEZ/MRZ will minimise light, noise and vibrations received by fauna habitat at those locations.	Proposal specific	No	Establishment of a MEZ/MRZ minimises impacts within the zone
	A Blast Management Plan will be implemented to manage impacts from vibration and maintenance of the structural integrity of the caves.	Proposal specific	No	The Proponent has well-established blasting management procedures across its mine sites in the Pilbara region and blast management plans for protection of significant cave structures

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Rehabilitate			
	<p>The MCP includes objectives to ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use. Final landforms are stable and consider ecological and hydrological factors</p>	<p>Industry standard</p>	<p>No</p>	<p>These measures follow the Statutory Guidelines for MCPs which are consistent with industry leading practises (DMIRS 2020b).</p> <p>Rehabilitation will be required to provide a vegetated and stable landform with habitat features. However, the uncertainty in relation to the recreation of habitat values following mining is recognised.</p> <p>Proposal Environmental Management Plan (EMP) addressing management measures applicable to the terrestrial fauna environmental factor (Section 9).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>
	<p>The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020a), that will detail proposed rehabilitation practices and closure outcomes for the site. Where practicable (e.g., when not limited by mine sequencing, pit designs and timing), rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement.</p> <p>Areas proposed for Progressive rehabilitation as per the MCP will utilise suitable local and culturally significant native species suited to a rehabilitated environment. The site species lists will contain and document the cultural significance and</p>	<p>Proposal specific MCP has been developed, based on RTIO standard approach to closure planning</p>	<p>No</p>	<p>These measures follow the Statutory Guidelines for MCPs (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>methods for species establishment. It should be noted that research and trials may be required for certain species over time. The species list will be evolving as knowledge increases.</p>			

6.8.2.6. Care for Country: Special Places

The Proponent has applied the mitigation hierarchy during the Proposal design process to develop mechanisms to address potential impacts to Traditional Owner important cultural sites and places, as discussed below and in Table 6-6. Note that measures that are specific to one of the Traditional Owner groups or their Country are identified, otherwise all measures apply generally to both groups and their respective lands.

Avoidance – Project design

The Revised Development Envelope and Conceptual Footprint have been amended and heritage site boundaries together with a commitment to no direct impacts as a result of this Proposal will be used to avoid impacts to important cultural areas.

Traditional Owner-Nominated Mining Exclusion Zones (MEZs)

NAC discussed MEZs with the Proponent and provided locations of culturally sensitive areas across the Range where no mining activity should be undertaken. The Mt Ella East Development Envelope and Conceptual Footprint has been significantly amended to remove this area from the Proposal.

The Proponent has adopted a number of these recommendations into its Proposal with the removal of Deposit J making adjustments to the proposed Development Envelope and Conceptual Footprint at Mt Ella East where appropriate. Ongoing consultation on these areas between Ngarlawangga and Yinhawangka Traditional Owners and the Proponent will continue.

Heritage Site Boundaries

The Western Hill heritage site complex (comprising 20 separate heritage sites), Mt Ella Site Complex (comprising seven separate heritage sites), the Range and Deposit H Waterhole site complex (comprising four separate heritage sites) will be protected by a heritage site boundary and commitment to no direct impacts as a result of this Proposal to avoid direct impacts from mining and minimise indirect effects of dust, noise, vibration and polluting run-off.

Avoidance – Mine Planning and Approvals Processes

All of the sites and places identified by Ngarlawangga and Yinhawangka during social surroundings consultations and submitted to the Proponent as part of the Social Surroundings reporting will be managed as heritage sites within Rio Tinto's Cultural Heritage Management System (CHMS) with appropriate boundaries. This is inclusive of the Range, and the unnamed range to the south of the existing West Angelas operations (that encompasses the Mt Ella Range). Where these important cultural sites and places and heritage sites interact with the Proposal or any other Rio Tinto related activities, these will be avoided as per Rio Tinto's mine planning process and internal ground disturbance approvals process based on the delineation in Rio Tinto's CHMS. Where these important cultural sites and places and heritage sites are at risk of impacts based on the conceptual footprint of the Proposal, or any other Rio Tinto related activities, the Proponent will consult with Yinhawangka or Ngarlawangga throughout the life of the mine to assess opportunities during mine and design and planning, and then in closure planning, to avoid and minimise impacts. Any disturbance will be in accordance with any existing approvals under section 16 and/or section 18 of the AH Act (and subject to relevant amendments to the act pending its reinstatement) and as agreed with Traditional Owners through co-design and consultation.

Avoidance – Workforce

Controls will be in place to restrict workforce access to important cultural areas (Table 6-18) including providing education such as relevant inductions and cultural awareness training covering importance and protocols around cultural heritage sites.

Minimisation – Project Design

The Conceptual Footprint has been optimised to reduce the total extent of disturbance and will continue to be reviewed in consultation with Traditional Owners through the life of the Proposal and the operation.

As part of standard heritage management processes, any rock shelter (or vibration sensitive) sites within 350 m of blasting are subject to geotechnical assessments which will inform a Blast Management Plan to manage blast vibration risks, while any site types within 200 m are subject to a Blast Management Plan to manage the risk of flyrock. Where heritage survey coverage is not completed to the full extent of 200 m (flyrock) or 350 m (blast vibration) blast management will be designed as if the edge of survey coverage itself is a heritage site requiring flyrock or blast vibration management until such time as heritage survey coverage can be completed. Implementation of blast management plans will be undertaken to minimise blast vibration risks to vibration sensitive heritage sites and fly rock risks.

Table 6-18: Application of the Mitigation Hierarchy for Social Surroundings – Special Places

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
Direct disturbance of Country and cultural heritage	Measures to Avoid			
	The Proponent has refined the Proposal scope and Revised Development Envelope via a Section 43A application under the EP Act and Section 156A application under the EPBC Act which significantly reduced potential impacts at Mt Ella East.	Proposal specific	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites).	<p>All potential disturbance will be subject to AH Act approvals processes</p> <p>The limit on clearing will ensure that disturbance of any site will be no more than is unavoidable to implement the Proposal.</p> <p>The Rio Tinto Approvals Request system is well-established and ensures clearing does not occur in Heritage site boundaries as part of Rio Tinto’s CHMS</p> <p>Heritage site boundaries, and the location of the Revised Development Envelope will ensure important cultural areas will not be subject to direct disturbance</p>
	Yinhawangka Deposit J has been removed from the Proposal altogether, with the Revised Development Envelope and Conceptual Footprint changed to reflect this via a Section 43A application under the EP Act and Section 156A application under the EPBC Act.	Proposal specific	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites).	
	Yinhawangka The Conceptual Footprint has been amended to avoid direct impacts to the Western Hill site complex, the Mt Ella East site complex, (now outside the amended Revised Development Envelope), and the unnamed range to the south of the existing West Angelas operations.	Proposal specific	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites).	
	Ngarlawangga The Conceptual Footprint has been amended to avoid direct impacts to the Deposit H Waterhole site complex and the Mt Ella Range (now outside the amended Revised Development Envelope).	Proposal specific	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites).	
Heritage site boundaries, the Proponent’s CHMS, and commitment to no direct impacts as a result of this Proposal be implemented in	Proposal specific	Yes – DPLH for administration of AH Act		

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	some sections of the Revised Development Envelope, which will avoid direct impacts to important cultural sites and places within these areas.		approvals processes (for impact to heritage sites).	
	Disturbance will be managed using the Proponent's Integrated Heritage Management Process (IHMP), CHMS, blast management plans and the Rio Tinto Approvals Request database to avoid unauthorised disturbance of sites of cultural significance. Information derived from surveys and consultations is used in the Proponent's GIS to spatially manage heritage and other important places, such as through the creation of exclusion boundaries, so that personnel designing a project can seek to avoid significant places where possible.	Industry standard Standard business practice	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites).	
	Prior to all disturbance heritage clearance surveys will be conducted to ensure all heritage sites are identified, with Proposal activities including blasting, designed to avoid heritage sites if possible.	Industry standard	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites).	
Measures to Minimise				
	The Conceptual Footprint has been minimised through project optimisation to reduce the total extent of disturbance.	Industry standard	No	Clearing limits will be established through ministerial conditions. This will be enforced by implementing the Proponent's Approval Request System and IHMP
	Consultation and engagement will be undertaken, as agreed with Traditional Owners under SCHMP processes, to inform decisions to relocate activities to minimise disturbance to important cultural sites and places	Proposal specific	No	These processes will be included in the SCHMPs developed with each Traditional Owner group. The SCHMPs are expected to be required by ministerial condition.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	Pre-disturbance heritage surveys will inform decision to relocate activities to minimise potential impacts to heritage sites where possible.	Industry standard	Yes – DPLH for administration of AH Act/ approvals processes (for impact to heritage sites)	All management of potential disturbance to heritage sites will be subject to AH Act / ACH Act approvals processes including implementation of CHMPs.
	Mine design optionality and potential impacts (direct and indirect) to important cultural sites and heritage sites will be assessed with Traditional Owners through appropriate consultation forums	Proposal specific	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites)	These processes will be included in the SCHMPs developed with each Traditional Owner group. The SCHMPs are expected to be required by ministerial condition. All management of potential disturbance to heritage sites will be subject to AH Act approvals processes including implementation of CHMPs.
	Salvage of artefacts will occur for sites unavoidably impacted, where salvage is not possible these values will be recorded.	Industry standard	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites)	All management of potential disturbance to heritage sites and materials will be subject to AH Act approvals processes including implementation of CHMPs. Consult and facilitation on opportunities for establishment of a 'keeping place' for salvaged cultural material will included in the SCHMPs developed with each Traditional Owner group.
	The Proponent will engage with Traditional Owners to provide Proposal workforce with cultural awareness training including importance of avoiding areas outside approved disturbance, other heritage requirements and recognition of artefacts.	Proposal specific	No	This will be enforced through the Proponent's training system and monitoring of implementation of SCHMPs.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	<p>Implementation of Traditional Owner LAPs to facilitate access to important cultural sites and places, and heritage sites.</p> <p>This may include restrictions on workforce access to culturally important sites and places that will be in place throughout implementation of the Proposal. Subject to protocols agreed with Traditional Owners (e.g. personnel may need to be accompanied by a Traditional Owner with appropriate cultural authority), as defined in the respective LAPs. The LAPs include (or, for the Ngarlawangga LAP in development, are expected to include) provision for register of visitation for workforce personnel accessing relevant areas.</p>	<p>Proposal specific</p> <p>Refer to Sections 6.5.4.2 and 6.8.2.3 (Access)</p>	<p>Yes – ILUAs administered under the NT Act</p>	<p>Ongoing engagement with Traditional Owners regarding access to Country will be addressed in the SCHMPs – expected to be required to be implemented under ministerial conditions</p>
Measures to Rehabilitate				
	<p>The repatriation of salvaged heritage materials will be undertaken in accordance with Traditional Owners preferences, to be discussed and confirmed as part of ongoing consultations with the relevant Traditional Owner groups. Salvage of heritage materials will occur from sites approved to be disturbed in accordance with the requirements of relevant AH Act/ACH Act approvals, and in accordance with the Proponent's IHMP and SCHMPs as relevant.</p>	<p>Proposal specific</p>	<p>Yes – DPLH for administration of AH Act/ approvals processes (for impact to heritage sites)</p>	<p>All management of potential disturbance will be subject to AH Act approvals including implementation of CHMPs.</p>
	<p>Prior to any repatriation salvaged heritage material will be stored in keeping place(s), that are set up in accordance with appropriate standards to ensure proper protection and conservation and be readily accessible by, and under the supervision and control of,</p>	<p>Proposal specific</p>	<p>Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites)</p>	<p>All management of potential disturbance will be subject to AH Act approvals including implementation of CHMPs.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	Traditional Owners. The Proponent will explore opportunities for joint funding of keeping places with other resource companies given Traditional Owner lands intersect other operations in the region.			
Indirect disturbance of cultural sites and places as a result of active mining	Measures to Avoid			
	N/A	N/A	N/A	N/A
	Measures to Minimise			
	Use of heritage site boundaries, the Proponent's CHMS; dust, noise and blast vibration and flyrock modelling, geotechnical assessment, blast management plans, caves within 350 m of rock shelter (or vibration sensitive) site to inform additional potential mitigation measures in consultation with Traditional Owners	Proposal specific	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites)	The Rio Tinto Approvals Request system and CHMS is well-established and ensures direct disturbance does not occur within heritage site boundaries.
	Dust, noise and vibration management and monitoring will be undertaken in the vicinity of key caves, and where agreed as per CHMS and under SCHMPs.	Proposal specific	No	Relevant monitoring (analyte/parameter and location) will be included in the SCHMPs developed with each Traditional Owner group The SCHMPs are expected to be required by ministerial condition
	Heritage and other specific survey activities for confirmation of values and site locations in regard to proposal designs as directed by Traditional Owners	Proposal Specific	Yes – DPLH for administration of AH Act approvals processes (for impact to heritage sites)	All management of potential disturbance will be subject to AH Act approvals processes Where appropriate, aspects will also be enforced through the Proponent's training system and monitoring of implementation of SCHMPs
Implementation of mine design controls such as waterhole/waterway sedimentation and	Standard business practice – see Section 7	No	Standard practice as recommended by numerous guidelines, including DWER WQPN 52 (DoW 2010)	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
	pollution management and monitoring, in consultation with Traditional Owners			Ongoing consultation with Traditional Owners will be addressed in the SCHMPs – expected to be required to be implemented under ministerial conditions
	Measures to Rehabilitate			
	The Proponent will develop a MCP in accordance with the DMIRS Statutory Guidelines (DMIRS 2020a) that will include measures regarding rehabilitation of disturbed areas and access. The SCHMPs will also include aspects of Traditional Owner consultation and engagement directly relevant to closure planning and implementation, including regarding indirect impacts to important cultural areas	Proposal specific MCP has been developed, in accordance with DMIRS 2020 Statutory Guidelines.	No	<p>Ministerial conditions requiring preparation and implementation of an MCP are expected</p> <p>Statutory guidelines for MCPS are available and consistent with industry-leading practice</p> <p>The MCPs must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b)</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>

6.8.3. Turee Creek Pastoral Station

6.8.3.1. Avoidance – Project Design

The proposed mining at Western Hill has been limited to AWT to avoid potential impacts to hydrogeological related values within Karijini National Park and by extension to Turee Creek Pastoral Station, downstream of the park.

The Conceptual Footprint has been optimised to reduce the total extent of disturbance and potential impact water catchments and water features. This includes removal of Deposit J from the Revised Development Envelope, removing the closest disturbance to Turee Creek Pastoral Station.

6.8.3.2. Minimisation – Project Design

The Conceptual Footprint has been optimised to reduce the extent of total disturbance and this is expected to minimise the visual impact from Turee Creek Pastoral Station.

Surface water management will be implemented to minimise disruption to natural flows, minimise erosion and sedimentation of surface water, as per Section 7.4.1.3.

Groundwater impacts from Western Hill will be monitored and managed via the implementation of the Groundwater Environmental Management Plan to ensure no change to groundwater at the boundary of, or within, Karijini National Park that are attributable to the Proposal as a result of abstraction for water supply. Notification to Turee Creek Pastoral Station will occur should any threshold exceedances occur as per the Groundwater Environmental Management Plan (Appendix A.9:).

Where structures, including infrastructure, stockpiles and WRLs, are unavoidably located within ephemeral creek lines and floodplains, the Proponent will ensure such structures are appropriately armoured or otherwise protected to keep erosion risk as low reasonably practicable. Surface water drainage will be constructed to minimise natural flows entering disturbance areas, including pit voids, with operational diversion drains proposed, where required, to reduce operational risk and maintain flows to downstream areas. Surface water management infrastructure will be designed to minimise erosion and downstream sedimentation risks.

Mine design is intended to limit pollution and sediment impacts will be mitigated through appropriate controls that are standard practice, such as sediment traps and settling ponds and armoured, as required, supported by ongoing monitoring. Potentially contaminating materials, including wastes, will be stored within appropriately contained areas.

Table 6-19: Application of the Mitigation Hierarchy for Social Surroundings – Turee Creek Pastoral Station

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
Alterations to surface water and groundwater hydrological regimes, affecting surface water and groundwater dependent values	Measures to Avoid			
	No additional surplus water discharge to Turee Creek East as a result of the Proposal. Continue to avoid discharge footprint (wetting front) within 2 km of KNP in accordance with requirements of MS 1113.	Proposal specific.	Yes – DWER licensed discharge.	Controls are considered effective and have been utilised to date.
	Groundwater is abstracted according to programs that have been modelled to ensure dewatering volumes are minimised while ensuring safe access to BWT mine pits. Ongoing groundwater level monitoring is used to verify the models and adjust dewatering programs as required. Operational water demand will be supplied from mine dewatering in the first instance (where feasible), reducing the requirement for water supply volumes.	Proposal specific.	Yes – DWER – groundwater abstraction licence.	The measures will minimise effect on aquifers in the Proposal area.
	Measures to Minimise			
	The Conceptual Footprint has been designed to minimise impacts to watercourses within the Revised Development Envelope. The Proposal largely relies on existing infrastructure, including crossings.	Industry standard.	No.	Limited impact to and disruption of surface water flows at local level and negligible impact at regional level are expected.
	A Groundwater Environmental Management Plan will be implemented to ensure no change to groundwater at the boundary of, or within Karijini National Park that are attributable to the Proposal (Western Hill) as a result of abstraction for water supply.	Proposal specific.	Yes – DWER – groundwater extraction license.	The measures will minimise effect on aquifers within and near the Revised Development Envelope. Ministerial conditions requiring preparation and implementation of a Groundwater

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
				Environmental Management Plan are expected. TCPS will be notified of threshold exceedances as per Groundwater Environmental Management Plan
	Measures to Rehabilitate			
	<p>Modelling will be used to ensure the integrity of legacy structures, such as WRL, is retained over the long term.</p> <p>All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure.</p> <p>The stabilisation and revegetation of landforms at closure is anticipated to minimise sediment runoff.</p>	Industry standard.	No.	<p>This is a standard approach recommended in most mine closure planning guidelines, including DMIRS (2020a).</p> <p>Standard requirement enforced, for example, by the <i>Contaminated Sites Act 2003</i> and regulations.</p>
Changes to local landforms, installation of infrastructure which may result in altered visual landscapes	Measures to Rehabilitate			
	The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020a), that will detail proposed closure landform designs and rehabilitation processes.	Industry Standard.	No.	<p>Ministerial conditions requiring preparation and implementation of an MCP is expected.</p> <p>Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific	Other Decision-making Process?	Effectiveness of the Controls
Alteration of the sense of place and amenity due to dust	Measures to Minimise			
	The Revised Development Envelope has been reduced and will minimise areas of potential disturbance and associated dust creation.	Proposal specific.	No.	High certainty that in areas removed from Development Envelope that dust emissions will not occur.
	The Conceptual Footprint has been minimised through project optimisation to reduce the total extent of clearing. The Proponent will avoid unnecessary clearing (causing dust [and noise]) by ensuring that no ground disturbance occurs without prior assessment and authorisation.	Proposal specific.	No.	Clearing limits will be established through ministerial conditions. This will be enforced by implementing the Proponent's Approval Request System.
	The Proponent will implement dust management measures, such as dust suppression and sediment traps to minimise indirect impacts to Turee Creek Pastoral Station.	Proposal specific.	No.	High level of certainty that the measure minimises substantial impacts resulting from mining activities.
	Measures to Rehabilitate			
	Revegetation and rehabilitation to minimise ongoing erosion and creation of dust following operations. Self-sustaining ecosystems that are compatible with the surrounding landscape are intended to be re-established.	Industry standard.	No.	A ministerial condition requiring preparation and implementation of an MCP is expected. Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b). Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.

6.8.4. Karijini National Park and Local Viewpoints

6.8.4.1. Avoidance – Project Design

The proposed mining at Western Hill has been limited to AWT to avoid potential impacts to hydrogeological related values within Karijini National Park, including heritage places and a potential GDE.

6.8.4.2. Minimisation – Project Design

The Conceptual Footprint has been optimised to reduce the extent of total disturbance and minimise impacts to access to important cultural areas and this is expected to minimise the visual impact from Karijini National Park and other nearby viewing points.

Table 6-20: Application of the Mitigation Hierarchy for Social Surroundings – Karijini National Park and Local Viewpoints

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process?	Effectiveness of the Controls
Changes to local landforms, installation of infrastructure which may result in altered visual landscapes	Measures to Rehabilitate			
	<p>The Proponent will implement a MCP following DMIRS Guidelines (DMIRS 2020a), that will detail proposed closure landform designs and rehabilitation processes.</p> <p>Progressive backfilling opportunities will be undertaken during the life of the operation, where practicable (e.g. when not limited by mine sequencing, pit designs and timing).</p>	Industry standard	No	<p>Ministerial conditions requiring preparation and implementation of an MCP is expected.</p> <p>Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all consultation and legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>
Alteration of the sense of place and amenity due to dust	Measures to Minimise			
	<p>The Revised Development Envelope has been reduced and will minimise areas of potential disturbance and associated dust creation.</p>	Proposal specific	No	High certainty that in areas removed from Development Envelope that dust emissions will not occur.
	<p>The Conceptual Footprint has been minimised through project optimisation to reduce the total extent of clearing.</p> <p>The Proponent will avoid unnecessary clearing (causing dust [and noise]) by ensuring that no ground disturbance occurs without prior assessment and authorisation.</p>	Proposal specific	No	<p>Clearing limits will be established through ministerial conditions.</p> <p>This will be enforced by implementing the Proponent's Approval Request System.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process?	Effectiveness of the Controls
	The Proponent will implement dust management measures, such as dust suppression and sediment traps to minimise indirect impacts to Karijini National Park and other nearby viewpoints.	Proposal specific	No	High level of certainty that the measure minimises substantial impacts resulting from mining activities.
Measures to Rehabilitate				
	Revegetation and rehabilitation to minimise ongoing erosion and creation of dust following operations. Self-sustaining ecosystems that are compatible with the surrounding landscape are intended to be re-established.	Industry standard	No	<p>A ministerial condition requiring preparation and implementation of an MCP is expected.</p> <p>Statutory Guidelines for MCPs set the standard for industry closure planning and practice. The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b).</p> <p>Note that although the MCP will be an important element of managing WRLs, as the Proposal is subject to a State Agreement, DMIRS will act as an advisory body rather than a decision-making authority in this regard.</p>

6.9. Assessment and Significance of Residual Impacts

6.9.1. Ngarlawangga and Yinhawangka

6.9.1.1. Water

Groundwater Dewatering and Discharge

Potential significant residual impacts with respect to Traditional Owner water values include the loss of water from the dewatered aquifers. Traditional Owners have acknowledged dewatering is required for the Proposal but, this is in and of itself is a compromise to the value of water held by Yinhawangka and Ngarlawangga People.

As described in Section 7 groundwater drawdown at Deposit H is proposed to be restricted to sump pumping which would result in minor, localised in pit impacts to groundwater only. Therefore, no groundwater effects on Turtle Pool are expected. However, further investigations are being undertaken to confirm groundwater links and mitigate any potential risk in accordance with Traditional Owner wishes, to be incorporated into ongoing consultation and the relevant SCHMP.

Dewatering at Deposit F North to enable BWT mining is expected to be confined entirely to the localised orebody aquifer, as available information indicates it is bound by low permeability geology that effectively isolates it, including from the regional Wittenoom aquifer. There are no known surface water expressions of this orebody aquifer.

The taking of water from these aquifers represents a cultural impact in terms of the spiritual significance of water for Traditional Owners, who prefer that no groundwater aquifers should be depleted by the Proposal. Acknowledging the Proposal does involve groundwater abstraction, Traditional Owners have indicated their next preference is for groundwater to be used efficiently on site (rather than discharged, which is viewed as wasteful). Noting that the Proponent has committed to no abstraction of groundwater from the Deposit H Aquifer for production.

No surplus dewatering water discharge to creeklines will occur from Proposal deposits (noting discharge to Turee Creek East from existing operations will continue in accordance with the current water management strategy). In the event of excessive stormwater ingress into Proposal pits, management will be required which may involve discharge to Turee Creek East, however in accordance with the Water Management Hierarchy, other options for use will be prioritised.

Catchment Reduction

Ngarlawangga maintain that the proposed reduction of the Deposit H Waterhole catchment area is likely to be considered by them to be a significant residual impact due to potential effects on the amenity and ecological vitality of the waterhole and gully, particularly as catchment reduction will be permanent. Although pool water levels are expected to be sustained and a small to moderate decrease in surrounding vegetation abundance and density expected – i.e. ecosystem function is expected to be maintained such that in ecological terms there will be no significant residual impact to the waterhole and creek ecosystem – given Ngarlawangga concerns regarding the sensitivity and status of this special place, the Proponent is committed to no mining within the Deposit H Waterhole catchment without written agreement from NAC. This process will be underpinned by further mine design reviews and studies as required, under the auspices of the SCHMP

Ongoing Management

Any other potential ongoing Traditional Owner concerns and concerns with respect to water are proposed to be addressed through implementation of the individual Traditional Owner and Proponent jointly prepared SCHMPs.

Ongoing consultation with Traditional Owners on water-related issues are included in the SCHMPs including involvement in:

- Mine planning aspects of water management (through appropriate forums)
- Monitoring of quality and other parameters at important cultural sites and places (e.g. Deposit H Waterhole and Turtle Pool)
- Application of the water management hierarchy, the use of water for dust suppression, and investigations into alternatives.

Subject to Traditional Owner agreement and availability, monitoring incorporated into the SCHMPs may include the Proponent sharing water data, and Traditional Owner involvement in field monitoring activities.

6.9.1.2. Access and Connection to Country

For safety, there will be areas within the Revised Development Envelope that Traditional Owners will not be able to have unfettered access during implementation of the Proposal, escorted access will be facilitated by the Proponent as per the Land Access Protocol representing a temporary or restrictive loss of access, and some areas that will never be safe to enter again (i.e. the abandoned pits). Some areas are not named or registered places or have had particular activities or social surroundings significance ascribed to them, although consultation is ongoing to regarding areas not already identified in Social Surroundings consultation to date.

The Proponent is committed to ensuring, as guided by health and safety requirements, ongoing safe access to Country is facilitated to allow Traditional Owners to conduct cultural activities such as the passing down of cultural knowledge to future generations and continued 'caring for Country'. The Proponent is committed to ensure that access to specific locations as identified by Traditional Owners remains no worse off wherever possible when existing access is altered, and that access is maintained.

The Proponent is committed to working with each Traditional Owner group to establish and update existing Land Access Protocols. The significance of access restrictions is to be determined by the relevant Traditional Owner groups.

Discussions around placement of development infrastructure will also be ongoing with Traditional Owners during development, construction, operation and closure phases of the Proposal to ensure site access requirements are responsive to project requirements. If any other locations are identified through ongoing fieldwork and consultation during the life of the Proposal, then further discussions regarding mitigation measures would be undertaken.

Safety bunding and other access restrictions will impede access and be a permanent restriction to abandoned pits and potentially some sites and places of cultural significance post closure. However consultation is ongoing as part of mine planning with the aim of maintaining access throughout operations or reinstating access to the majority of relevant places as part of closure planning. The loss of access to those parts of Country that remain as abandoned pit voids or where rehabilitation is not undertaken will be felt by Traditional Owners as an enduring impact on part of their cultural heritage and with respect to the restriction of Native Title rights to that land.

Site access and engagement on access matters are included within the co-designed SCHMPs and MCP, as appropriate.

6.9.1.3. Amenity

Landform Changes

The Proposal will result in permanent changes to landforms from the development of mine pits and associated WRLs and landbridges. These changes will permanently impact how that specific part of

Country is used, enjoyed and connected to. The land will always be different to that which Ancestors walked and will be different to the land experienced by future generations. Some sections of Country will be permanently excised and Native Title rights restricted post mining (within abandonment bunds, or where rehabilitation will not take place). The desire to be on, and enjoyment of, this part of Country will be diminished by the felt impacts of these changes.

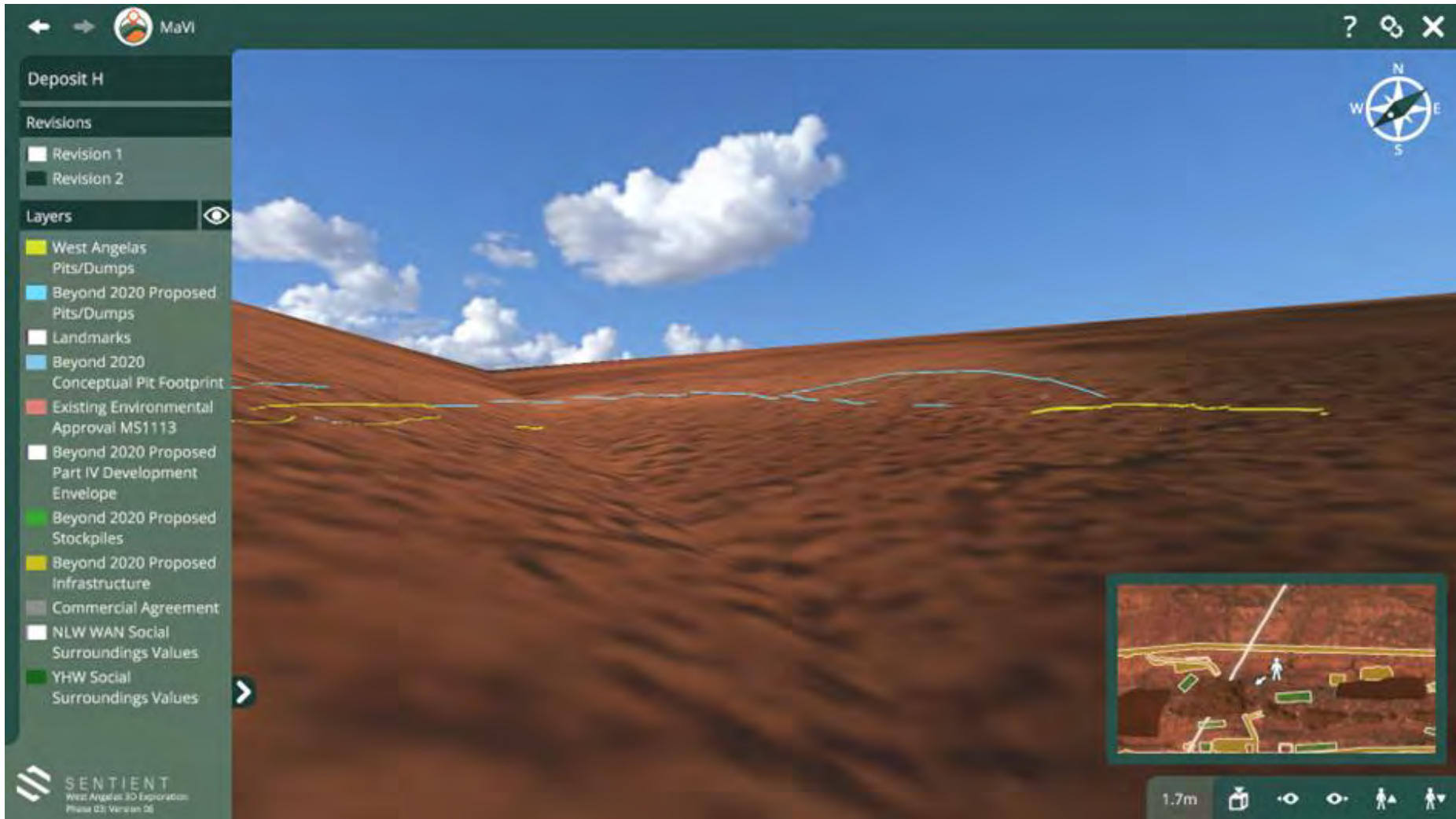
Continued consultation and engagement with Ngarlawangga and Yinhawangka with respect to mine planning, closure design including final landforms and rehabilitation to minimise landform change, permanent restrictions to access and loss of Native Title rights to sections of Country post mining, as well as visual amenity impacts is incorporated into the SCHMPs. This will include ongoing use of 3D visualisations to update Traditional Owners on landscape impacts and closure landform changes and support informed feedback.

Following consultation with Traditional Owners, extensive changes have been implemented in Proposal design to avoid and minimise impacts, including with respect to visual amenity, on important cultural areas including at:

- Western Hill (pit design amendment)
- Mt Ella East (pit design amendment and amendment of Development Envelope)
- Deposit J (removed completely from Proposal)
- Deposit H (Pit and stockpile amendments) – these proposed stockpiles were removed due to their proximity to Deposit H waterhole and the sense of place, noting that the geography of Deposit H provides a natural barrier whereby proposed Deposit H development (3D dump crests or pit boundaries) are not visible (see Figure 6-9).

These changes will significantly minimise the visual impact of the Proposal from important cultural areas. However, the permanent landscape impacts and change is expected to result in a significant residual impact on the social surroundings of the Ngarlawangga and Yinhawangka people. Consultation with Ngarlawangga and Yinhawangka regarding the significance of amenity impacts (including visual amenity and other amenity values) to culturally important areas is ongoing and to be determined by those groups, with the Proponent aiming to achieve informed non-opposition to the proposed outcomes.

Figure 6-9: View Southwest from Deposit H Waterhole towards closest Conceptual Footprint



Dust, Noise and Vibration and Waste/Litter

As the modelling has indicated for the sites close to existing operations (Table 6-10), the existing West Angelas operations generates dust that exacerbates the dusty natural environment. Additional mining activities to support the Proposal will temporarily cause additional excessive dust to be generated during construction and operations. Consultation has identified dust effects on cultural landscapes as a key concern of Traditional Owners, who are very interested in dust management, dust creation reduction and mitigation strategies, as well as the impact of dust on landscapes, amenity, pools, animals and plants. To minimise airborne dust the Proponent will implement dust management measures such as use of a water truck, sealed bitumen roads, water cannons on crushers and stockpiles and dust collectors connected to screenhouse, and, where practicable, will progressively rehabilitate cleared surfaces that are no longer required for construction or operational purposes, to minimise the extent of exposed surfaces. The Proponent will continue to investigate opportunities to improve dust suppression and review dust management processes in a bid to reduce the created amount prior to suppression. Consultation and review of dust management approaches and reporting, and provision for opportunities to collaborate on and undertake dust monitoring, is included in the SCHMPs.

Potential dust generation is not expected to result in permanent impacts to culturally important areas, including waterholes (Table 6-21). TSP concentrations and dust deposition rates at modelled cultural sites and places are generally all well below the assessment criteria, with the exception of TSP at the rockshelter site WA-16-45-ENG, at which concentrations are expected to fall back below assessment criteria after 90-days (Table 6-22). However, it is acknowledged that these criteria and rates have limitations with respect to capturing or quantifying the felt impacts of dust to social surroundings values.

Implementation of dust management measures to suppress, reduce creation of, and minimise airborne dust in combination with progressive rehabilitation of cleared surfaces which are no longer required for construction or operational purposes (to minimise the extent of exposed surfaces) is expected to ensure no permanent significant impact to amenity for Traditional Owners as a result of airborne dust generation and deposition.

While dust generation is temporary, forecast to be below the assessment criteria and subject to ongoing management and suppression, dust creation will remain a residual impact to Traditional Owner amenity during the life of the Proposal. Visually, the presence of dust, along with ongoing concerns relating to pools, flora and fauna health, and particularly concerns that dust prevalence motivates fauna into moving away from Country as a result of dust impacts is anticipated to impact sense of place, enjoyment and desire to visit, camp and be on that part of Country. This will affect Traditional Owner ability to use that landscape for hunting or other cultural practices until such time as mining activities cease and rehabilitation is successful.

Table 6-21: TSP Concentration at Modelled Cultural Sites and Places – excluding Background ($\mu\text{g}/\text{m}^3$)

Receptor	Maximum 24-hr Average ($\mu\text{g}/\text{m}^3$)		Concentration After 90 Days ($\mu\text{g}/\text{m}^3$)	
	Kwinana EPP – 90 $\mu\text{g}/\text{m}^3$		Kwinana EPP – 90 $\mu\text{g}/\text{m}^3$	
Year of Operation	2	10	2	10
Ngarlawangga				
Deposit H Waterhole	56	21	0	0
Turtle Pool	68	12	0	0
Yinhawangka				
WA-16-61-SS	67	27	0	0

Receptor	Maximum 24-hr Average ($\mu\text{g}/\text{m}^3$)		Concentration After 90 Days ($\mu\text{g}/\text{m}^3$)	
WA-16-45-ENG	70	343	0	45
WANETH06-2	84	174	0	3
Ngarlawangga and Yinhawangka				
Mt Ella East SE Con	88	20	0	0
Mt Ella East S Con	57	20	0	0

Orange: above assessment criteria ($90 \mu\text{g}/\text{m}^3$)

Table 6-22: Maximum Monthly Deposition Rate ($\text{g}/\text{m}^2/\text{month}$) at Modelled Cultural Sites and Places

Receptor	Year 2	Year 10
Ngarlawangga		
Deposit H Waterhole	2.1	0.1
Turtle Pool	0.1	0
Yinhawangka		
WA-16-61-SS	0.4	1
WA-16-45-ENG	0.2	0.2
YINHARR-39	0.2	0.2
WANETH06-2	0.2	0.2
Ngarlawangga and Yinhawangka		
Mt Ella East SE Con	0	0
Mt Ella East S Con	0	0

Noise and vibration from the Proposal at important cultural areas is expected to be temporary, negligible and below assessment criteria (Section 6.9.1.3). This, however, does not dismiss the temporary presence of mining-related noise and vibration (blasting) in the landscape that would otherwise not be present, nor avert concerns that such noise and vibration may cause fauna to move away from that part of Country. This effect on the natural state will impact Traditional Owner amenity and represents a felt impact to the sense of place, enjoyment and desire to be on that part of Country. Moreover, any realised noise and vibration impacts to fauna prevalence and movement in particular would impact how that part of Country can be used culturally.

Noise and vibration will present a temporary residual impact to Traditional Owner amenity, but no permanent significant impacts to Traditional Owners are expected.

Ongoing consultation and engagement with Traditional Owners will occur, including as agreed in the co-designed SCHMPs to ensure that dust, noise and other potential impacts related to Traditional Owner use, enjoyment, sense of place and any other important cultural associations with their Country are managed and minimised. The SCHMPs will outline agreed approaches to monitoring and reporting on the Proposal's effects in this regard including opportunities to collaborate on and undertake noise and vibration monitoring.

6.9.1.4. Care for Country: Plants and Animals

Direct disturbance, dust, noise and vibration from mining activities have the potential to temporarily impact fauna and flora habitat, distribution and prevalence in and around the Proposal - although permanent effects will occur within areas that are not intended to be rehabilitated, such as pit voids. This is expected to impact Traditional Owner sense of place, cultural use such as hunting and resource gathering, and enjoyment of Country until mining activities cease and rehabilitation is completed.

The Proposal is located near an existing operational mine (West Angelas Iron Ore Project) and a study on impacts of dust on plant health in semi-arid environments found no evidence dust deposition up to 77 g/m²/month results in detrimental effects on plants (Matsuki et al. 2016). Little information is available regarding dust effects on fauna in the Pilbara; however, it is expected local fauna are well adapted to the relatively dusty environment. The Proponent will implement dust management measures to minimise airborne dust and will progressively rehabilitate cleared surfaces that are no longer required for construction or operational purposes. This is anticipated to reduce adverse effects on plants and animals such that they are not significantly impacted locally.

Furthermore, the management and mitigations measures outlined in Flora and Vegetation (Section 8) and Terrestrial Fauna (Section 9), respectively are anticipated to extend protection to non-listed species that are otherwise culturally important or have intrinsic value under Traditional Owner's Care for Country ethos. This includes:

- Establishment of MEZs and MRZs around 17 caves within the Proposal Area, with no mining disturbance permitted in MEZs and limits on disturbance within MRZs. An additional 20 caves are currently protected under MS 1113 Restriction and Exclusion Areas
- Establishment of MRZs around critical and supporting habitat linking bat roosts where appropriate. The Revised Development Envelope and Conceptual Footprint have been designed to minimise, where practicable, disturbance of high significance fauna habitats (Gorge/Gully and Hillcrest/Hillslope), and clearing limits within these habitat types have been proposed
- Implementation of upper clearing limit for the regionally significant vegetation; West Angelas Cracking Clays Priority 1 PEC, for the Proposal as detailed in the West Angelas EMP (Appendix A.8)
- Implementation of upper clearing limit for riparian vegetation for the Proposal as detailed in the West Angelas EMP (Appendix A.8)
- In addition, the avoidance of direct impacts to Deposit H Waterhole site complex including the downstream gully, and minimal impact to the Turtle Pool catchment will ensure these water sources, containing microhabitats, foraging and shelter habitats, and which may provide migration pathways, will remain intact (noting Ngarlawangga concerns with respect to effects of catchment reduction on the amenity and ecological vitality of the Deposit H Waterhole gully system).

Other mitigation measures as indicated in Terrestrial Fauna (Section 9), Flora and Vegetation (Section 8) and MNES (Section 13) are anticipated to ensure indirect impacts to culturally important plants and animals will not be significant.

However, the Proponent acknowledges it has limited knowledge regarding Traditional Owner cultural association and values attached to plants and animals, including native honeybees and honey trees that have been a point of concern for Traditional Owners. As such continued consultation and engagement will occur with Traditional Owners to understand and manage these better throughout the approval process and during the life of the Proposal (from mine planning to operation to closure), to be included within the SCHMPs as relevant. Relevant upcoming activities include the forthcoming ethnobotanical surveys (see below) and cultural values mapping. The Proponent will also work with Traditional Owners to ensure culturally important plants are considered for use in rehabilitation. If suitable species are identified through the ethnobotanical surveys or other sources, the seed mixes will be detailed within

the MCP with processes for consultation and involvement of Traditional Owners regarding MCPs expected to be included in the co-designed SCHMPs.

Ethnobotanical/Traditional Ecological Knowledge surveys are being conducted and more planned with Traditional Owners, such as an additional wet season Traditional Ecological Knowledge Project planned with Ngarlawangga, to provide more information on native honeybees, honey trees, goannas, kangaroos, emus, bush turkey, fish and other species and myriad other fauna and flora species of cultural value - there is expected to be many other such species that could occur in the Revised Development Envelope. The surveys are intended to provide a deeper understanding of the key culturally important plant species within the Revised Development Envelope, for example, which species are valued and their habitat preferences. The management of these surveys and associated ongoing consultation is addressed in the SCHMPs.

The Proponent acknowledges that all plants and animals and their habitats that occur within or near the Revised Development Envelope have intrinsic cultural value, therefore any direct and indirect disturbance, disruption and loss or impact to distribution of these attributable to the Proposal will represent a locally significant residual impact by Ngarlawangga and Yinhawangka that will be felt during mining activities until rehabilitation is successful (while acknowledging the permanent impact to areas that are not subject to rehabilitation such as pit voids which will have an enduring impact and restriction of Native Title rights for those areas of land.). These impacts will be managed through the jointly developed SCHMPs. Further work will occur to understand the potential use of these species in rehabilitation, and the Proponent has committed to consider culturally significant species in the seed mix for West Angelas rehabilitation. Results will inform ongoing social, cultural and heritage management, closure planning and ongoing Traditional Owner consultation.

6.9.1.5. Care for Country: Special Places

Notwithstanding ongoing design amendments and consultation with Traditional Owners regarding potential impacts, the current Conceptual Footprint may directly impact 91 heritage sites (see Appendix B.4) including rock shelter sites and other sites, including artefact scatters, grinding patches, quarries and scarred trees, including:

- Ngarlawangga sites: 39
- Yinhawangka sites: 52.

None of the Yinhawangka or Ngarlawangga sites of special significance as identified as part of Social Surroundings fieldwork and reporting are at risk of impact from the Conceptual Footprint. The three Yinhawangka sites within the Development Envelope, the Range, the Western Hill site complex and Mt Ella site complex; and the two Ngarlawangga locations – Deposit H waterhole site complex and WAN-22-100-EX – are protected by the Proponent commitment not to disturb within these areas (discussed in Section 6.8 and below), the appropriate SCHMP and ongoing engagement and consultation with the relevant Traditional Owner groups.

The Revised Development Envelope and Conceptual Footprint has been amended with the removal of Deposit J and a substantial reduction to Mt Ella East to remove interactions with areas of cultural importance and significant sites identified by Traditional Owners during Social Surroundings consultation (Figure 6-5).

In addition, during design and planning of the Proposal, the Conceptual Footprint was contracted to avoid direct impacts to the Western Hill heritage site complex, the Mt Ella Site Complex, the unnamed range to the south of the existing West Angelas operations, and the Deposit H Waterhole site complex.

Ongoing consultation with Ngarlawangga and Yinhawangka may identify other areas of potential cultural and heritage significance. Guidance on the significance of any such location will be sought from Traditional Owners to inform later assessment stages and/or incorporated as appropriate into management through the SCHMPs, and as guided by the Proponent's IHMP, which may include

opportunities for adjustments to planned disturbance areas to avoid or minimise adverse effects to key locations. Ongoing consultation and fieldwork will occur throughout approval stages and life of the Proposal to provide Traditional Owners opportunities to record, develop and share knowledge of Country and culture. This includes, but not limited to, forthcoming heritage, cultural values mapping and ethnobotanical surveys.

Where the risk of vibration impacts required to pursue the conceptual footprint are considered by the Proponent to be un-manageable, the Proponent will seek appropriate approvals under the AH Act in consultation with the relevant Traditional Owners. The Proponent will also provide the Blast Management Plan and monitoring data to the groups. Heritage surveys will be completed within proposed disturbance areas yet to be surveyed to inform mine planning and any approval requirements under Aboriginal heritage legislation prior to ground disturbance.

Given the protection provided to all identified important cultural sites, ongoing consultation and anticipated involvement of Traditional Owners in monitoring, and the mechanisms in place under Aboriginal heritage legislation to assess and approve disturbance of sites within the Conceptual Footprint, the Proposal is considered not expected to result in a significant residual impact to important cultural sites and places.

The Proposal will nonetheless represent a significant residual impact to Country for both Ngarlawangga and Yinhawangka with these impacts to be managed through their respective jointly developed SCHMPs.

6.9.2. Turee Creek Pastoral Station

Turee Creek Pastoral Station owners have expressed ongoing concerns regarding water related impacts from the existing West Angelas operation. These same concerns have been expressed in relation to the Proposal, including downstream impacts to water such as alterations to surface water and groundwater hydrological regimes, affecting surface water and groundwater dependent values, which were addressed during the consultation process.

Removal of Deposit J from the Revised Development Envelope has removed the closest disturbance to Turee Creek Pastoral Station which has further minimised effects along with dedicated water monitoring practises occurring during the LoM. While this reduces the likelihood of water related impacts for Turee Creek Pastoral Station, it does not alter their concerns nor the consequences for the station should groundwater or surface water impacts be realised as a result of the Proposal. No significant visual effects from the Proposal are expected at the station including at its homestead, nearly 50 km from the Revised Development Envelope.

Ongoing consultation will continue with Turee Creek Pastoral Station regarding mine designs and water impacts and management will continue during the life of the operation via established consultation forums.

6.9.3. Karijini National Park and Local Viewpoints

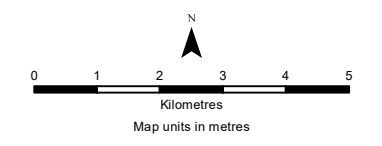
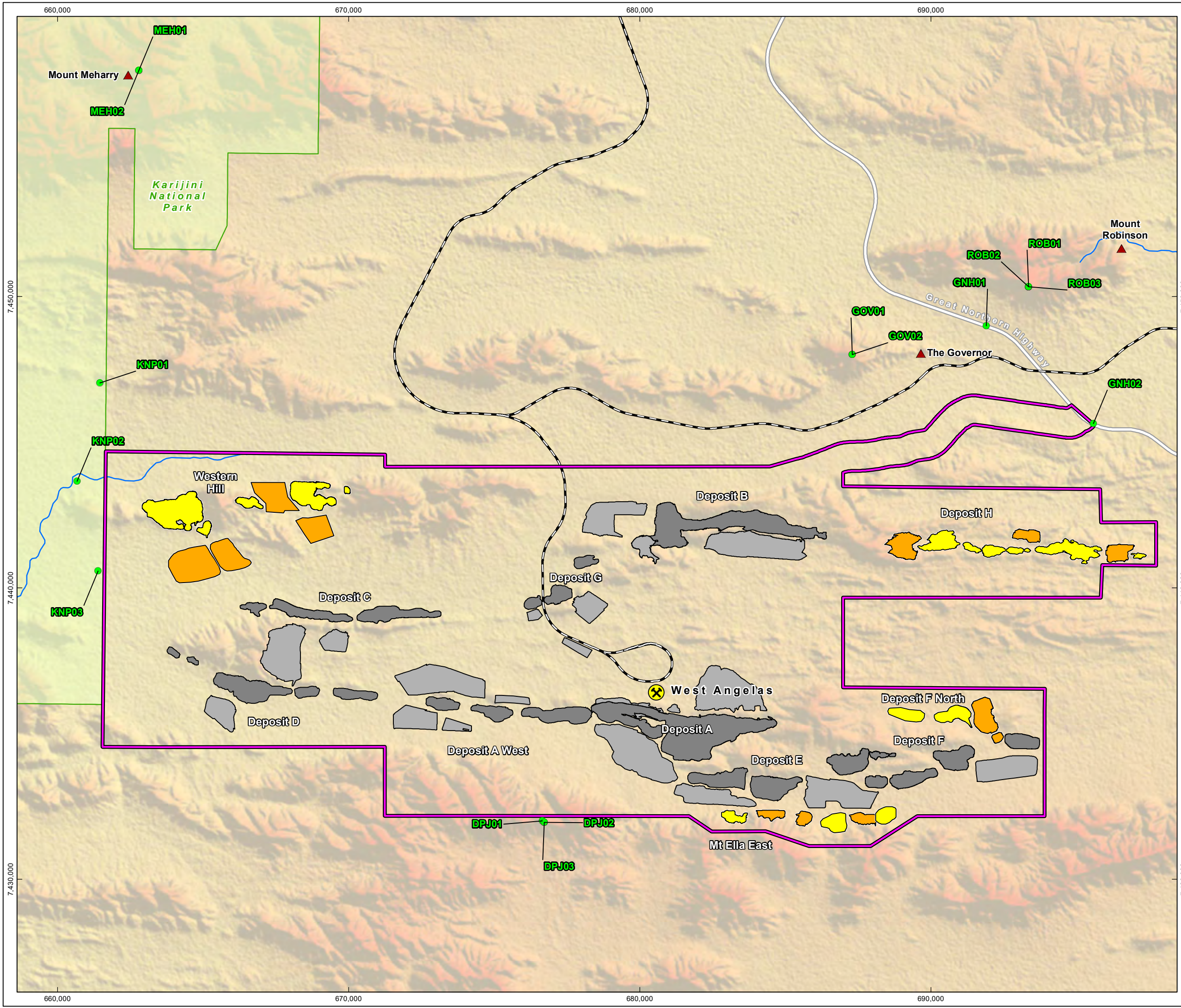
Of the high vantage points surrounding the Revised Development Envelope accessible to the general public, and the boundary of Karijini National Park, views will take in the Proposal disturbance including proposed WRLs (Figure 6-11); Rio Tinto 2021b). Views from The Governor (*Illingurra*), not readily accessible to the general public but an important place for the Yinhawangka People, will also take in Proposal disturbance including proposed waste rock landforms (Figure 6-19; Rio Tinto 2021b). However, the visualisations for each of these locations suggest these changes will appear distant and not stand out prominently against the surrounding landforms. The effect of the Proposal on views are therefore not expected to be significant. The Mt Robinson rest area is much lower in the landscape, and separated from the Proposal area by additional hills, so will not be visually affected at all by the Proposal.

Figure 6-10
West Angelas
Photo Locations

Drawn: D von Holdt
Plan: RTIO-0980374v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

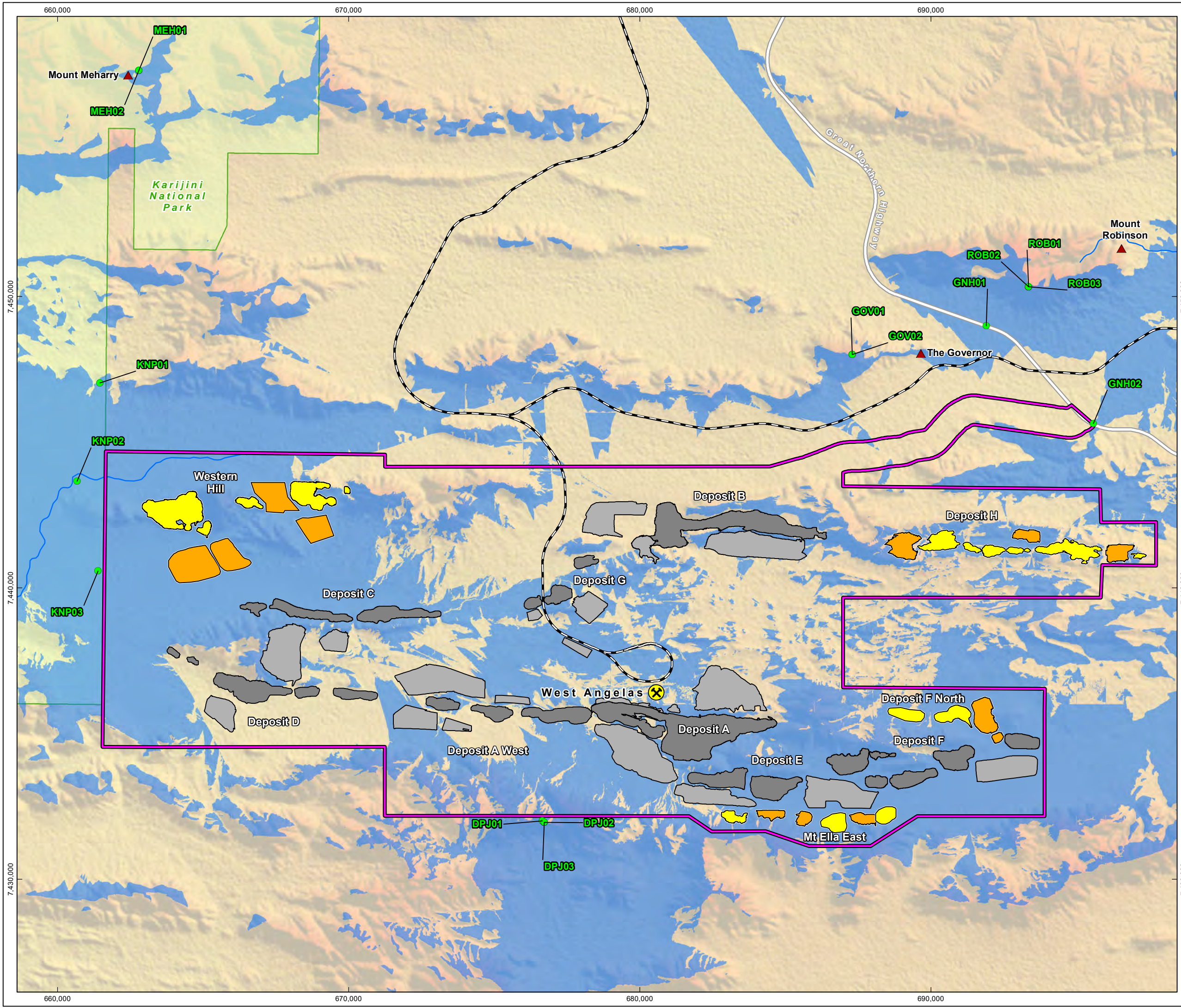
- ▲ Mountain
- ⊗ Rio Tinto Mine
- Actual Photo Locations
- ▭ Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- Rio Tinto Railway
- Highway
- Major Creek
- ▭ National Park



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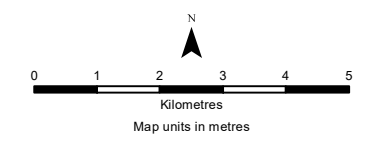
Figure 6-11
West Angelas
Photo Locations and
Viewshed

Drawn: D von Holdt
Plan: RTIO-0980374v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



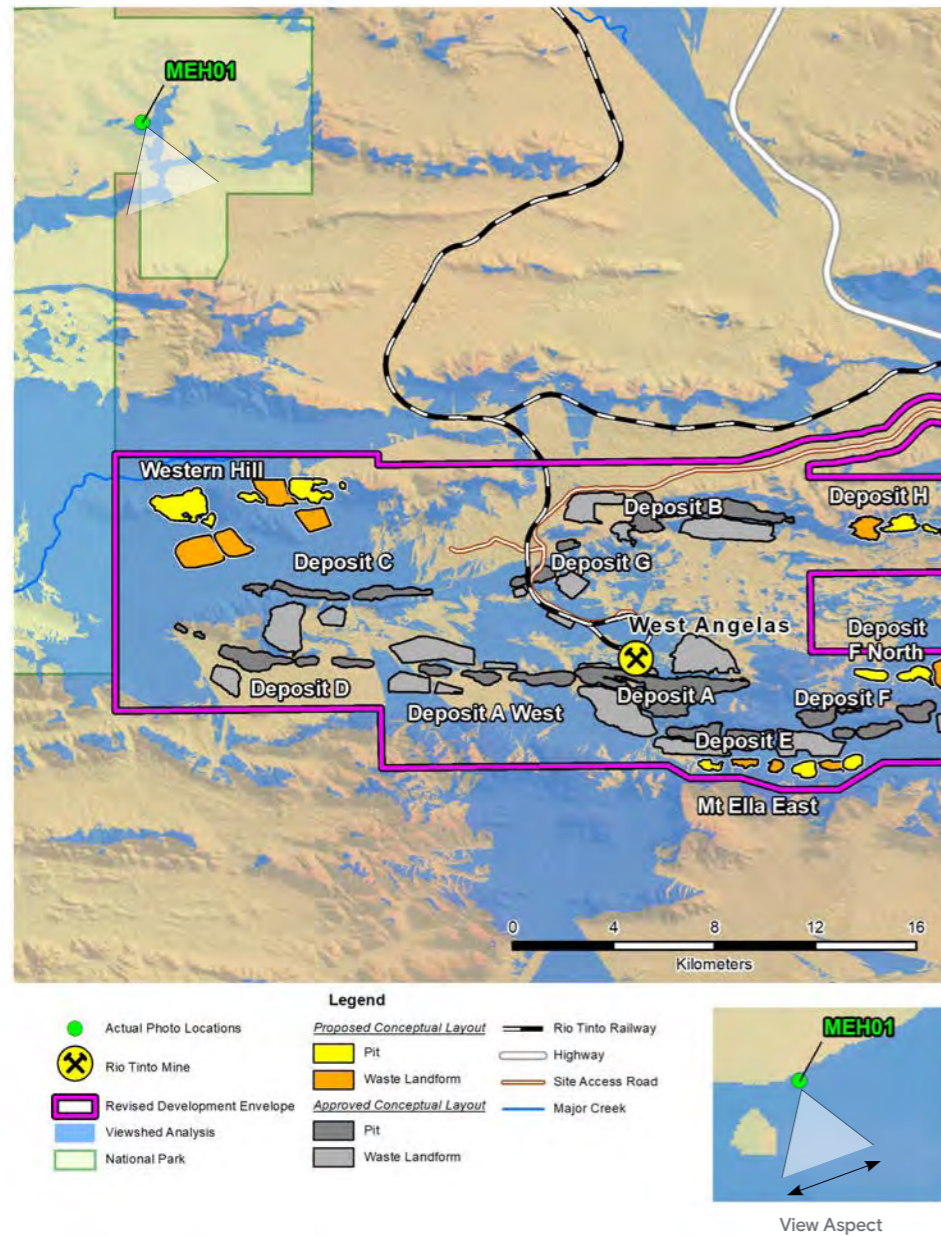
Legend

- Actual Photo Locations
- ▲ Mountain
- ⊗ Rio Tinto Mine
- ▭ Revised Development Envelope
- Proposed Conceptual Layout*
- Pit
- Waste Landform
- Approved Conceptual Layout*
- Pit
- Waste Landform
- Rio Tinto Railway
- Highway
- Major Creek
- Viewshed Analysis
- National Park

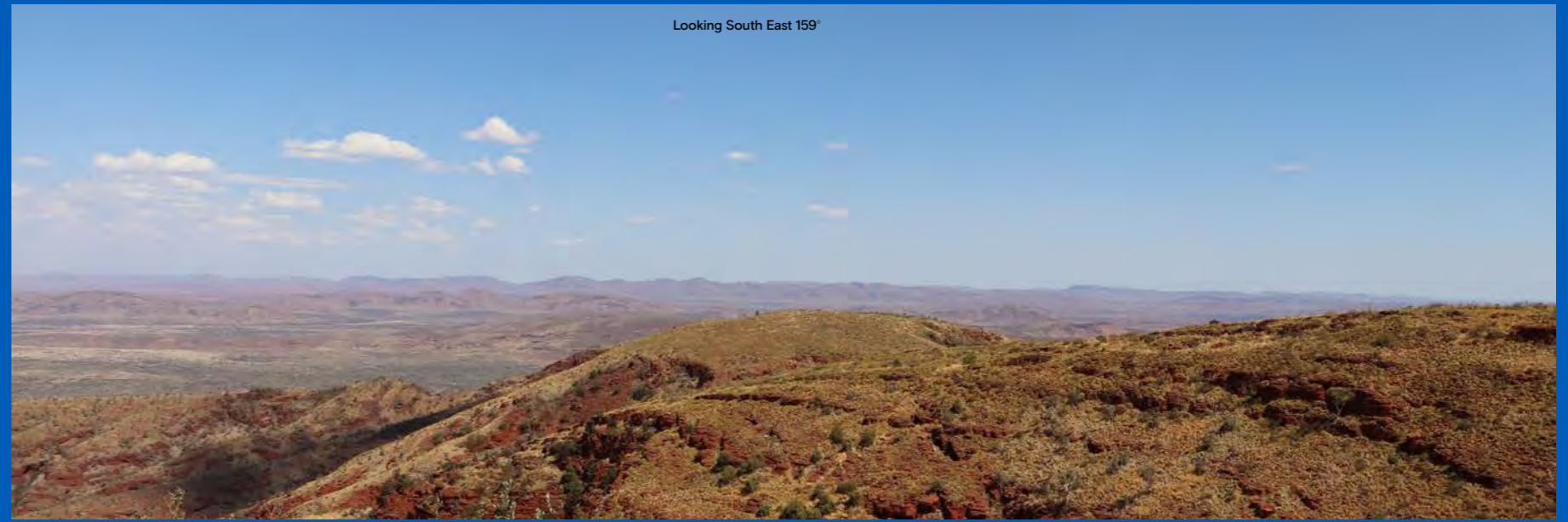


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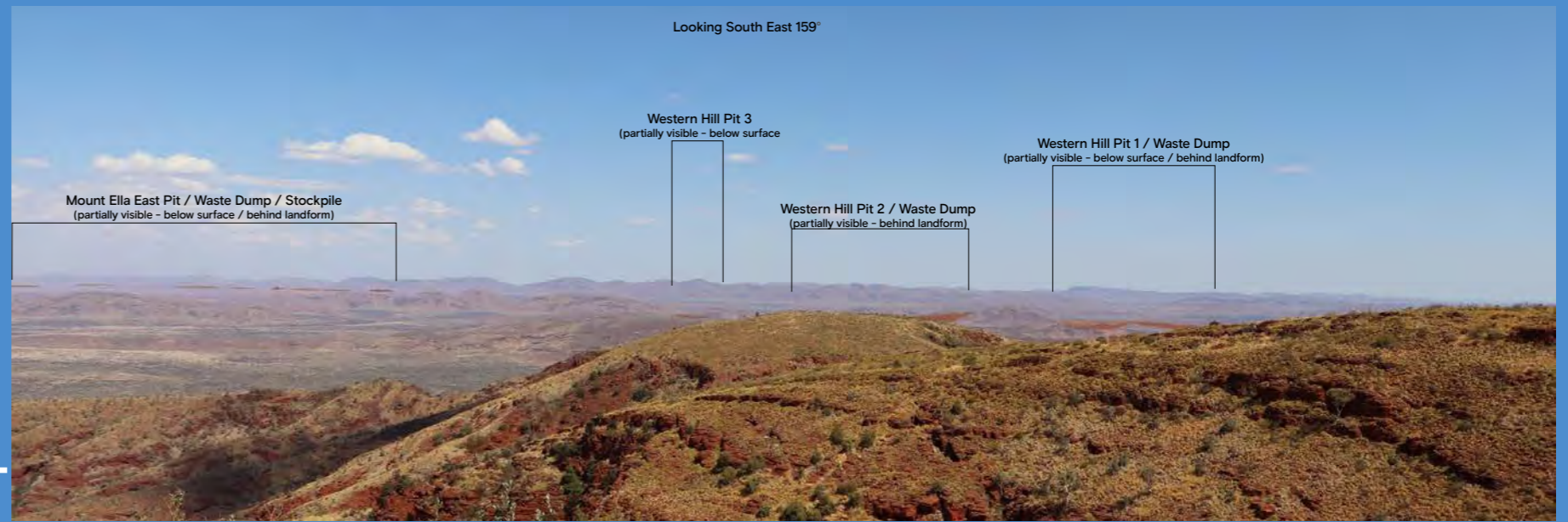
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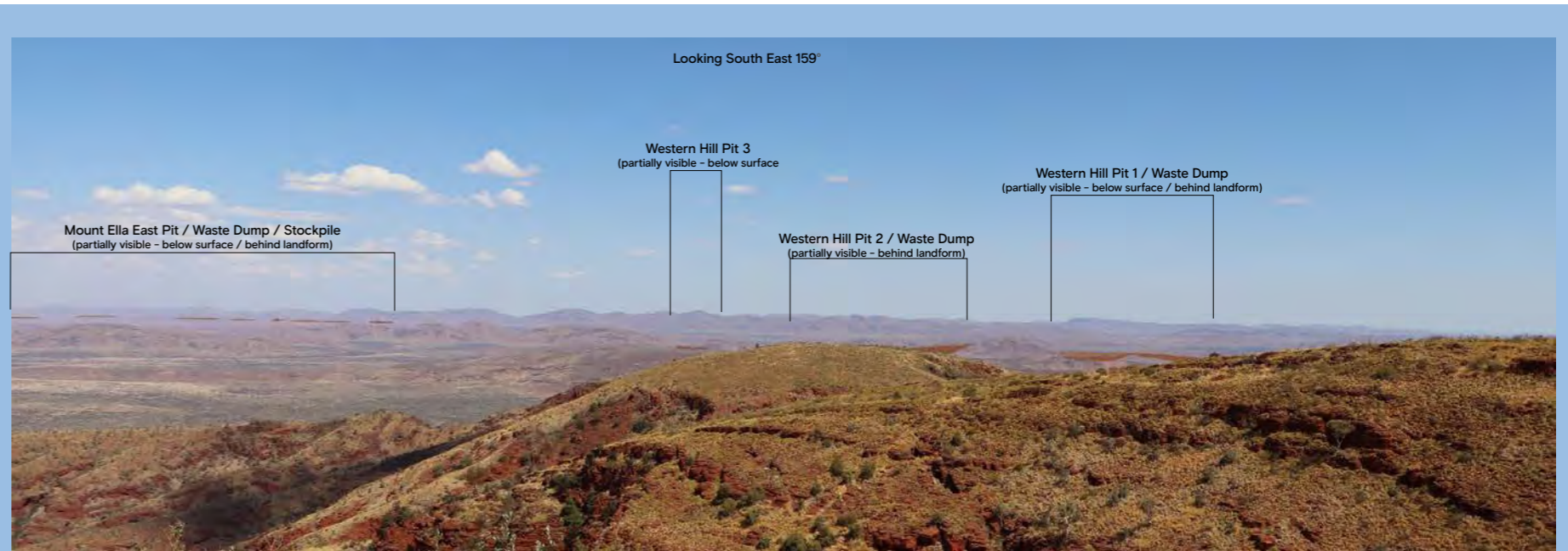
Current View



Operations View



Closure View

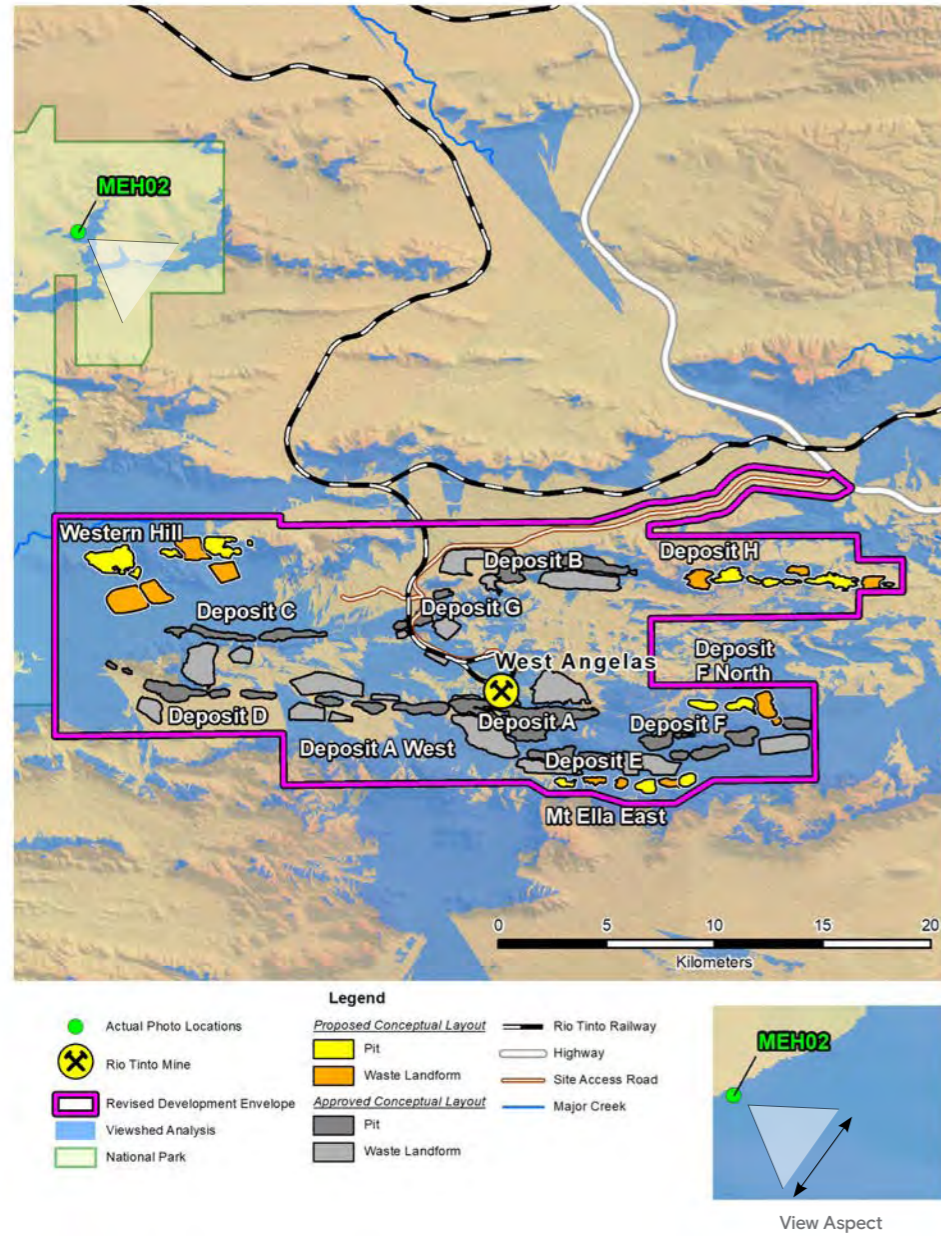


Viewpoint Characteristics

Name	01 - MEH01 - Mount Meharry
Co-ordinates	662,796.60mE / 7,457,755.00mN
Direction	South East (Bearing 159°)
Description	Located on top of Mount Meharry with clear view towards West Angelas Revised Proposal. Medium level vegetation with view well above tree line.
Site Significance	Located within Karijini National Park, this site is regularly visited by tourists.
Comments	Clear view to the proposed Western Hill operations. Very hot and windy.

Figure 6-12 Mount Meharry

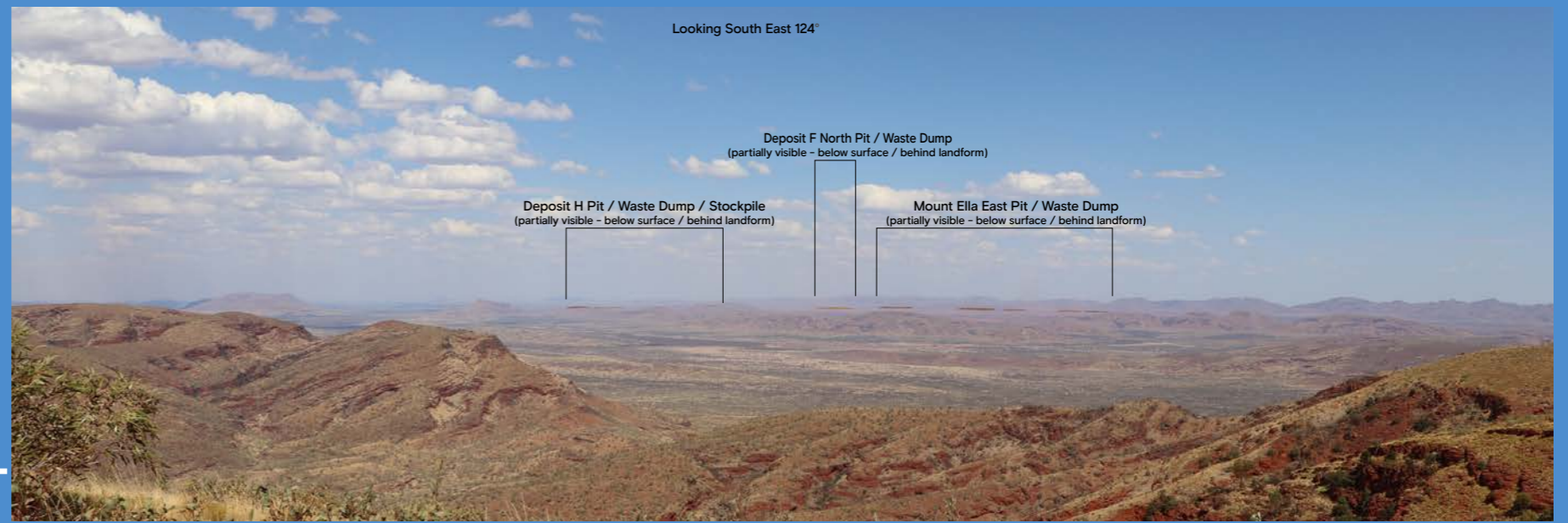
Location Map



Current View



Operations View

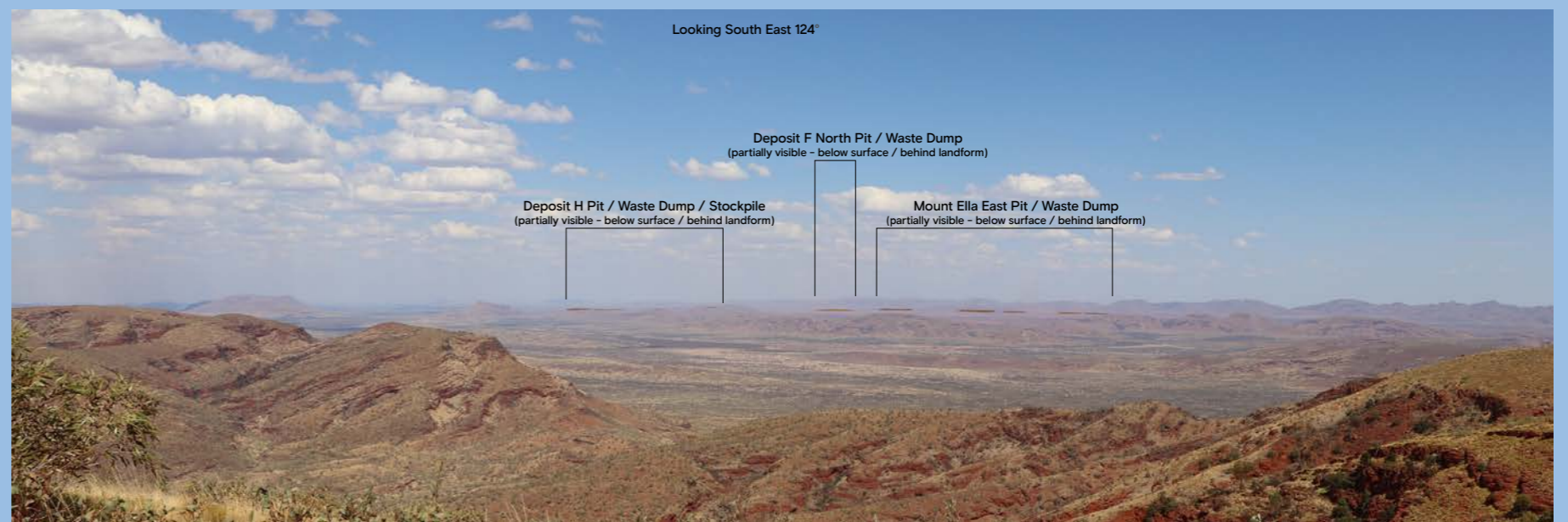


Viewpoint Characteristics

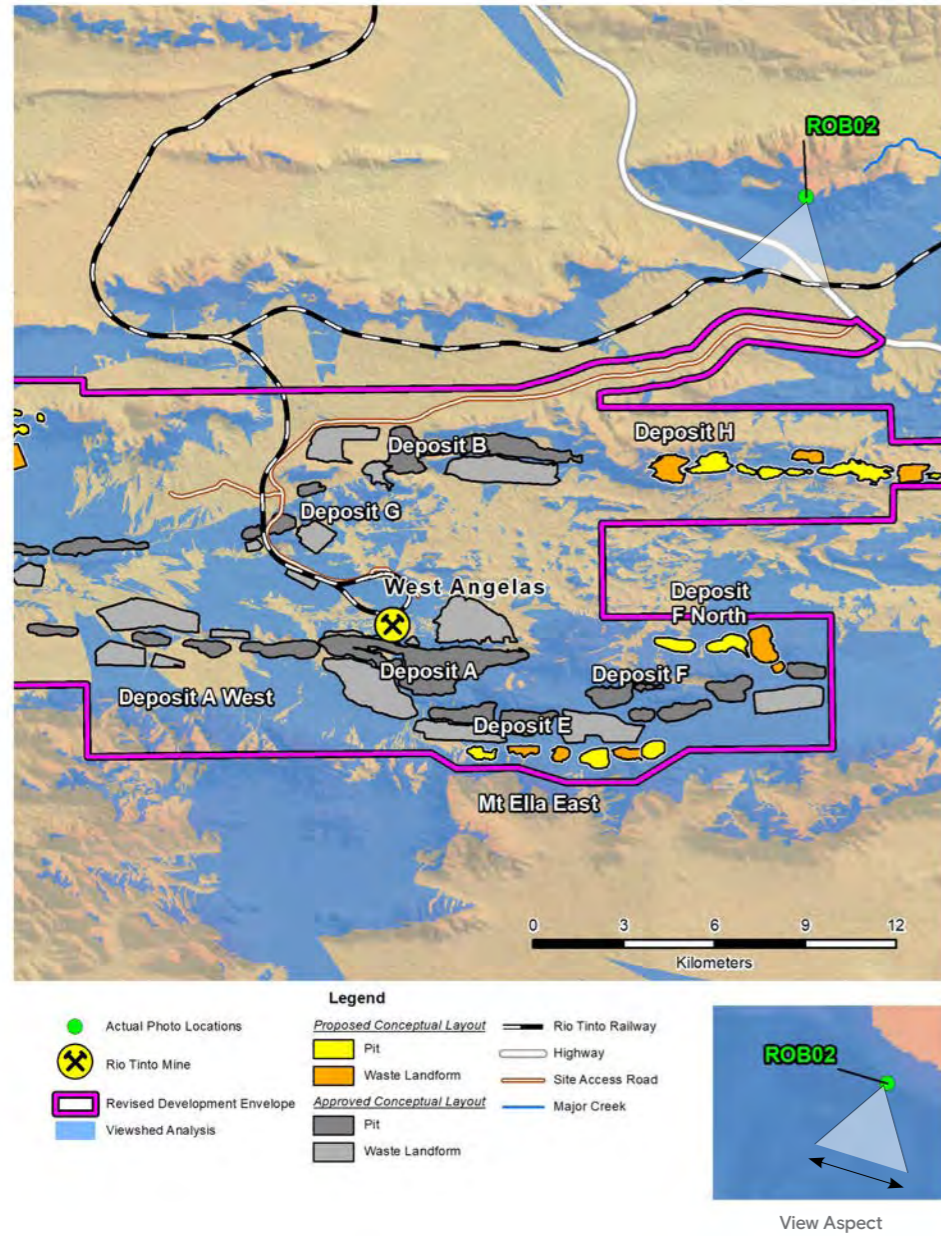
Name	02 - MEH02 - Mount Meharry
Co-ordinates	662,796.60mE / 7,457,755.00mN
Direction	South East (Bearing 124°)
Description	Located on top of Mount Meharry with clear view towards West Angelas Revised Proposal. Medium level vegetation with view well above tree line.
Site Significance	Located within Karijini National Park, this site is regularly visited by tourists.
Comments	Clear view with Mount Robinson and Hope Downs 2 to the left. Very hot and windy.

Figure 6-13 Mount Meharry

Closure View



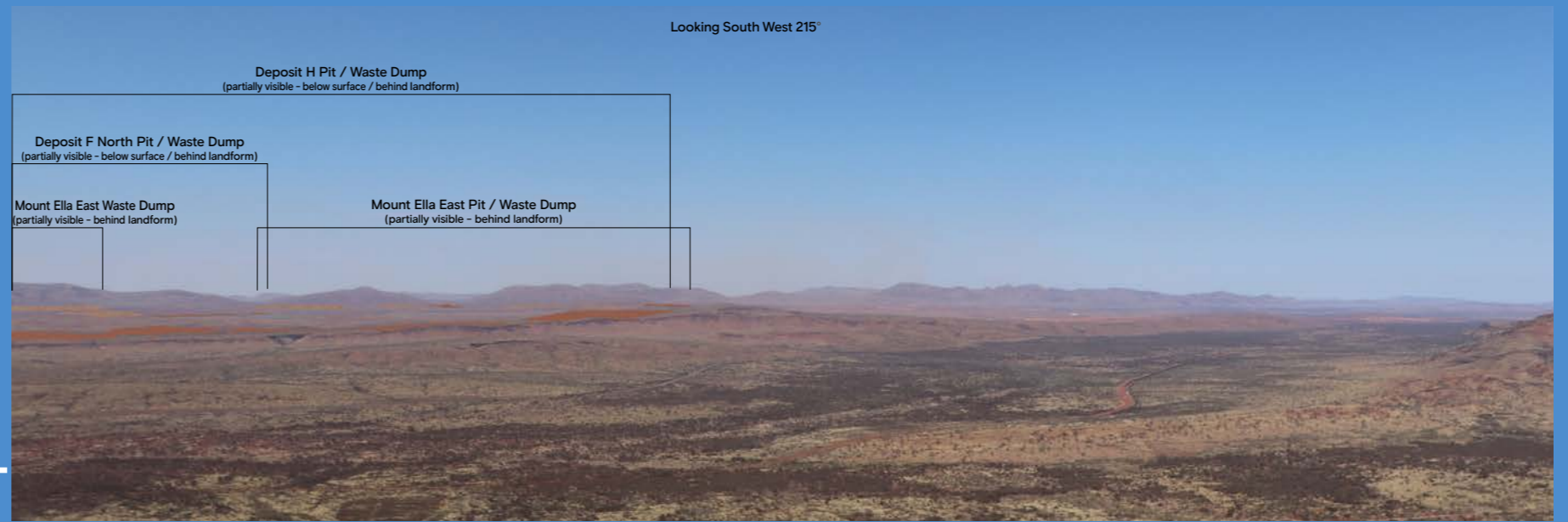
Location Map



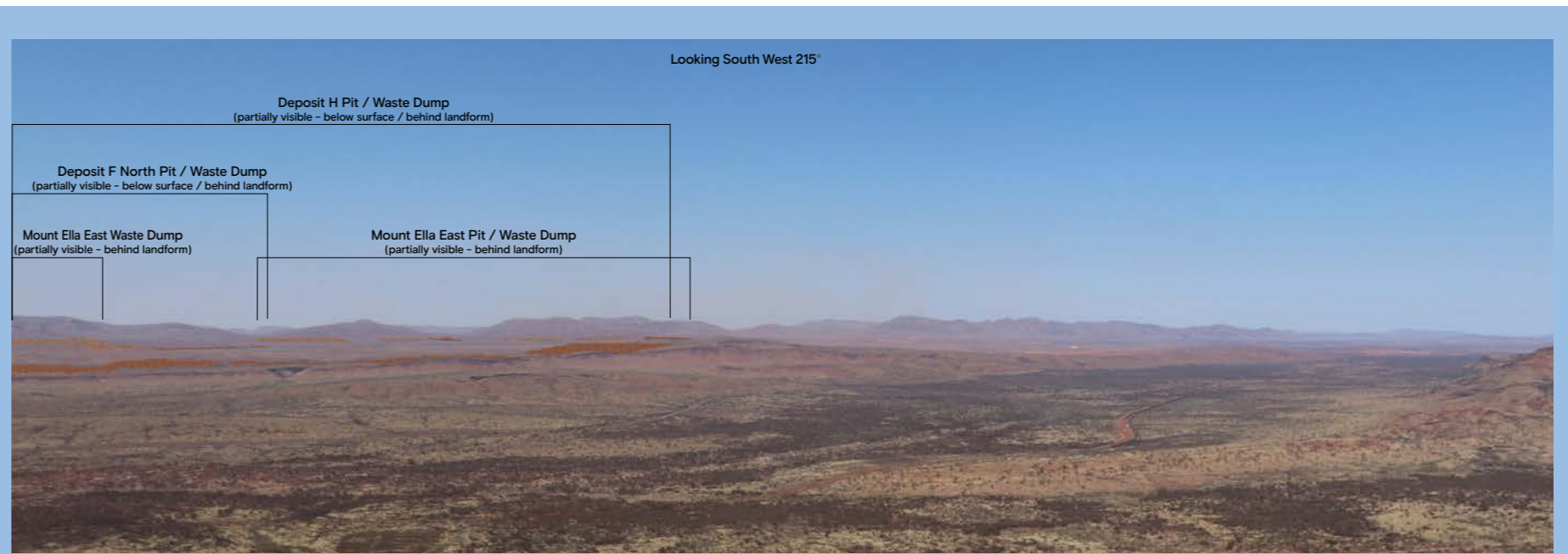
Current View



Operations View



Closure View

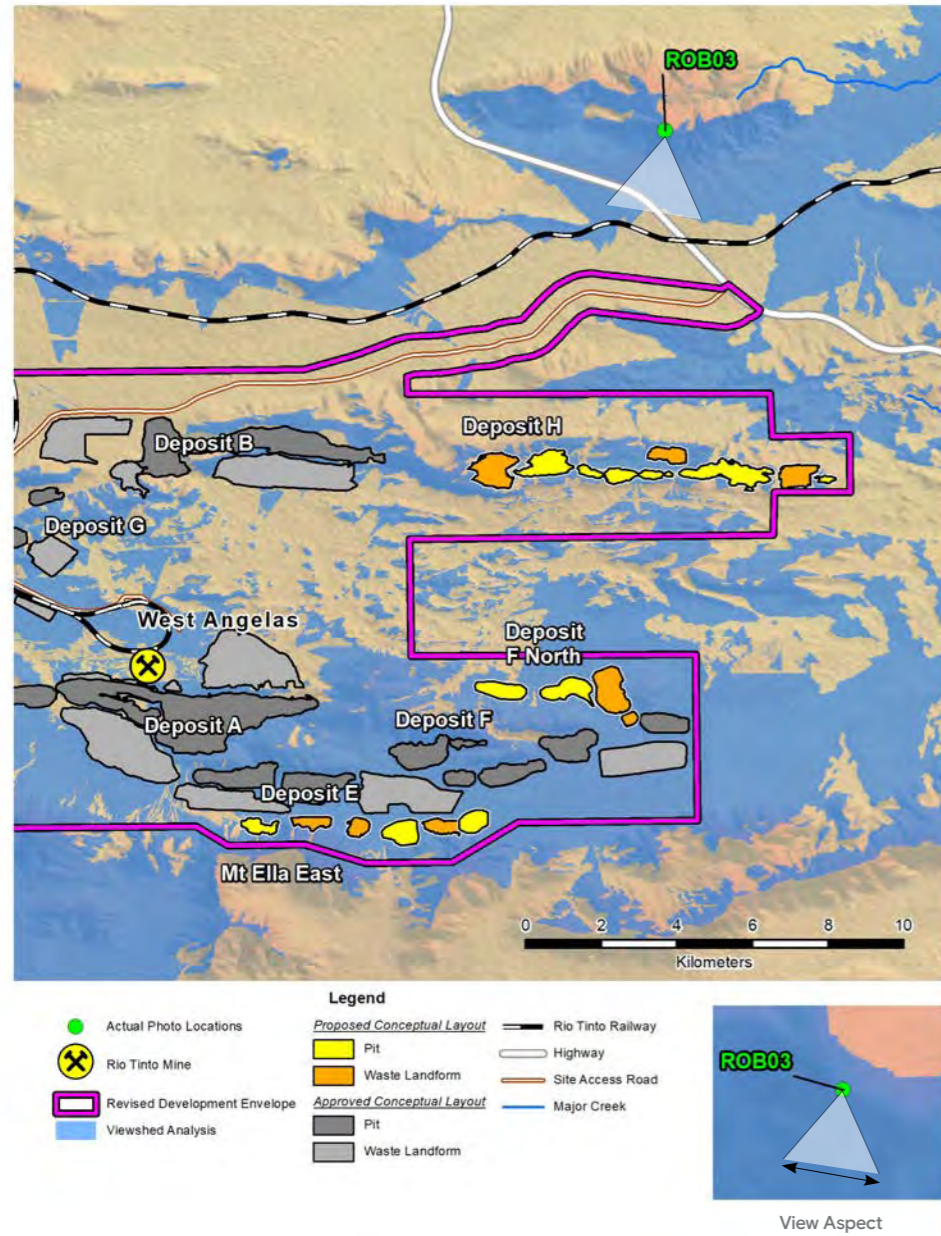


Viewpoint Characteristics

Name	05 - ROB02 - Mount Robinson
Co-ordinates	693,349.30mE / 7,450,333.00mN
Direction	South West (Bearing 215°)
Description	Located on top of Mount Robinson with clear view towards proposed Deposit H operations. Medium level vegetation with view above tree line.
Site Significance	Mount Robinson is a significant site for the Yinhawangka People and Banjima People.
Comments	Clear view towards West Angelas Revised Proposal. Very hot and windy.

Figure 6-14 Mount Robinson

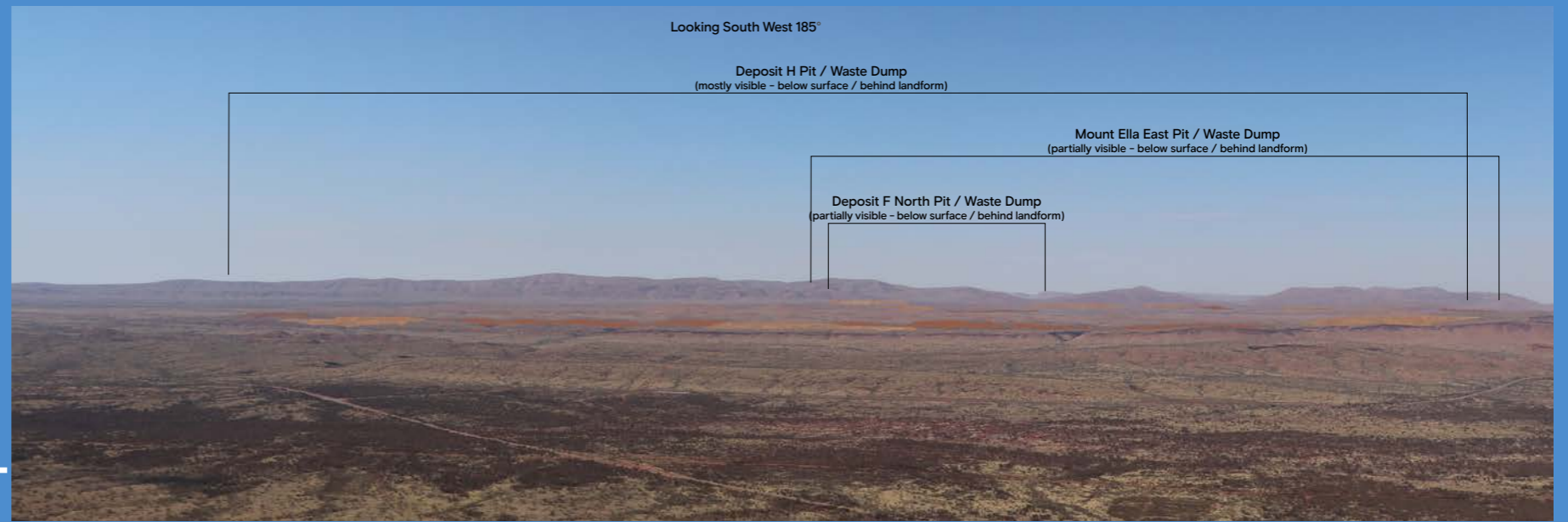
Location Map



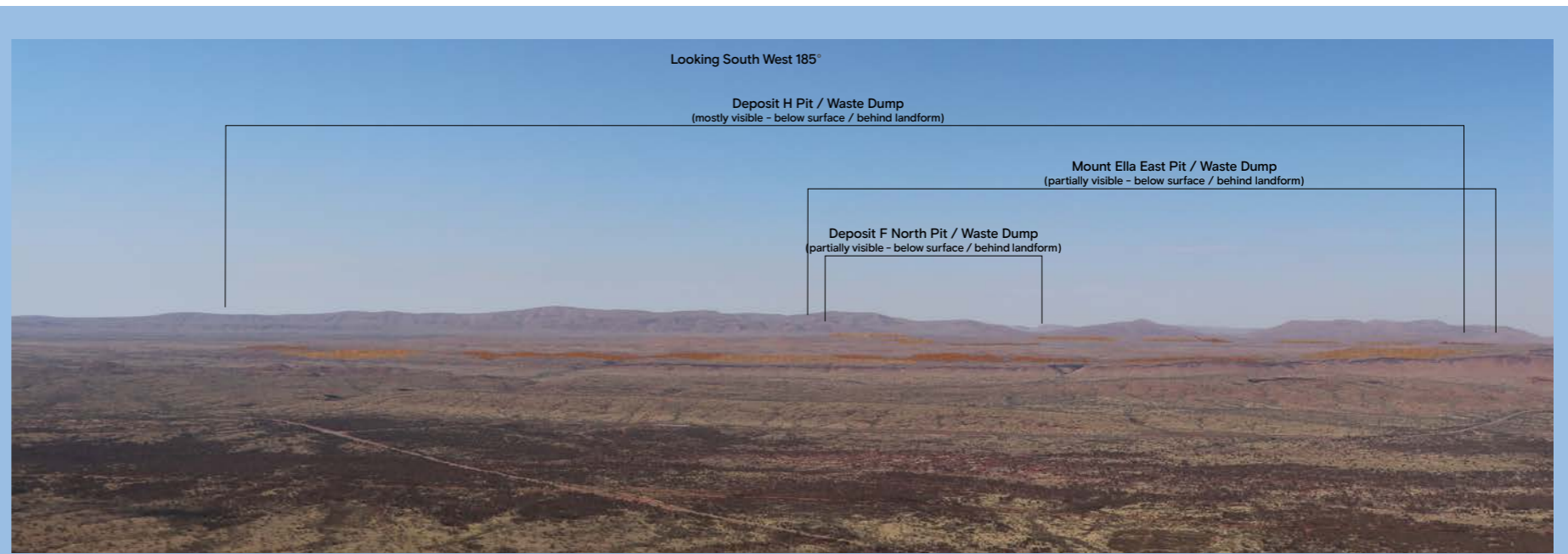
Current View



Operations View



Closure View

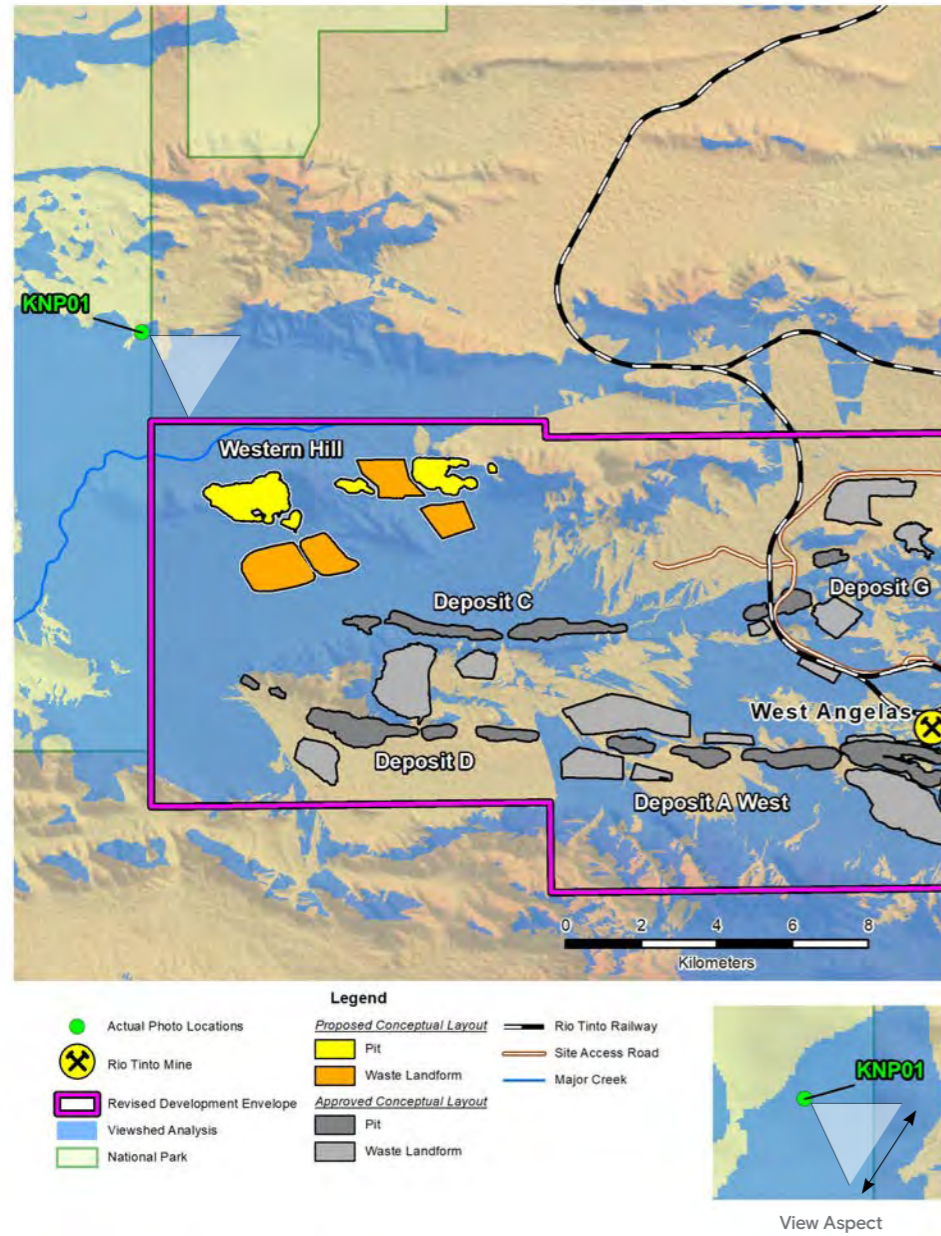


Viewpoint Characteristics

Name	05 - ROB03 - Mount Robinson
Co-ordinates	693,349.30mE / 7,450,333.00mN
Direction	South West (Bearing 185°)
Description	Located on top of Mount Robinson with clear view towards proposed Deposit H operations. Medium level vegetation with view above tree line.
Site Significance	Mount Robinson is a significant site for the Yinhawangka People and Banjima People.
Comments	Clear view towards West Angelas Revised Proposal. Very hot and windy

Figure 6-15 Mount Robinson

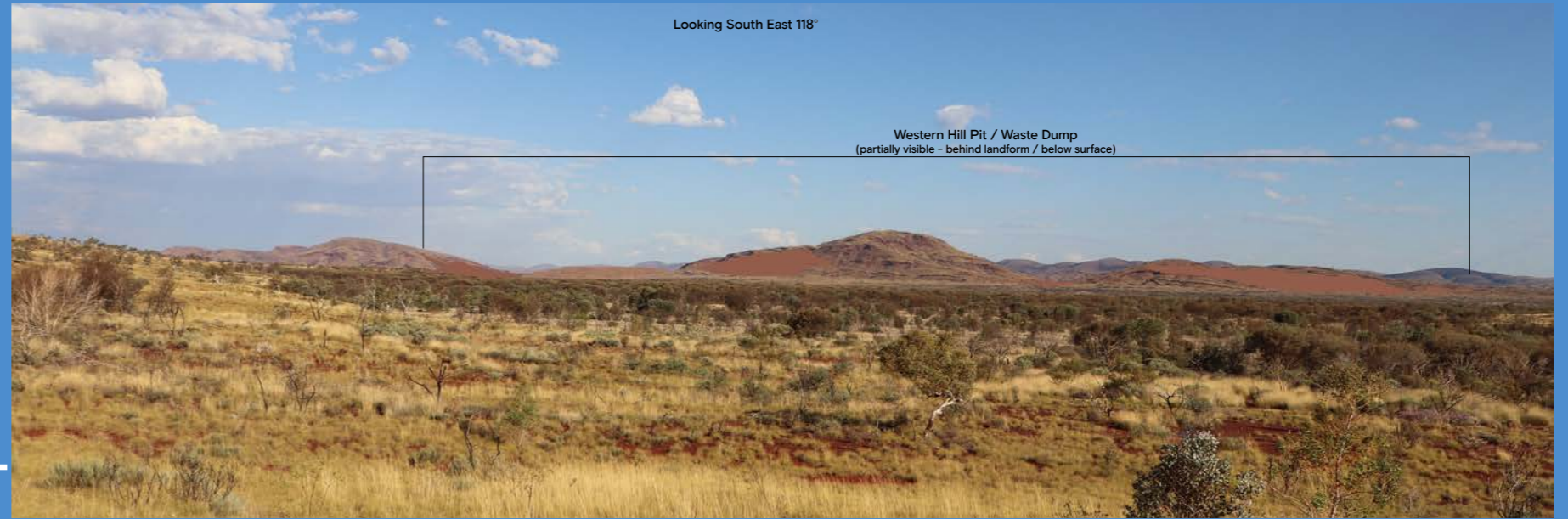
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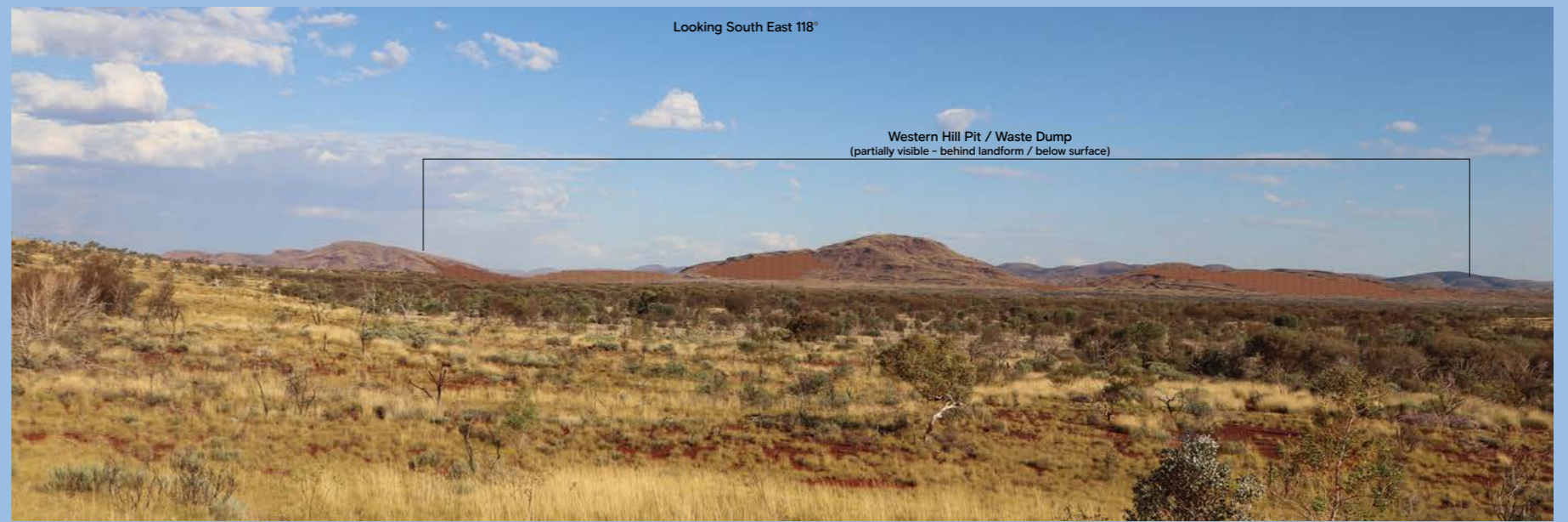
Current View



Operations View



Closure View

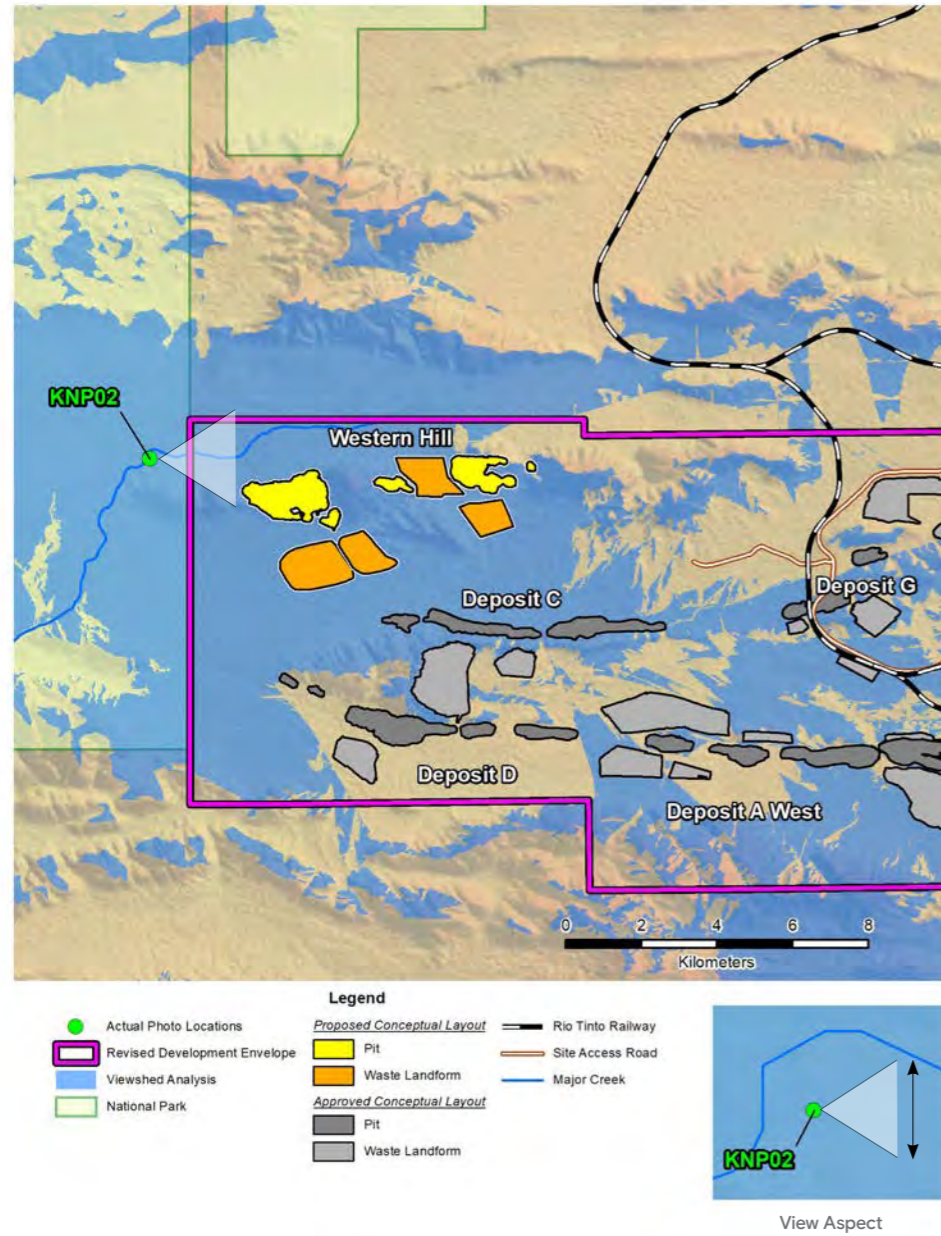


Viewpoint Characteristics

Name	13 - KNP01 - Karijini National Park
Co-ordinates	661,462.40mE / 7,447,025.00mN
Direction	South East (Bearing 118°)
Description	Located at the Western boundary of Karijini National Park, looking towards proposed Western Hill operations. Medium level vegetation with clear view.
Site Significance	Located within Karijini National Park, this site is regularly visited by tourists.
Comments	Clear view towards West Angelas Revised Proposal. Very hot and windy.

Figure 6-16 Karijini National Park

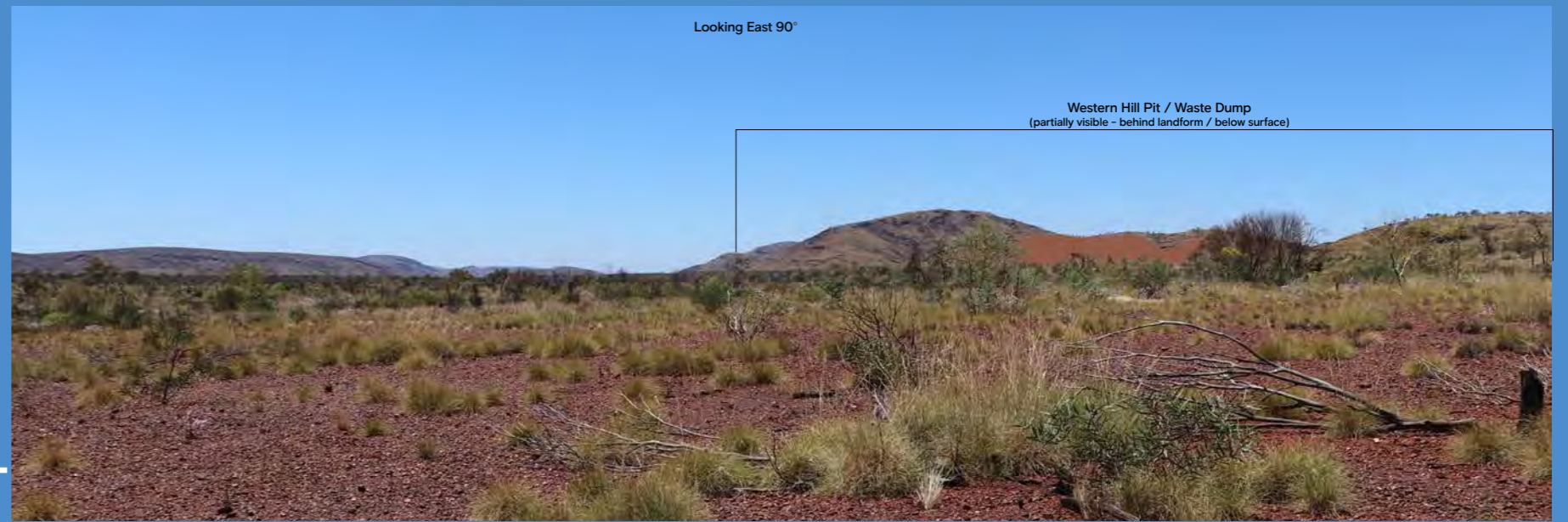
Location Map



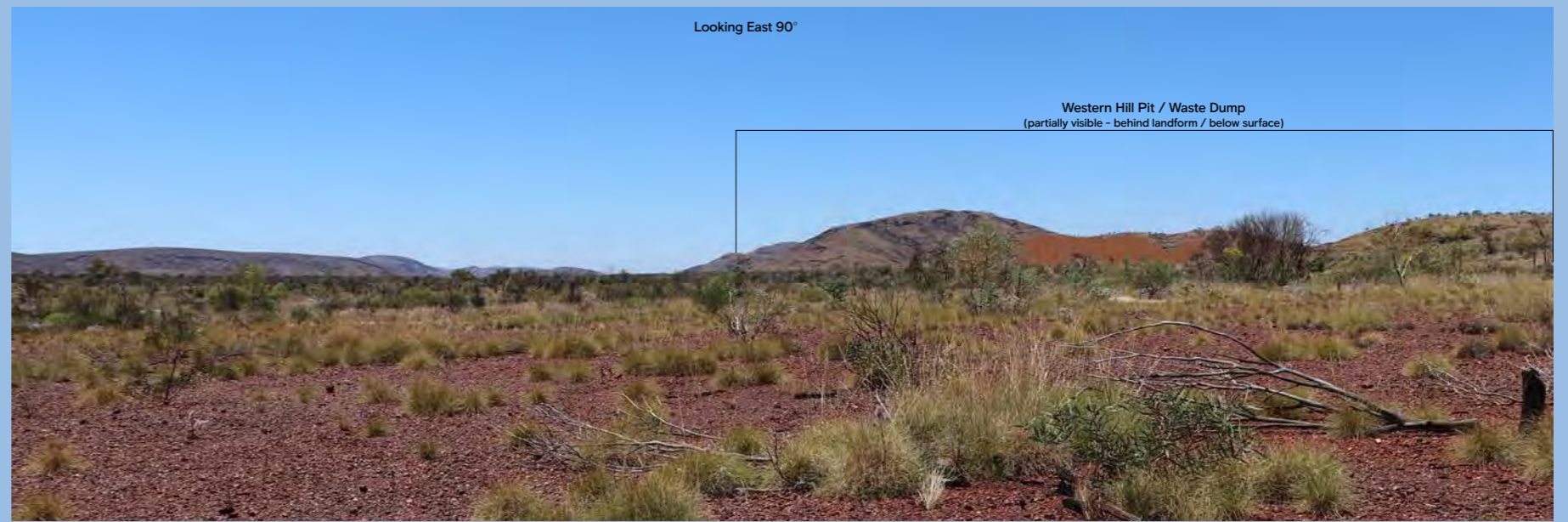
Current View



Operations View



Closure View

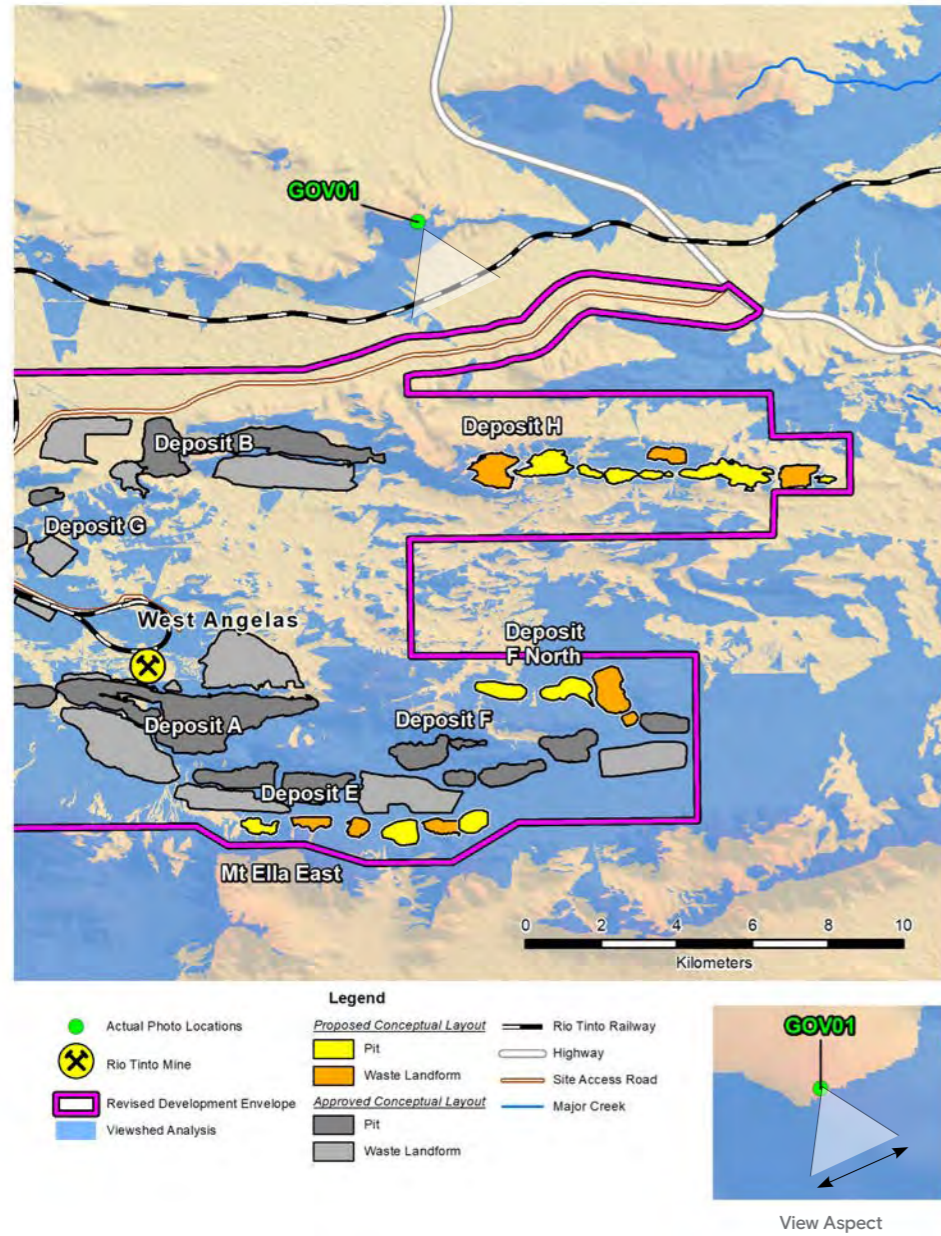


Viewpoint Characteristics

Name	14 - KNP02 - Karijini National Park
Co-ordinates	660,672.50mE / 7,443,651.00mN
Direction	East (Bearing 90°)
Description	Located at the Western boundary of Karijini National Park, looking towards proposed Western Hill operations. Medium level vegetation with clear view.
Site Significance	Located within Karijini National Park, this site is regularly visited by tourists.
Comments	Clear view towards West Angelas Revised Proposal. Very hot and windy.

Figure 6-17 Karijini National Park

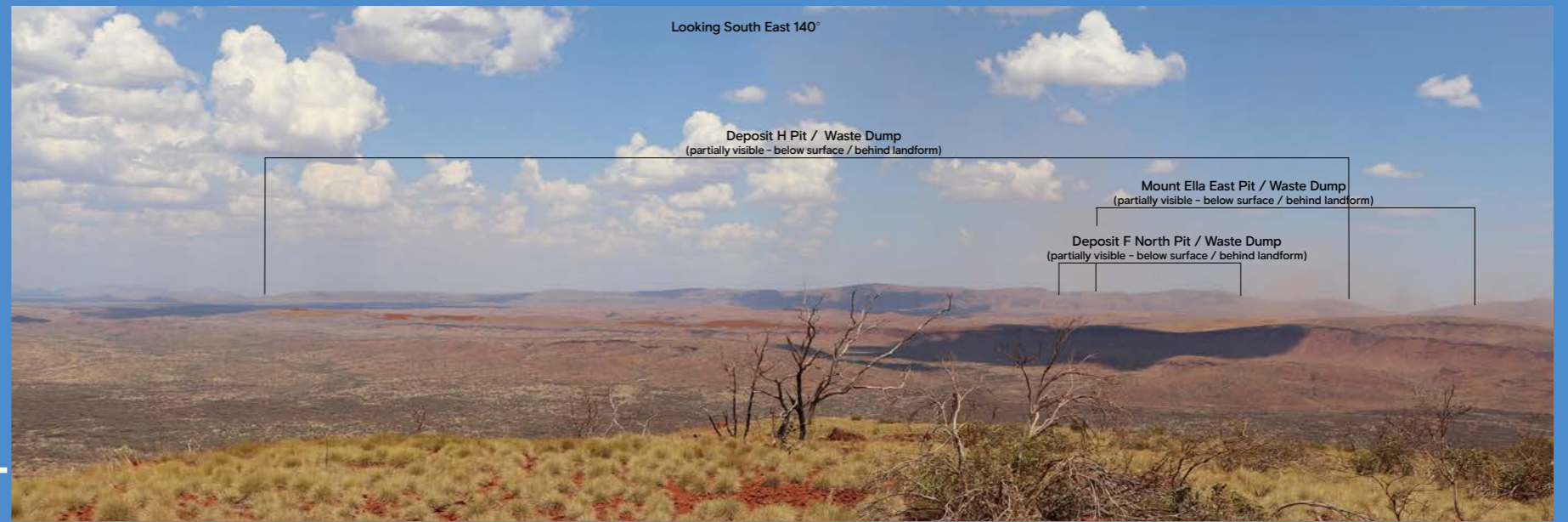
Location Map



Current View



Operations View



Closure View

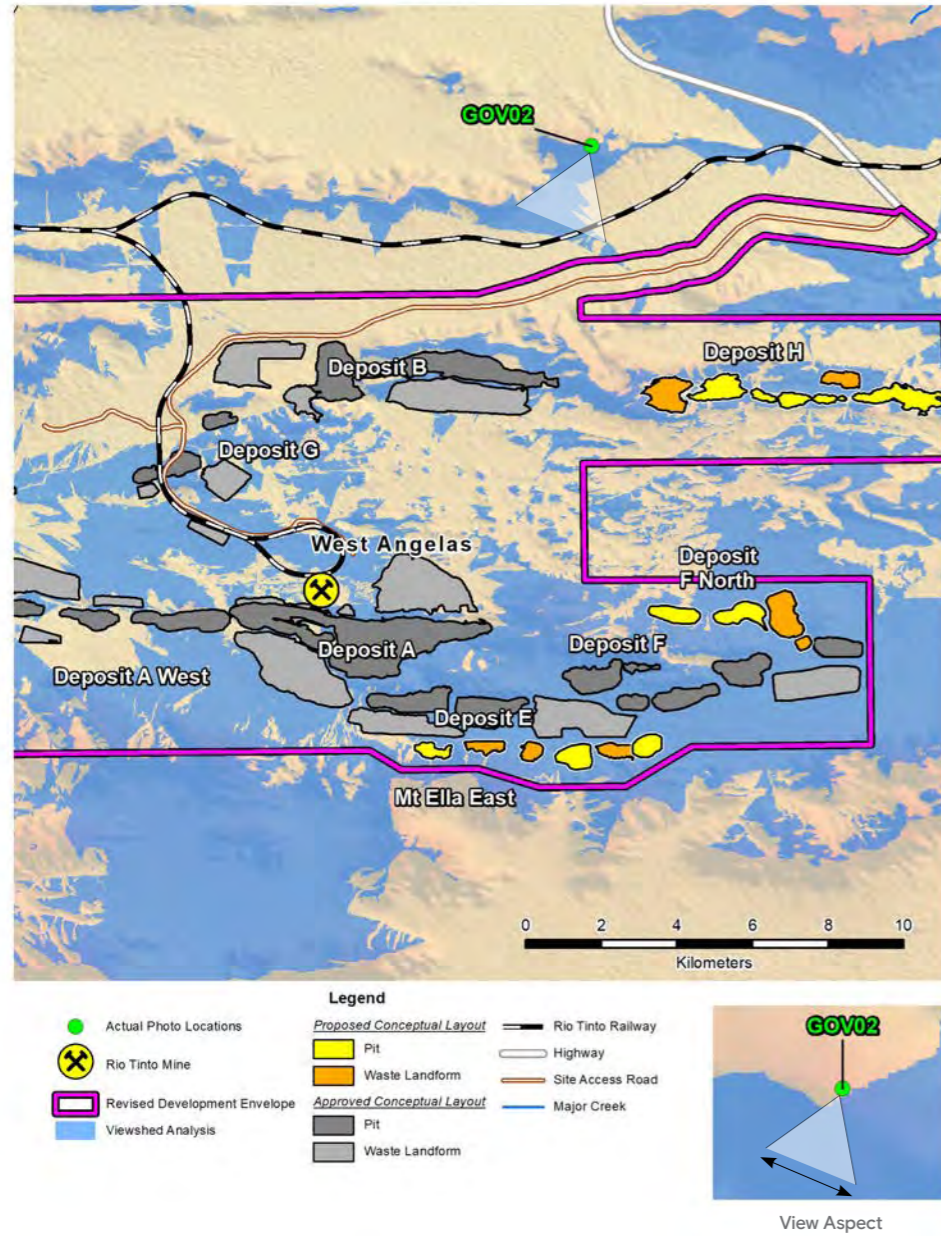


Viewpoint Characteristics

Name	06 - GOV01 - The Governor
Co-ordinates	687,295.40mE / 7,448,002.00mN
Direction	South East (Bearing 140°)
Description	Located on top of The Governor with clear views towards proposed Deposit H operations. Low level vegetation with view above tree line.
Site Significance	The Governor is a significant site for the Yinhawangka People.
Comments	Clear view towards West Angelas Revised Proposal. Very hot and windy.

Figure 6-18 The Governor

Location Map



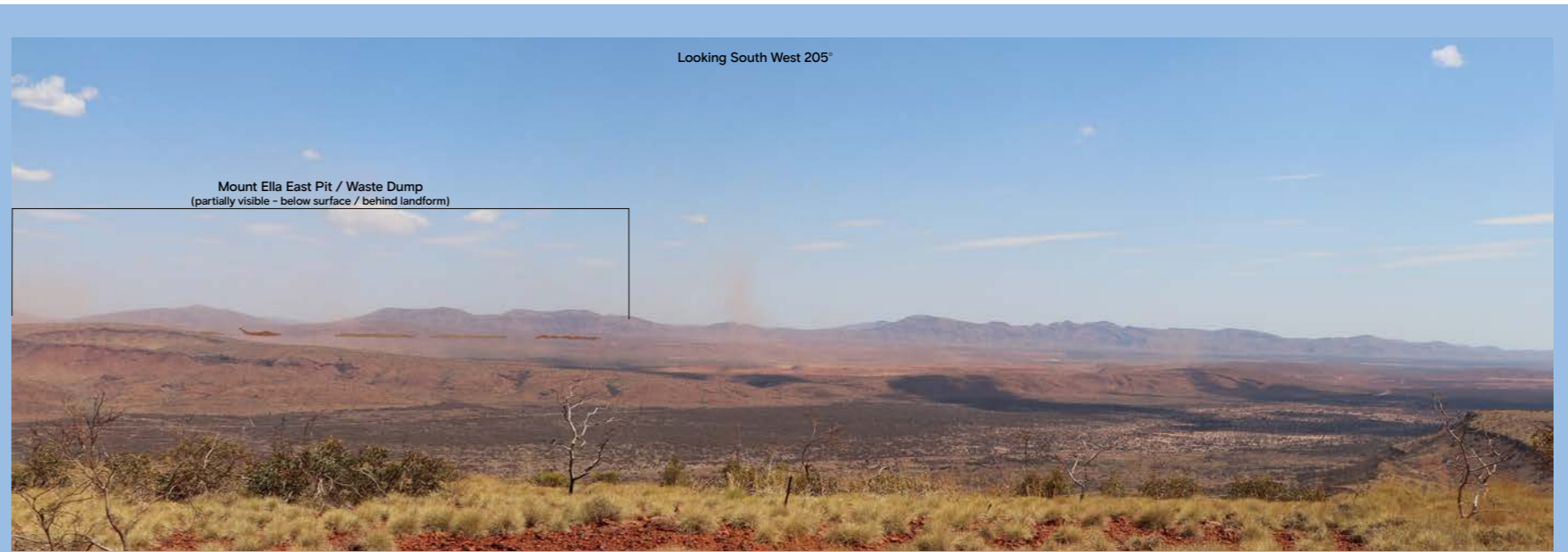
Current View



Operations View



Closure View



Viewpoint Characteristics

Name	07 - GOV02 - The Governor
Co-ordinates	687,295.50mE / 7,448,002.00mN
Direction	South West (Bearing 205°)
Description	Located on top of The Governor with clear views towards proposed Mt Ella East operations. Low level vegetation with view above tree line.
Site Significance	The Governor is a significant site for the Yinhawangka People.
Comments	Clear view towards West Angelas Revised Proposal. Very hot and windy.

Figure 6-19 The Governor

6.10. Significance of Residual Impacts

6.10.1. Non-Significant Residual Impacts

The proposed avoidance and management measures associated with the Proposal - including no direct impacts to Deposit H Waterhole site complex, Turtle Pool, Mt Ella East site complex, Western Hill site complex, the Range and the unnamed hill range to the south of the existing West Angelas operation - demonstrate non-significant residual impact to Social Surroundings, including:

- To the ecological vitality of Turtle Pool due to catchment reduction
- To the hydrological regime of Turtle Pool as a result of groundwater impacts from sump pumping from the Deposit H aquifer
- The visual amenity of Karijini National Park and high viewpoints
- Upstream water impacts that concern Turee Creek Pastoral Station
- Temporary loss of access to Country limiting the Ngarlawangga and Yinhawangka ability to Care for Country, to use and enjoy Country and conduct cultural activities
- Temporary impacts to Traditional Owner amenity including from mining activity itself and generated noise, dust and vibration which will affect sense of place, connection to Country, desire and enjoyment to be on Country and to undertake cultural practices
- Localised impact on plants and animals disturbed by Proposal, managed through SCHMP
- Indirect impacts to cultural sites
- There are no predicted significant impacts predicted to the general public. The Revised Development Envelope is not frequented by member of the public for recreational activities
- No European heritage sites have been documented within the Revised Development Envelope.

6.10.2. Significant Residual Impacts

The Proponent has applied the mitigation hierarchy (Section 6.8) against the environmental objective for social surroundings. After applying the mitigation hierarchy, the Proponent considers that the following residual impacts to key social surroundings values are significant. As these all apply to Traditional Owner social surroundings, ongoing consultation and management of these significant residual impacts will be managed through co-developed SCHMPs.

- The loss of water from dewatered aquifers due to water's sacred nature and the multigenerational timeframe for recharge; however, the volume of water proposed to be abstracted is limited and will not result in the abstraction of entire aquifers. Traditional Owners have acknowledged dewatering is required for the Proposal
- Permanent changes to landscape and landforms will impact cultural heritage, usage and amenity of Country
- Permanent change to amenity and ecological vitality of the Deposit H Waterhole site complex as a result of catchment reduction and its effect on flows and potential for a small to moderate decrease in vegetation abundance and density over time (i.e. reduced ecological vitality)
- The loss of permanent access, use of, and connection to those parts of Country that remain unrehabilitated or behind abandonment bunds will be felt by Ngarlawangga and Yinhawangka peoples as an enduring impact their cultural heritage and restriction of Native Title rights for those areas of land
- Permanent changes to landforms that alters Traditional Owner amenity, sense of place and connection to Country as well as the enjoyment and desire to be on this part of Country
- Permanently changed landscape that impacts the spiritual connection to Ancestor use of Country and future generation's understanding of Country
- Direct disturbance of heritage sites:
 - Of the 46 potential or known heritage site identified within the Ngarlawangga portion of the Revised Development Envelope, 39 intersect the current proposed Conceptual Footprint.
 - Of the 85 potential or known heritage site identified within the Yinhawangka portion of the Revised Development Envelope, 52 intersect the current proposed Conceptual Footprint.
 - There are other cultural sites in the broader landscape which have the potential to be indirectly impacted through dust, noise, vibration, changes to landforms and visual amenity, workforce visitation and changes to biological attributes.

6.11. Mitigation of Impacts at Closure

In preparing for closure, the Proponent recognises the native title rights of the Ngarlawangga and Yinhawangka People. As native title holders the Ngarlawangga and Yinhawangka have a deep connection to the Country the Proposal is located on and this will continue during Proposal operation and after it has completed. Being mindful of this, the Proponent recognises the importance of Ngarlawangga and Yinhawangka involvement in mine planning and the subsequent rehabilitation and closure planning and implementation of the mining landscape. The Proponent will continue to consult with Ngarlawangga, Yinhawangka and Turee Creek Pastoral Station along with other key stakeholders where relevant via existing consultation forums or dedicated forums to incorporate consideration of their involvement, feedback and values into rehabilitation and closure planning and outcomes.

The draft MCP for the Proposal is included in Appendix A.5. A summary of the approach to closure and how it relates to the Social Surroundings environmental factor is provided below. The MCP will be updated on a regular basis to ensure its objectives remain relevant and are informed by stakeholder expectations, and its strategies and plans are appropriate to achieve closure outcomes.

The proposed post-mining land use, which includes the continued exercising of Native Title rights by Ngarlawangga and Yinhawangka people, assumes that the land the subject of the Proposal will be rehabilitated to create a safe, stable and non-polluting landscape revegetated with native species to the maximum extent practicable, to be consistent with identified environmental and cultural outcomes and ensure the site is compatible with the surrounding land use. It is acknowledged; however, that Native

Title rights for some sections of Country will be permanently impacted where access is prevented, and rehabilitation not undertaken (such as within abandonment bunds and pit voids).

The main closure objective for Social Surroundings values of the Proposal is to preserve, protect and manage those values in the area in cooperation with the Yinhawangka, People, YAC, Ngarlawangga People, NAC, Turee Creek Pastoral Station as well as Local Government and Regional communities, including Newman. Management of Traditional Owner Social Surroundings values for closure will be conducted through processes incorporated into MCP reviews and the co-designed SCHMPs, and as based on ongoing consultation.

During closure, above ground and near surface (<1 m deep) infrastructure will be demolished and recycled, salvaged or appropriately disposed of, typically via burial on site in approved locations. The resulting disturbance footprint will be rehabilitated. Other infrastructure that may typically be greater than 1 m below ground can include but not be limited to buried cabling, pipes and footings which are generally retained in situ post mining as determined within the MCP. However, some access infrastructure (e.g. roads, tracks) may be retained post-closure if a suitable use is identified and in consultation with Traditional Owners. The Proponent will continue to engage with Traditional Owners through established arrangements such as via LoM Planning forums, Native Title Agreements (NTAs), or as detailed in the relevant SCHMPs as appropriate to determine the final fate of infrastructure at closure.

Below Water Table pits will be backfilled to a minimum of two metres above original watertable level to prevent formation of permanent pit lakes. Other opportunities for in-pit disposal of waste rock will be identified and assessed over the life of operations. Yinhawangka have identified that consent to mining of the Mt Ella East pits is conditional to backfilling to surface of these specific pits, due to their proximity to the Range and cultural responsibility to minimise impacts to this significant cultural feature. It is understood that where permanent changes to landscape occur, where access is prevented or where rehabilitation does not occur, that this represents a multigenerational compromise for Traditional Owners.

The Proponent will continue to engage with Traditional Owners through established arrangements such as under Life of Mine Planning forums, NTAs, or as detailed in the relevant SCHMPs as appropriate, to consider backfill options throughout the life of the operations, particularly in relation to minimising long term impact on areas of cultural importance, as well as with respect to rehabilitation and design options to minimise visual impacts. Consultation will also focus on understanding post-closure access requirements of Traditional Owners, which will inform closure planning.

Although considered during landform design and planning (which includes rehabilitation designs), there is potential for social and cultural values to be impacted as a result of closure implementation. This can include footprint encroachment, zones of instability, and lack of access to country within abandonment bunds.

As detailed in the MCP, safety bunding is required around potentially unstable pit edge zones. An assessment has not been undertaken to determine if the preliminary bund location would impede access to key cultural sites and places and heritage sites post closure. This will be assessed in future stages of closure planning to ensure acceptable and safe access is available. Regular and ongoing consultation with Ngarlawangga and Yinhawangka on closure planning, including with respect to mandatory MCP reviews, will be incorporated in the SCHMPs.

Ngarlawangga and Yinhawangka have indicated a preference for rehabilitation to occur as soon as practicable. Traditional Owners have also advised that they would like closure rehabilitated landscapes to return to as natural state as possible and for this to be a consideration as part of mine planning consultation as well as within ongoing engagement regarding the MCP and rehabilitation practices. The Proponent has presented information to Traditional Owners during consultation on rehabilitation sequencing and timing to inform expectations regarding what may be reasonably feasible in this regard. Traditional Owners have also requested more examples of successful rehabilitation from other

operations, to inform their own expectations on what may feasibly be achieved. This will form part of ongoing social surroundings and closure consultation, including as addressed under the SCHMPs.

The Proponent is committed to training and employing Traditional Owners as suitable opportunities are identified to be involved in operational, closure and rehabilitation activities, such as seed collection, seeding, rehabilitation earthworks and monitoring, water monitoring and feral animal and weed control along with opportunities for employment and business opportunities in the construction and future operational phases. If not adequately addressed under existing arrangements such as NTAs, actions to facilitate such opportunities will be included in the SCHMPs.

6.12. Assessment of Cumulative Impacts

The Proposal adds to existing impacts to Social Surroundings, including effects upon amenity, heritage and culture, and Care for Country practises and outcomes.

Mining at West Angelas Operations commenced in 2002 and has continued since that time. Existing operations in the region have retained prominent landscape features and avoided impacts to many significant places of high cultural heritage value. However, the landscape and connection to Country and the cultural use and enjoyment of the area has been permanently altered, and will continue to be affected for the duration of mining related activities in this area. Many heritage sites have also been approved to be disturbed within the existing West Angelas Operations. The Proposal will add to those permanent cumulative impacts to landscape changes, sense of place, use and enjoyment of Country and heritage sites as well as to temporary cumulative impacts to water and from dust. There are extensive exploration activities for other proponents (principally BHP, FMG and Mineral Resources) immediately surrounding the Proposal. Nearby operating and proposed mines which contribute to cumulative impacts include (approximate distances):

- West Angelas Operations – Within the Revised Development Envelope
- West Angelas Iron Ore Mine Deposits C, D and G – Within the Revised Development Envelope
- Hope Downs 1 Iron Ore Mine – 22 km
- Hope Downs 2 (proposed) – 2 km
- Hope Downs 4 Iron Ore Mine – 60 km
- Mineral Resources – Wonmunna – 40 km
- Yandicoogina Iron Ore Project Expansion – 50 km
- Gudai-Darri Iron Ore Mine and Infrastructure Project – 65 km
- Marandoo Iron Ore Project – 65 km
- Mining Area C Southern Flank – 35 km
- Yandi Iron Ore Mine – 50 km
- Iron Valley Iron Ore Mine – 65 km.

The Proposal has been designed to avoid potential significant cumulative impacts to Social Surroundings due to impacts to cultural and heritage values at Deposit H Waterhole site complex, Turtle Pool, Mt Ella East site complex, Western Hill site complex, the Range, which are of high cultural significance to Ngarlawangga and/or Yinhawangka Traditional Owners. Following changes to the design of the Proposal, Deposit H Waterhole site complex, Turtle Pool, Mt Ella East site complex, Western Hill site complex, the Range, will be retained in-situ. The Proponent has committed to avoiding direct impacts to these sites by establishing heritage site boundaries and undertaking geotechnical assessments at sensitive site features and has made commitment to not impact the catchment of Deposit H Waterhole, or extract groundwater for production from the Deposit H aquifer without written agreement from NAC. The Proponent is committed to maintaining and facilitating (where required) Traditional Owner access to these sites (noting that if these sites are unable to be kept safely accessible,

then further discussions regarding offsets or mitigation measures would be undertaken). The design of the Proposal was amended to contract the Revised Development Envelope to avoid direct impacts to the Range, the unnamed hill range to the south of the existing West Angelas operation. The Conceptual Footprint was amended to avoid direct impacts to the Range, the Western Hill site complex, the Deposit H Waterhole site complex and the Mt Ella East site complex.

The expected cumulative impact from the Proposal and surrounding operations on Turee Creek East catchment area, including parts of Karijini National Park and Turee Creek Pastoral Station, is a 6.3% reduction in catchment size, representing approximately 1.75% of the Turee Creek (total) catchment – this impact not considered significant in relation to environmental values and catchment function.

The Proponent will continue to consult with Ngarlawangga, Yinhawangka, Turee Creek Pastoral Station along with other key stakeholders where relevant via existing consultation forums or via dedicated forums to incorporate consideration of their involvement, feedback and values into cumulative impacts particularly to landscape impacts, water use and dust related outcomes.

The dust assessment (ETA 2022) predicts dust deposition rates will remain under the human amenity and health values or nuisance assessment threshold (4 g/m²/30 days) used for all modelled locations. While these deposition rates are low against the nominated thresholds, dust is expected to remain as a temporary (albeit over the life of operations, approximately 15 years). The thresholds also do not adequately reflect the felt impacts to social surroundings values which will include impact to sense of place, connection to Country, enjoyment of, and desire to be on, Country and the undertaking of cultural practices as well as impacts to flora, fauna and amenity.

The inclusion of cumulative sources of dust (i.e. the existing operations and other nearby mines), identifies several locations that will experience maximum modelled TSP concentrations above the 24-hour amenity or nuisance assessment criteria (90 µg/m³) (ETA 2022). Turtle Pool is predicted to experience more than 90 days above the assessment criteria in each of the modelled assessment years. YINHARR-39 is predicted to experience more than 200 days above the assessment criteria in model Year 2; however, this reduces to seven days in model Year 10.

Table 6-23: TSP Concentration at Key Sensitive Receptors – including Background (µg/m³)

Receptor	Max. 24 hr Average (µg/m ³)		No of Days Above Assessment Per Year Criteria	
Assessment criteria	Kwinana EPP – 90 µg/m ³		Kwinana EPP - 90 µg/m ³	
Year of Operation	2	10	2	10
Ngarlawangga				
Deposit H Waterhole	131	130	4	2
Turtle Pool	539	539	98	94
Yinhawangka				
WA-16-61-SS	86	52	0	0
WA-16-45-ENG	83	343	0	62
YINHARR-39	1370	140	219	7
WANETH06-2	97	174	2	3
Ngarlawangga and Yinhawangka				
Mt Ella East SE Con	184	96	5	1
Mt Ella East S Con	135	78	1	0

Orange: above assessment criteria (90 µg/m³)

Table 6-24: Maximum Monthly Deposition Rate (g/m²/month) with Inclusion of Nearby Mines

Receptor	Year 2	Year 10
Ngarlawangga		
Deposit H Waterhole	2.3	0.3
Turtle Pool	0.2	0.2
Yinhawangka		
WA-16-61-SS	0.4	1
WA-16-45-ENG	0.3	0.3
YINHARR-39	0.2	0.2
WANETH06-2	0.3	0.2
Ngarlawangga and Yinhawangka		
Mt Ella East SE Con	0.1	0
Mt Ella East S Con	0.1	0.1

Orange: above assessment criteria (4 g/m²/30 days)

6.13. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented (EPA 2021). Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA’s objectives for the environmental factor.

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Social Surroundings are: avoid, where practicable, and otherwise minimise direct and indirect impacts as a result of implementation of the Proposal to Ngarlawangga and Yinhawangka cultural heritage and amenity values in accordance with the respective SCHMPs.

The Proponent also will avoid, where practicable, and otherwise minimise direct and indirect impacts in relation to Turee Creek Pastoral Stations Social Surroundings, particularly upstream water values.

The Proponent has outlined ongoing commitments to avoid impacts and implement controls to minimise and monitor residual impacts. SCHMPs have been developed with both Yinhawangka and Ngarlawangga (Appendix B.2.d and Appendix B.3.b) Traditional Owners.

The Proponent has ensured implementation of dedicated water monitoring practises and management occur during the LoM as an ongoing commitment to avoid impacts and implement controls to minimise and monitor residual impacts that are of a concern to Turee Creek Pastoral Station. Ongoing consultation via existing consultation forums or dedicated forums with Turee Creek Pastoral Station regarding designs, impacts and management through study phases and LoM will continue.

Based on this assessment, the Proposal was assessed as having a significant residual impact on Ngarlawangga and Yinhawangka social surroundings with respect to its permanent effects on amenity and cultural heritage values, particularly landform changes which impact sense of place, connection to

Country, enjoyment of and desire to be on Country and undertake cultural practices within and in proximity to the Revised Development Envelope. The Proposal will also add to permanent cumulative impacts to landscape changes, sense of place, use and enjoyment of Country and heritage sites as well as to temporary cumulative impacts to water and from dust.

The Proposal was assessed as having a low residual and cumulative impact on Turee Creek Pastoral Station and will continue with dedicated consultation forums with Turee Creek Pastoral Station and other key stakeholders regarding designs, impacts and management.

A range of measures have been developed with Ngarlawangga and Yinhawangka Traditional Owners in SCHMPs co-developed with each group after extensive and ongoing social surroundings consultation. The Proponent considers that there is a process of consultation and engagement in place with application of the mitigation hierarchy. The SCHMPs will ensure the Proponent continues to apply the EPA mitigation hierarchy (avoid, minimise, rehabilitate) to all planning and activities in consultation and in partnership with Ngarlawangga and Yinhawangka and their representatives, while acknowledging that permanent residual impacts to amenity will remain in perpetuity. A condition of approval requiring implementation of these SCHMPs, and reporting on their performance, is expected for this Proposal.

The Proponent also attests to a process of consultation and engagement with application of mitigation hierarchy in relation to heritage sites and places through the IHMP and CHMS that will ensure that the Proposal meets the EPA's objective for this factor in this regard. Potential direct impacts to such heritage values will be appropriately managed via Aboriginal heritage legislation and the IHMP. Any disturbance will be in accordance with approvals under section 16 and/or section 18 of the AH Act and as agreed with Traditional Owners through ongoing engagement and consultation, based on the principle of free, prior and informed consent (Appendix A.6).

In addressing the proposed commitments and implementation of the SCHMP in addition to meeting the requirements of other legislation (AH Act), the Proponent considers the Proposal can be managed to meet the EPA's objective "*to protect Social Surroundings from significant harm*".

7. INLAND WATERS

7.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021c) describes the following objective for Inland Waters:

To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected

This section addresses (but is not limited to) the following:

- Baseline hydrological regimes (surface and groundwater) and water quality at, and downgradient of, the Revised Development Envelope
- Pathways through which the hydrological regimes and water quality may be impacted by the Proposal, taking into account climate change forecasts
- Application of the mitigation hierarchy to avoid and/or minimise impacts to inland waters, where possible
- Significance of any residual impacts the alteration of the hydrological regime will have on water dependent ecosystems and other environmental values
- Outcomes for the key values for inland waters.

For assessment by the EPA, Inland Waters include groundwater, such as superficial and confined aquifers, and surface water, such as waterways, wetlands and estuaries (EPA 2018a). A 'waterway' is any river, creek, stream or brook, floodplain, estuary or inlet. This includes systems that flow permanently, for part of the year or occasionally, and waterways that have been artificially modified.

7.2. Relevant Policy and Guidance

Table 7-1 presents the relevant policy and guidance for Inland Waters and demonstrates how this has been considered for the Proposal.

Table 7-1: Relevant Policy and Guidance for Inland Waters

Relevant Policy and Guidance	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for Inland Waters forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Inland Waters (EPA 2018a)	The information required for impact assessment has been considered in the scope of this section
Instructions on how to prepare an Environmental Review Document (EPA 2021b)	This document forms the basis of the headings and content provided in this ERD.
Environmental Outcomes and Outcomes-based Conditions: Interim Guidance (EPA 2021g)	The guidance has been used to define environmental outcomes and identify if approval conditions are to be recommended, as well as their wording, in order to ensure the outcome is achieved.

Relevant Policy and Guidance	Explain How the Policy and Guidance has been Considered
Evaluating the environmental condition of Weeli Wolli Creek (EPA 2018b)	The report has been considered with respect to those elements of the Proposal that intersect the Weeli Wolli Creek catchment.
Other State or Commonwealth	
Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	The MCP (Appendix A.5) has been prepared in accordance with the guidance and addresses matters related to Inland Waters.
Statutory Guidelines for Mine Closure Plans (DMIRS 2020b)	
Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (DER 2015a)	Section 7.3.5 summarises the efforts and findings of investigations into AMD risk for the Proposal and sets out the risk profile based on mine lithologies.
Treatment and Management of Soil and Water in Acid Sulfate Soil Landscapes (DER 2015b)	Section 7.5 describes the management controls that will be applied to ensure AMD risk is as low as reasonably practicable.
Use of Mine Dewatering Surplus (DWER 2020a)	The water management strategy has been developed with consideration of this guidance, and surplus water will be preferentially discharged to mine pit voids once operational and environmental needs have been met.
Western Australian Water in Mining Guidelines (DoW 2013)	Discharge of surplus water is subject to the DWER Water in Mining guideline (DoW 2013) and licence requirements. It is noted that the Proponent's undertaking of dewatering will not be permitted to discharge to the environment where there is a likelihood that it will cause impacts on other land users (including inundation of land) or significant environmental damage (including water quality, acidification, erosion, damage to the riverbed and/or banks and altered water levels at sites with ecological and cultural assets) (DoW 2013). Water licence conditions may be applied to any groundwater abstraction licence to reduce and, where possible, eliminate risks and require monitoring, management and mitigation.
Pilbara Water in Mining Guidelines (DoW 2009a)	The water management strategy has been prepared with consideration of this guidance.
Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (DoW 2009b)	Groundwater abstraction will be licenced, and monitoring will follow the operating strategy. This provides confidence that DWER is regulating the monitoring and review of aquifer performance.
Use of operating strategies in the water licencing process (DWER 2020b)	
Water Quality Protection Notes (DOW, various)	Several of the Water Quality Protection Notes (WQPN) published by the WA Govt are very relevant to the Proposal and have been used to inform the impact assessment and well as mitigation approaches.
Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2018 (ANZG 2018e)	Australia's National Water Quality Management Strategy (WQMS) guides the management of water quality in Australia and New Zealand. This guidance has been used in consideration of surface water management and setting appropriate water quality targets.
National Water Quality Management Strategy (ANZG 2018)	

7.3. Receiving Environment

7.3.1. Studies and Survey Effort

The surface and groundwater hydrology of the Revised Development Envelope and surrounding area are generally well understood. This knowledge has been gained from long-term studies undertaken since the mid 1990's to support the development, construction, and ongoing operation of the Existing Operations.

Table 7-2 summarises the studies for Inland Waters undertaken for, or particularly relevant to, the Proposal. Key studies are provided in the appendices. Investigations into Turtle Pool are continuing to better understand the hydrology of the Pool.

Table 7-2: Summary of Key Studies

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Surface Water		
Assessment of the Risk Posed to Flora and Vegetation/Ecosystem Values at the Deposit H Ephemeral Pool and Gully by the Proposed Catchment Changes (Rio Tinto 2023a)	<p>Study/Survey Area: Deposit H Waterhole and surrounding values</p> <p>Type: Assessment of the potential impacts on flora and vegetation and ecosystem values caused by a reduced surface water catchment</p> <p>Timing: Assessment completed in 2023</p>	N/A
Hydrology and Floodplain Assessment for the West Angelas Beyond 2020 Study (Rio Tinto 2021c; Appendix C.1) Prepared for Rio Tinto	<p>Study/Survey Area: Proposal Area and Revised Development Envelope for floodplain mapping</p> <p>Type: Catchment/drainage assessment and hydraulic modelling of the proposed deposits using detailed topographic information and parameters optimised during previous investigations and monitoring</p> <p>Timing: 2018 to 2020</p>	The assessment is consistent with the Water in Mining Guidelines (DOW 2013) and provides information necessary to describe and assess the Proposal's impacts.
Site Inspection and surface water monitoring at Guburingu heritage area Western Hill (Rio Tinto 2020a; Appendix C.2) Prepared for Rio Tinto	<p>Study/Survey Area: Guburingu heritage area, within Karijini National Park</p> <p>Type: Description of outcomes of physical site assessment to identify key drainage features and conceptualise the site's surface water regime and creek geomorphology. Outcomes of two seasons of water level monitoring</p> <p>Timing: Site inspection in 2018. Monitoring was undertaken between 2018 and 2020</p>	N/A
Site inspection and monitoring of ephemeral pool, Deposit H (Rio Tinto 2020b; Appendix C.3) Prepared for Rio Tinto	<p>Study/Survey Area: Deposit H Waterhole</p> <p>Type: Description of outcomes of physical site assessment to identify key drainage features and conceptualise the site's surface water regime. Outcomes of two seasons of water level monitoring</p> <p>Timing: Site inspection in 2018. Monitoring was undertaken between 2018 and 2020</p>	N/A
Groundwater		
Western Hill Hydrogeological Impact Assessment (Rio Tinto 2021d; Appendix C.4).	<p>Study/Survey Area: Western Hill Deposit and surrounding hydrogeology</p> <p>Type: Hydrogeological assessment with conceptual hydrogeological modelling, groundwater flow modelling, and assessment and management/monitoring of potential impacts</p> <p>Timing: Assessment completed in 2021</p>	Assessment is consistent with the Water in Mining Guidelines (DOW 2013) and Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (DoW 2009b).

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
Deposit H Hydrogeological Impact Assessment (Rio Tinto 2023; Appendix C.5).	<p>Study/Survey Area: Deposit H and surrounding hydrogeology</p> <p>Type: Hydrogeological assessment with conceptual hydrogeological modelling, groundwater flow modelling, and assessment and management/monitoring of potential impacts</p> <p>Timing: Assessment completed in 2023</p>	Assessment is consistent with the Water in Mining Guidelines (DoW 2013) and Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (DoW 2009b).
West Angelas - Deposit F North Hydrogeological Conceptualisation (Rio Tinto 2022b) (Appendix C.6)	<p>Study/Survey Area: Deposit F North and surrounding hydrogeology</p> <p>Type: Hydrogeological assessment with conceptual hydrogeological modelling, groundwater flow modelling, and assessment and management/monitoring of potential impacts</p> <p>Timing: Assessment completed in 2022</p>	Assessment is consistent with the Water in Mining Guidelines (DoW 2013) and Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (DoW 2009b).
West Angelas - Deposits C, D and G H3 Hydrogeological Assessment (Rio Tinto 2018a).	<p>Study/Survey Area: Hydrogeology of areas west of the Proposal, including Karijini National Park</p> <p>Type: This study provides an in-depth review of the hydrogeology of the western side of the Approved Proposal, focussing on the potential for dewatering pits at Deposit C and D to impact Karijini National Park. It has been released previously as part of the environmental assessment of Deposits C, D and G (EPA Assessment No. 2132)</p> <p>Timing: Assessment completed in 2018</p>	Assessments are consistent with the Water in Mining Guidelines (DoW 2013) and Operational Policy 5.12 – Hydrogeological reporting associated with a groundwater well licence (DoW 2009b).
Geochemistry		
West Angelas Geochemical Characterisation (Rio Tinto 2021e; Appendix C.7).	<p>Study/Survey Area: Deposit F North, Deposit H, Mt Ella East and Western Hill.</p> <p>Type: Geochemical assessment (including acid-base accounting and geochemical analysis) of rock samples from the full range of lithologies</p> <p>Timing: Assessment completed in 2021</p>	Investigation and risk assessment within scope of DWER and DMIRS guidelines.
Acid Mine Drainage Source Hazard Risk Assessment West Angelas (Mine Waste Management 2021; Appendix C.8).	<p>Study/Survey Area: All West Angelas mine pits, including the proposed Deposit F North, Deposit H, Mt Ella East and Western Hill</p> <p>Type: AMD source hazard assessment to highlight at-risk geological materials requiring additional management during operations/closure</p> <p>Timing: Assessment completed in 2021</p>	Investigation and risk assessment within scope of DWER and DMIRS guidelines.

Studies/Survey/Prepared for	Study Area, Type and Timing	Consistency with Guidance
<p>Greater West Angelas AMD Risk Assessment (Rio Tinto 2016; Appendix C.9).</p>	<p>Study/Survey Area: All West Angelas mine pits as approved/proposed in 2016: Deposits A, A West, B, C, D, E, F and G Type: AMD source hazard assessment to highlight at-risk geological materials requiring additional management during operations/closure Timing: Assessment updated in 2016</p>	<p>Investigation and assessment used to support EPA assessment of the 2019 Approved Proposal (Pits C, D and G) for West Angelas Iron Ore Project.</p>
<p>Geochemical Assessment of Samples from West Angelas (EGI 2013).</p>	<p>Study/Survey Area: All West Angelas mine pits as proposed in 2013: Deposits A, B, and D Type: AMD source hazard assessment to highlight at-risk geological materials requiring additional management during operations/closure Timing: Assessment conducted in 2013</p>	<p>Investigation and assessment used to support EPA assessment of the Approved Proposal.</p>

7.3.2. Climate

The Proposal area is located in a semi-arid to arid environment, characterised by hot summers and warm winters. The region experiences climate extremes, where severe droughts and major floods can follow in close succession.

The long-term annual rainfall for the West Angelas region is approximately 315.3mm (BoM 2022), however rainfall is highly variable both temporally, and spatially, predominantly occurring over a summer wet season dominated by tropical cyclones, low pressure systems and convective thunderstorms.

7.3.3. Surface Water

Watercourses within the Pilbara region are ephemeral and exhibit high temporal variability, with flows occurring in response to high rainfall events. The primary mechanism for runoff occurs when the rate of rainfall exceeds the infiltration capacity of the soil. This mechanism is commonly associated with high-intensity cyclonic rainfall and impervious catchments.

7.3.3.1. Catchment Setting

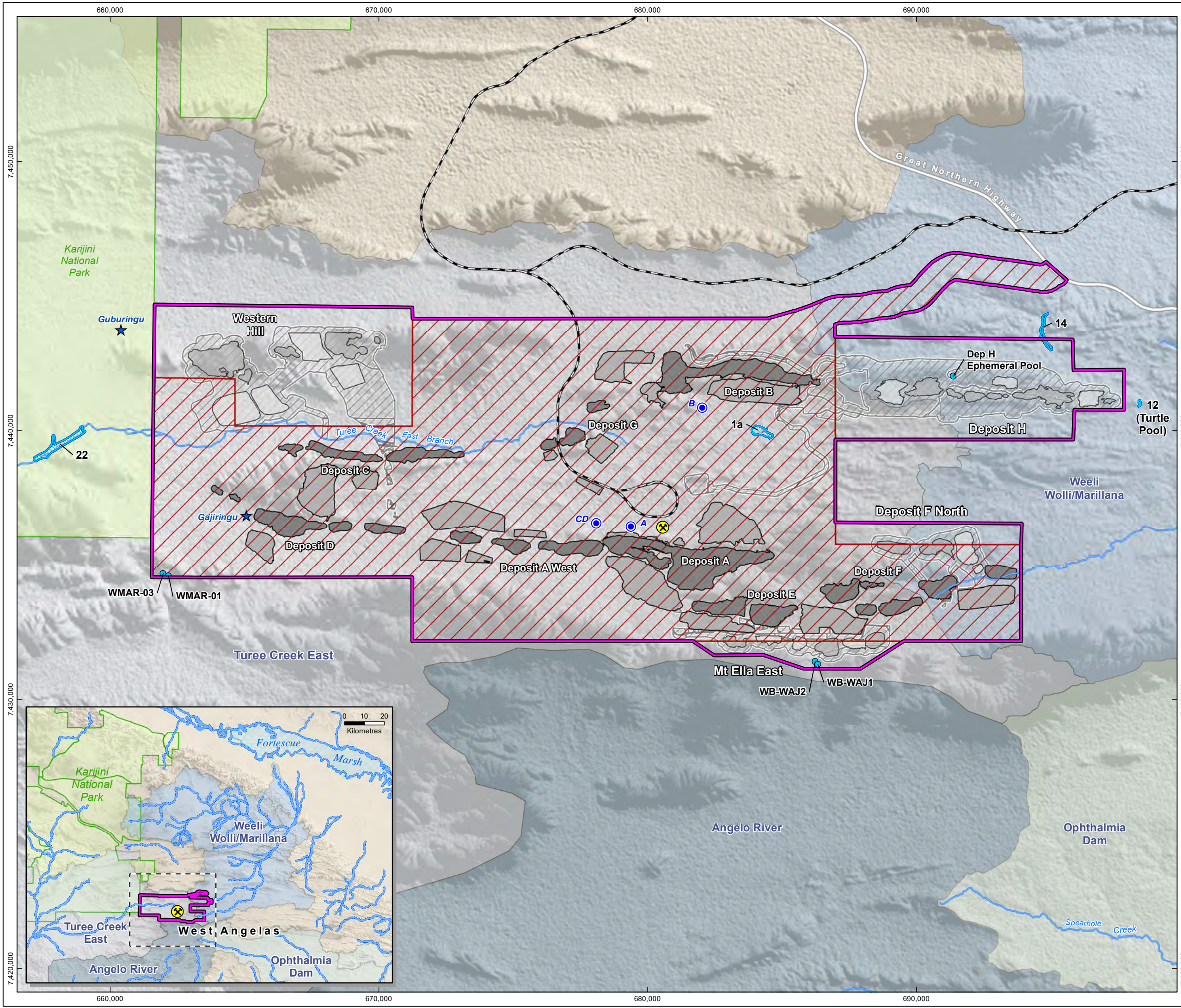
Regionally, the Proposal and associated new deposits are spread across two main surface water catchments (Figure 7-1):

- **The Turee Creek East catchment** (2,050 km² in area) which contains Western Hill, most of Mt Ella East and part of Deposit F North. It extends west of the Revised Development Envelope and includes Karijini National Park. Only 430 km² of the 2,050 km² catchment area is upstream of Karijini National Park, of which approximately 26% has been affected by existing mining activities (Rio Tinto 2021c). Turee Creek East drains into the Turee Creek Catchment (7,400 km² total area), which itself drains westwards into the Ashburton River
- **The Weeli Wolli Creek catchment** (4,770 km² in area) contains Deposit H and parts of Deposit F North and Mt Ella East. Weeli Wolli Creek drains to the east and is a tributary of the Fortescue River.

The upper reaches of both catchments have complex drainage patterns characterised by intermittent flow and infrequent widespread flooding and respond rapidly to rainfall events of sufficient duration and/or intensity. Further details on rainfall events and modelled catchment responses are provided in Rio Tinto 2021c; Appendix C.1, and the Proposal impacts to existing flow regimes are discussed in Section 7.4.

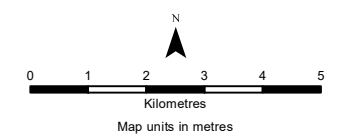
Figure 7-1
Surface water catchments
and surface water features

Drawn: A.D.
Plan: RTIO-0210038v3
Date: March 2023
Proj: GDA 1984 MGA Zone 50
Scale: 1:130,000 @A3
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Legend

- Rio Tinto Mine
- Revised Development Envelope
- Approved Development Envelope 1113 & DN 8299/2018
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Conceptual Footprint
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Heritage Site
- Water Feature
- Existing Licensed Discharge Point
- Potential GDE
- Marsh
- Sub Catchment**
 - Angelo River
 - Ophthalmia Dam
 - Weeli Wolli/Marillana
 - Turee Creek East
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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Western Hill

Western Hill is located in the upper reaches of the Turee Creek East catchment. The deposit sits elevated and intercepts several small catchments (all <0.5 km²) associated with steep drainage. These convey runoff to two main creeks north and south of the deposit. Both these un-named creeks are minor tributaries of Turee Creek East and flow directly westwards and into Karijini National Park. Several sensitive receptors are present downstream from Western Hill, including Karijini National Park, the Guburingu heritage site and a potential GDE (Feature 22; Zone C. 'Moderate' groundwater dependence likelihood). This feature is the previously described potential GDE located outside the Revised Development Envelope to the west within Karijini National Park and associated with Turee Creek East (Section 8; Figure 7-2). Surface water monitoring in relation to the Approved Proposal is currently undertaken as specified in the West Angelas EMP (Rio Tinto 2020d).

Deposit H

Deposit H is located in Pebble Mouse Creek's upper reaches, a Weeli Wolli Creek tributary within the Weeli Wolli catchment. The deposit sits in an elevated position and intercepts a series of small catchments associated with steep drainage, which convey runoff to the northeast. The waterhole is currently monitored via surface water loggers SW18WAN004 and SW18WAN006 (Figure 7-3).

Deposit F North

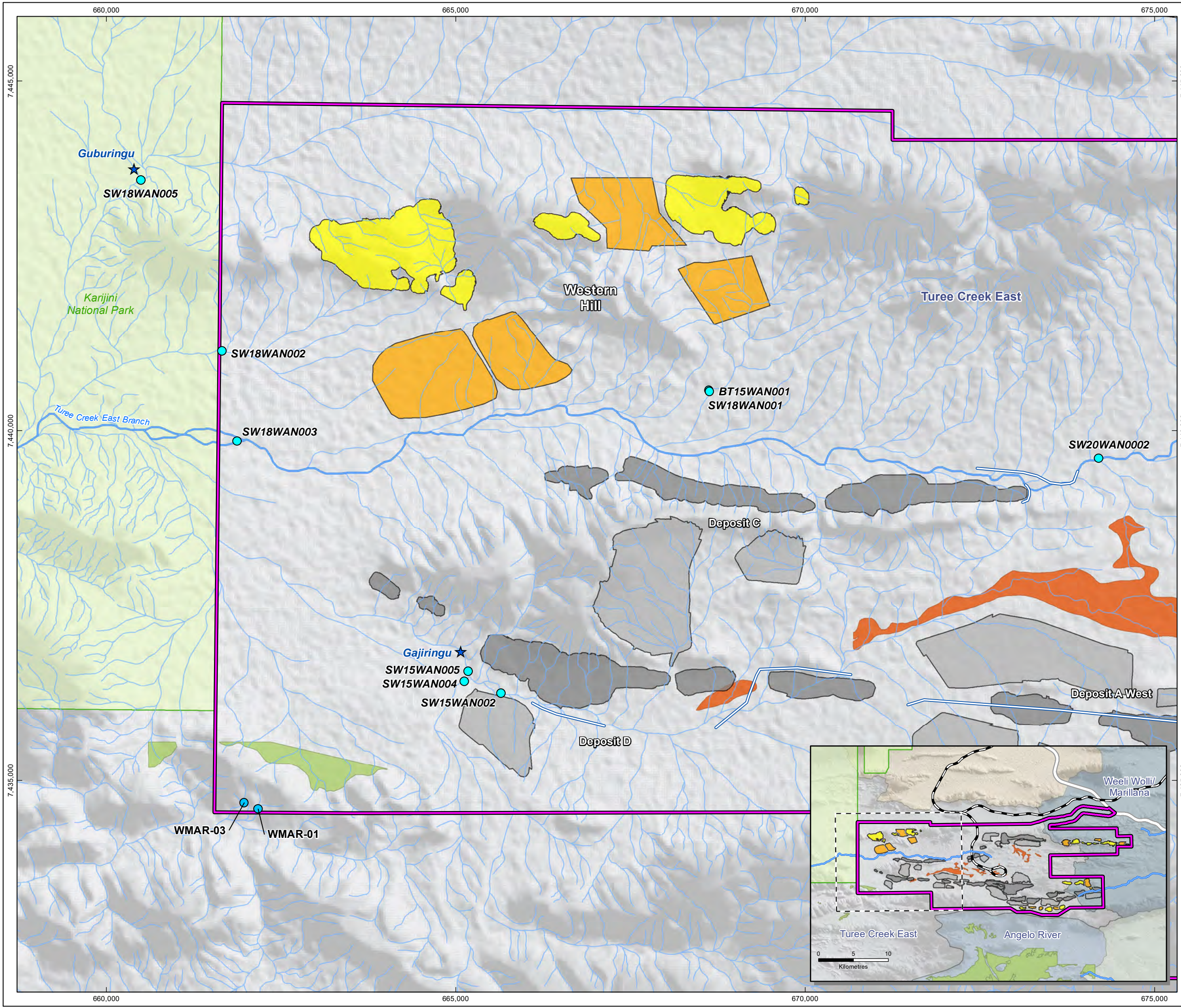
Deposit F North sits on a catchment divide, draining eastward to Weeli Wolli Creek, and west into Turee Creek East. The deposit is elevated across several small catchments (all <0.5 km²) associated with steep drainage lines along the southern perimeter. Modelling (Rio Tinto 2021c; Appendix C.1) confirms that the creeks typically only flow for a short time following rainfall, and no ephemeral pools have been identified in or downstream of the area (Figure 7-4).

Mt Ella East

The Mount Ella East deposits are located within the Turee Creek East catchment at the base of steep hills dividing the Turee Creek and Angelo River catchments. Several small, steep, incised drainage lines run from south to north through the resource area, with a surface water fed ephemeral pool (Mt Ella East Pool) located along one creek to the south (upstream) of the Mt Ella East development area (Figure 7-5). As such, no impacts to the surface water regime of this site as a result of the Proposal are predicted.

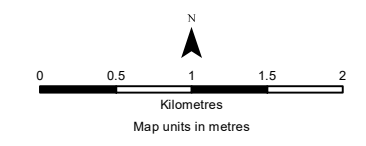
Figure 7-2
Western Hill surface water setting

Drawn: A.D.
Plan: RTIO-0210040v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:50,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Surface Water Monitoring
- Water Feature
- Diversion
- Sub Catchment**
 - Angelo River
 - Ophthalmia Dam
 - Weeli Wolli/Marillana
 - Turee Creek East
- Heritage Site
- Cracking Clays P1
- Mulga Community
- National Park
- Rio Tinto Railway
- Highway
- Major Creek
- Minor Creek

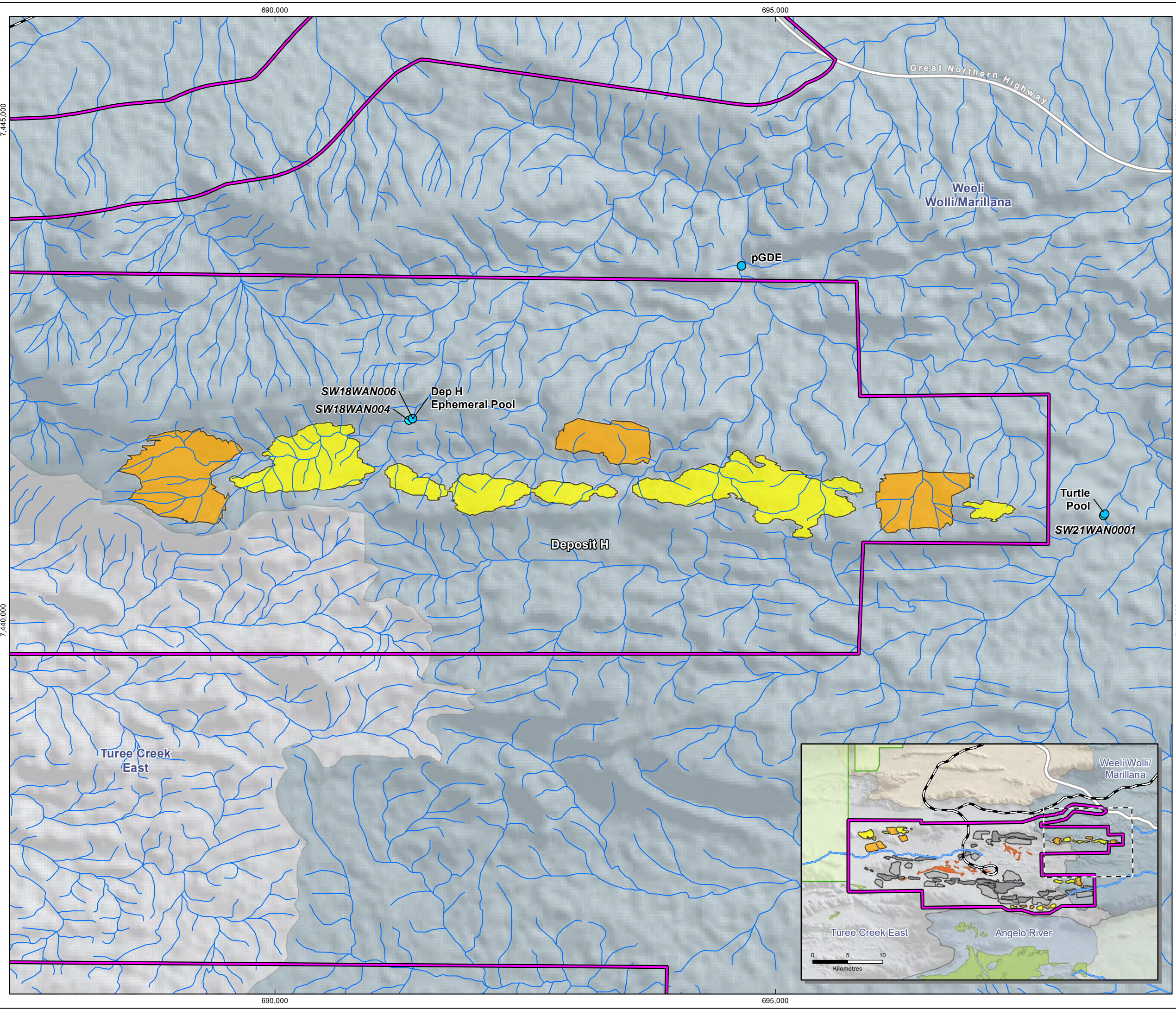


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Figure 7-3
Deposit H surface water setting

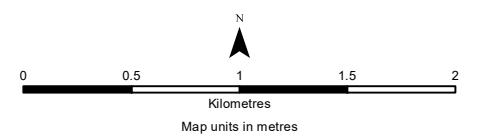
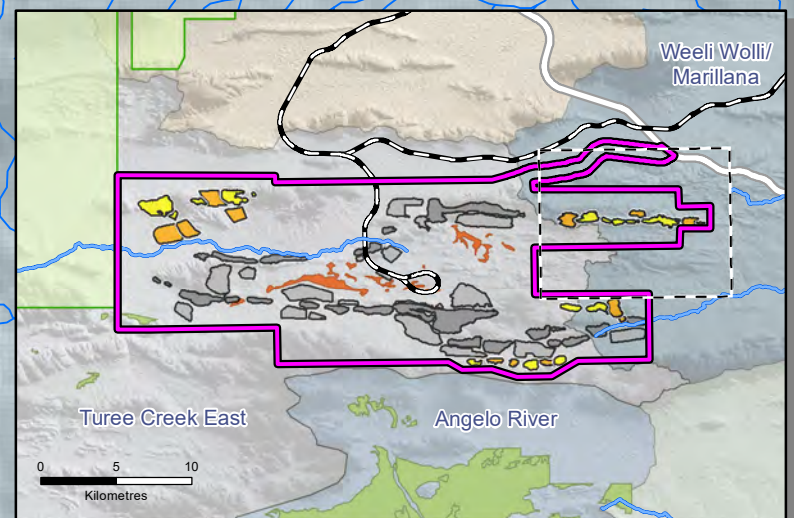
Drawn: A.D.
Plan: RTIO-0210041v3
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:35,000 @A3
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Legend

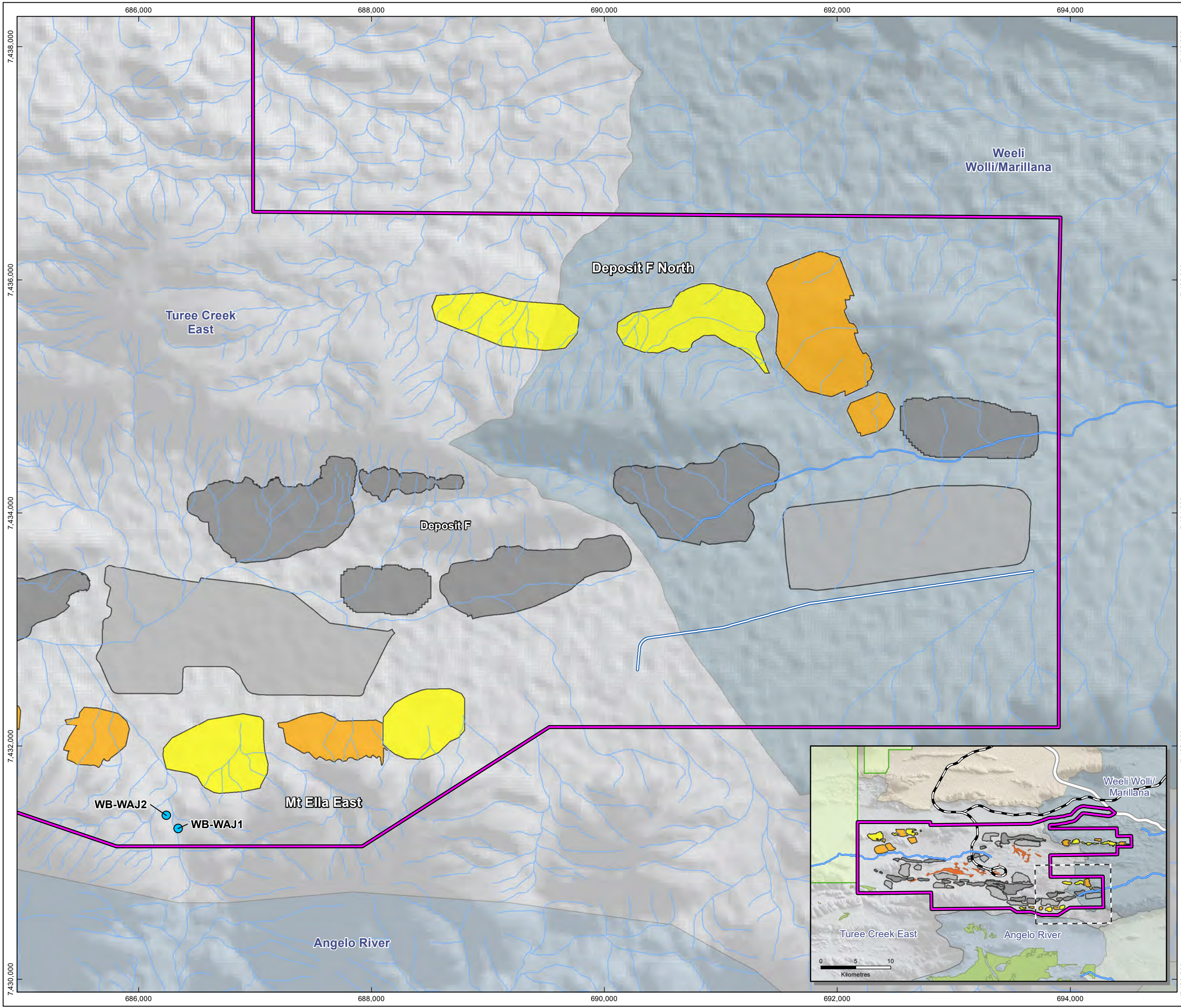
- Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- Surface Water Monitoring
- Water Feature
- Sub Catchment**
- Angelo River
- Ophthalmia Dam
- Weeli Wollli/Marillana
- Turee Creek East
- Cracking Clays P1
- Mulga Community
- National Park
- Rio Tinto Railway
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- Major Creek
- Minor Creek



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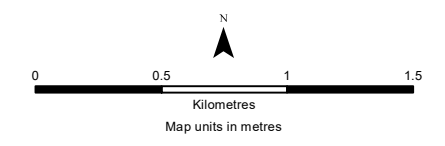
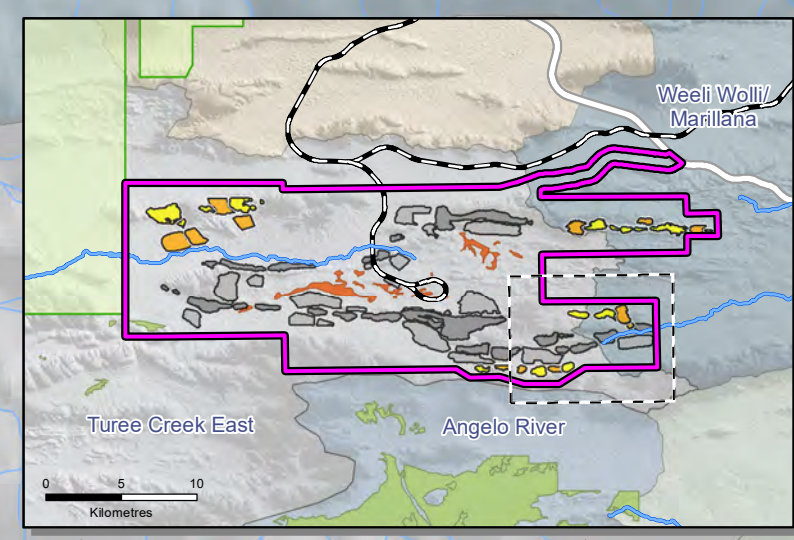
Figure 7-4
Deposit F North surface
water setting

Drawn: A.D.
Plan: RTIO-0210042v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:30,000 @A3
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Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- Water Feature
- Diversion
- Sub Catchment**
- Angelo River
- Ophthalmia Dam
- Weeli Wollli/Marillana
- Turee Creek East
- Cracking Clays P1
- Mulga Community
- National Park
- Rio Tinto Railway
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- Minor Creek

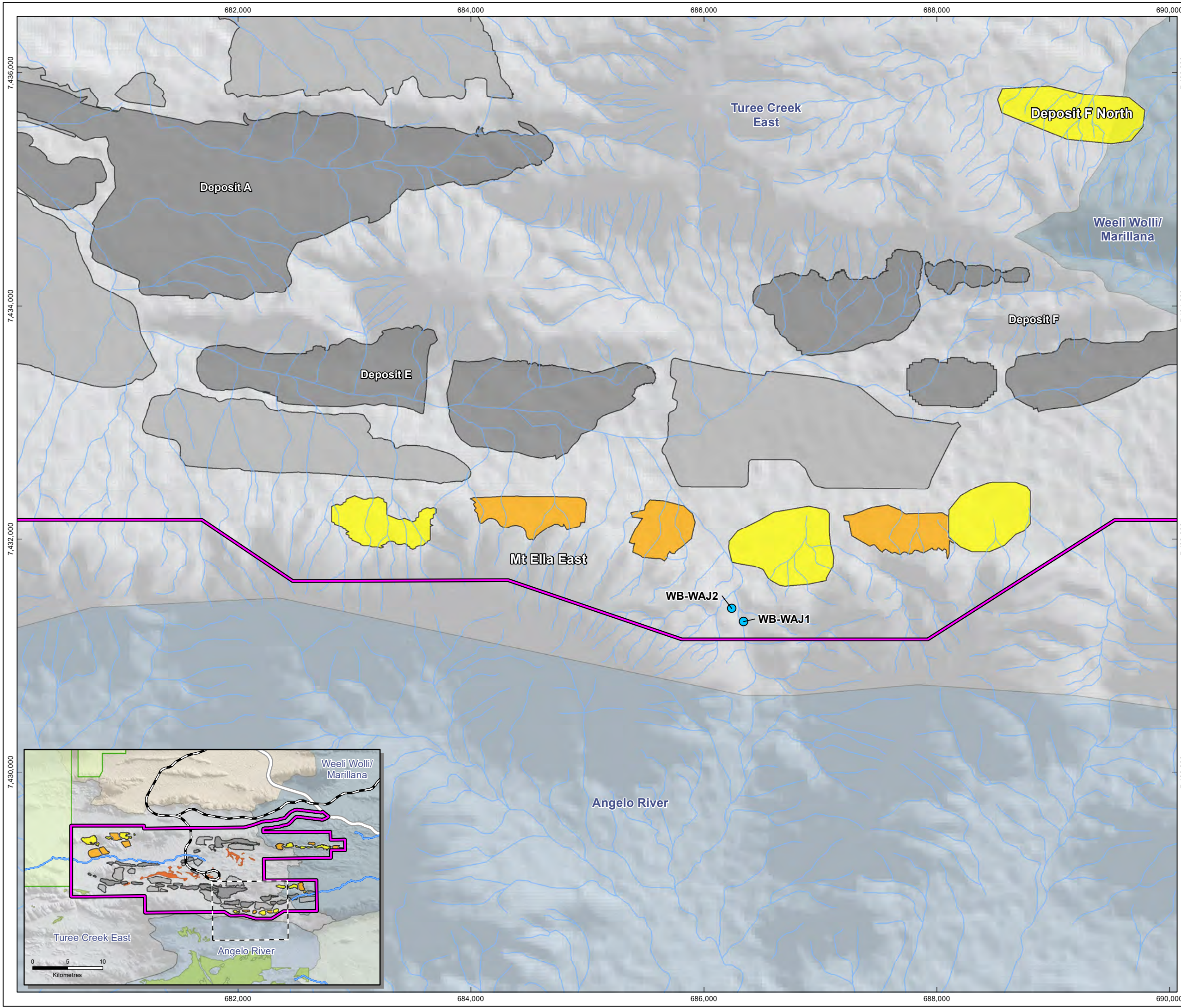


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Figure 7-5
Mount Ella East
surface water setting

Drawn: A.D.
Plan: RTIO-0210043v2
Date: March 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:30,000 @A3
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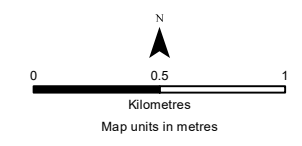
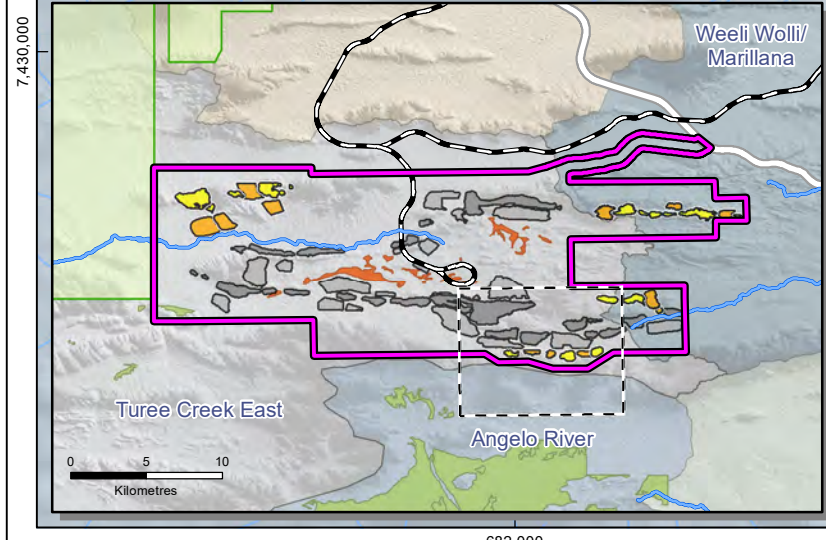
Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform

- Water Feature
- Sub Catchment**
- Angelo River
- Ophthalmia Dam
- Weeli Wolli/Marillana
- Turee Creek East

- Cracking Clays P1
- Mulga Community

- National Park
- Rio Tinto Railway
- Highway
- Minor Creek



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7.3.3.2. Watercourses

Turee Creek East is an ephemeral watercourse that flows depending on high intensity rainfall events, typical of Pilbara watercourses. Turee Creek East generally flows westward across the Revised Development Envelope, continuing west south-westerly through the Karijini National Park before merging with Turee Creek (Turee Creek merges with the Hardey River, which flows into the Ashburton River). Several West Angelas deposits (including Deposits A, B, C, E, F and G) and the proposed Western Hill deposit are intersected by tributaries of Turee Creek East (Figure 7-1; Figure 7-2). Existing diversions direct surface water flows from local ephemeral tributaries away from operational deposits.

Immediately downstream of the Revised Development Envelope, Turee Creek East flows through Karijini National Park. Within Karijini National Park, surface water flows along Turee Creek East are naturally ponded behind the Mount McRae Shale, which outcrops across the creek, forming surface water pools that may persist for an extended period following flow events. The attenuation and ponding of surface water results in increased localised groundwater recharge, which contributes to dense vegetation cover and the establishment of potential groundwater dependent vegetation.

7.3.3.3. Pools and Waterholes

The Revised Development Envelope contains no permanent surface water features such as pools and springs. Five ephemeral surface water features have been recorded within the Revised Development Envelope, two within the current Approved Development Envelope and three within the Proposal Area. Of the three surface water features within the Proposal Area two occur at Mt Ella East (WB-WAJ1 and WB-WAJ2) and one at Deposit H (WB-WAH1) (Figure 7-1). The two surface water features within the Approved Development Envelope are located within the southwestern corner of the Revised Development Envelope (WMAR-01 and WMAR-03). They are protected from direct disturbance under the requirements of MS 1113 (Appendix A.3). The Proposal will not affect these water features and hence are not discussed further.

Three surface water related heritage sites outside the Revised Development Envelope have been identified (Turtle Pool, Gajiringu and Guburingu) and potential impacts on these features have been considered as part of this assessment (Figure 7-1). Pools within the Proposal Area and surface water related heritage sites (immediately outside the Revised Development Envelope) are discussed in detail in the following sections.

Deposit H Waterhole (WB-WAH1) – within Proposal Area at Deposit H

A creekline in one of the Deposit H sub catchments includes a small surface water fed ephemeral pool (Figure 7-3; Plate 7-1) located at the base of a gorge, which is significant to the Ngarlawangga People (Section 6). The pool is approximately 175 m² in area and holds an estimated 207 m³ when full. The pool has a rocky floor and sits at the base of a steep waterfall at the outlet of the main creek line. High velocity plunging flows scour sediment from the pool and maintain depth and water. Water has persisted in the pool for >6 months following flow events.

The water level in the pool has been monitored since 2018 (Rio Tinto 2020b) and indicates it is a surface water system supported by rainfall and catchment inflows. The pool's water level has been confirmed via monitoring at approximately 757 mRL, (22 m above the height of the Deposit H water table level).

The pool was observed to be full in February 2018 but dried completely at the end of 2018 and did not fill in the 2018/19 wet season. Rainfall was well below average over this period, with no large single-day rainfall totals recorded at West Angelas. Deposit H Waterhole filled again in the 2019/2020 wet season and held water for over six months, steadily declining over the dry season in line with evaporation. These observations indicate that the Deposit H Waterhole likely fills in most years if catchment flow occurs but can dry out in low rainfall periods. Based on observations, relatively small frequent storm events (typical in most wet seasons) are adequate to fill the pool. This has been confirmed by modelling of the pool and its contributing catchment (Rio Tinto 2020b), with the results indicating that a 1:2 AEP event (i.e.,

an event occurring every two years) would see 24,000 m³ flow to the pool, which is more than 110 times its capacity.



Plate 7-1: 'Deposit H Waterhole, August 2020

Mt Ella East Pool(s) (WB-WAJ1 and WB-WAJ2) and Heritage Site (WA-ETH-18-01) - within Proposal Area South of Mt Ella East

A surface water fed ephemeral rock pool with associated cultural heritage value is located south of the proposed Mount Ella East development (WA-18-ETH-01). The rock pool and heritage site is inclusive of surface water fed pools WB-WAJ1 and WB-WAJ2, which were identified as minor pools, approximately 1 m apart in the same rocky gully. The water in these pools likely came from the high rainfall in June 2018, three months prior. Following the lack of rainfall between June and October of the same year, the pools were observed to be drying up, indicating that they provide only temporary sources of water following periods of rain (Biologic 2020a).

'Turtle Pool' – Outside Revised Development Envelope

As it is known colloquially, Turtle Pool is a semi-permanent surface/groundwater water feature located approximately 700 m east of Deposit H, outside of the Revised Development Envelope, in a tributary of Weeli Wolli Creek (Figure 7-3). The pool is of high significance to the Ngarlawangga People (Section 6).

The hydrology of Turtle Pool indicates it is potentially replenished via a combination of groundwater and surface water flows. It is confirmed to be dependent on rainfall and direct surface flows, through observation of filling after rainfall and subsequent streamflow events. However, Turtle pool may be partly dependent on groundwater with LiDAR undertaken to compare Deposit H groundwater level to Turtle

Pool indicating the water level within Turtle Pool to be approximately the same height above sea level as the aquifer (approximately 735 mRL). A groundwater connection therefore cannot be ruled out.

Gajiringu Heritage Site – Outside Revised Development Envelope

The *Gajiringu* heritage site is located on a tributary of Turee Creek East. The site is currently managed under the West Angelas Deposit C and D YINHARR-20 (*Gajiringu*) Management Plan. The proposed development of deposits relevant to this Proposal is not predicted to result in any incremental increase in impact to the site, as no development is planned within the contributing catchment. Hence, this site is not discussed further in this ERD.

Guburingu Heritage Site – Outside Revised Development Envelope

This site is located within Karijini National Park at the western extent of Western Hill at the confluence of two ephemeral creeks. The mining footprint of Western Hill is located within the catchment which feeds the heritage site. Monitoring is currently undertaken in the creek confluence zone within the heritage site with permission from the Yinhawangka Group. Based on investigations to date there is no evidence of persistently available surface or groundwater at the site. As such this location is representative of a typical ephemeral creek confluence zone.

7.3.4. Groundwater

The Proponent has been operating the Existing Operations since 2000. During the intervening period, groundwater abstraction for mining purposes and for dewatering below water table mine pits has been ongoing, resulting in changes to the groundwater environment. To ensure these changes are not environmentally significant, the Proponent manages its groundwater abstraction in accordance with the following instruments:

- MS 1113 West Angelas Iron Ore Project - Revised Proposal, including subsequent amendments (2 Sep. 2019)
- EPBC Act Approval Decision Notice 2018/8299, including subsequent variations (25 May 2021)
- Groundwater Environmental Management Plan (Appendix A.9) West Angelas Revised Proposal (Feb.2022)
- West Angelas Operations Environmental Management Program (Nov. 2013)
- Groundwater Operating Strategy West Angelas Iron Ore Mine (Feb. 2023)
- Groundwater licence GWL98740(13) (Feb. 2023).

7.3.4.1. Conceptual Hydrogeological Model

In order to identify and assess potential impacts associated with the proposed abstraction of groundwater to facilitate the Proposal, a hydrogeological conceptual model was developed for the Western Hill, Deposit H, and Deposit F North mining areas, incorporating results from hydrogeological investigations (Rio Tinto 2021d, 2023d and 2022b).

7.3.4.2. Regional Groundwater Setting

The groundwater system is characterised as a large basin-type aquifer with water storage within the weathered Wittenoom Formation, mineralized Marra Mamba Formation and overlying alluvial dolerecrete/dolerite units.

The Wittenoom Formation is in the valleys between the low-lying sub-cropping Marra Mamba Iron Formation and Fortescue Group core of the Wonmunna anticline and the higher relief Brockman Iron Formation hills to the north and south. Permeability within the Wittenoom Formation can be enhanced

through development of secondary permeability associated with dissolution of dolomitic units. These secondary features have significant hydraulic conductivity and storage.

The Wittenoom Formation is generally overlain by a detrital sequence of variable thickness, which forms part of the regional aquifer when saturated.

Orebody aquifers also occur in the mineralised sections of the Marra Mamba Iron Formation and the overlying West Angelas Member of the Wittenoom Formation. Where hydraulic connection with the Wittenoom Formation or saturated detritals exists, the orebody aquifer forms part of the regional aquifer.

In other situations, the synclinal structure of the Marra Mamba Iron Formation which contains the mineralised (and permeable) Mt Newman Member is underlain and bounded by low permeability, non-mineralised units including the Macleod and Nammuldi Members of the Marra Mamba Formation and the Jeerinah Formation of the Fortescue Formation. This results in localised orebody aquifers commonly called “bathtubs” that are not connected to the regional aquifer.

The water table within this aquifer is relatively deep (between 50 – 120 mbgl) across the Revised Development Envelope, with a relatively flat gradient from east to west for most mining areas.

Due to the substantial depths to groundwater, recharge is usually negligible and estimated to be approximately a small percentage of rainfall.

7.3.4.3. Local Groundwater Setting

The local groundwater setting for the proposed new mining areas where dewatering (Deposit F North) or abstraction for water supply (Western Hill) is proposed is described below. Deposit H will be a BWT mining operation, however no abstraction via production bores will be carried out as in pit sump pumping will be used to dewater BWT ore. Operational water demands are to be met from water supplied from other deposits at West Angelas. Mt Ella East will be an AWT mining operation and will obtain its water needs from existing sources, so no detailed assessment of the groundwater environment is required.

A summary of hydrostratigraphy for the Proposal is provided in Table 7-3 and described in the following sections.

Table 7-3: Hydrostratigraphy of Proposal deposit areas

Deposit	Aquifer	Hydro-Stratigraphic Unit	Lithology	Typical Characteristics	Distribution, Local Characteristics
Western Hill	Aquifer	Brockman Iron Formation – Dales Gorge Member	Interbedded Banded Ironstone Formations (BIF), chert, and shale.	Groundwater is predominantly associated with secondary porosity developed through mineralisation of BIF and fractures. Where mineralised, the Brockman Iron Formation orebodies tend to form discrete orebody aquifer units surrounded by relatively less permeable BIF and shale units.	<ul style="list-style-type: none"> • A regionally significant dolerite dyke exists to the east of Western Hill that is known to impart a 13 m head difference across it and act as an aquitard • Yields of 40 to 50 L/s • Electrical Conductivity (EC): ~600-1,130 µS/cm • Groundwater levels at Western Hill are known to be in hydraulic connection to some extent with the regional Wittenoom Formation that surrounds the Brockman Iron Formation deposit.
	Aquitard	Mount McRae Shale (MCS) / Mount Sylvia Formation (MTS)	Carbonaceous shale, chert and minor dolomitic shale.	The Mount McRae Shale is generally observed to have low permeability and act as an aquitard. At Western Hill, the Mount McRae Shale almost entirely surrounds both the western and eastern pits, with the exception of where fault blocks have caused significant offset gaps in the shale.	
West Angelas all deposits	Aquifer	Wittenoom Formation – West Angelas member	Weathered/altered dolomite, shale with minor BIF and chert bands.	Weathered members of the Wittenoom Formation occur in the strike orientated valley floors between ridges of Brockman and Marra Mamba Iron formations. This aquifer can show extensive karstification leading to areas of high permeability and is often hydraulically connected to the overlying Tertiary Detritals to form an important groundwater system.	<ul style="list-style-type: none"> • Main aquifer at West Angelas; average thickness of up to 85 m • Compartmentalised by cross-cutting dykes and abutting low permeability lithologies (i.e. fresh/massive dolomite), channel like geometry • Yields of 10 to 50 L/s • Electrical Conductivity (EC) ~500 – 2,000 µS/cm • Detritals present along drainage lines, generally partially saturated following rainfall events • Known connection to the aquifer at Hope Downs 2 (evident from abstraction at Deposit B drawing down water levels at HD2).
		Marra Mamba Iron Formation – Mt. Newman Member	BIF with thin shale bands.	This local aquifer system occurs where secondary porosity has developed in basement rock due to fracturing, weathering or mineralisation. It can be in direct or partial hydraulic connection with the regional aquifer (Tertiary Detritals and Wittenoom Formation).	

Deposit	Aquifer	Hydro-Stratigraphic Unit	Lithology	Typical Characteristics	Distribution, Local Characteristics
	Aquitard	Marra Mamba Iron Formation – MacLeod and Nammuldi Members	BIF, chert with extensive interbedded and/or extensive bands of shales with 'podded' BIF horizons.	Generally poor yielding due to limited primary porosity and storage. They generally form no flow boundaries to the Marra Mamba ore bodies (unless mineralised).	<ul style="list-style-type: none"> • Underlies or abuts the Wittenoom aquifer • Low to negligible yields • EC ~3,000 uS/cm.
		Jeerinah Formation	Shale, sandstone, siltstone, mudstone, dolomite, local micro banded chert, jaspilite, thin basalt/dolerite and andesitic basalt flows.		

7.3.4.4. Western Hill Groundwater

Western Hill is a Brockman Iron Formation deposit consisting of several ore bodies along an 8 km E-W trending synclinal structure. A regionally significant dolerite dyke exists to the east of Western Hill which imparts a 13 m head difference across it and acts as an aquitard (Rio Tinto 2021d). The groundwater table is relatively flat across the Western Hill area at approximately 624 mAHD. The depth to groundwater is >50 m across the Western Hill mine area.

Groundwater within the Wittenoorm Formation surrounding Western Hill is inferred to flow in a south westerly direction towards an alluvial channel beneath Turee Creek East approx. 9 km south-west of Pit 1 in shallow groundwater within Karijini National Park. The Wittenoorm Formation to the south is hydraulically connected to the Deposit C orebody aquifer, and the Wittenoorm Formation to the north is conceptually bounded by a Marra Mamba Iron Formation range 3.5 km to the north of the pits.

The two discrete Western Hill orebodies are both surrounded by Mt McRae Shale (a low permeability unit known for its ability to impede groundwater flow). However, there may be some limited connectivity with the underlying and surrounding Wittenoorm Formation (the regional aquifer unit) that may support potential GDE in the nearby Karijini National Park (refer to Section 7.3.4.9) (Rio Tinto 2021d).

The depth to groundwater is >50 m across the Western Hill mine area.

Groundwater is fresh (425 mg/L TDS), pH is neutral, alkalinity is low (<28 mg/L), and metal concentrations are low indicating limited rock-water interaction and hydrochemical development (Rio Tinto 2020a).

The groundwater chemistry indicates there is a likelihood that groundwater within Western Hill is connected at least to some extent to groundwater outside Western Hill as shown by the similarity in chemistry between the shallow monitoring bore and other regional bores. However, the chemistry from the deeper production bores indicates that connectivity to the surrounding Wittenoorm Formation may decrease with depth.

A peer review was undertaken and found that the Western Hill groundwater modelling has been conducted competently and is consistent with best practice methods, including uncertainty analysis (HydroGeoLogic 2022; Appendix C.10).

7.3.4.5. Deposit H Groundwater

The aquifer (mineralised Marra Mamba Iron Formation) that hosts the orebody is bounded on all sides and below by low-permeability Marra Mamba Iron Formation members (Rio Tinto 2023d).

The conceptualisation of the Deposit H local groundwater suggests the deposit is hosted within an aquifer which is bound in all directions by the impermeable unmineralised units of the Marra Mamba Iron Formation that encapsulates the interior zone of the deposit. Groundwater through flow into the deposit is likely minimal with the low permeability hydrostratigraphy surrounding the deposit having limited connection to the orebody aquifer. Similarly, outflow from the orebody aquifer is likely minimal and would most likely consist of shallow groundwater flow through alluvials in eroded channels that incise the low permeability material that bounds the deposit. This is supported by pumping tests which indicate that the aquifer has low transmissivity and storage parameters.

Groundwater levels at Deposit H are approximately 735 mAHD (Rio Tinto 2023d). A very slight hydraulic gradient may be present towards the north-east, which suggest some through flow, consistent with the occurrence of some recharge and outflow from the bowl-like aquifer basin.

Due to the substantial depths to groundwater, recharge is usually negligible and estimated to be a small percentage of rainfall. Observed groundwater level variation of up to 0.2 m correlates with site rainfall and is consistent with the stated groundwater flow and recharge processes.

The groundwater chemistry of Deposit H is markedly fresher, or of lower ionic concentration, than typical (deep) fractured rock aquifers in the Pilbara. Overall, the groundwater chemistry is characteristic of a regionally isolated aquifer, with limited throughflow to or from the system.

Groundwater is fresh (<1,000 $\mu\text{S}/\text{cm}$), pH is near neutral, and dissolved metal concentrations are generally low, indicating limited rock-water interaction and hydrochemical development (Rio Tinto 2023d).

7.3.4.6. Deposit F North Groundwater

Geologically, Deposit F North is a localised east-west trending syncline with a primary aquifer of mineralised Mt Newman Member surrounded on all sides by low permeability unmineralised Macleod and Nammuldi Members.

A fault (striking SSE, dipping SW) cross-cuts the mineralisation (AWT only) and results in Macleod Member being offset over a small portion of the mineralisation. Several dolerite dykes have been identified however, it has not been established if these cause any compartmentalisation of groundwater.

Deposit F North forms a 'bathtub' style aquifer being surrounded by the impermeable Nammuldi and Macleod members of the Marra Mamba Iron Formation. Water levels in Deposit F North are deep, estimated at ~716mRL (~77m below ground), interpreted from exploration hole geophysics and validated with water levels from two 2017 exploration grade holes converted into monitoring bores. The water table is approximately 46 m higher than in Deposit F to the south, which suggests a disconnect between these orebodies. As groundwater is approximately 77 mbgl it is anticipated that recharge is likely to be insignificant.

7.3.4.7. Mt Ella East

The regional water table is inferred at approximately 668mRL at Mount Ella East, approximately 50m below surface. This deposit is a Mineralised Brockman (Dales Gorge Member) and mature detrital ore body comprising three AWT pits.

7.3.4.8. Existing Groundwater Use

The Proponent abstracts groundwater within the area under two abstraction licences. Groundwater Licence (GWL) No. 98740(13) permits an annual abstraction of 14,000,000 kL, and GWL No. 103136(9) permits an annual abstraction of 3,102,500 kL. Groundwater is used for the purposes of mine dewatering, dust suppression for earthworks and construction, exploratory drilling operations, industrial processing, potable water, aquifer reinjection and power plant supply. There are no groundwater supply bores operated by third parties within or near the Revised Development Envelope.

Groundwater levels around active mining areas (e.g. Deposit B) show a declining trend as a response to dewatering (up to 10 m per year), with less to no decline recorded in more distant monitoring bores (Rio Tinto 2023b). Groundwater levels in areas where groundwater abstraction occurs for the purposes of supply only (e.g. Deposit C and D) show a general to slightly decreasing trend (less than one metre per year) reflective of the minimal groundwater abstraction required to supply the construction activities (Rio Tinto 2023b).

7.3.4.9. Groundwater Dependent Ecosystems

Groundwater dependent ecosystems (GDE) are ecosystems that require access to groundwater to provide some portion of their environmental water needs to persist in the landscape.

For terrestrial ecosystems, there are three key types of GDE:

- Aquatic ecosystems: that rely on the surface expression of groundwater – this includes surface water ecosystems that may have a groundwater component, such as rivers, wetlands and springs
- Terrestrial ecosystems: that rely on the subsurface presence of groundwater – this includes all vegetation ecosystems or Groundwater Dependent Vegetation (GDV)
- Subterranean ecosystems: stygofauna ecosystems in aquifers.

These ecosystems rely on either below ground access to groundwater (via the capillary fringe) or surface water expression of groundwater to provide some of the community's environmental water needs.

Four vegetation features within and around the Proposal exhibiting either a 'Low-moderate' or 'Moderate' likelihood of groundwater dependence based on the utilised biological and hydrological evidence (Section 8):

- Feature 1a (19 ha). 'Low-moderate' groundwater dependence likelihood. *E. camaldulensis* woodland over *E. xerothermica* low open woodland associated with an upper tributary of Turee Creek between Western Hill and Deposit H. This feature overlies basaltic parent rock possessing generally negligible hydraulic conductivity, any drawdown related to the proposal is highly unlikely to be able to propagate into this area, and as such, regardless of the nature of its supporting water resource, potential for indirect impact is considered negligible.
- Feature 12 ('Turtle Pool' – see section 6) (>1 ha). 'Low-moderate' groundwater dependence likelihood. Woodland of *E. victrix* and *E. camaldulensis* co-dominant, *E. xerothermica* also common over *Acacia* shrublands; located outside of the Revised Development Envelope to the east of Deposit H; inferred depth to regional groundwater >50 m, potential for impact to this feature is considered very low.
- Feature 14 (14.6 ha). 'Low-moderate' groundwater dependence likelihood. Woodland of *E. victrix* and *E. camaldulensis* co-dominant, *E. xerothermica* also common over *Acacia* shrublands; located outside of the Revised Development Envelope to the north of Deposit H where the inferred depth to regional groundwater is >50 m; vegetation appears severely water limited, indicating association with at least a seasonal water resource, probably a local perched aquifer
- Feature 22. 'Moderate' groundwater dependence likelihood. This feature is the previously described potential GDE located outside the Revised Development Envelope to the west within Karijini National Park and associated with Turee Creek East (EPA 2019a).

None of these features are considered likely to be reliant to any extent on the groundwater resources that will be impacted by the Proposal (Section 7.3).

7.3.4.10. Aquatic Plants and Fauna

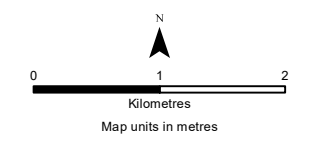
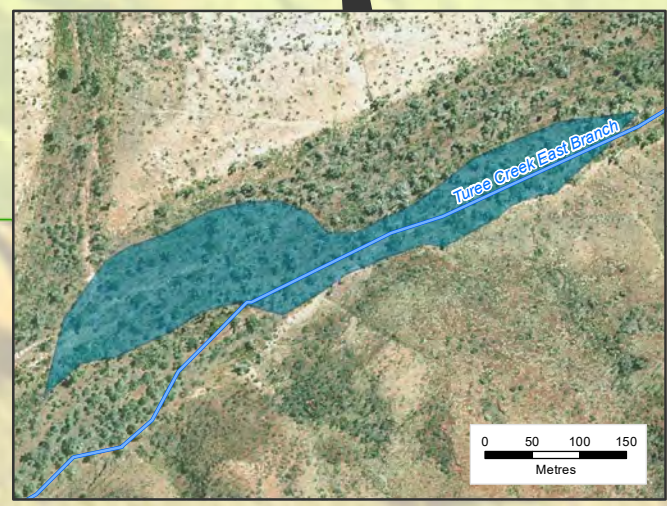
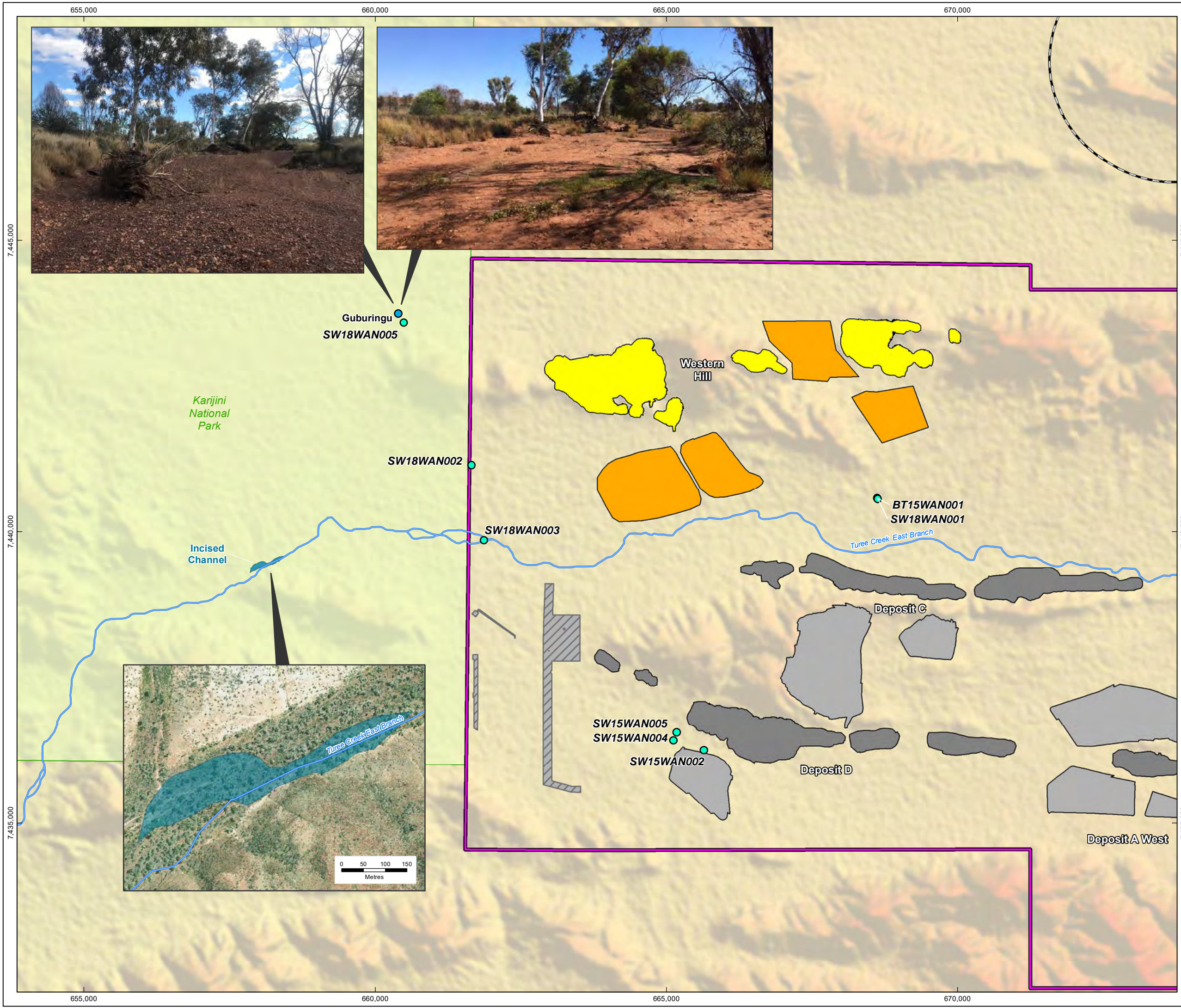
The creeks within and surrounding the Revised Development Envelope are dry in their natural state and do not contain pools of sufficient permanence or size to host aquatic plants and/or fauna.

Figure 7-6
Location of potential GDE
within Karijini National
Park

Drawn: A.D.
Plan: RTIO-0210044v3
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:60,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Guburingu
- Surface Water Monitoring
- Incised Channel Zone 5 - Medium Risk
- Indicative MAR Disturbance Footprint
- National Park
- Rio Tinto Railway
- Major Creek



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7.3.5. Geochemistry

The Proponent has completed a geochemical characterisation study (Rio Tinto 2021e) and an AMD hazard risk assessment (Mine Waste Management 2021) consistent with WA Government guidance (DER 2015a) to inform waste rock management across the Proposal. The two reports supplement previous assessments conducted across the Existing Operations.

7.3.5.1. Outcomes of Previous Studies

Previous AMD assessments (e.g., EGI 2013, Rio Tinto 2016), which considered, among other things, deposit geology, lithology, sulfur levels, geochemistry, acid-base accounting, and kinetic tests, all concluded that risks associated with AMD for the West Angelas deposits were all low and the significant majority of sulfur present was in oxidised, unreactive forms. Consistent with this, prior EPA assessment reports of the West Angelas Iron Ore Project (1999, 2015, 2019a) did not identify AMD risks as requiring assessment or specific management/outcomes.

7.3.5.2. Outcomes from Current Studies

The outcomes of the more recent studies to support the current Proposal are summarised below. They are consistent with the previous studies' findings that the overall acid-generating potential for the proposed new pits remains low. Similar to some of the Existing Operations pits, some of the Western Hill pits intersect lithologies with elevated sulfur content; however, no below water table mining is planned at Western Hill and any above water table sulfur is likely to be in the oxidised (sulfate) form (Mine Waste Management 2021).

A suite of 99 samples from the Proposal deposits were assessed for acid base accounting. The majority of the 99 rock samples tested from across the Proposal deposits were NAF (33 samples) or Uncertain (54 samples). A small portion of samples were classified as PAF (5 samples) or Potentially Acid Forming – Low capacity (PAF -LC) (7 samples) from the Western Hill deposit. As such, the overall risk of AMD from the Proposal is considered as low, however the Western Hill deposit is considered to have a moderate AMD risk due to PAF-LC samples recorded (Rio Tinto 2021e). PAF material is restricted to small pockets at the lower benches of the eastern and western pits at West Angelas. This finding is consistent with the previous studies of the existing deposits.

Geochemical data from the 99 samples were also assessed to identify enriched concentrations of elements that may pose an environmental risk. The results indicate that Fe, Bi, Te, Sb and Se are considered enriched or elevated across most rock units, with Mo, Re and S enriched in some Mount McRae Shale rock types. Ongoing groundwater quality studies and monitoring at West Angelas and surrounding areas include consideration of these metals in the analytical suite (refer to Sections 7.3.5 and 7.6.2). Given the mineralised nature of the Pilbara, elevated concentrations of metals are not unexpected, and the surrounding receptors have likely adapted to the naturally elevated concentrations (Rio Tinto 2021e).

7.3.6. Current Water Management

The Approved Proposal commenced in 1998 and has been developed and operated in accordance with several key environmental approvals, licences, and approved management plans (see section 3.2). In accordance with the water hierarchy, mine dewater is used for operational purposes in the first instance. Surplus water to the requirements of operational use is managed via discharge to Turee Creek East via approval conditions and management objectives as described below.

Supply water is abstracted from the Turee Creek borefield located to the southwest of the mining operations via Groundwater Licence 98740(13). No changes to abstraction volume is proposed in relation to the Proposal.

7.3.6.1. Surplus Water Discharge to Turee Creek East

Surplus water produced from dewatering Approved Proposal deposits to access below water table ore at West Angelas is discharged into a tributary of Turee Creek East, which then flows westwards through Karijini National Park. Discharge of surplus mine dewater is authorised under discharge licence L7774 which allows for discharge of up to 12,000,000 kL of surplus water. All creeks in the area are naturally ephemeral, and the Proponent is required to manage discharge so that surface water in the tributary does not come within 2 km of the park boundary under natural no-flow conditions, consistent with the requirements of MS 1113.

Discharge water quality is subject to the conditions of the Part V EP Act licence held by the Proponent for the Approved Proposal and administered by DWER. Quarterly sampling for hydrocarbons, key metals, PAF analytes and suspended solids is carried out at discharge points and compared to Australian water quality guidelines, with results reported annually.

The modelled water balance and water surplus per deposit over the LOM, including the Proposal and Existing Operations, are shown in Figure 7-7.

7.3.6.2. Managed Aquifer Recharge

Drawdown from the Approved Proposal was identified as having the potential to extend across the common boundary with Karijini National Park to the west (EPA 2019a). Under existing approval conditions, dewatering must be managed so there is no drawdown within or at the boundary of Karijini National Park (Condition 6-1 of MS 1113 and Condition 3 of EPBC Decision Notice 2018/8299).

To ensure compliance with Conditions 8-1 and Condition 3 of MS 1113 and DN2018/8299 respectively, the Proponent has constructed a MAR scheme located between the current approved mining areas (Deposits C and D) and the National Park to ensure drawdown does not extend as far as the park boundary. Operation of the MAR is described in the Groundwater Environmental Management Plan that has been approved under MS 1113 and also as per the requirements of the EPBC Act approval (EPBC 2018/8299) or the Existing Operations. Surplus mine dewater is used for the operation of the MAR as required and in accordance with the Groundwater Environmental Management Plan.

The Proponent holds a groundwater licence under the RIWI Act and administered by DWER. The licence allows for up to 14 GL/year of groundwater abstraction over the Approved Development Envelope for purposes including dewatering, dust suppression, campsite purposes, etc.

7.3.7. Proposed Water Management Strategy

The Proposal includes BWT mining which requires dewatering mine pits to safely access ore at Deposit H and Deposit F North, all of which will be used for operational purposes. The site water balance is site wide, however is primarily related to existing approved deposits which have a higher below water table ore content than the Proposal deposits, with Proposal deposits accounting for none of the surplus water.

The water balance has been estimated based on the summation of deposit level water balances (pit dewatering and operational demand) considering site-wide level water demands and surplus management options (Figure 7-7).

Based on the modelled site water balance for the both the Approved and Proposal deposits, the West Angelas operation currently experiences dewatering abstraction exceeding the operational water demand and this continues until approximately 2035, after which time demand will exceed abstraction. As the Proposal deposits do not increase the surplus dewatering volumes, no additional or new discharge options to Turee Creek or other creeklines will be required for the Proposal. However temporary in pit storage is proposed for the Proposal and Approved Proposal to assist with water management on site (Section 7.3.7.3).

Water is required for operational purposes across the site and in processing, as well as for use in the MAR both throughout operations and closure as part of the EMP provisions for the Approved Proposal.

Under the current approval, surplus water additional to requirements is discharged to Turee Creek East, however during peak abstraction times and to preserve a source of water for use in the MAR post closure, alternative management of surplus water will be required.

The site water balance estimates indicate that West Angelas operations will transition to water deficit sites after the mid to late 2030's as BWT pits are completed. This water deficit is proposed to be addressed through accessing surplus water temporarily stored within disused mine pits/aquifers (Section 7.3.7).

The modelled water balance over the LOM, including the Proposal and Existing Operations, are shown in Figure 7-7.

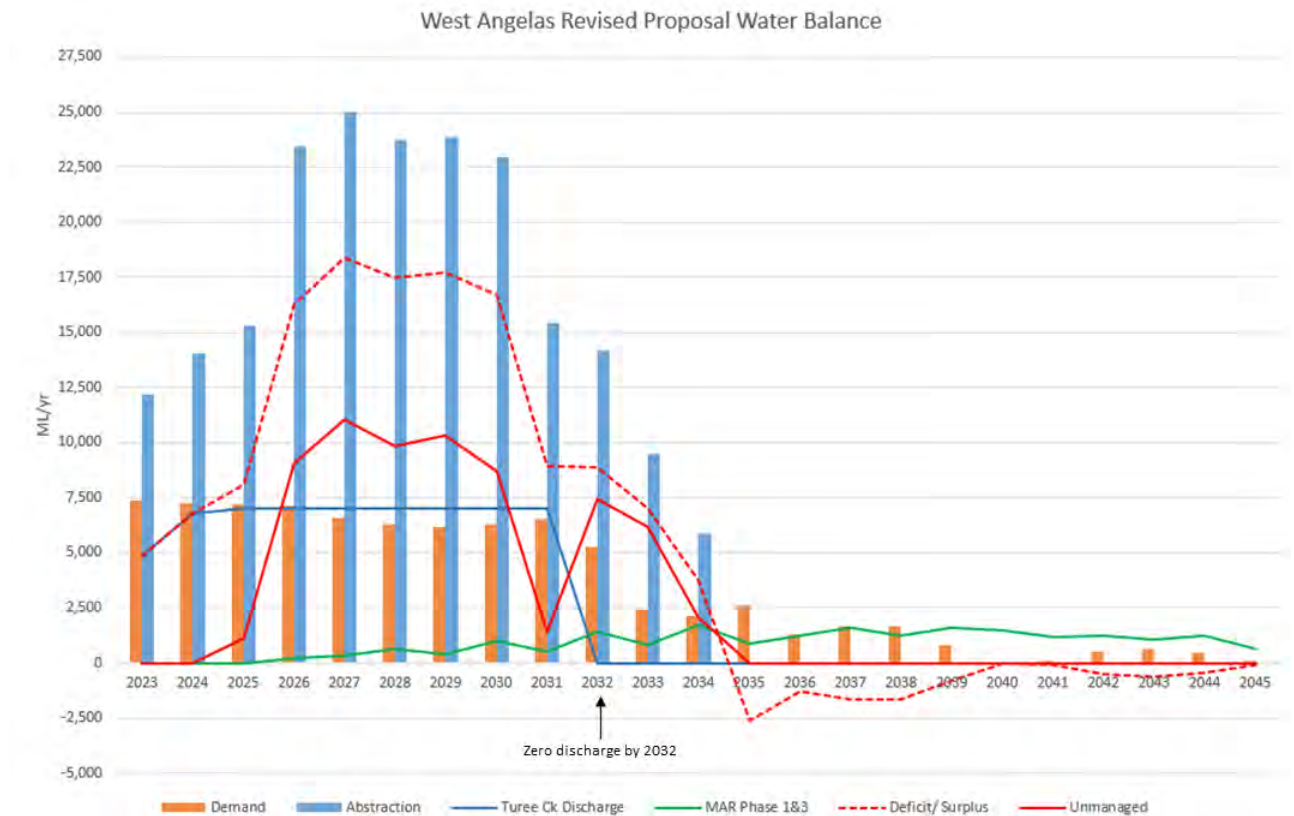


Figure 7-7: Modelled Water Balance over Life of Mine

7.3.7.1. Operational Use

The major water demand for the Existing Operation and the Proposal is associated with the operation of the West Angelas processing plant and water use for dust suppression across the current operational areas, with smaller volumes utilised for administration and camp use. Operational water demands have been modelled based on historic actual usage of 0.25 x 10⁻⁴ ML per tonne of material mined, including for dust suppression, are likely to remain relatively consistent throughout the project life as the production profile is stable.

7.3.7.2. Managed Aquifer Recharge

A MAR scheme, comprising the intentional recharge of an aquifer under controlled conditions, either by active injection or passive infiltration of water, has been constructed to meet Conditions 6-1 and 3 of MS 1113 and DN 2018/8299. The modelled surplus water, including water stored in disused pits, will be used to operate the MAR as required in relation to potential drawdown from approved deposits C and D propagating towards Karijini National Park. Any additional MAR requirements at closure will be addressed in the MCP.

7.3.7.3. Storage Within Disused Mine Pits

The storage of surplus water in disused pits and/or dewatered formations provides an opportunity to:

- Allow for storage of water for future beneficial use
- Accelerate groundwater recovery post-dewatering.

This strategy increases passive recharge of the aquifers and reduces the total water deficit from the Revised Development Envelope. Therefore, in accordance with the water use hierarchy, surplus water will be preferentially temporarily stored in suitable disused mine pits, to be used for operational purposes, in the MAR or discharged to Turee Creek East if excess to requirements.

In addition to mine planning and engineering constraints, the following hydrogeological and environmental criteria will be assessed to determine the suitability of disused mine pits to be used for water storage:

- An assessment undertaken of pit suitability for storage, including PAF considerations/risks
- There will be no significant change to the quality of the receiving groundwater system, i.e., water transfer will only occur between aquifers with comparable water quality
- Pit storage will not cause groundwater mounding in areas with a shallow water table
- Pit storage will not result in water seeping out of pit walls on down-gradient slopes
- Infrastructure required to support pit storage (i.e., pipelines) are within approved clearing limits and minimise clearing of vegetation with elevated significance
- Minimal potential for storage to increase dewatering requirements of other pits (i.e. recirculation)
- Geotechnical assessment undertaken to assure pit is suitable for water storage and not scheduled for progressive backfill during operations
- Pit storage will not result in overtopping of the mine pit.

The current MS 1113 requires backfilling of pits to prevent the formation of pit lakes at closure and no changes are proposed to this requirement. To ensure this requirement can be met, and to avoid potential over topping, water will not be stored above the pre-mining water level in pits.

7.3.8. Key Inland Waters Values

The key environmental values associated with Inland Waters include:

- Turee Creek East (which flows westwards into and through Karijini National Park)
- The regional groundwater aquifer (Wittenoom Formation) that underlies the Proposal and Karijini National Park
- Potential Groundwater Dependent Ecosystems (features 1a, 12, 14 and 22)
- Ephemeral pools (Deposit H Waterhole, Turtle Pool, Mt Ella East Pool(s))

7.4. Potential Environmental Impacts

7.4.1. Direct Impacts

Implementation of the Proposal has the potential to result in the following direct impacts to Inland Waters:

- Lowering of groundwater levels as a result of mine pit dewatering and water supply (note potential impacts to GDE and stygofauna are addressed in Section 8 and Section 10)
- Changes to surface water catchments from the development of mine landforms and placement of infrastructure causing a reduction in catchment discharges and potentially impacting surface water hydrological regimes
- Changes to surface hydrological regime of Turee Creek from the continued discharge of surplus water
- Groundwater mounding from surplus storage in disused mine pits.

The Proponent has previously committed to ensuring all BWT pits will be backfilled to a level above the recovery groundwater level, thereby avoiding any potential impacts typically associated with pit lakes. Additionally, all groundwater abstracted from dewatering of Deposit H and Deposit F North will be used at the respective sites, so no change to existing surface water discharge regimes is expected as a result of the Proposal.

7.4.1.1. Lowering of Groundwater Levels

A numerical groundwater model was developed to quantify the groundwater drawdown for the Proposal based on the proposed BWT mining and groundwater abstraction as described in Section 7.3.4. Details of the groundwater modelling is included in Appendix C.42

Modelled drawdown due to groundwater abstraction is described for each of the Proposal Areas below.

Mining of Proposal deposits in relation to potential lowering of groundwater is summarised as follows:

- Western Hill – AWT mining, abstraction for supply (~0.37 GL/a over 5 years, ~1.85 GL)
- Deposit H – AWT and BWT mining, in-pit sump pumping only, no abstraction for supply (water retained in pit)
- Mt Ella East – AWT mining, no abstraction for supply
- Deposit F North – BWT, abstraction for supply (~0.03 GL/a over 2 years, ~0.07 GL).

Western Hill

Although the Western Hill deposits contain BWT ore, the Proponent will restrict mining to AWT for this Proposal and will not undertake any abstraction for BWT mine pit dewatering purposes at the Western Hill deposit due to its proximity to Karijini National Park.

The Proposal includes installing a series of groundwater production bores screened in the localised Brockman Iron Formation to supply water for dust suppression and other purposes during construction and initial operations of up to 1 ML/d for 5 years (approximately 0.37 GL/a). The bores will be located central to the Western Hill development, more than 3 km from the boundary with Karijini National Park.

There are no GDE's or permanent pools near the Western Hill deposit, and the closest potential GDE is located within Karijini National Park (Feature 22; Zone C). Drawdown does not extend to any major creeklines or near any pools. Worst case modelling indicates a potential drawdown of approximately 6.5 m within in an area intersecting Turee Creek East (Figure 7-9) and Zone A pGDE, however this feature is highly unlikely to be reliant on groundwater and potential drawdown is considered to have a negligible affect on this feature (refer to Section 8 for further details).

Groundwater modelling (Rio Tinto 2021d) has shown that the estimated drawdown associated with water supply is highly unlikely to impact groundwater levels at the Karijini National Park boundary outside of natural recorded groundwater level seasonal variations (Figure 7-8). The model is conservative with respect to drawdown propagation as all potential connections between the source aquifer and the regional Wittenoom Formation via gaps in the McRae Shale are assumed to exist and are included in the model. Model sensitivity was examined with the model run 981 times with the key parameters (specific yield and hydraulic conductivity) randomly (within statistically valid ranges) varied for each domain. This resulted in 95% of model runs showing no impact to groundwater levels at the Karijini National Park boundary. The other 5% of runs are characterised by low specific yield for the Wittenoom Formation and any resultant modelled drawdown at the Karijini National Park boundary was less than 0.1 m.

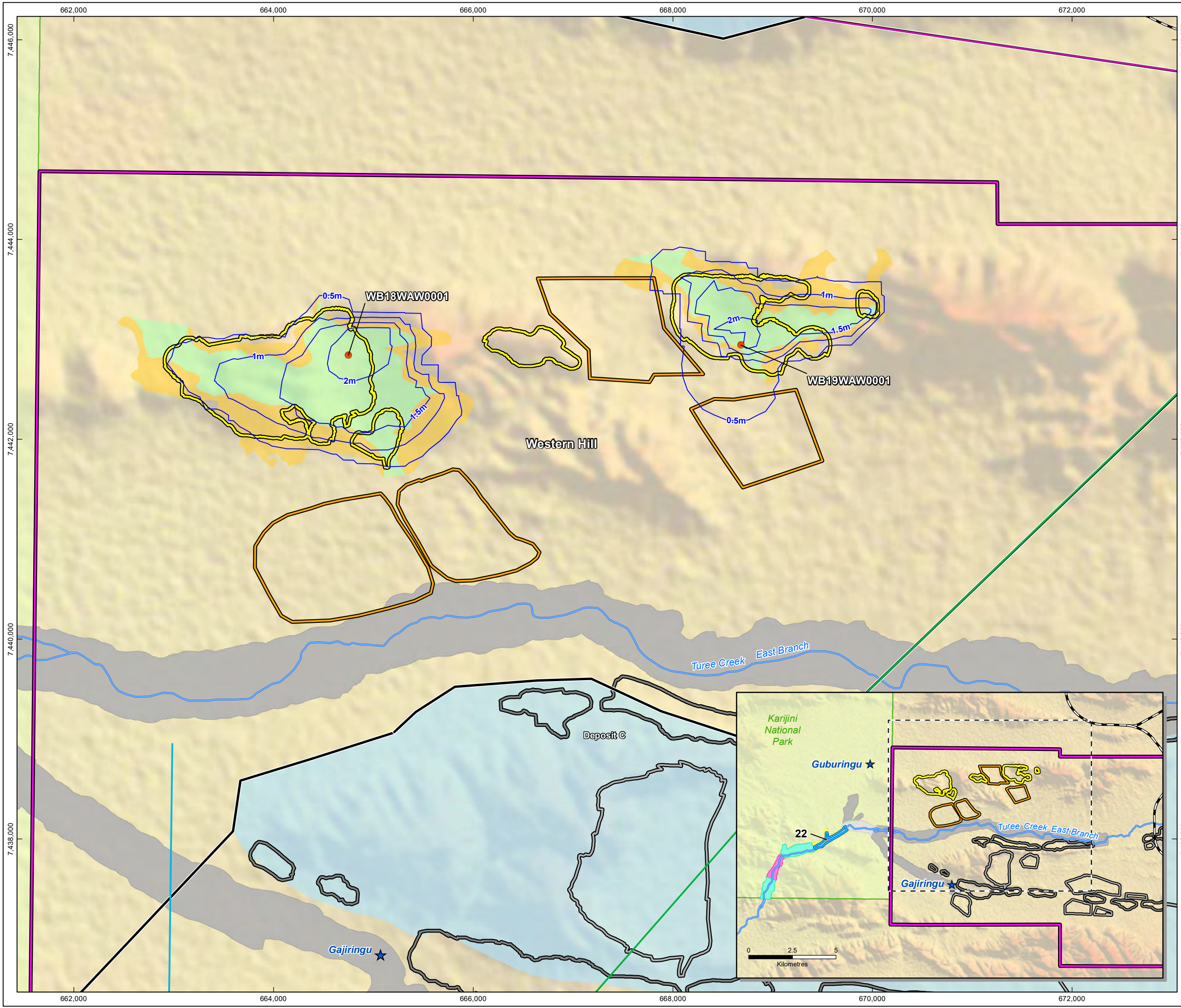
The P50 model simulation (probability of 50% that will occur) is considered the most likely and has been used for the purposes of generating groundwater drawdown contours. Drawdown is not predicted to approach the Karijini National Park boundary in this scenario. The P80 simulation (20% chance that this will occur) is considered the most conservative realistic simulation, and in this scenario drawdown is not predicted to approach the Karijini National Park boundary.

Predicted drawdown contours for the P50 and P80 simulations are shown in Figure 7-8 and Figure 7-9.

Figure 7-8
Western Hill Simulated P50
drawdown extents

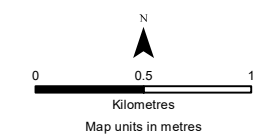
Drawn: A.D.
Plan: RTIO-0983812v1
Date: March 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:35,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
-
- ★ Heritage Site
- Production Bore
- Drawdown (m)
- WANG MAR Scheme
- Dolerite Dyke
- Aquifer Barrier
- Model Domain Outerboundary
- Brockman Iron Formation
- Mount McRae Shale
- Marra Mamba Iron Formation
- Potential GDE
- Potentially Groundwater Dependent Vegetation Zones**
- Zone A
- Zone B
- Zone C-1
- Zone C-2
- Zone C-3
- Zone D
- Zone E
-
- National Park
- Rio Tinto Railway
- Major Creek

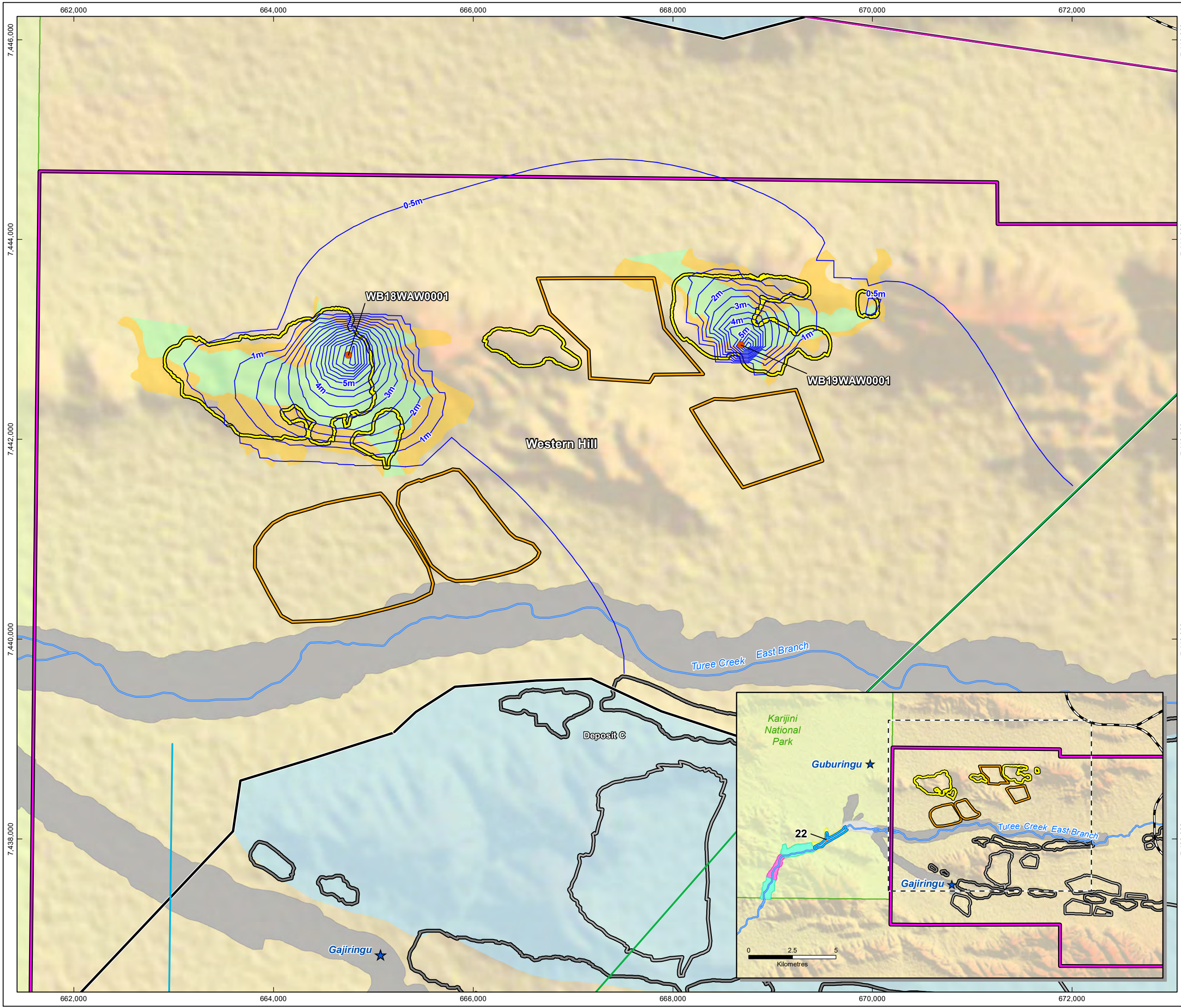


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Figure 7-9
Western Hill Simulated P80
drawdown extents

Drawn: A.D.
Plan: RTIO-0983813v1
Date: March 2023

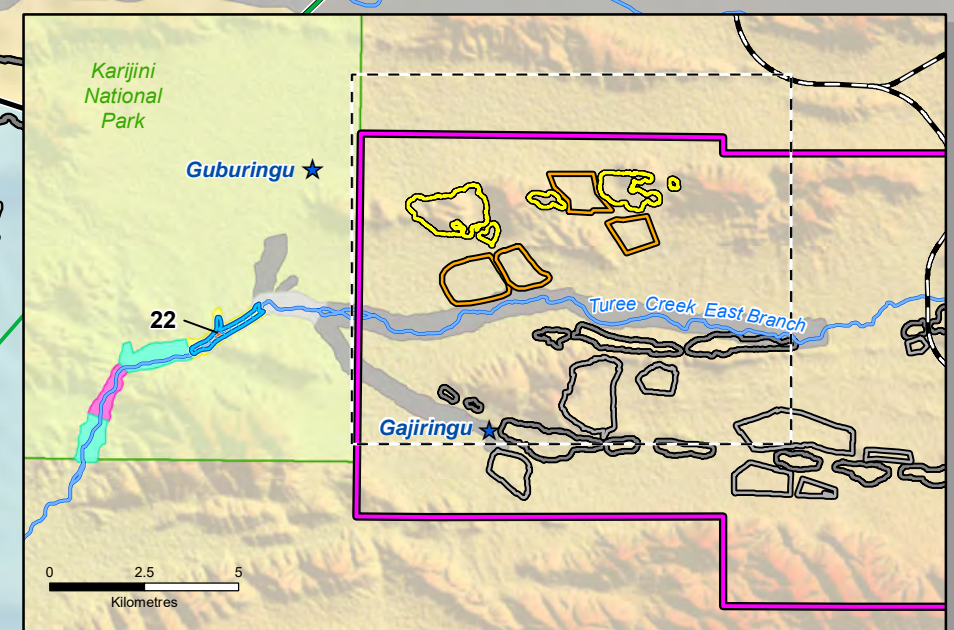
Proj: GDA 1994 MGA Zone 50
Scale: 1:35,000 @A3
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Legend

- Revised Development Envelope
- Proposed Conceptual Layout*
 - Pit
 - Waste Landform
- Approved Conceptual Layout*
 - Pit
 - Waste Landform
- Heritage Site
- Production Bore
- Drawdown (m)
- WANG MAR Scheme
- Dolerite Dyke
- Aquifer Barrier
- Model Domain Outerboundary
- Brockman Iron Formation
- Mount McRae Shale
- Marra Mamba Iron Formation
- Potential GDE
- Potentially Groundwater Dependent Vegetation Zones*
 - Zone A
 - Zone B
 - Zone C-1
 - Zone C-2
 - Zone C-3
 - Zone D
 - Zone E
- National Park
- Rio Tinto Railway
- Major Creek

0 0.5 1
Kilometres
Map units in metres



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Deposit H

Mining of Deposit H will extend below the water table to approximately 21.5 m below water table.

Modelling of drawdown has been undertaken for both the proposed impermeable (likely) and permeable scenario's (IGS 2022) and results suggest that if the surrounding stratigraphy is more permeable than anticipated, there will be drawdown observed in groundwater beneath Turtle Pool if the orebody aquifer is dewatered using bores. Modelling applying low permeabilities of the surrounding stratigraphy shows minimal to no drawdown of groundwater beneath Turtle Pool and is considered the more likely scenario.

Turtle Pool is likely to be partly groundwater fed and connected to the same aquifer as Deposit H, and as such, sump pumping rather than abstraction via dewatering bores to access BWT ore, and an alternative supply source within the Revised Proposal Development Envelope is proposed. Investigations into the hydrological regime of Turtle Pool are ongoing.

Deposit F North

The standing groundwater level at Deposit F is currently approximately 716 mAHD. Groundwater is proposed to be abstracted lowering the groundwater level by approximately 20 m to allow BWT mining of the Deposit F North deposit to a base of 696 mAHD. Mine dewater is proposed to be used on site for dust suppression and other operational requirements. Approximately 66 ML is required to be abstracted during the life of mining the deposit which is anticipated to be approximately 2 years. As the orebody aquifer is bounded on all sides by low permeability unmineralised Macleod and Nammuldi Members, the drawdown is considered to be restricted to the mineralised orebody aquifer. Drawdown is not predicted to propagate beyond the contact with the low permeability strata. Accordingly, there is considered a negligible likelihood for residual impacts and hence this aspect is not considered further in this assessment.

Mt Ella East

Mining at Mt Ella East will be above the water table and no dewatering or installation of additional production bores for water supply is required.

Groundwater Dependent Ecosystems

Of the four vegetation features within and around the Proposal Area exhibiting either a 'Low-moderate' or 'Moderate' likelihood of groundwater dependence based on the utilised biological and hydrological evidence (Section 8; Figure 7-1), none of these features are considered likely to be reliant to any extent on the groundwater resources that will be impacted or potentially impacted by the Proposal and as such, impact to these features as a result of groundwater impacts from the Proposal are likely to be negligible.

Creeks and Pools

There are no permanent pools or creeklines within or adjacent to the Revised Development Envelope. All the pools and creeklines within or adjacent to the Revised Development Envelope are surface water fed ephemeral features, except for Turtle Pool, and as such drawdown from supply abstraction and/or dewatering is not expected to impact these. Turtle Pool is likely a combination of surface and groundwater fed, and further investigation to confirm the hydrology are underway, however mitigation measures are proposed to avoid and/or minimise potential impacts on Turtle Pool in consideration of it being likely both groundwater and surface water fed.

To avoid impacts to Turtle Pool from potential drawdown of groundwater, no abstraction of groundwater via bores for the purpose of dewatering to access BWT ore is proposed at Deposit H. Sump pumping and local in pit storage/infiltration of abstracted water is proposed at Deposit H. The minor and localised drawdown cone will not propagate beyond the pit extent and will not impact Turtle Pool.

7.4.1.2. Groundwater Mounding from Surplus Storage in Disused Mine Pits

To reduce its need to discharge surplus mine dewater to the environment and reduce overall groundwater demands, the Proponent intends to periodically use its exhausted mining pits to temporarily store surplus mine dewater. This management option may result in temporary mounding of groundwater levels surrounding the pits; however, the selection of pits to be used for this purpose and the volume of water stored will be done to avoid impacts to surrounding values, including native vegetation. Excess water will be stored below the pre mining water levels in these pits only.

7.4.1.3. Changes to Surface Water Catchments

Turee Creek East and Tributaries

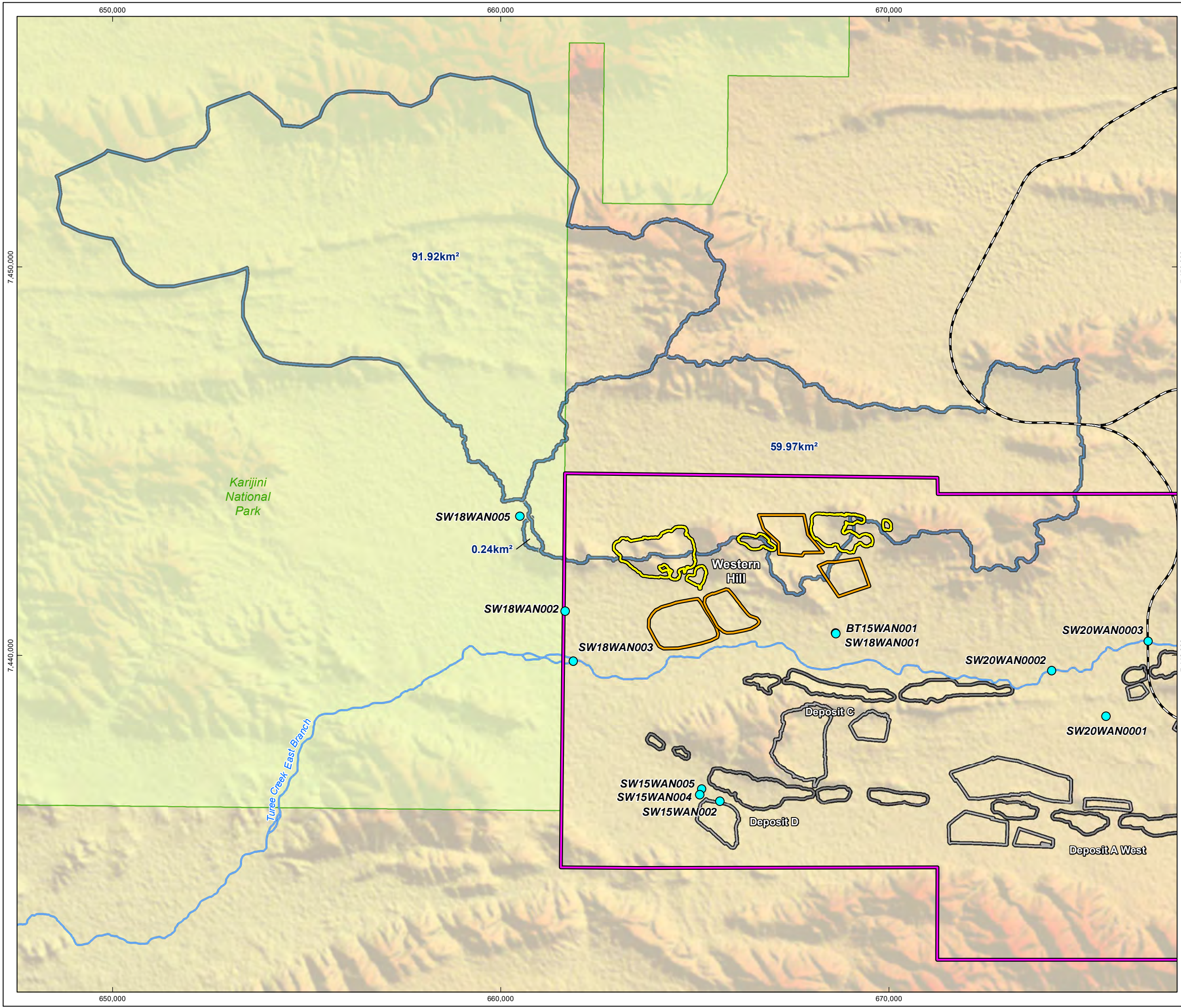
Development of the proposed Western Hill mining area will reduce the catchments of creeks and tributaries that flow directly through Karijini National Park and are part of the Turee Creek East catchment (Figure 7-10).

Removal of the catchment area and restriction of flows at creek crossings will impact on the flow regime of Turee Creek East (Figure 7-10). To quantify the likely impact, pre- and post-development hydrographs were recorded at the western boundary of the development for flow paths leading to Karijini National Park using the Western Hill TUFLOW modelling. Three locations were assessed as shown in Figure 7-11. These were at the main channel of Turee Creek East (TCE_KNP), a sheet flow area flowing from Western Hill to the park (Tribes_KNP), and the northern tributary flowing towards Guburingu heritage area (To_Guburingu) within the park boundary.

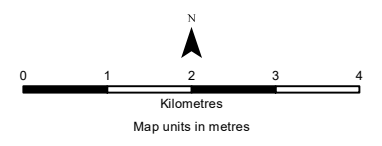
The main channel of Turee Creek East (TCE_KNP) will experience a reduction in overall peak ephemeral flow volumes of between 5% for more frequent events (1:2 AEP) and 12% for larger 1:100 AEP events associated with the development of mine pits and placement of water landforms, which will result in a reduction of the catchment area at Western Hill. This is evident in the modelled reduced initial peak flow and associated volume shown in the first, smaller peak of the hydrograph (Figure 7-12). This is caused by a reduction in flow from the smaller tributaries close to the Karijini National Park boundary and the effect is present for all modelled events (from 1:2 to 1:100 AEPs). Impacts to ephemeral catchment flow are modelled to be less pronounced in the second larger peak of the hydrograph, which is associated with surface water flow sourced from higher in the catchment constituting the main body of a modelled flood event scenario and the largest proportion of water delivered downstream. A small attenuating effect is evident for the rarer modelled flood events (1:10 AEP and 1:100 AEP) with a reduced peak flow and extended hydrograph tail, caused by the storage and release of water behind the new creek crossings. For the more frequent smaller 1:2 AEP event, water will be delivered downstream uninhibited.

Figure 7-10
Turee Creek East Catchments
and Western Hill Hydrological
Setting

Drawn: A.D.
Plan: RTIO-0983835v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:90,000 @A3
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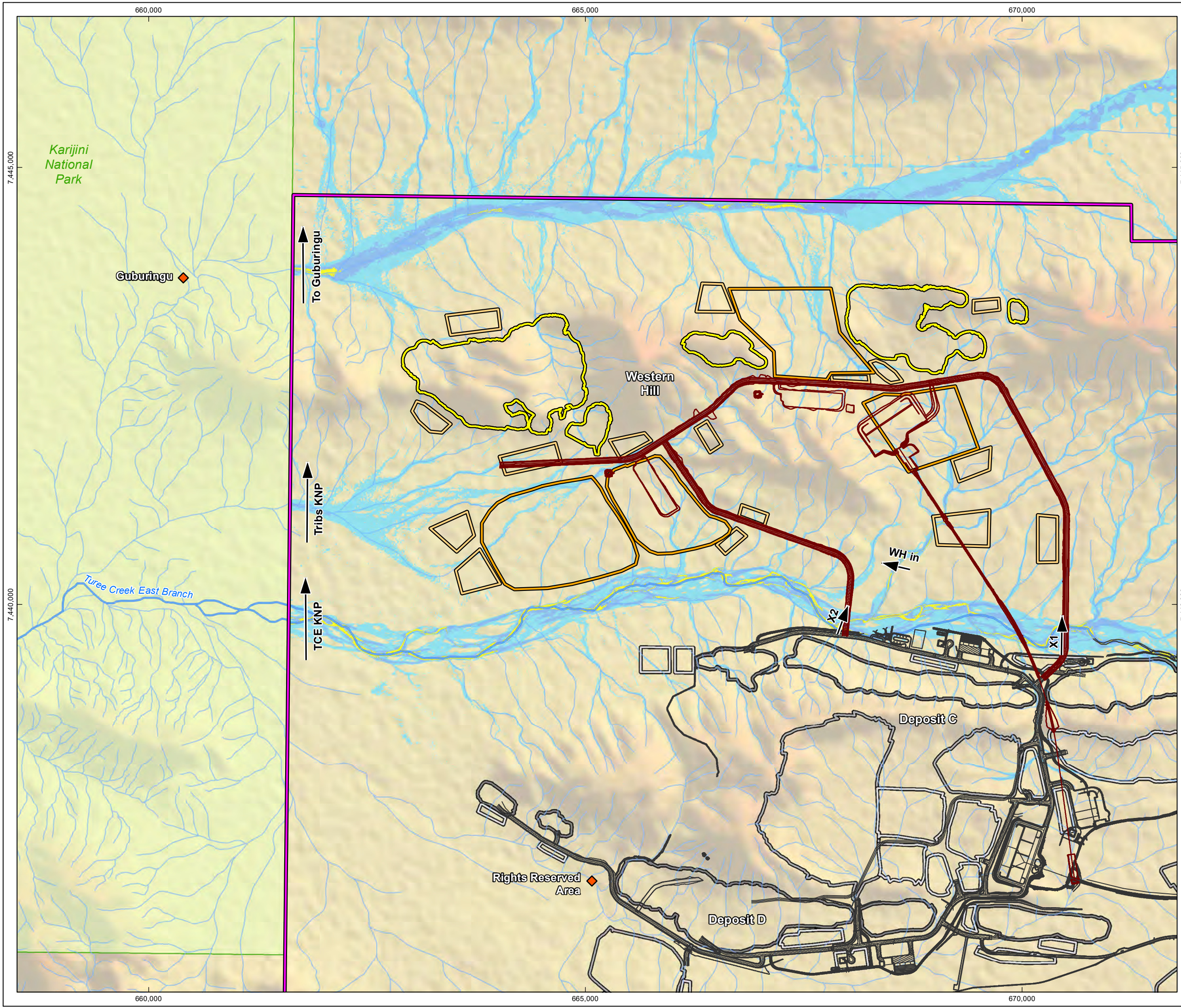
- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout*
 - Pit
 - Waste Landform
 - Approved Conceptual Layout*
 - Pit
 - Waste Landform
 - Surface Water Monitoring
 - Catchment
 - National Park
 - Rio Tinto Railway
 - Major Creek



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Figure 7-11
Western Hill Infrastructure and 1:100
AEP Max Floodplain with Hydrograph
Impact Assessment Locations

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Plan: RTIO-0983838v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
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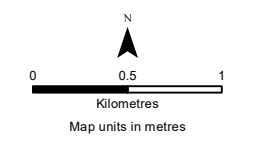
Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
 - Infrastructure
 - Pit
 - Waste Landform
 - Stockpile
- Approved Conceptual Layout**
 - Infrastructure
 - Pit
 - Waste Landform
 - Stockpile

- Sensitive Receptor
- TUFLOW PO Line

- 100 AEP max**
- Depth (m)
- 0 - 0.1
 - 0.1 - 0.5
 - 0.5 - 1
 - 1 - 2
 - 2 - 5
 - 5 - 10

- National Park
- Major Creek
- Minor Creek

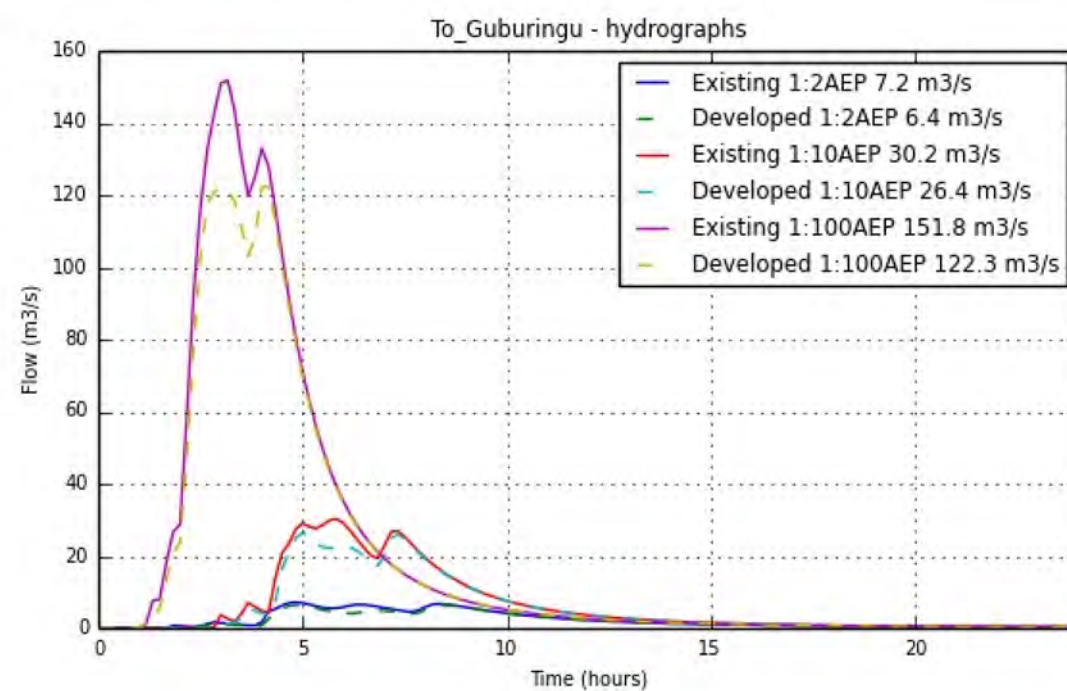
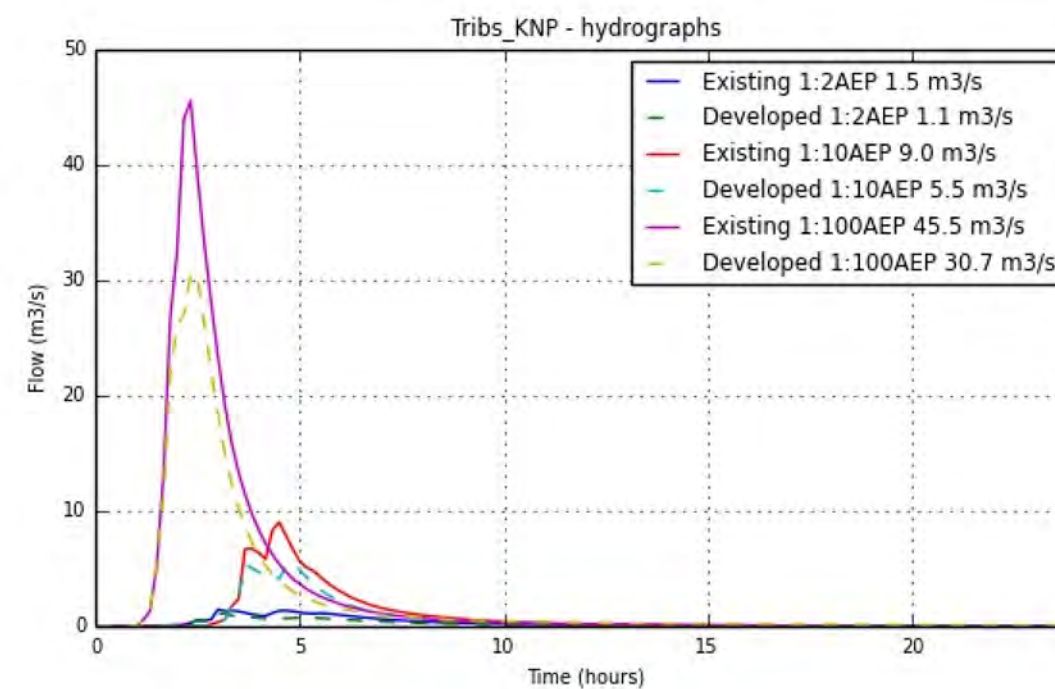
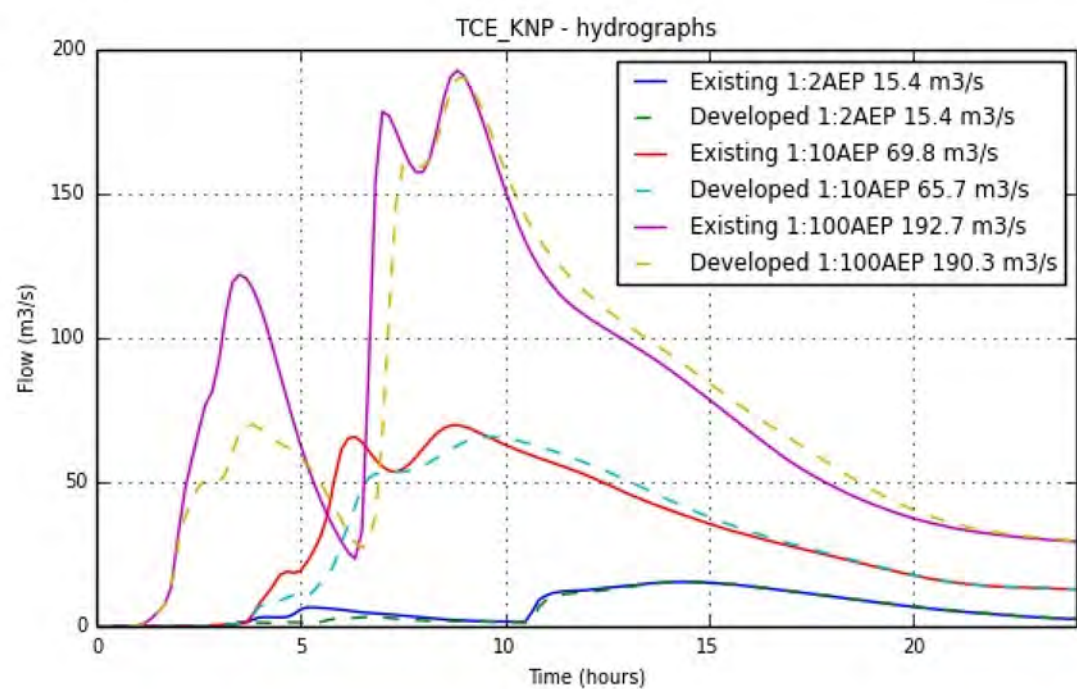


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Figure 7-12
Pre and Post-development
Flow Hydrographs at the
Karijini National Park

Drawn: A.D.
Plan: RTIO-0983840v2
Date: November 2023

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The proposed pit and waste landform development will reduce flow from the small tributaries and sheet flow area immediately east of the Karijini National Park boundary (Tribs_KNP). This reduction in flow is unavoidable, given the limited flat terrain over which waste rock dumping can occur, and limited options for in pit backfill whilst the mine pit is in operation. Nonetheless, the waste rock landform footprint in this location will be placed to minimise disruption of flow where possible.

The Approved Proposal extends across approximately 26% of the 430 km² Turee Creek East catchment area upstream of Karijini National Park and the Proposal will increase this extent by a further 3% (cumulatively 29%) (Rio Tinto 2021c). The majority of the 3% increase is associated with the development of the Western Hill deposits. The Proponent has designed the Western Hill development to avoid or minimise any reductions in catchment flow that might result from the increased footprint, with infrastructure located outside of the 1:100 yr floodplain as far as practicable (Section 7.5).

Modelled impacts of the Proposal flows within the Turee Creek East catchment into Karijini National Park (Rio Tinto 2021c) are shown in Table 7-4.

Table 7-4: Post Proposal Changes in Peak Flow and Volume for Flow Delivered to Karijini National Park Boundary

	Existing Conditions			Post-Proposal			Change (%)		
	1:2	1:10	1:100	1:2	1:10	1:100	1:2	1:10	1:100
AEP									
Peak flow (m ³ /s)	23.7	109	391	22.5	97.5	343	-5%	-11%	-12%
Event volume over 24hrs (ML)	769	3,249	8,584	697	3,073	8,078	-9%	-5%	-6%

A reduction in peak flow and volume from the eastern tributary of the Guburingu heritage area is expected as a result of pit and waste landform development. This is evident across all design events assessed.

The other deposits are all located only partially within the Turee Creek East catchment boundary. No impact to the other catchments is expected, based on their respective sizes (see Section 7.3.3).

There is no additional discharge of surplus water to Turee Creek East or tributaries proposed in relation to this Proposal, with all surplus water from the Proposal to be used on site. As such there is no change to the volume, rate and quality of controlled surface water discharge (from dewatering) as a result of the Proposal.

Deposit H Waterhole

The Proposal will impact up to 2.8 km² (88%) of the 3.3 km² catchment that feeds Deposit H Waterhole (Figure 7-13). The impacts to the hydrological regime of the Deposit H Waterhole are considered over two different timeframes: during mining (approximately 6 years) and post-mining. Depending on final mine plan, which is still the subject of ongoing consultation with Ngarlawangga Traditional Owners, the scale of impact will likely be greatest during mining / operational phase, as most of the catchment (up to 2.8 km²) could be isolated from the pool and the watercourse in general to prevent flooding of the mine area and protect water quality.

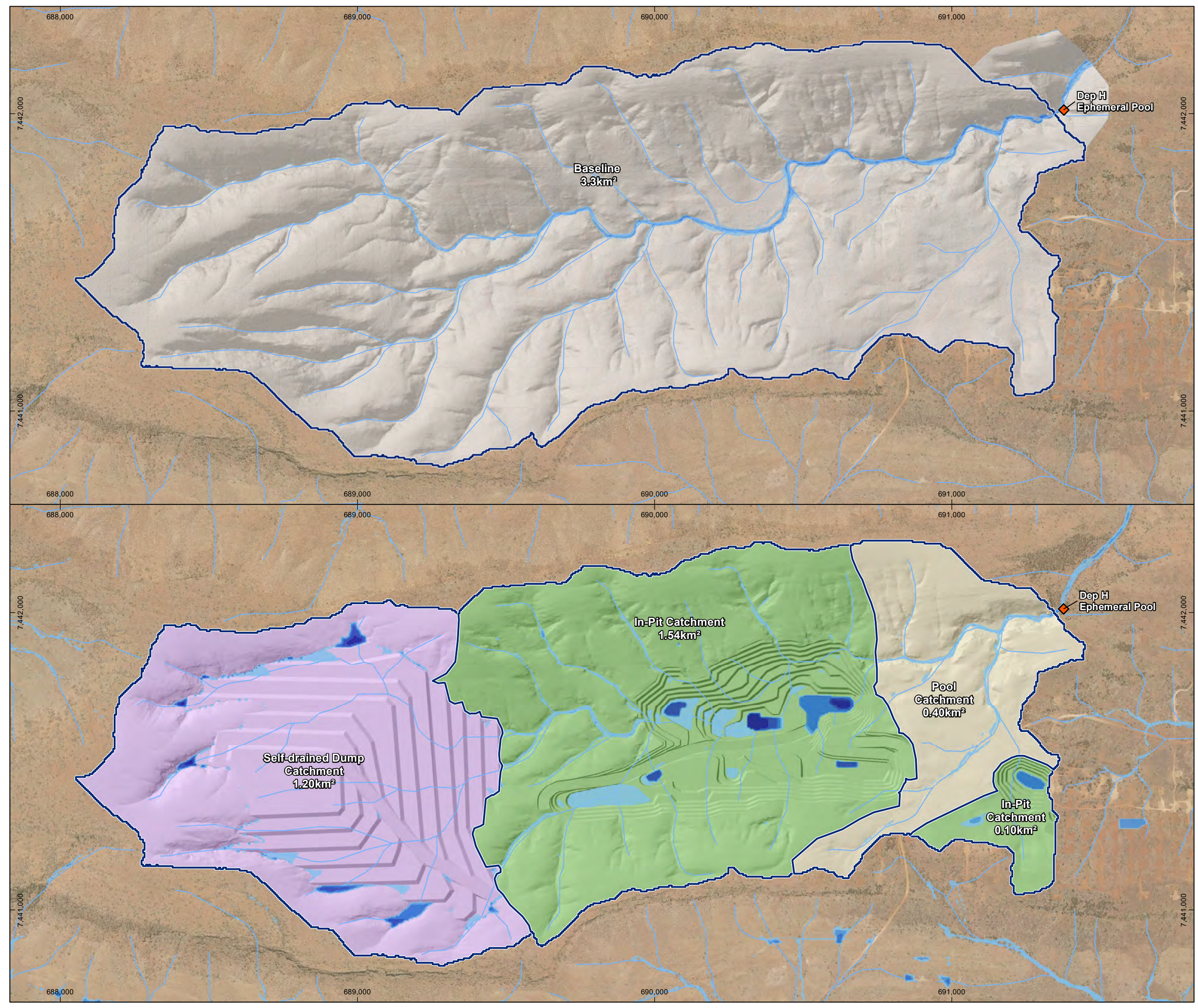
An alternative scenario has been developed and is the subject of ongoing consultation with Traditional Owners and comprises construction of a diversion drain to the north of the western deposit at Deposit H (Figure 7-14). This proposed alternative may be constructed dependent on the outcomes of consultation with Traditional Owners. The diversion drain would intercept flows from the northern area of the catchment and create a pathway to convey these flows to Deposit H Waterhole. Mining of Deposit H western pit with construction of the diversion drain would result in impact to the catchment of approximately 67%. Run off from the Deposit H western waste landform would be prevented from

entering the diversion drain and will be contained within toe bunds constructed around the base of the landform. Run off from mining areas surrounding the pit will be diverted into the pit to avoid the risk of contamination to Deposit H Waterhole.

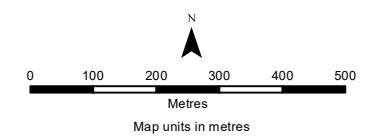
The diversion drain is designed to convey 1:100 AEP rainfall events to facilitate flows during operations. The MCP will be updated with respect to the diversion drain as knowledge progresses.

Figure 7-13
Deposit H Waterhole Pre- and Post-development Impact Modelling (88% impact)

Drawn: A.D.
Plan: RTIO-0983843v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:12,000 @A3
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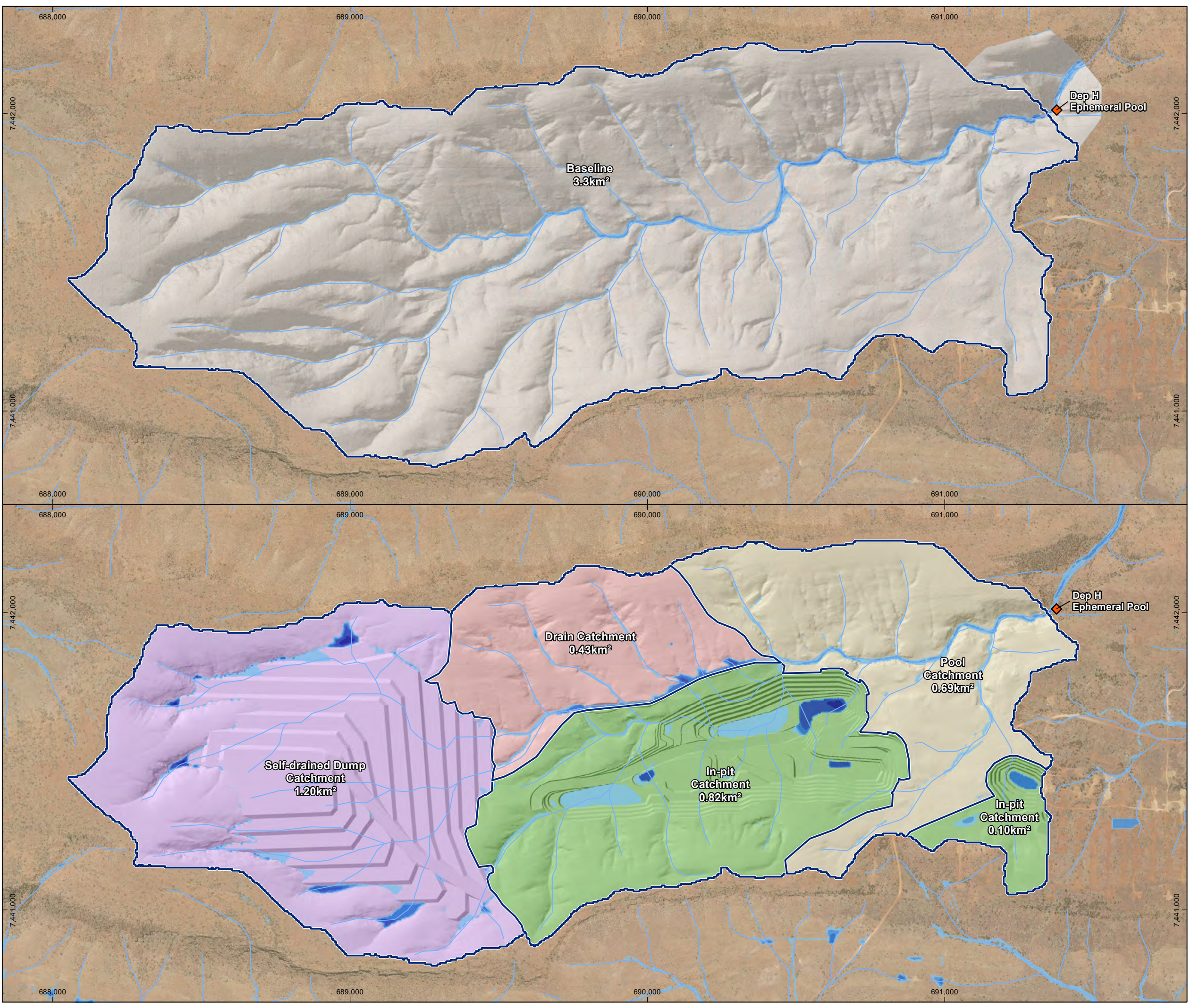
- Legend**
- Flood Impact Modelling*
- 1:100 AEP Flood - Depth (m)
- 0 - 0.1
 - 0.1 - 0.5
 - 0.6 - 1
 - 1.1 - 2
 - 2.1 - 5
 - 5.1 - 10
- Catchment*
- In-pit
 - Pool
 - Self-drained Dump
- ◆ Sensitive Receptor
- ▭ Pool Catchment
- Minor Creek



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Figure 7-14
Deposit H Waterhole Pre- and Post-development Impact Modelling (~67% Impact)

Drawn: A.D.
Plan: RTIO-1028967v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:12,000 @A3
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Legend

Flood Impact Modelling

1:100 AEP Flood - Depth (m)

- 0 - 0.1
- 0.1 - 0.5
- 0.6 - 1
- 1.1 - 2
- 2.1 - 5
- 5.1 - 10

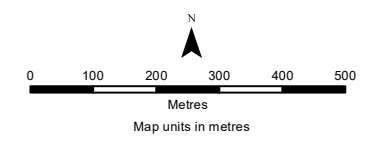
Catchment

- Drain
- In-pit
- Pool
- Self-drained Dump

◆ Sensitive Receptor

□ Pool Catchment

— Minor Creek



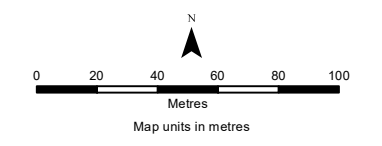
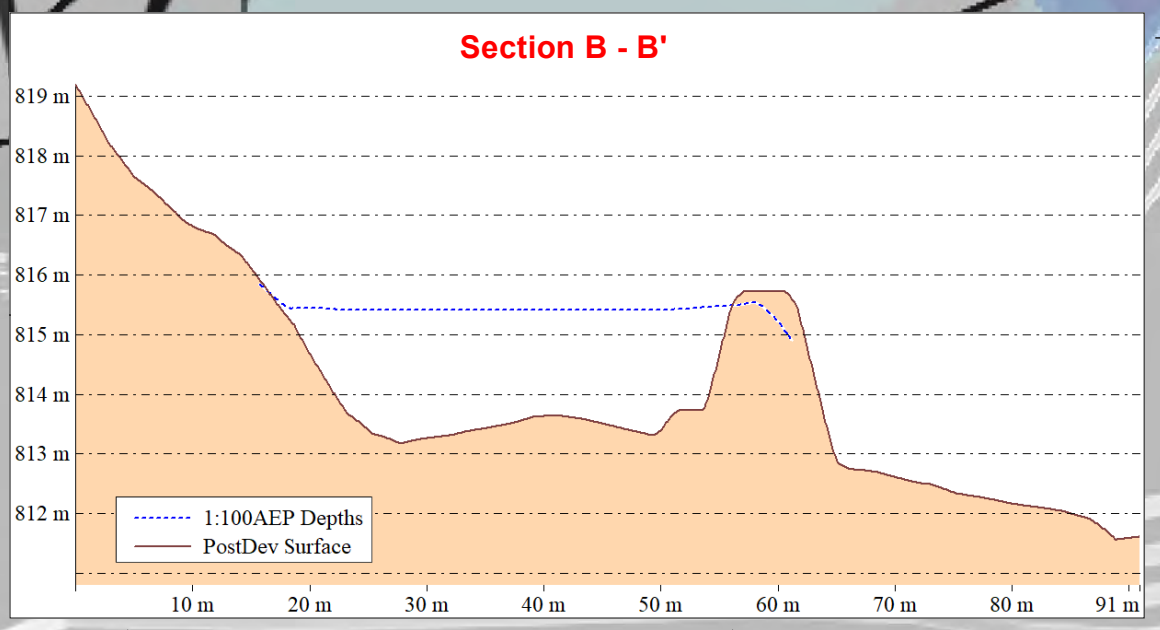
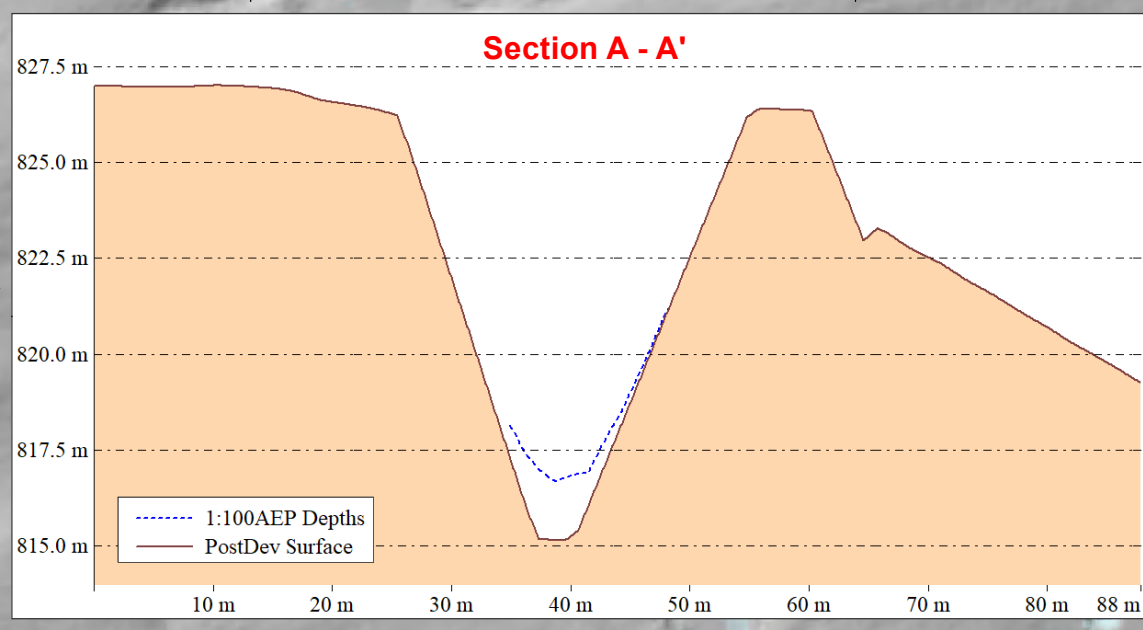
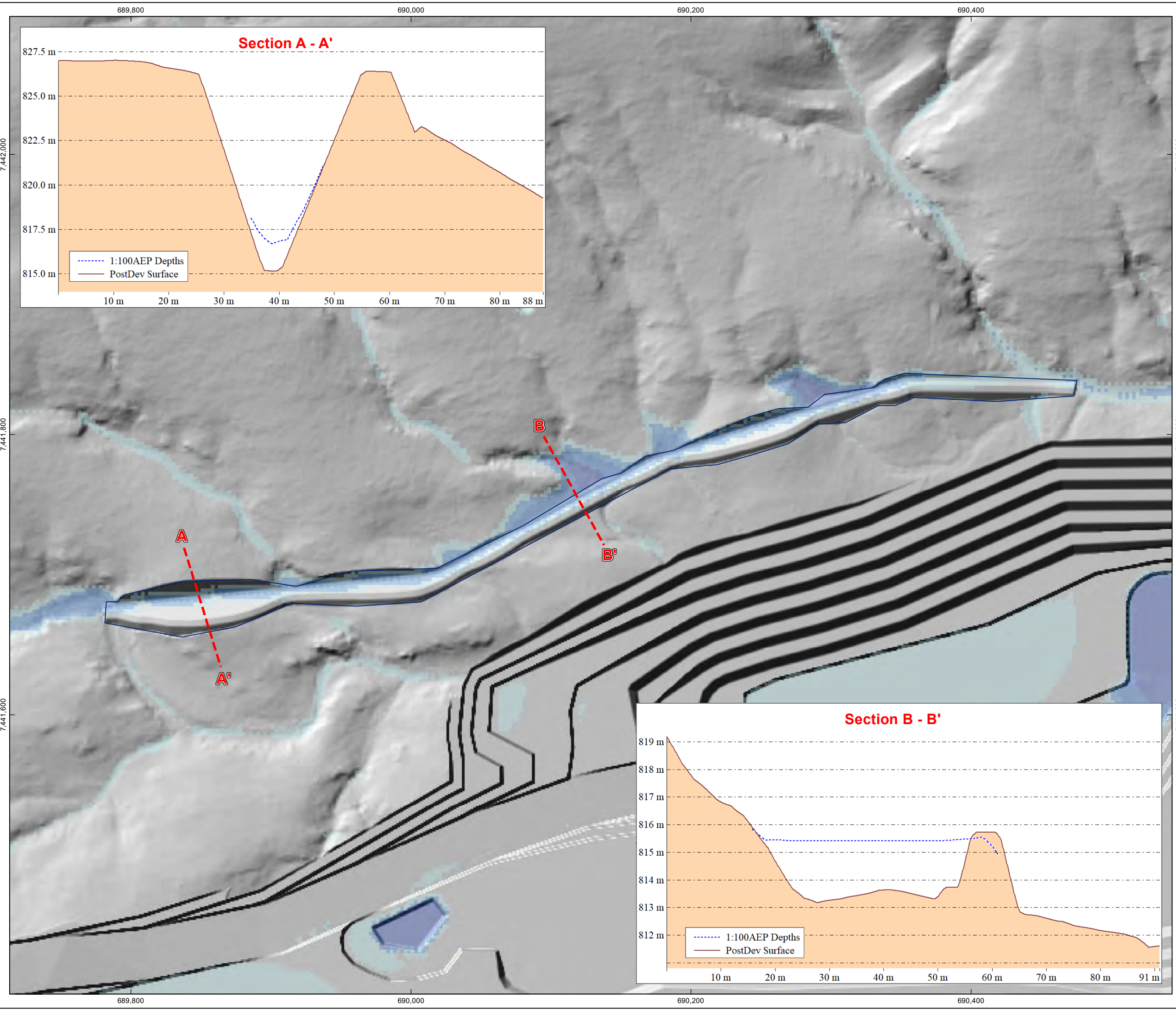
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Figure 7-15
Deposit H Proposed Diversion
Drain Design Layout
and Cross-sections

Drawn: A.D.
Plan: RTIO-1029268v2
Date: November 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:2,500 @A3
GIS.Team@riotinto.com

- Legend**
- 1:100 AEP Depths*
- 0.1 - 0.1
 - 0.2 - 0.5
 - 0.6 - 1
 - 1.1 - 2
 - 2.1 - 5
- Diversion Drain
- Cross Section



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Modelling of flows from the impacted catchment based on maximum catchment removal of 2.8 km² using TUFLOW was used to inform anticipated outcomes for the Deposit H Waterhole as a result of proposed impacts associated with the development of Deposit H. Modelling used a 1:2 AEP rainfall event (32 mm in 3 hours) which is considered a typical high intensity rainfall event that would generate flows to the pool in most years. The TUFLOW modelling assessed changes in hydrology at the pool and accounted for changes in terrain and flow paths due to mining.

The results including Figure 7-15 provided are based on high-resolution 2D modelling which was used to quantify potential changes in the volume of water delivered to the pool in different development scenarios for selected 1:2 and 1:5AEP rainfall events (events expected to happen on average each year). The modelling was undertaken for the critical duration of 3 hours event.

In all cases, it was concluded that there is adequate volume to fill the pool multiple times, despite a large reduction in overall flow from the catchment. For example, without a diversion in place (worst case scenario with 88% catchment reduction), modelled flow volumes for the 1:2AEP event are 14 times the flow volume required to fill the pool to its spill point. Including a northern diversion drain to retain additional catchment area would increase the overall volume of flow through the pool, approximately 39 times the volume.

Modelling found that the overall flow volume delivered to the pool would be ~13% of baseline and the peak flow rate would be reduced. High flow velocities of greater than 4m/s for scour are retained and the pool storage level impacts are negligible. As such it was concluded that the filling and spilling regime of the pool will largely be maintained post mining. However, the total flow volume through the system, and downstream, would be reduced.

Pre and post development catchment impacts are shown in Figure 7-13 and flows to and filling of the Deposit H surface water fed ephemeral pool are shown in Figure 7-16. On the basis that the pool will continue to fill and retain water for as long after the last replenishment as before mining the overall impact to the pool's hydrological regime is considered to be minor. Monitoring will be implemented to ensure that the hydrological regime at Deposit H Waterhole is not adversely affected and is documented in the West Angelas EMP (Appendix A.8). The sensitivity of the pool in terms of conservation significant fauna and also cultural values are considered and assessed in 6, 9 and 13 of this ERD.

Water quality at Deposit H Waterhole

There is a low risk of contamination at Deposit H Waterhole from contaminants such as hydrocarbons, PFAS and any acid mine drainage (Figure 7-14). Potential sediment load will be minimised and can be managed via the use of toe bunds, rock armouring and sediment traps.

Surface runoff from mining operations, including WRLs will be diverted away from the Deposit H Waterhole such that only run off from clean (non-mining) areas enter the upstream gully and diversion drain supplying the Deposit H Waterhole. Toe bunds at the base of the Deposit H western waste landform will be constructed to ensure potentially sediment laden run off from the landform is isolated from the gully feeding the Deposit H Waterhole. Additionally, sediment traps will be installed upstream of the diversion drain as required, and rock protection of the diversion drain will be installed to minimise sedimentation loading in the diversion drain.

The nature of the waterhole is such that it scours with filling due to the flow velocity and height of the infill point for the waterhole. There is no source or pathway for contamination other than sediment, which is considered adequately managed via operational methods as detailed. Refer to section 7.6.2.1 for further information.

Turtle Pool – Weeli Wolli Catchment

Pits and waste landforms at Deposit H are primarily located outside the catchment supplying Turtle Pool (Figure 7-17). Turtle Pool catchment impacts will be localised to limited proposed infrastructure in the

upper reaches of the catchment, which will include culverts/floodways to ensure existing ephemeral flows to Turtle Pool are maintained such that flows to the pool will not be significantly impacted.

Deposit H Potential Groundwater Dependent Ecosystem

Biological surveys completed in 2020 (Biologic 2020a) identified a small stand of *E. camaldulensis* (River Red Gum) near the outlet of the 43 km² catchment in which the eastern extent of Deposit H is located. The trees are located immediately upstream of a natural surface flow constriction between two ridge lines. Historical aerial photography does not indicate persistent pools or persistently active vegetation in the dry season. Mining of Deposit H will remove 5.4 km² (13%) of this catchment as shown in Figure 7-18. As such a small reduction in ephemeral flow volume through the site is likely following the development of Deposit H.

Mount Ella East Ephemeral Pool and Heritage Area

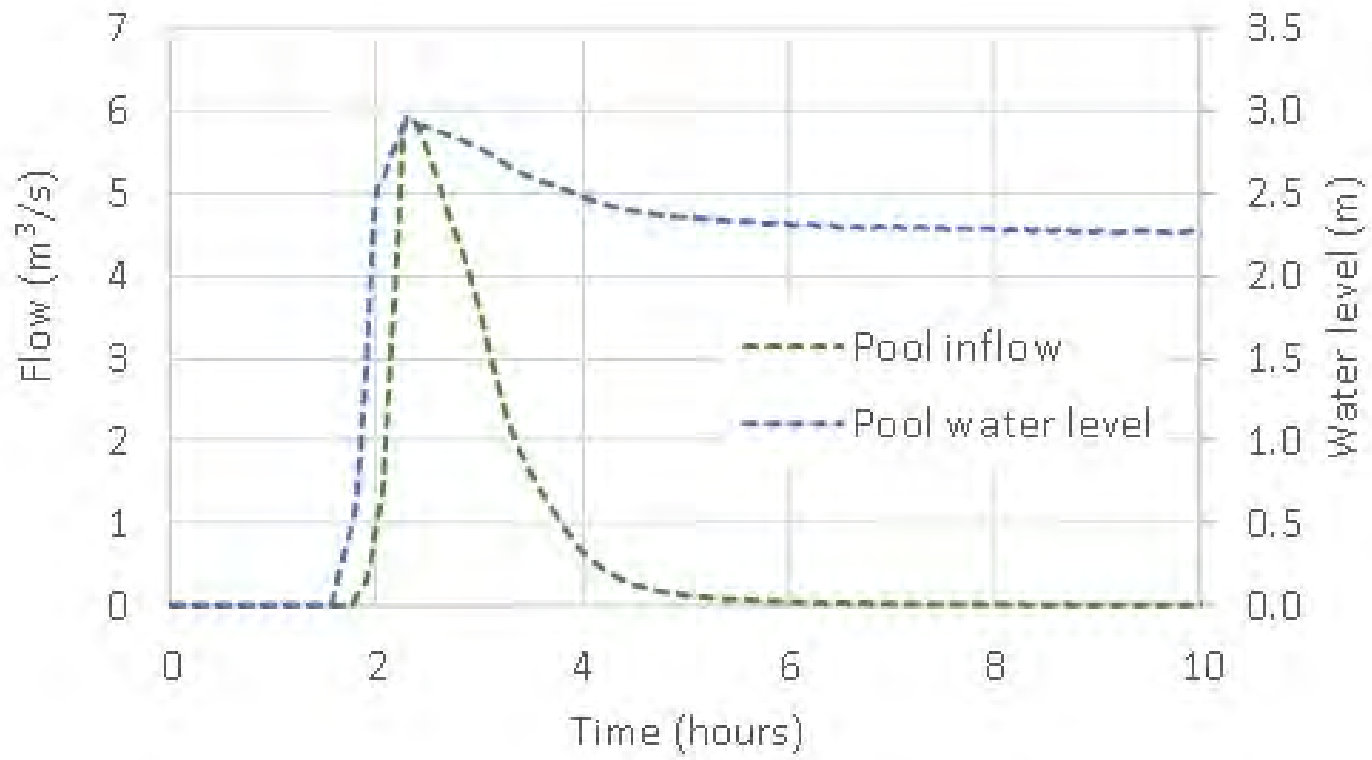
The Mt Ella East Pool and heritage site sit at the base of steep hills dividing the Turee Creek and Angelo River catchments (Figure 7-19). A series of small, steep and incised drainage lines run from south to north towards the site complex and catchments feeding the pool are located south of both the development and the pool. Negligible impacts are predicted to the surface water regime of this site as a result of the Proposal and hence is not considered further in this assessment.

Figure 7-16
Deposit H Waterhole Pre-
and Post-development Flow
and Fill Modelling

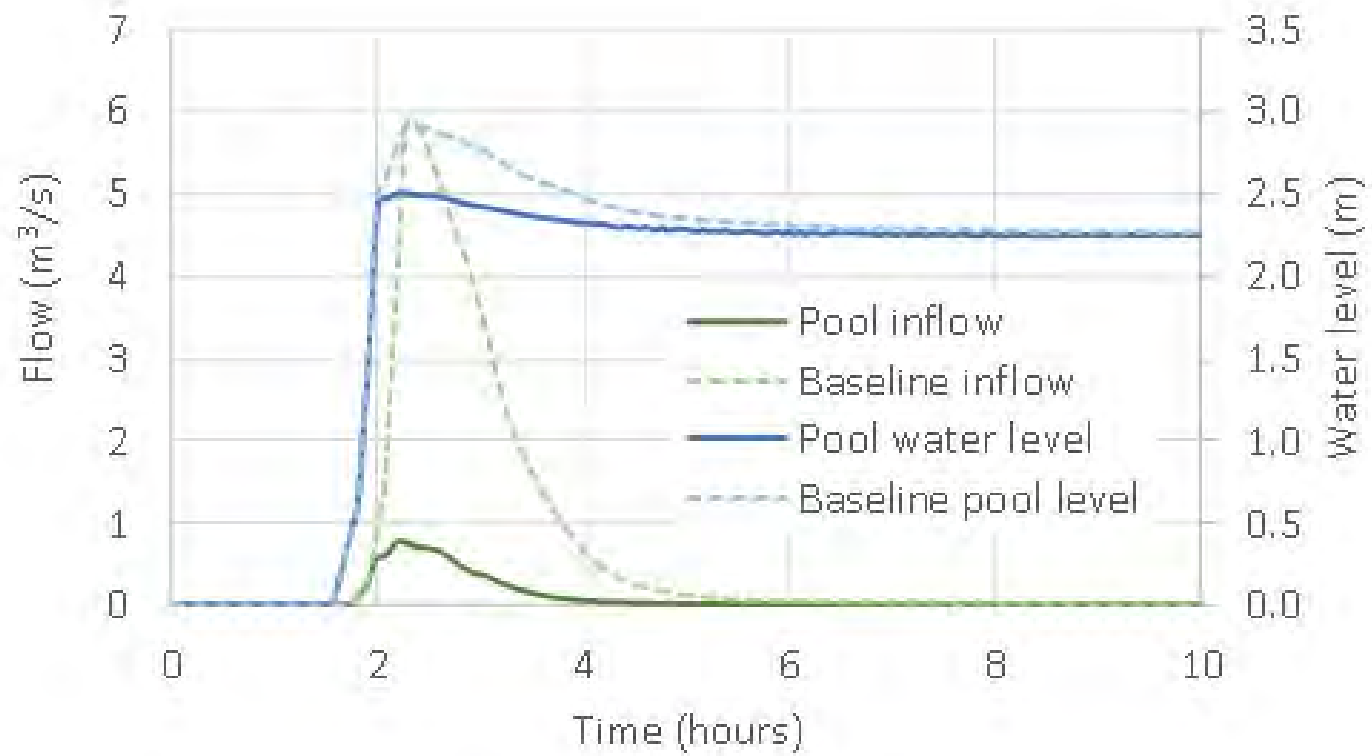
Drawn: GIS Team
Plan: RTIO-0983851v2
Date: November 2023

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

1. Baseline



2. 88% Impact



3. ~67% Impact

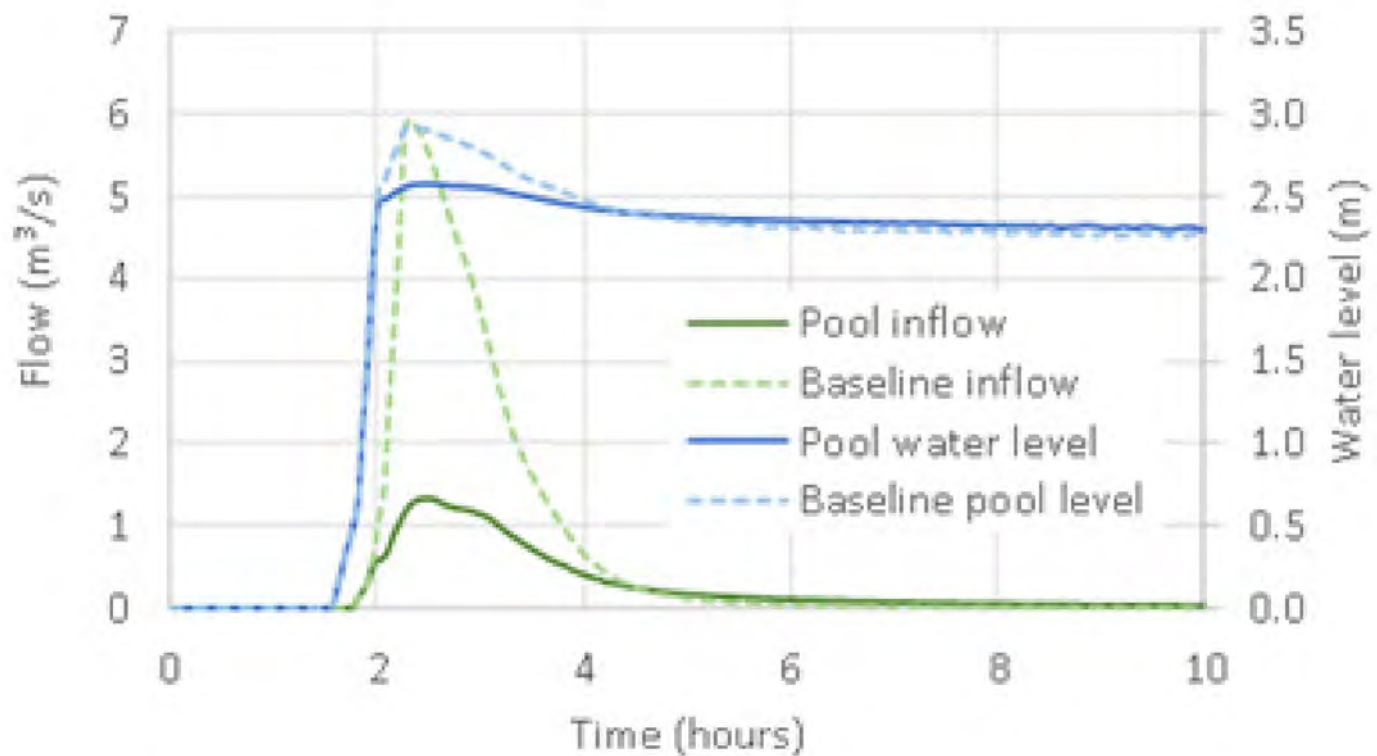
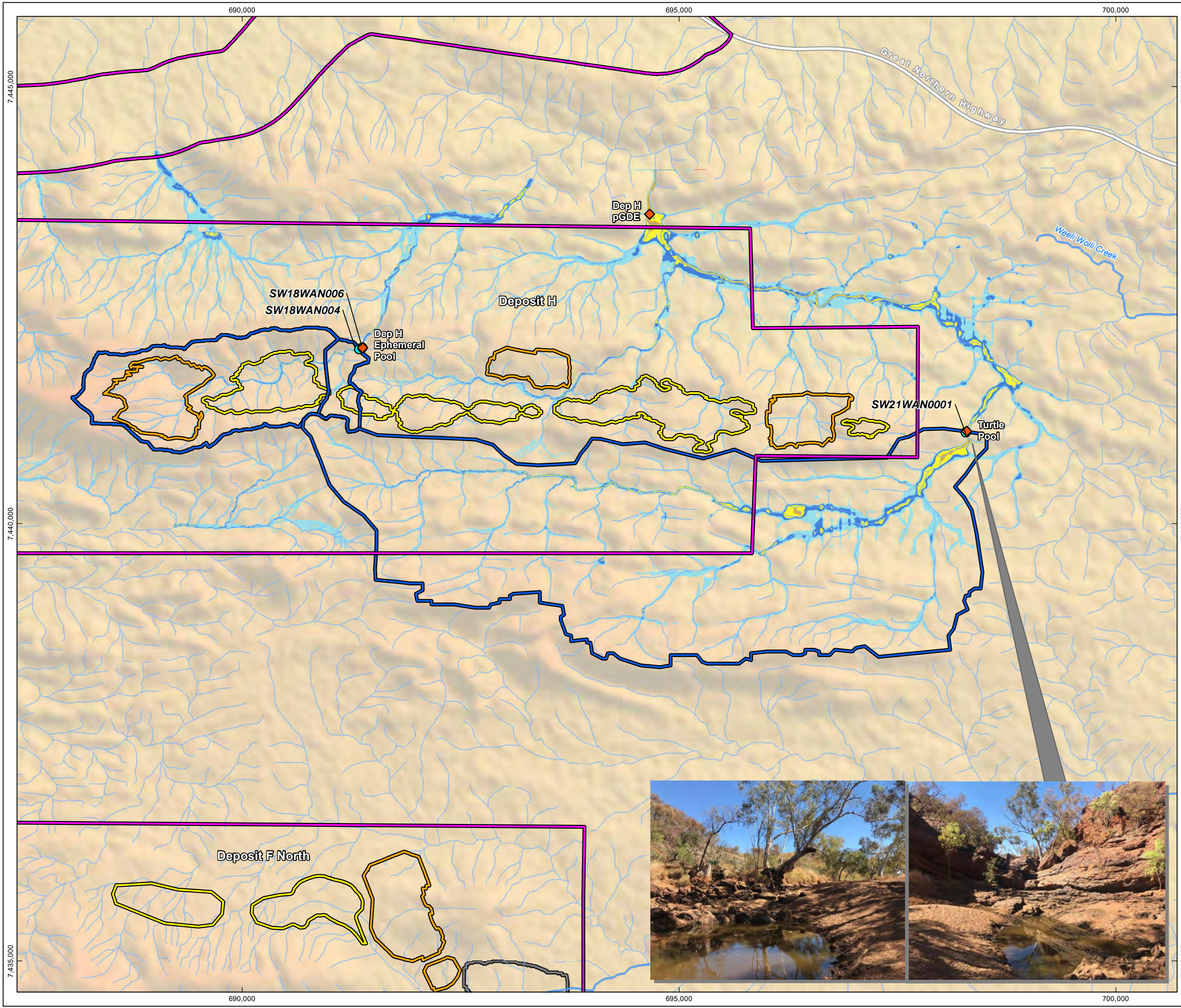


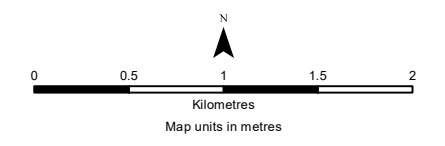
Figure 7-17
Turtle Pool, Proposed
Infrastructure and Catchment
Impacts

Drawn: GIS Team
Plan: RTIO-0985297v3
Date: November 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



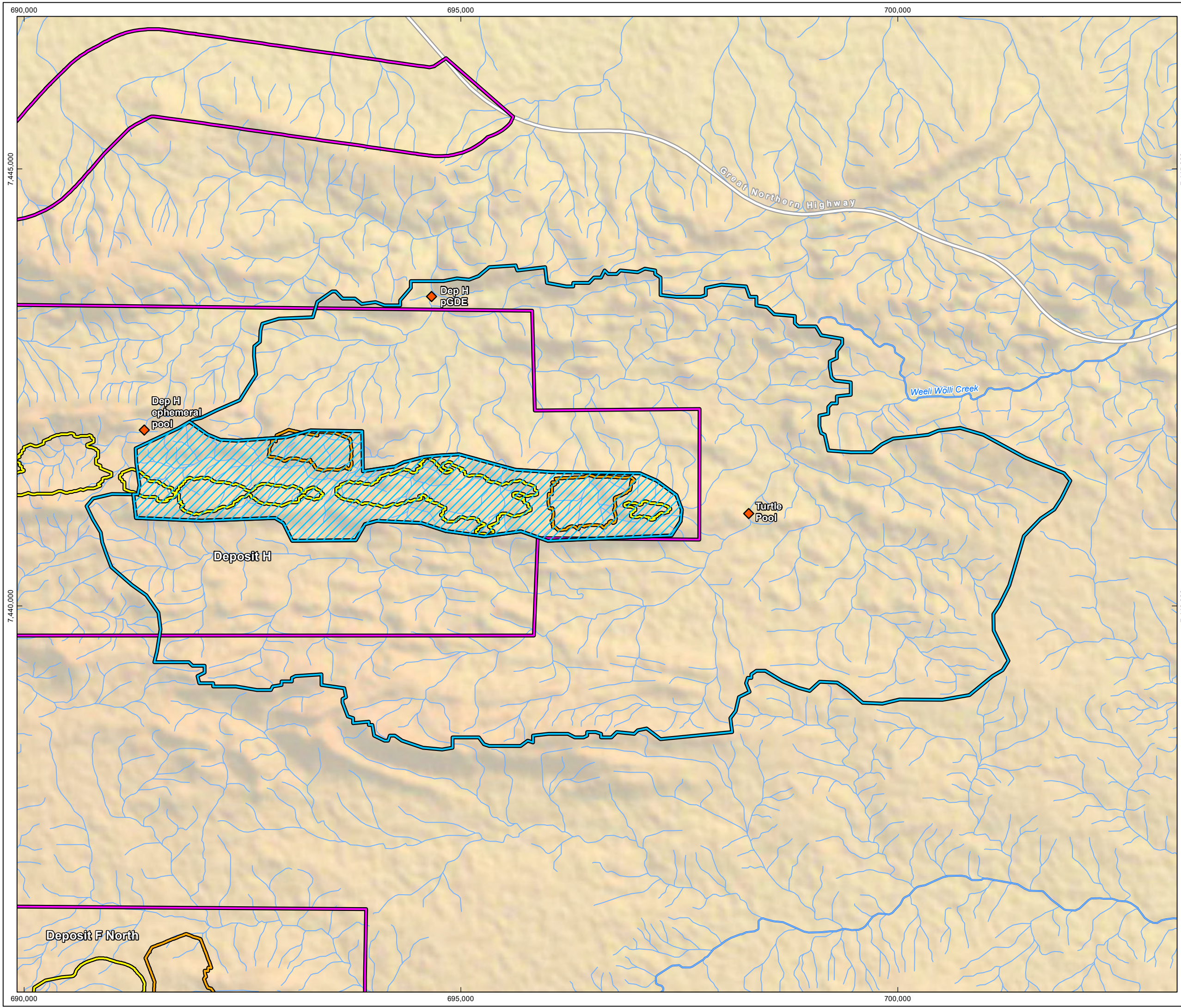
- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - ◆ Sensitive Receptor
 - Surface Water Monitoring
 - Existing Catchment
 - 1:100 AEP max**
 - Depth (m)
 - 0 - 0.1
 - 0.2 - 0.5
 - 0.6 - 1
 - 1.1 - 2
 - 2.1 - 5
 - 5.1 - 10
 - Highway
 - Major Creek
 - Minor Creek



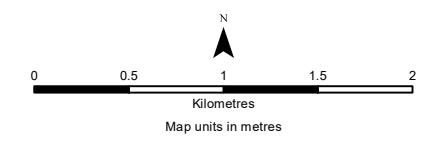
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Figure 7-18
Deposit H Catchment
Reduction at Potential GDE

Drawn: GIS Team
Plan: RTIO-0983631v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout*
 - Pit
 - Waste Landform
 - Sensitive Receptor
 - Catchment Removed
 - Catchment Retained
 - Highway
 - Major Creek
 - Minor Creek



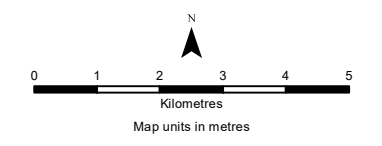
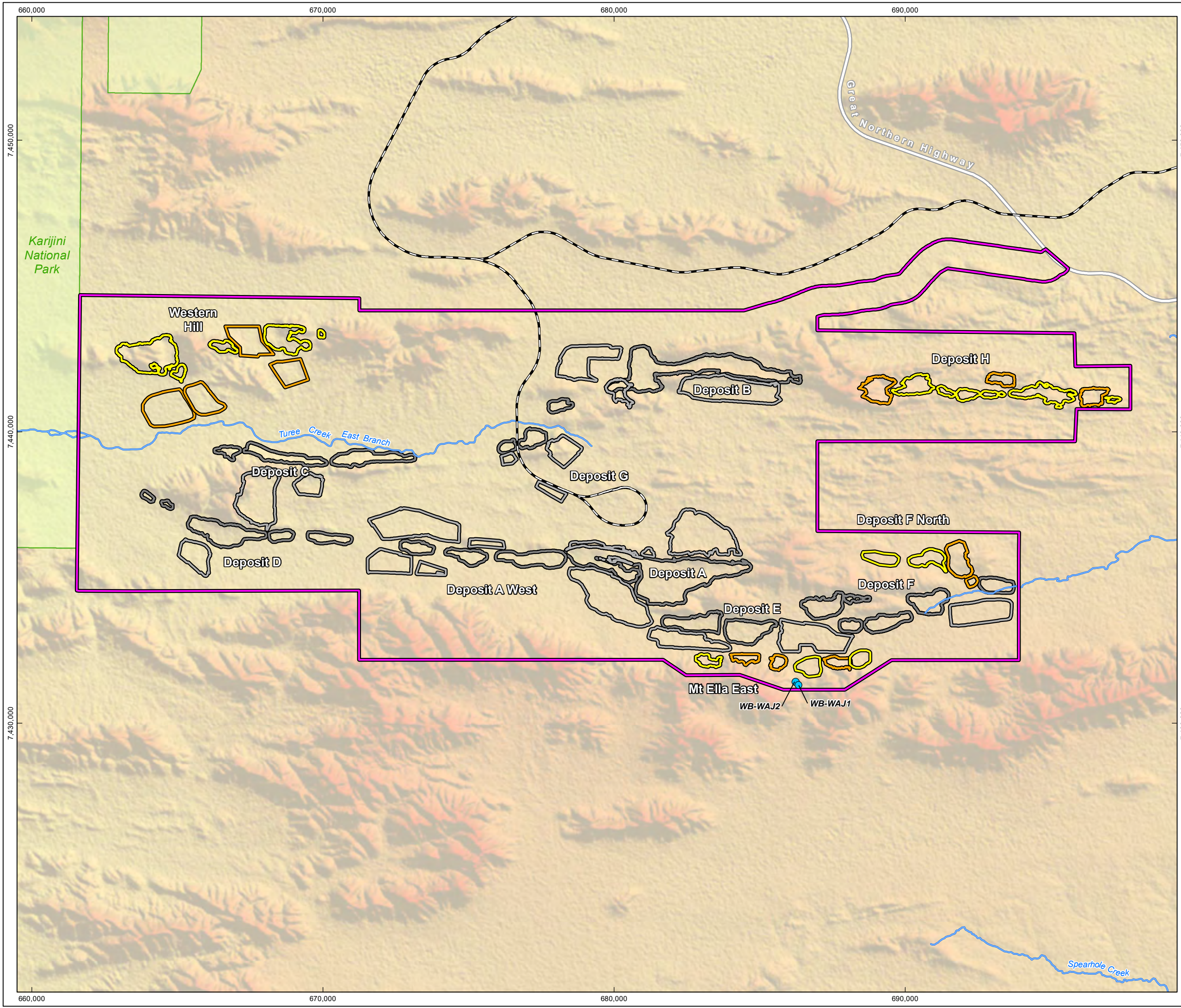
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Figure 7-19
Mount Ella East Ephemeral Pool

Drawn: A.D.
Plan: RTIO-0983620v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Pool
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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Guburingu – Heritage Site

Development of Western Hill is within the eastern contributing catchment of this site and will result in ~4 km² reduction in catchment area. This constitutes 6% of the eastern catchment (90 km²) and 2% of the total contributing catchment (151 km²). The closest development is the western pit, which is still over 4 km along the flow path from the Guburingu area across very flat, slow draining terrain. Impacts to Guburingu are considered low due to the minimal change in flows from the Western Hill development and the site being located at the confluence of creeks such that the site is fed also from a tributary not impacted by the proposal. There is a very low risk of sediment transport due to the distance of the Proposal from the site.

7.4.1.4. Changes to Surface Hydrological Regime of Turee Creek from the Continued Discharge of Surplus Water

Dewatering associated with the Proposal deposits is minimal and is restricted to Deposit H and Deposit F North. All mine dewater from these deposits is proposed to be used for operational purposes. As such, no changes are proposed to the current approved surplus water discharge volume or extent to Turee Creek East as a result of this Proposal.

Surplus mine dewater from the Approved Proposal will continue to be discharged from approved and licensed discharge points over the life of the mine. As the Proposal extends the life of the West Angelas operation, surplus water discharge associated with the Approved Proposal may be extended. Surplus water discharge to Turee Creek East will remain otherwise unchanged and will be managed in accordance with the requirements of MS 1113, the West Angelas EMP (Rio Tinto 2020d) and secondary approvals.

7.4.2. Indirect Impacts

Implementation of the Proposal has the potential to result in the following indirect impacts to Inland Waters:

- Impacts to ground and/or surface water quality due to mineral waste management, stormwater runoff from disturbed areas, and/or temporary storage of surplus mine dewater within pits.

7.4.2.1. Impacts to Water Quality

Potential AMD from Pits and WRL

The Proposal includes the development of multiple mining pits at four deposits, of which Deposit H and Deposit F north extend below the water table and several large waste landforms. As described in Section 7.3.5, the Western Hill deposit had a moderate risk of AMD as it may intersect small amounts of PAF-LC material and is located nearby to Karijini National Park. All other deposits have a low AMD risk and comprise NAF or Uncertain material. If PAF waste material is encountered at Western Hill it will be encapsulated within NAF material within waste landforms to minimise potential for contaminated leachate. All pits will be backfilled at closure to prevent further exposure and potential for generation of AMD.

The overall risk of AMD from the Proposal area is considered low owing to the relatively small amounts or portion above the water table (Rio Tinto 2021e). This finding is consistent with the previous studies of the existing deposits, and the subsequent risk to the environment from such materials is considered low.

Sediments and Other Contaminants in Stormwater Runoff / Accidental Spills

The increase in scale and extent of soil disturbance/movement and heavy vehicle use across the Revised Development Envelope increases the potential for suspended sediments, hydrocarbons and potentially PFAS (per- and polyfluoroalkyl) substances if present and stored waste materials to be lost to the environment.

While the depth to water table is typically >50 m, which makes groundwater contamination highly unlikely, the Proposal is located within surface water catchments that support ephemeral flows into Karijini National Park.

Increased PFAS levels have been detected at sites like airports, defence bases, and other sites where fire-fighting training has been conducted. There is no history of fire training occurring within the Proposal Area and as such it is unlikely that increased levels of PFAS would be present.

Fibrous Materials

Fibrous material has been identified during drilling and geological modelling to be encountered in the Deposit H East and West pits.

Fibrous materials can pose a significant risk to human health when fibres of a respirable size become airborne and are inhaled. Due to their fine size (microns), shape (long thin needle-like crystals), and long life within the lungs, such fibres can become a source of irritation to lung tissues which can subsequently lead to several potential lung diseases (DMP 2015]).

Naturally occurring fibrous minerals can be found in many parts of Western Australia but are particularly prominent in banded iron formations of the Pilbara. At Rio Tinto Pilbara operations, fibrous minerals are generally encountered in waste material from below watertable in Marra Mambas Iron Formation but have also been encountered in other stratigraphic units, including the Brockman and Joffre iron formations. Fibrous minerals may also occur as clasts (i.e., fragments) found within the overlying alluvium.

7.4.2.2. Temporary In-pit Storage of Surplus Mine Dewater

The water quality regionally within the Pilbara and locally at West Angelas is fresh and of suitable quality for discharge to the environment down Turee Creek East. The risk of groundwater contamination from the temporary storage of surplus water is considered low due to the quality of the groundwater to be stored and the limited temporal nature of the storage. An hydrogeological and environmental criteria will be assessed to determine the suitability of disused mine pits to be used for water storage including PAF considerations/risks, impacts on water quality, depth to water table and geotechnical stability (further detail is provided in Section 7.3.7.3).

It is noted that temporary storage of surplus water in disused pits may require a licence under Part V of the EP Act. Detailed information required to support the assessment includes design information, emissions and modelling of impact pathways, and ongoing management and monitoring.

7.4.3. Cumulative Impacts

7.4.3.1. Surface Water – Catchment Area

Turee Creek East Catchment

In the context of surface water, a review of potential cumulative impacts is centred on catchment area reduction. The Western Hill and Mt Ella East deposits and western extents of Deposit H and Deposit F North are located within the Turee Creek East catchment, along with operations at Paraburdoo, Channar and Marandoo, located west of the Proposal.

The total cumulative area of the Turee Creek East catchment impacted by the Proposal and surrounding operations is anticipated to be approximately 164 ha (8.0%), representing 2.2% of the Turee Creek Catchment (7,400 km²). Table 7-5 shows the breakdown of the expected cumulative impact to Turee Creek East catchment.

Table 7-5: Cumulative Impacts – Turee Creek East Catchment Area

Total Catchment Area (km ²)	Area Reduction from Proposal (km ²)	Area Reduction by Other Project (km ²)				Cumulative Impact	Total Reduction (%)
		Approved Proposal (WAN)	Eastern Range	Channar	Greater Paraburdoo	Total Cumulative Disturbance (km ²)	
2,059	15	112	13	24	2.2*	164	8.0

*Greater Paraburdoo Iron Ore Hub Proposal, previous Paraburdoo operations not subject to a MS issued under Part IV of the EP Act

** Catchment impacts from Eastern Range and Channar are closure studies, and are indicative at best, as these are not final closure scenarios and hence subject to change.

Weeli Wolli Catchment

The eastern extent of Deposit H and Deposit F North are located within the Weeli Wolli catchment area along with Hope Downs 1 and Baby Hope and BHP’s South Flank and North Flank (Mining Area C) and the proposed Hope Downs 2 project. The Proposal will impact approximately 19 km² of the 4,770 km² catchment with approximately 348 km² impacted by the Approved Proposals. The total cumulative area of the Weeli Wolli Creek catchment impacted by the Proposal and surrounding operations is 7.7% as shown in Table 7-6.

The Yandicoogina Iron Ore Project and Iron Valley Below Water Table project are within the Weeli Wolli catchment. There is no publicly available information on the extent of the impacts of these projects on the catchment; however, the Iron Valley Below Water Table project is expected to impact <1% of the Weeli Wolli catchment.

Table 7-6: Cumulative Impacts – Weeli Wolli Creek Catchment Area

Total Catchment Area (km ²)	Area Reduction from Proposal (km ²)	Area Reduction by Other Project (km ²)						Cumulative Impact	Total Reduction %
		Approved Proposal	Hope Downs 1	Baby Hope	South Flank	North Flank	Hope Downs 2	Total Cumulative Disturbance (km ²)	
4,770	19	3	28	15	145	111	46	367	7.7

Notably, a reduction in the catchment area is not directly linked to reduced surface water flow or volume. Considering this reduction's impact, current modelling results (Section 7.4.1.3) show no significant reductions in surface water flow and volume modelling during mining operations.

7.4.3.2. Groundwater Drawdown

The regional Wittenoom aquifer underlying the Proposal is also subject to dewatering from Rio Tinto managed Hope Downs and BHP’s Mining Area C (South Flank), and drawdown contours from these operations may extend into the Revised Development Envelope.

Deposit H and Deposit F North dewatering is modelled to be confined to or have a limited extent outside of the orebody aquifers as they are surrounded by impermeable geology and are ‘bathtub’ type aquifers.

The Western Hill orebody aquifer utilised for supply abstraction is confined on three sides, with minimal connection to the regional aquifer. Abstraction associated with the Proposal is unlikely to impact this aquifer significantly; however, it may interact with and further extend drawdown within the aquifer from other sources.

Given the limited drawdown from the Proposal and the confined nature of the aquifers to be impacted, the Proposal is unlikely to contribute to the existing groundwater drawdown related effects on the regional Wittenoom aquifer and its values.

7.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids or minimises, where practicable, impacts on Inland Waters key environmental values and to use best practice to achieve agreed rehabilitation outcomes relevant to Inland Waters.

7.5.1. Mitigation Hierarchy

Table 7-7 summarises how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during Proposal design to develop appropriate mitigation and management strategies to address the key potential impacts on Inland Waters. Mitigation is proposed to protect the key environmental values associated with inland waters where such actions are required to achieve the proposed environmental outcome.

7.5.2. Avoidance

7.5.2.1. Avoidance of Impacts to Karijini National Park

Groundwater

Management of abstraction associated with the Proposal to avoid potential drawdown within Karijini National Park requires a high level of management which has been identified in the previous West Angelas approval for Deposits C, D and G. The Proponent will continue to ensure that the Proposal does not change groundwater levels or quality within or at the boundary of Karijini National Park in accordance with existing requirements (Condition 6-1 of MS 1113 and Condition 3 of DN 2018/8299).

The Western Hill deposit is located nearby to Karijini National Park and the orebody aquifer at this deposit which will be targeted for supply is expected to be somewhat connected to the regional Wittenoom aquifer which is located to the south of Western Hill at Deposits C and D and extends westwards into Karijini National Park. While BWT mining at Western Hill has been removed from the scope of this Proposal owing to its proximity to Karijini National Park, the abstraction of a small portion of groundwater (~0.37 GL/a) for water supply to meet operational requirements is required. Abstraction will be carried out to ensure the risk to groundwater levels at the Karijini National Park boundary is as low as reasonably practicable. Other BWT deposits in this proposal are not modelled to impact the regional aquifer associated with Karijini National Park but rather are constrained orebody aquifers and as such do not require specific management or mitigation.

The current Groundwater Environmental Management Plan will be updated and implemented prior to abstraction of water at Western Hill to ensure drawdown from supply abstraction at Western Hill does not impact groundwater at the boundary of or within Karijini National Park.

Surface Water

There is no additional discharge to Turee Creek East or tributaries proposed in relation to this Proposal, with all surplus water proposed to be used in accordance with the water use hierarchy, prioritising operational use on site. The Proponent will continue to avoid surplus discharge wetting front advancing

within 2 km of Karijini National Park in accordance with MS 1113. Temporary storage of surplus water in disused mine pits is proposed to assist with achieving this (Section 7.3.7.3)

To minimise impacts to surface water flows within Karijini National Park, clearing will be minimised within Turee Creek East catchments directly adjacent to the Park boundary at the Western Hill deposit.

7.5.2.2. Deposit H Groundwater

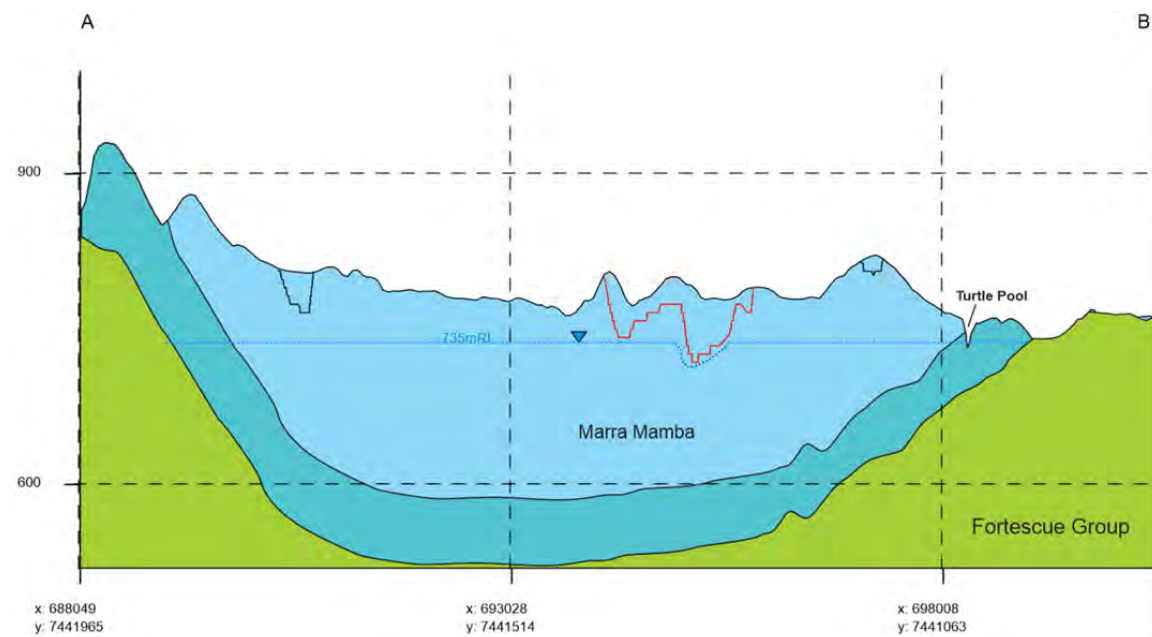
No abstraction of groundwater for production supply or for local mining needs will occur at Deposit H. Production and mining supply water sourced from alternative locations within the Revised Development Envelope.

No abstraction of groundwater dewatering will occur via bores in Deposit H. BWT ore will be accessed via in pit sump pumping, with water discharged into backfilled areas of the pit to facilitate infiltration back into the aquifer. Only localised drawdown of groundwater in the immediate vicinity of the pit is anticipated using the sump pumping approach. Groundwater drawdown is not expected to extend beyond the immediate vicinity of the pit as no dewatering is taking place, but rather sump pumping is undertaken to access the BWT ore.

A monitoring bore located between Deposit H and Turtle pool will be installed to monitor for any potential impacts to Turtle Pool. The bore will be up to 100 m deep and screened across both the MacLeod and Nammuldi members to target the same geological members of the Marra Mamba Iron Formation as Turtle Pool. The bore will be monitored as specified in Appendix A.8; EMP.

After the proposed mitigations, the risk of impact to Turtle Pool is considered low.

Figure 7-20: Proposed Groundwater Drawdown at Deposit H



7.5.2.3. Groundwater Reuse

Total avoidance of mine dewatering is not possible for this Proposal. However, all operational water demand will be supplied from mine dewatering, avoiding the need for additional non-potable water supply borefields.

7.5.2.4. Placement of Legacy Infrastructure and Potentially Contaminating Substances

WRL, other legacy infrastructure, and potentially contaminating substances, including solid and liquid waste, will be preferentially placed outside the 1:100 ARI floodplain of local creeklines and watercourses.

Mine pits intersecting the broader floodplains of ephemeral creeklines will be appropriately bunded to exclude large inflows. These preventative measures will prevent unnecessary interactions with high ephemeral stream flow events, ensuring that natural regimes (such as flow pathways and water quality) are protected.

7.5.2.5. Backfill of Mine Voids

The Proponent has an existing commitment to backfill all mine voids as necessary to avoid the formation of pit lakes at closure (note that pits used for the temporary storage of surplus mine dewater will be managed so as not to result in permanent pit lakes). This aspect is described in the MCP (Appendix A.5) and will avoid potential post-closure considerations commonly associated with pit lakes, including potential impacts to groundwater levels and quality.

7.5.2.6. Diversion Drains

The Proposal includes a number of diversion drains to sub-catchments and minor creeklines for the purposes of directing natural catchment runoff away from disturbed areas, including mining areas and WRL. This is a recommended practice (e.g. DOW 2010) and avoids the need to control, treat and discharge large volumes of potentially affected stormwater runoff.

7.5.2.7. Water Management Strategy to Minimise Discharge to Turee Creek East

The water management strategy has been designed to:

- Reduce surpluses where possible with mine scheduling and efficient dewatering design
- Minimise discharge to creeks through preferential use for operation and discharge to mine pits for temporary storage.

Surplus water discharge to Turee Creek East will continue from dewatering associated with the Approved Proposal within existing limits as required, however the proposed water management strategy will minimise discharge and reduce the potential impacts to creek environmental values. The existing management and monitoring of water quality will continue to be implemented for creek discharge as specified in the EMP.

Storage of surplus water in disused mine pits is an important part of the water management strategy and will be managed to ensure that no acidic pit lakes will form during the temporary storage phase such that water cannot be either used on site or discharged to Turee Creek at a later date if needed. Mounding of groundwater in areas of shallow watertable (i.e. <20 m bgl) will be avoided through selection of pits for storage. This will ensure that the stored water will provide passive local recharge to aquifers where appropriate and is available as a water supply life when the operational demand versus dewatering abstraction water balance is in deficit.

7.5.3. Minimisation

7.5.3.1. Minimising Impacts to Catchments Supporting Key Values

The Proposal has been designed to minimise impacts to surface flows within Karijini National Park by preferentially locating infrastructure outside of the 1:100 year ARI floodplain. Clearing within the Turee Creek East catchments directly adjacent to Karijini National Park will be minimised as far as possible with preferential non-critical infrastructure outside these catchments. WRL's have been designed and located to minimise impact to overland flow paths adjacent to Karijini National Park. Clearing will be managed using the approval request system currently in operation at Rio Tinto and will ensure that impacts are minimised and are no greater than required.

Impact to the Deposit H Waterhole catchment will be limited such that sufficient flows are maintained to facilitate filling of the pool in line with pre mining frequency and level. The West Angelas EMP details pool flow monitoring to ensure this outcome.

7.5.3.2. Stabilisation of Erosion Risks

Where structures, including infrastructure, stockpiles and WRL, are unavoidably located within floodplains, the Proponent will ensure such structures are appropriately armoured or otherwise protected to keep erosion risk as low reasonably practicable.

7.5.3.3. Best Practice Design and Placement of Culverts and Crossings

The Proponent will minimise impacts to hydrological regimes by:

- Ensuring culverts for crossings are large enough to accommodate flows up to 1:10 AEP or higher and are positioned so that disruptions to low flows are minimised, to ensure they convey events up to the 1:100 AEP with limited restriction of flow in Turee Creek East up to this event
- Designing the crossings to act as floodways in larger flows to minimise upstream flooding and scouring downstream of culvert outlets
- Ensure culverts and crossings within the Deposit H Waterhole contributing catchment are appropriately sized and positioned so that disruptions flows are minimized and non critical infrastructure is preferentially located outside of this catchment.

7.5.3.4. Management of PAF and Prevention of AMD

Rio Tinto operations in the Pilbara manage and reduce the risk of AMD through standard operational procedures and implementation of provisions included in the MCP (Appendix A.5). A Mineral Waste Management Plan (MWMP) is currently implemented at the Approved Proposal for existing operations and will be implemented as part of this Proposal to ensure waste material is geochemically characterised in line with existing operational procedures. Rio Tinto takes a hierarchical approach to the management of PAF where 'Avoidance' during the mine planning design process is applied in the first instance.

The Proponent will continue to implement approved MWMP for the early identification of PAF materials in the mining sequence, ensuring that any PAF material encountered for the Proposal that poses an AMD risk is appropriately managed. Rio Tinto implements the Pilbara wide Spontaneous Combustion and Acid Rock Drainage (SCARD) Management Plan when PAF material is planned to be or is encountered during mining. The SCARD is currently not implemented at the Approved Proposal as all existing operations are low risk of AMD. The SCARD will be implemented at Western Hill if PAF material is encountered to ensure risk is minimised and the environmental values are not significantly impacted.

Current operations have a low AMD risk and no material requiring management has been encountered in the Approved Proposal. Any PAF potentially encountered in the proposed pits (Western Hill) will be managed on-site, in accordance with the SCARD. Management strategies implemented to mitigate risk may include but are not limited to encapsulation within inert material within WRL's, blended or encapsulated with NAF or high ANC materials from elsewhere in the mine geological profile or encapsulation within ex-pit waste landforms or in-pit as backfill.

Selection and design criteria for any new above or below ground PAF material storage areas will be detailed in the MCP. Locations of any new PAF waste landforms or below water table storage areas will take into consideration environmental and heritage/social receptors and any potential risk is assessed to ensure the likelihood and consequence of impact is understood and managed appropriately.

The current Groundwater Environmental Management Plan (Rio Tinto 2022d) will be updated to include groundwater quality monitoring in identified suitable monitoring bores to detect potential AMD in groundwater from mining at Western Hill. Groundwater monitoring will be implemented in accordance with the updated Groundwater Environmental Management Plan and will have associated response

actions to reduce and/or mitigate any potential impacts. There is no below water table mining at Western Hill and all water abstracted for supply will be used in operations. As such there is no discharge of surplus water from Western Hill to Turee Creek and no risk of AMD impacts to surface water.

The Proponent commits to ensuring no significant ecological risk from potential AMD management at closure. All proposed pits (Western Hill) with a closure AMD risk of moderate or high will be backfilled to above post mining recovered water levels to support achieving this outcome as per the MCP. Backfilling will cover the PAF and therefore reduce the risk of AMD at closure.

7.5.3.5. Sediment Control and Hydrocarbon / Waste Management

In order to keep the risk of sediment-laden stormwater runoff from disturbed areas impacting local surface water resources, such as Turee Creek East, the Proponent will ensure drainage from at-risk areas includes appropriate erosion and sediment controls, such as armoured and settling ponds.

At Deposit H a toe bund will be constructed around the base of the western waste landform to ensure potentially sediment laden run off from the landform does not enter the gully and/or diversion drain. The diversion drain will be rock armoured where required to reduce the potential for the sediment loading of Deposit H Waterhole, and sediment traps will be constructed along the gully and/or diversion drain supporting the Deposit H Waterhole.

The Proponent will continue to store its bulk hydrocarbons and manage its solid and liquid wastes in accordance with its legal obligations and industry best practice. This includes storing potentially contaminating materials, including wastes, within appropriately contained areas and ensuring incident response equipment and signage/training is up to date and appropriate to the range and scale of potential incidents (e.g. spills, leaks and fires).

7.5.3.6. Per- and Polyfluoroalkyl Substances (PFAS)

Rio Tinto will implement its internal guidance note E15 "*Per-and poly-fluoroalkyl substances (PFAS) at Rio Tinto operations*" as relevant at the West Angelas Revised Proposal. The internal guidance note aligns with the National PFAS Position Statement (2019) and provides information on PFAS and why are they important to manage, technical guidance, asset management and purchasing, operational practices and contaminated site management. Contaminated site management includes information on PFAS risk registers, preliminary and detailed investigations, remediation and reporting.

Rio Tinto will comply with regulatory requirements in local jurisdictions and no fluorinated fire-fighting foam will be used or stored at West Angelas.

7.5.3.7. Fibrous Materials

To ensure the mining workforce, Traditional Owners and any other public accessing the Development Envelope are not exposed to fibrous materials, the Proponent will implement its internal Fibrous Materials Management Plan (FMMP) and comply with all relevant legislation regarding the handling of fibrous materials (i.e., *Occupational Safety and Health Regulations 1996 and Mines Safety and Inspection Regulations 1995*).

The FMMP describes the management of fibrous minerals encountered during mine production and at closure. This includes the encapsulation of fibrous minerals with a minimum of 1.0m of inert material in designated waste dumps with a preference for the use of in-pit dumps. The encapsulation procedure also considers the final rehabilitation design of the landform to ensure that the material remains secure after mine closure.

7.5.4. Rehabilitation

The West Angelas MCP has been reviewed and updated to address closure requirements for the Proposal (Appendix A.5). The MCP includes closure outcomes relevant to the restoration and/or maintenance of values associated with Inland Waters, including:

- All disturbed areas that are no longer required will be stabilised and, if appropriate, rehabilitated
- All contamination risks are appropriately managed
- Mine pits will be backfilled to a level that prevents the formation of pit lakes
- All remaining mineral waste landforms and other structures remaining within floodplains have additional erosion protection as appropriate to their risk potential
- All infrastructure within creeklines, such as crossings and culverts, that are no longer required will be removed
- All surface water diversions remaining after closure are designed and engineered to minimise impacts on local hydrological regimes, ensure long term stability across the realistic range of expected flow events, and do not significantly cause or contribute to water quality impacts
- Dewatering bores will be decommissioned or transferred to 3rd party or Traditional Land Owner in accordance with relevant guidelines
- Catchment flows will continue to replenish the Deposit H Waterhole, albeit at a reduced rate
- No drawdown of groundwater or impact to quality occurs as a result of the Revised Proposal, including closure and post-closure, at the boundary of, or within, Karijini National Park.

The MCP for the Proposal will be reviewed and updated as necessary, including consideration of inputs from stakeholders, including Traditional Owner groups, every three years at a minimum throughout the life of operations.

Table 7-7: Application of the Mitigation Hierarchy for Inland Waters

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Lowering of Groundwater Levels	Measures to Avoid			
	<p>Mining of ore reserves at Western Hill will be limited to AWT to avoid mine pit dewatering for this Proposal, owing to the proximity to Karijini National Park.</p> <p>Groundwater Environmental Management Plan will be implemented to ensure no change to groundwater levels at the boundary of, or within Karijini National Park that are attributable to the Proposal as a result of supply abstraction.</p> <p>No abstraction of groundwater for production supply or for local mining needs will occur at Deposit H</p> <p>No abstraction of groundwater dewatering will occur via bores in Deposit H. BWT ore will be accessed via in pit sump pumping, with water discharged into backfilled areas of the pit to facilitate infiltration back into the aquifer.</p> <p>Post mining hydrological regime at Deposit H Waterhole is modelled to be in accordance with pre mining regime (based on proposed catchment disturbance), taking into consideration natural variation as detailed in the West Angelas EMP (Appendix A.8).</p>	Proposal Specific	No	Ongoing monitoring of groundwater levels across the area will be used to adapt the program as necessary to achieve the outcome.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Minimise			
	<p>Groundwater is abstracted according to programs that have been modelled to ensure dewatering volumes are minimised while ensuring safe access to BWT mine pits. Ongoing groundwater level monitoring is used to verify the models and adjust dewatering programs as required.</p> <p>Operational water demand will be supplied from mine dewatering in the first instance (where feasible), reducing the requirement for water supply volumes.</p>	Standard Practice	Yes – DWER – Groundwater Licence (5C) and Groundwater Operating Strategies developed as part of the Groundwater Licences	The models used to optimise and balance the dewatering programs are recognised across the industry and have been used successfully by the Proponent across numerous projects in the region.
	Measures to Rehabilitate			
	<p>Groundwater level recovery timeframes will be modelled in future iterations of the MCP (Appendix A.5).</p> <p>All dewatering and production bores no longer required will be decommissioned in accordance with relevant guidelines or transferred to a third party or Traditional Land Owner.</p> <p>Storage in pits may produce some passive aquifer recharge which may support groundwater level recovery should it be implemented</p>	Standard Practice	Yes	<p>Groundwater recovery trends have already been recorded where other dewatering programs have concluded across projects operated by the Proponent.</p> <p>The bore decommissioning guidelines in place at the time would be recognised by industry and relevant government stakeholders.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Groundwater mounding from surplus storage in disused pits	Measures to Avoid			
	To avoid impacts to environmental values, surplus water storage in pits will only occur where pit lakes would not be expected to cause mounding in areas of shallow water table (i.e., <20 m bgl).	Proposal specific	No	This strategy will effectively remove any potential pathway for impact to vegetation as a result of changes to water availability in the root zone.
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	
	No surplus water storage in pits that would cause mounding of groundwater in areas of shallow watertables (i.e., <20 m bgl). Surplus water storage in mine pits will only occur when pit suitability criteria (Section 7.3.7) are met.	Outcome based condition addressed in the EMP		
Changes to Surface Water Catchments	Measures to Avoid			
	Major infrastructure, including WRL, have been preferentially located outside of the ephemeral watercourses and their tributaries. Where WRL cannot be located outside of ephemeral drainage lines, flows will be diverted around WRLs through the use of diversion bunds or drains if required.	Standard practice	No	Established and proven practice.
	Measures to Minimise			
Pits will be isolated from significant creeklines and their floodplains to minimise interception of surface water catchment flows. Minimise clearing within and preferentially locate non critical infrastructure outside of Turee Creek East catchments directly adjacent to Karijini National Park at Western Hill. Placement of sedimentation basins at the outlet of stormwater drainage to prevent migration of sediment off site. Water levels within the waterhole at Deposit H Waterhole and Turtle Pool are modelled to continue to fill in accordance with pre mining frequency and level fill in accordance with pre mining frequency and level, taking into consideration natural	Standard practice generally with additional proposal specific element	No	Established and proven practice.	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>variation as detailed in the West Angelas EMP (refer to EMP; Appendix A.8).</p> <p>Linear infrastructure will be designed to convey high frequency flood events (up to 1 in 10 AEP) through culverts or similar structures to avoid impediment of flows.</p> <p>Infrastructure may be designed to allow overtopping in lower frequency events to minimise upstream flooding and scouring downstream of culvert outlets.</p> <p>Surface water fed ephemeral pools WB-WAJ1 and WB-WAJ2 will be protected via Heritage site exclusion areas (refer Section 6). Flow to these pools will not be impacted by the Proposed Action as they are fed from catchments to the south of the pools, and the Proposed Action is located to the north.</p>			
	Measures to Rehabilitate			
	<p>Once satisfactorily decommissioned and rehabilitated, drainage diversions (other than pits, which will be appropriately bunded) will be removed and surface water systems reconnected unless specified to be retained in the MCP.</p>	<p>Standard practice generally, with additional proposal-specific elements.</p>	<p>No</p>	<p>Standard approach consistent with other MCPs.</p>

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Changes to surface hydrological regime of Turee Creek	Measures to Avoid			
	No additional surplus water discharge to Turee Creek East as a result of the Proposal. Continue to avoid discharge footprint (wetting front) extending within 2 km of KNP in accordance with requirements of MS 1113. Existing approved operations discharge will remain otherwise unchanged and will be managed in accordance with the requirements of MS 1113 and the West Angelas EMP (Rio Tinto 2020d).	Proposal specific	Yes – DWER licensed discharge	Controls are considered effective and have been utilized to date.
	Measures to Minimise			
	Surplus water storage in disused mine pits will potentially reduce both discharge Turee Creek and abstraction for supply.	Proposal specific	Yes – DWER licensed discharge points	Controls are considered effective.
Indirect Impacts				
Impacts to Water Quality - Potential AMD from pits and WRL	Measures to Avoid			
	BWT mine pits will be backfilled to a level where the formation of pit lakes will be avoided.	Proposal specific	No	Recommended approach to protect water quality from adverse outcomes in the long-term (e.g. Cth. of Aust. 2015)
	Measures to Minimise			
Implement established procedures for the early identification of PAF materials to ensure adequate blending with NAF/high ANC materials, or encapsulation if required. Implement the Mineral Waste Management Plan to reduce risks associated with mineral waste. If PAF waste material is encountered at Western Hill the SCARD plan will be implemented.	Standard business practice at Rio Tinto iron ore mines in the Pilbara	Yes – DMIRS – MCP	Consistent with the Proponent's industry standard established practices for managing AMD risk.	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	PAF material will be encapsulated within NAF material within waste landforms to minimise potential for contaminated leachate. Pits will be backfilled to cover any exposed PAF material at closure to prevent further exposure and potential for generation of AMD. Update Groundwater Environmental Management Plan (Rio Tinto 2022d) prior to commencement of mining at Western Hill and implement.			
	Measures to Rehabilitate			
	All contamination will be appropriately managed at closure, as per the <i>Contaminated Sites Act 2003</i> .	Legal requirement	Yes – DWER.	Legislated instrument.
Impacts to Water Quality - Sediments and other contaminants (including PFAS) in stormwater runoff / accidental spills	Measures to Avoid			
	Where possible, surface water diversion drains will be constructed to avoid natural flows from entering disturbed areas, including mining voids. The flow diversions will be designed, constructed and maintained so as to minimise mobilisation and transport of sediment laden runoff to sensitive environmental receptors. Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements and industry guidelines, including within secondary containment. Impacts to water quality from PFAS will be avoided by implementation of regulator requirement to use fluorine-free fire-fighting foams.	Standard practice	No	Standard practice as recommended by numerous guidelines, including DWER WQPN 52 (DoW 2010). Careful placement of at-risk substances is included in many water quality protection guidelines, including DOW WQPN 51 (2009c) Impact avoided as no introduction of potential PFAS fire-fighting foams.
	Measures to Minimise			
	All structures within creeklines and floodplains will be appropriately armoured or otherwise protected to ensure erosion risks are minimised. Specifically in relation to Deposit H Waterhole, a toe bund will be constructed at the base of the Western waste landform, the diversion drain will be rock	Standard practice	Yes - DWER	Established practice that can be adapted/expanded if regular post-flood inspections observe evidence of excessive erosion.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls	
	<p>armoured where required, and sediment traps will be constructed where appropriate.</p> <p>Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will not be stored within or near creeklines, or within floodplains.</p> <p>All personnel involved in the storage and handling of potentially contaminating materials will be appropriately trained and supported by adequate resources including signage, spill kits and PPE.</p> <p>Impacts to water quality from PFAS will be minimised by implementation of the internal guidance note E15 'PFAS at Rio Tinto operations.'</p> <p>Prioritise dust suppression and monitoring, particularly around Deposit H Waterhole and Turtle Pool as a recommendation from social surroundings consultation with Ngarlawangga Traditional Owners</p>			Legislated requirement for some aspects; standard requirement of EP Act Part V licences for others.	
	Measures to Rehabilitate				
	<p>Modelling will be used to ensure the integrity of legacy structures, such as WRL, is retained over the long term.</p> <p>All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure.</p> <p>The stabilisation and revegetation of landforms at closure is anticipated to minimise sediment runoff.</p>	Standard practice	No	<p>This is a standard approach recommended in most mine closure planning guidelines, including DMIRS (2020a).</p> <p>Standard requirement enforced, for example, by the <i>Contaminated Sites Act 2003</i> and regulations.</p>	
Temporary in-pit storage of surplus mine dewater	Measures to Minimise				
	<p>Surplus water storage in mine pits that do not have exposed PAF is the proposed surplus water strategy once mine pits are available and criteria for storage are met.</p>	Proposal specific	Yes – DWER discharge licence	Storage of surplus water in disused mine pits is not expected to affect groundwater beyond the pits and the local aquifers. There is high confidence in this approach as the hydrogeology of the area is well understood.	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	
	Surplus water storage in mine pits will only occur when pit suitability criteria (Section 7.3.7) are met.		Discharge licence under Part V of the EP Act	
Fibrous Materials	Measures to Minimise			
	Implement internal Fibrous Materials Management Plan (FMMP) and comply with all relevant legislation regarding the handling of fibrous materials (i.e., <i>Occupational Safety and Health Regulations 1996 and Mines Safety and Inspection Regulations 1995</i>).	Standard Practice	No	This is a standard approach

7.6. Assessment and Significance of Residual Impacts

7.6.1. Assessment of Direct Impacts

7.6.1.1. Lowering of Groundwater Levels

Western Hill

The potential for drawdown from the proposed water supply production bores at Western Hill (~0.37 GL/a) to propagate towards and into Karijini National Park has been assessed (Section 7.4.1.1; Appendix C.42). There is a very high level of confidence that the potential for impact on groundwater levels at the boundary of Karijini National Park without additional management is negligible. Additionally, no GDV or other ecological values supported by the regional aquifer have been recorded within the predicted drawdown zone (Figure 7-8). Worst case predicted drawdown intersects a portion of Turee Creek East riparian vegetation, however this vegetation is highly unlikely to be accessing groundwater at a depth of ~50 mbgl and is thought to be supported by surface water and associated infiltration from surface flows.

Condition 6-1 of the current MS 1113 and Condition 3 of Decision Notice 2018/8299 require the Proponent to ensure that there is no drawdown of groundwater associated with the Proposal at the boundary of, or within, Karijini National Park. This outcome is managed by implementing the approved Groundwater Environmental Management Plan as described in Condition 6-2 of the Statement. The Groundwater Environmental Management Plan will be updated and implemented prior to the commencement of abstraction at Western Hill. The Groundwater Environmental Management Plan specifies triggers, thresholds, response actions, and mitigations and will ensure that this outcome can be met.

Deposit H

The hydrostratigraphy surrounding Deposit H is understood to be low permeability, and anecdotal data from the Pilbara support this conceptualisation (albeit from a limited dataset). Modelling has been undertaken and results suggest that if the surrounding stratigraphy is more permeable than anticipated, there will be drawdown observed in groundwater beneath Turtle Pool. Modelling applying low permeabilities of the surrounding stratigraphy shows minimal to no drawdown of groundwater beneath Turtle Pool.

The conceptualisation and field observations suggest that Turtle Pool is likely to be groundwater and surface water dependant. No abstraction of groundwater will occur via dewatering bores, BWT ore will be accessed via in pit sump pumping, with water discharged into backfilled areas of the pit to facilitate infiltration back into the aquifer. Only small localised drawdown of groundwater in the immediate vicinity of the pit is anticipated using the sump pumping approach. After the proposed mitigation, the risk of impact to Turtle Pool is considered low.

Other Deposits

No residual impacts associated with lowering the groundwater table are expected for Deposit F North as the aquifer, and the surrounding impermeable Nammuldi and Macleod members of the Marra Mamba Iron Formation will constrain groundwater drawdown extent.

7.6.1.2. Groundwater Mounding from Surplus Water Storage in Disused Mine Pits

The final location, timing and volumes of surplus water storage in pits will be dependent on mine schedule, operational water demands, ongoing materials characterisation work, mine closure planning and consultation with Traditional Owners. However, surplus water storage in pits will be selected on the basis that this would not be expected to cause groundwater mounding in areas of shallow water tables and where there are associated values that would be potentially impacted.

7.6.1.3. Changes to Surface Water Catchments

Turee Creek East and Tributaries

The Approved Proposal extends across approximately 26% of the 430 km² Turee Creek East catchment area upstream of Karijini National Park and the Proposal will increase this extent by a further 3% (cumulatively 29%) (Rio Tinto 2021c). The majority of the 3% increase is associated with the development of the Western Hill deposits. The Proponent has designed the Western Hill development to avoid or minimise any reductions in catchment flow that might result from the increased footprint. A limit on clearing within the Turee Creek East catchment directly upstream of Karijini National Park will ensure impacts to flows are minimised and do not exceed expected outcomes.

Table 7-8: Combined Post-Proposal Changes in Peak Flow and Volume for Flow Delivered to Karijini National Park Boundary

AEP	Existing Conditions			Post-Proposal			Change (%)		
	1:2	1:10	1:100	1:2	1:10	1:100	1:2	1:10	1:100
Peak flow (m ³ /s)	23.7	109	391	22.5	97.5	343	-5%	-11%	-12%
Event volume over 24hrs (ML)	769	3,249	8,584	697	3,073	8,078	-9%	-5%	-6%

On completion of mining at Western Hill and other areas, all disturbances will be rehabilitated in accordance with the approved MCP and all surface water flows other than those captured by decommissioned pits, will discharge to original watercourses. Post closure creek flow regimes (such as flow pathways and water quality) will be similar to pre-mining regimes and impacts to any downstream surface water values, including the potential GDE within Karijini National Park (feature 22), are unlikely, particularly given the high variability in rainfall patterns in the Pilbara region and that such variability will likely be increasing as a result of climate change. After application of mitigation measures, residual impacts are expected to be minor and not represent a significant potential impact to the environment or values within Karijini National Park.

7.6.1.4. Changes to Surface Hydrological Regime of Turee Creek from the Continued Discharge of Surplus Water

All mine dewater from Proposal deposits is proposed to be used for operational purposes. As such, no changes are proposed to the current approved surplus water discharge volume or extent to Turee Creek East as a result of this Proposal.

Surplus water discharge to Turee Creek East volume and impact extent will remain unchanged from this Proposal, however due to the mine life, discharge timing may be extended. Discharge will continue to be managed in accordance with the requirements of MS 1113, the West Angelas EMP (Rio Tinto 2020d) and secondary approvals.

Residual impacts associated with the Proposal from discharge to Turee Creek East are not considered to be significant.

Deposit H Waterhole, Turtle Pool and Potential Groundwater Dependent Ecosystem

Depending on the final mine plan, mining at Deposit H could remove up to 2.8 km² of the Deposit H rock pool's contributing catchment, significantly reducing runoff into the pool. Modelling, however, has shown that this is unlikely to affect the fill regime of the pool due to the high run off volume in relation to the pool size. No riparian or groundwater dependent vegetation has been recorded in association with the pool.

Deposit H Waterhole is of high significance to the Ngarlawangga People and is proposed to be protected from direct impacts by establishing a heritage site boundary. Deposit H pit designs and stockpile locations have been redesigned to avoid proximity to the pool. Consultation and mine design optionality is ongoing to further understand potential direct and indirect impacts and risks and appropriate management options to further minimize impacts with Traditional Owners. The Proposal will maintain the Deposit H Waterhole fill regime so that there is no significant impact compared to pre mining levels and persistence through implementation of the West Angelas EMP. The residual risk of impact to Deposit H Waterhole is low.

Negligible impacts to Turtle Pool are anticipated due to the minimal impact to the supporting catchment which is limited to proposed infrastructure in the upper reaches of the catchment, that will include culverts/floodways to ensure existing ephemeral flows to Turtle Pool are maintained.

7.6.2. Assessment of Indirect Impacts

7.6.2.1. Impacts to Water Quality

Potential AMD from Pits and Waste Rock

Geochemical investigations confirm that the geological materials encountered in Deposit H, Deposit F North and Mt Ella East orebodies are consistent with the existing low risk AMD profile for the Existing Operations (Section 7.3.5) and are therefore suitable for management under existing strategies and controls. Western Hill deposit is classified as having a moderate AMD risk as it intersects a small volume of PAF-LC material. The Mineral Waste Plan and SCARD will be implemented to manage the AMD risk utilising strategies, including blending PAF materials with non-PAF materials or encapsulation with high ANC or low permeability materials; ensuring waste landforms are stable and non-polluting; and backfilling of mine voids as necessary to avoid the formation of pit lakes and to cover exposed PAF material, post closure. The Groundwater Environmental Management Plan will be amended and implemented prior to commencement of mining at Western Hill to ensure any potential impacts are identified and mitigated in relation to groundwater adjacent to or within Karijini National Park.

Sediments and Other Contaminants in Stormwater Runoff

The creeklines and tributaries crossing the Revised Development Envelope are highly ephemeral and may not flow in some years (Rio Tinto 2021c). They do not support aquatic vegetation or fauna and contain few pools. When surface water is present as a result of adequate rainfall, it offers high value resources to the fauna of the area and are also associated with groundwater recharge in some areas (Rio Tinto 2018a).

Wastes and hydrocarbons at the Existing Operations are managed in accordance with the site EP Act Part V licence (L7774/2000) and the Dangerous Goods Safety Regulations, where applicable. Stormwater controls are in place around all significant infrastructure, including mine pits, WRL, and workshops. The same control strategies and mechanisms will be employed across the new mining areas and key infrastructure that form the Revised Proposal. The Part V licence will be reviewed and amended as required by the EP Act, before the new areas become operational.

The Existing Operation at West Angelas has been in operation since 1998 and monitoring of surface water quality (including for suspended sediments and hydrocarbons) has been an ongoing requirement, with no significant water quality incidents being recorded in that time. Accordingly, the likelihood of a significant impact occurring to Inland Waters and associated values based on the current management approach is considered to be very low and would also be reversible following the appropriate remediation measures.

7.6.2.2. Temporary In-pit Storage of Surplus Mine Dewater

If required, the temporary in-pit storage of surplus mine dewater from Existing Operations will be managed in an informed and adaptive manner to ensure there is negligible risk of impacts to surrounding environmental values, including surface and groundwater quality, and native vegetation and fauna. Water will not be stored in pits where there is shallow groundwater or where the pit is unsuitable. Discharge of surplus water to disused mine pits will be regulated under Part V of the EP Act.

7.6.3. Assessment of Cumulative Impacts

Surface Water

The total expected cumulative impact on Turee Creek East catchment area from the Proposal and surrounding operations is 6.3% (reduction in catchment size), representing approximately 1.75% of the Turee Creek catchment. No pools or surface water dependent ecosystems are identified in the upper reaches of Turee Creek East. The reduced catchment area has the potential to impact the potential GDE (feature 22, zone c) and Guburingu heritage site within the Karijini National Park at the western extent of Western Hill.

There are limited cumulative impacts for the potential GDE (feature 22, zone c) and Guburingu heritage site within Karijini National Park. This is due to the location of the other projects being downstream of these values. The Approved Proposal and this Proposal are the main contributors to the reduction of the Turee Creek East catchment (upstream of these values). No significant impacts on the environmental values of the Turee Creek East catchment, including the potential GDE and Guburingu heritage site, are likely to occur (see Section 7.6.1).

The total expected cumulative impact on the Weeli Wolli Creek catchment areas from the Proposal and surrounding operations is ~7.7%. Due to the location of Deposit H on the catchment divide, cumulative impacts from surrounding operations on Turtle Pool are similar to those of the Proposal as no other projects are located upstream of this ephemeral pool in the Weeli Wolli catchment. Considering the above and that the Proposal does not substantially contribute to the cumulative reduction of the Weeli Wolli Creek catchment, no significant impacts to the environmental values of Weeli Wolli Creek catchment are anticipated to occur.

Overall the additional impacts from the Proposal and cumulative impacts in the Turee Creek and Weeli Wolli catchments are not considered to significantly impact catchment environmental values and function of these catchments.

Groundwater

As discussed in Section 7.4.1.1, drawdown from supply abstraction at Western Hill has been modelled to be minimal and confined to the orebody aquifer. At Western Hill the proposed supply source aquifer and the regional Wittenoom Formation are unlikely to be connected, however gaps in the McRae Shale are assumed to exist to ensure a conservative model was used to inform outcomes.

Cumulative impacts between Western Hill and Deposit C are not significant due to the impermeable aquiclude between the aquifers (Figure 7-21).

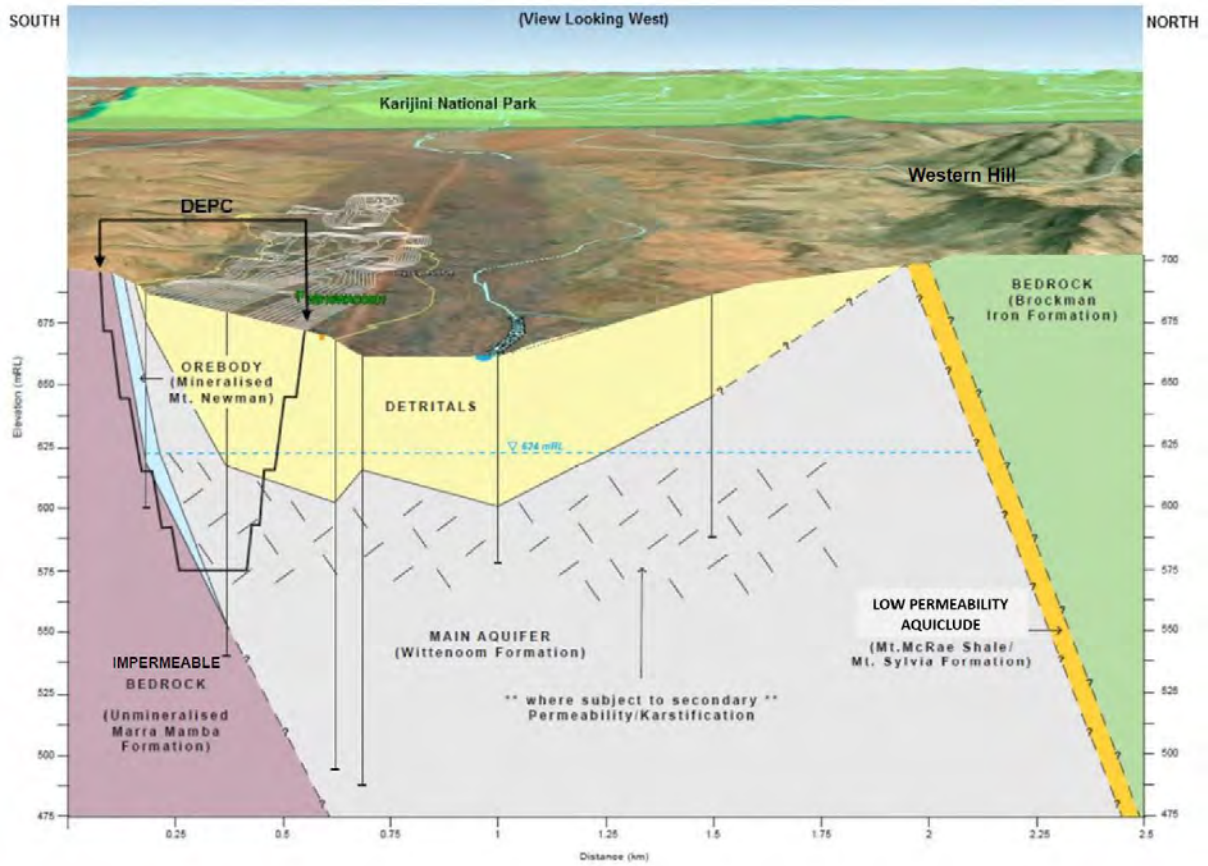


Figure 7-21: North-South Cross Section of Conceptual Hydrogeology Model (Rio Tinto 2017a)

Deposit H will be sump pumped such that a local impact within the footprint of the pit and confined to the local aquifer will be realised. No cumulative impacts related to groundwater for Deposit H are anticipated.

As the Deposit F North orebody aquifer is bounded on all sides by low permeability unmineralised Macleod and Nammuldi Members, the drawdown is considered to be restricted to the mineralised orebody aquifer. Drawdown is not predicted to propagate beyond the contact with the low permeability strata. Accordingly, there is considered a negligible likelihood for cumulative interactions with the regional aquifer and/or drawdown impacts associated with other deposits or proposals.

For groundwater-related values, none of the expected drawdowns associated with the Proposal interact significantly with potential or existing drawdowns associated with the Approved Proposal. There are multiple drawdown areas across the Revised Development Envelope however no significant cumulative increase in drawdown within the regional aquifer is anticipated. Similarly, drawdown from other projects within the regional aquifer are unlikely to significantly impact the aquifer when combined with Proposal impacts. Consequently, cumulative impacts to groundwater levels as a result of the Proposal are considered negligible.

7.6.4. Significance of Residual Impacts

7.6.4.1. Non-Significant Residual Impact

The proposed avoidance and management measures associated with the Proposal, that demonstrate non-significant residual impacts to Inland Waters include:

- Reduction in catchment of the Turee Creek East Catchment by up to ~3%, which may reduce Turee Creek flow events into Karijini National Park by ~9%
- Impact to the catchment reporting to Deposit H Waterhole does not impact pool filling frequency and level comparative to the pre mining regime of the pool
- Drawdown at Western Hill is not modelled to propagate towards Karijini National Park and no groundwater dependent sensitive receptors are located within the modelled impact area
- The Deposit H Waterhole is surface water fed and will not be impacted by drawdown at Deposit H
- Turtle Pool is confirmed to be surface water fed, but may also be connected to groundwater. No abstraction of groundwater will occur via dewatering bores, BWT ore will be accessed via in pit sump pumping, with water discharged into backfilled areas of the pit to facilitate infiltration back into the aquifer. Only localised drawdown of groundwater in the immediate vicinity of the pit is anticipated using the sump pumping approach. After the proposed mitigation, the risk of impact to Turtle Pool is considered low
- There are no sensitive groundwater receptors at Deposit F North
- Proposal abstraction and/or dewatering of ~1.92 GL, has been assessed as part of the Proposal. Due to minimal amount of abstraction/dewatering and mitigation measures applied to sensitive receptors and limited amount of BWT mining proposed, the assessment is that this is not a significant residual impact and can continue to be managed under the RiWI Act
- In relation to the Approved Proposal groundwater abstraction is currently authorised by Groundwater Licence (GWL) No. 98740(13) which currently permits an annual abstraction of 14,000,000 kL, and GWL No. 103136(9) which currently permits an annual abstraction of 3,102,500 kL. Water abstraction related to the Revised Proposal will continue to be managed via Licence requirements under the RiWI Act.

7.7. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

7.7.1. Proposal

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes and objectives that apply to Inland Water are set out below.

The following environmental outcomes are proposed in relation to Deposit H for the **Proposal**:

- No significant change to the water levels at Deposit H Waterhole as a result of any impacts to the catchment attributable to the Proposal
- No significant impact to vegetation downstream of the Deposit H Waterhole as a result of impacts to the reporting catchment
- No significant change to Turtle Pool as a result of any impacts to the catchment attributable to the Proposal
- No drawdown of groundwater associated with the Proposal at the boundary of or within Karijini National Park as a result of supply abstraction at Western Hill. The Groundwater Environment Management Plan Revision 3 (RTIO-HSE-0349522) approved 14 June 2022 (your reference A2106795) will continue to be implemented and will be updated to address management and monitoring of groundwater prior to commencement of abstraction for supply at Western Hill
- No significant impacts to groundwater quality related to Western Hill. The current approved Groundwater Environmental Management Plan will continue to be implemented for the Approved Proposal and updated before mining begins at Western Hill
- No change to discharge of surplus dewatering to Turee Creek as a result of the Proposal.

7.7.2. Revised Proposal

- **Revised Proposal:** The Revised Proposal will continue to be managed to ensure that Condition 6-1(1) of current approval MS 1113; '*ensure there is no drawdown of groundwater associated with the proposal at the boundary of, or within, Karijini National Park*'.
- **Revised Proposal:** The Revised Proposal will continue to be managed in accordance with the current approved requirement of 'Dewatering water will be used onsite in the first instance to supply water for operational purposes. Surplus dewatering water, exceeding the operational requirement is discharged to a local ephemeral tributary of Turee Creek East. The surface discharge extent will not extend within 2 km of the boundary of Karijini National Park under natural no-flow conditions'.

Environmental outcomes for stygofauna present within the groundwaters of the Proposal Area are presented in Section 10.7.

7.7.3. Summary

After implementation of the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to Inland Waters. Accordingly, the Proponent considers the Proposal can be managed to meet the EPA's objective to maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.

8. FLORA AND VEGETATION

8.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2021c) lists the following as their objective for Flora and Vegetation:

To protect flora and vegetation so that biological diversity and ecological integrity are maintained

For this EIA, flora is defined as native vascular plants and vegetation as groupings of different flora patterned across the landscape that occur in response to environmental conditions (EPA 2016b). Significant flora and vegetation are defined as any flora species or vegetation community protected under legalisation, listed as a Priority species under DBCA or important locally.

8.2. Relevant Policy and Guidance

8.2.1. EPA Policy and Guidance

Table 8-1 presents relevant policy and guidance for flora and vegetation and demonstrates how this has been considered for the Proposal.

Table 8-1: Relevant Policy and Guidance for Flora and Vegetation

Policy or Guidance	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for flora and vegetation forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Flora and Vegetation (EPA 2016b)	Considered in the design (methods and approach) of the flora and vegetation surveys (previous guidelines were used where surveys were undertaken before current guidelines being available).
EPA Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c)	
Instructions on how to prepare an Environmental Review Document (EPA 2021b)	This document forms the basis of the headings and content provided in this ERD, which has been prepared by WA EIA practitioners.
Instructions on how to prepare <i>Environmental Protection Act 1986</i> Part IV Environmental Management Plans (EPA 2021f)	The EMP has been prepared in accordance with the guidance and addresses, amongst other things, matters related to flora and vegetation (Appendix A.8).
Instructions on how to prepare <i>Environmental Protection Act 1986</i> Part IV Impact Reconciliation Procedures and Impact Reconciliation Reports (EPA 2021i)	Considered in the impact assessment and offset strategy for Flora and Vegetation.
Template for <i>Environmental Protection Act 1986</i> Part IV Reconciliation Procedures (EPA 2021j)	

Policy or Guidance	Explain How the Policy and Guidance has been Considered
Cumulative environmental impacts of development in the Pilbara region – Advice of the Environmental Protection Authority to the Minister for Environment under Section 16(e) of the <i>Environmental Protection Act 1986</i> (EPA 2014)	Considered in understanding cumulative impacts and supports conclusions on significance, and therefore offsets required for clearing of vegetation based on its condition.
Other State or Commonwealth	
Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	The MCP has been prepared in accordance with the guidance and addresses matters related to flora and vegetation (Appendix A.5).
Statutory Guidelines for Mine Closure Plans (DMIRS 2020b)	
WA Environmental Offsets Policy (Government of Western Australia 2011)	Considered in the impact assessment and offset strategy for Flora and Vegetation.
WA Environmental Offsets Guidelines (Government of Western Australia 2014).	

8.3. Receiving Environment

8.3.1. Studies and Survey Effort

Multiple flora and vegetation surveys have been undertaken within or overlapping the Revised Development Envelope since 1998 (Table 8-2). As such, the Proponent has an in-depth understanding of the environmental values within and surrounding the Proposal. Relevant survey reports are provided as appendices. Figure 8-1 illustrates how the surveys relate to each other for the Proposal. Figure 8-2 provides a map of the Proposal-specific survey coverage.

Flora and vegetation mapping has been completed for the Revised Development Envelope using several Detailed and Targeted surveys of the Proposal Areas conducted over multiple phases since 2019. These have been used to consolidate and incorporate historical vegetation mapping previously conducted over the Existing Operations (Biologic 2021a). An assessment of GDV has also been undertaken (SLR 2022).

Table 8-2: Summary of Technical Studies for the Flora and Vegetation Environmental Factor

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
Key Studies and Surveys			
2022			
<p>West Angelas Beyond 2020 Infrastructure Corridors Reconnaissance and Targeted Survey (Biologic 2022a; Appendix D.1)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0254 (Western Hill and Deposit F)</p> <p>IBSA-2023-0259 (Deposit H)</p>	<p>Survey Area: Proposed infrastructure corridors within Approved Development Envelope.</p> <p>Type: Desktop assessment, reconnaissance and targeted flora and vegetation survey.</p> <p>Timing: February (Western Hill and Deposit F) & May (Deposit H) 2022.</p>	<p>No limitations identified</p>	<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> • Statement of Environmental Principles, Factors and Objectives (EPA 2021c) • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016b)
<p>West Angelas Beyond 2020 Mt Ella East and Deposit J Detailed and Targeted Survey (Biologic 2022b; Appendix D.2)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0381</p>	<p>Survey Area: Proposed Mt Ella East and Deposit J previously unsurveyed areas. Mt Ella East (East) and Deposit J have been removed from the scope of the proposal. Data is used as a reference and to support impact assessment.</p> <p>Type: Desktop assessment, detailed and targeted flora and vegetation survey.</p> <p>Timing: May and August 2022.</p>	<ul style="list-style-type: none"> • Access issues were identified as a significant survey constraint within the Deposit J portion of the Study Area • Access issues were identified as a significant survey constraint within the Deposit J portion of the Study Area 	<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> • Statement of Environmental Principles, Factors and Objectives (EPA 2021c) • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016b)

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>West Angelas Beyond 2020 Deposit H and Deposit F North Reconnaissance Survey (Rio Tinto 2022; Appendix D.3)</p> <p>Internal survey by Rio Tinto IBSA-2023-0382</p>	<p>Survey Area: Identified field survey coverage gap, eastern extent of Revised Development Envelope at Dep H and northern extent of Revised Development Envelope at Dep F North.</p> <p>Type: Desktop assessment and single-phase reconnaissance flora and vegetation survey.</p> <p>Timing: November 2021</p>	<p>No limitations identified</p>	<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> • Statement of Environmental Principles, Factors and Objectives (EPA 2021c) • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016b)

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>Targeted Flora and Fauna Survey Mt Ella East and Deposit J pit and waste dump footprints</p> <p>Biologic Environmental Survey Pty Ltd (Biologic 2022d; Appendix D.4).</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0260</p>	<p>Survey Area: Mt Ella East and Deposit J covering approximately 237.9 ha of the Revised Development Envelope. Mt Ella East (East) and Deposit J have been removed from the scope of the proposal. Data is used as a reference and to support impact assessment.</p> <p>Type: A single season targeted survey for conservation significant flora and fauna.</p> <p>Survey Methods: Habitat assessment, targeted searches, water feature and cave assessments, Ultrasonic recordings and opportunistic observations.</p> <p>Timing: August 2021.</p>	<ul style="list-style-type: none"> Some portions of the Mt Ella East Survey Area were not traversed because of the safety risk of steep terrain, breakaways and free faces. Survey timing may have been a minor limitation for two taxa: <i>Goodenia nuda</i> (P4) and <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725) (P2) 	<p>Survey meets relevant EPA and EPBC Act policy and guidance. Survey approach and method undertaken with consideration of the following:</p> <ul style="list-style-type: none"> Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) Survey guidelines for Australia's threatened bats (DEWHA 2010a) Survey guidelines for Australia's threatened birds (DEWHA 2010b) Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a) Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b) Interim guideline for preliminary surveys of Night Parrot (<i>Pezoporus occidentalis</i>) in Western Australia (DPaW 2017) EPBC Act referral guideline for the endangered Northern Quoll (<i>Dasyurus hallucatus</i>) (DoE 2016b)
<p>West Angelas: Baseline Groundwater Dependent Ecosystem Assessment for the Greater West Angelas Areas (SLR 2022; Appendix D.5)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: The greater West Angelas area, encompassing the Revised Development Envelope.</p> <p>Type: Assessment of potential GDE features based on desktop data sources, targeted field investigations and analysis of remotely sensed vegetation indices.</p>	<p>The following limitations and constraints associated with this report are detailed below:</p> <p>Riparian Vegetation - Flora & Vegetation Factor</p> <p>No limitations or constraints identified – a targeted flora and vegetation survey was conducted as per the Technical Guidance for Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).</p>	<p>N/A – The EPA has developed no guidance specific to this type of study. Based on relevant EPA guidance, the study has drawn on hydrogeological, hydrological, and vegetation studies for the Proposal and utilised the experience of GDE experts from Rio Tinto and Biologic.</p> <p>For this EIA the classification of GDEs in this ERD is based on the results of this report as the most in-depth investigation conducted to</p>

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
	<p>Timing: Field work conducted in 2018 and 2021</p>	<p>Inland Waters Factor</p> <p>In the absence of a prescriptive methodology for industry use the Proponent has developed a risk assessment methodology for the detection and assessment of GDEs specific to the Pilbara. Similar risk assessment approaches are utilised in GDEs assessments being conducted in eastern states of Australia. This approach initially identifies and then aims to quantify potential impacts to riparian ecosystems by providing an initial indication of significance of these features at a local and regional scale.</p> <p>Groundwater Dependent Ecosystem detection</p> <p>The Proponents approach to GDE detection utilises a multi-step qualitative and quantitative assessment leveraging, NDVI persistence analyses, the use of high-resolution aerial photography for the assessment of vegetation structure and overstorey composition, eco-physical characteristics (for example landform, landscape position), available groundwater height data and conceptual understanding of relevant hydrogeology/topography. These are supported by targeted field survey of key riparian characteristics and composition of key potential GDE features identified by the above evidence.</p> <p>As with all technical studies some limitations exist, these are listed below:</p> <p>Vegetation persistence mapping (remote sensing)</p>	<p>identify and assess GDEs. It is noted that this work builds on previous vegetation survey data and supersedes the general identification of potential GDEs in Biologic (2021a) Consolidated Vegetation Mapping report.</p>

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
		<ul style="list-style-type: none"> • There is potential for minor inaccuracies in the persistence ranges used to delineate riparian vegetation and GDE classes (e.g., classification between ephemeral riparian, inflow dependent ecosystems, potential GDE and GDE). <p>Aerial photography interpretation</p> <ul style="list-style-type: none"> • Variability in the spectral characteristics, resolution and timing of aerial photography capture, which may impact the accuracy of the interpretation of riparian vegetation structure and composition. <p>Groundwater</p> <ul style="list-style-type: none"> • Groundwater tables in relevant bores adjacent to features of interest were assumed to be flat. • Constraints surrounding the available network of groundwater monitoring bores in targeted areas. This also intersects with challenges surrounding the interpretation of the available suite and scale of surface water and groundwater sources (noting that a number of these sources cannot be detected by traditional monitoring infrastructure). <p>It is noted that these limitations are also true for the traditional approach to GDE detection.</p>	

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>West Angelas Development Envelope Vegetation Condition Assessment (Biologic 2022e; Appendix D.6)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: West Angelas Revised Development Envelope.</p> <p>Type: Vegetation mapping condition assessment.</p> <p>Timing: 2022.</p>	<p>Some of the reports that were reviewed to assess vegetation condition are considered outdated, so it is likely that the condition of the vegetation across the Study Area may have changed over time, especially near the mining operations. As such, a conservative approach to the vegetation condition assessment was employed.</p>	<p>N/A - desktop assessment to assign condition ratings to the vegetation units mapped across the West Angelas Project Envelope.</p> <p>The condition of the vegetation within the Study Area was mapped based on a desktop assessment and limited on-ground observations. The existing consolidated vegetation mapping (Biologic 2021a) and the recent revisions (Biologic 2022a, 2022b, 2022c) formed the basis of the condition assessment, with the existing vegetation unit polygons assigned a condition rating.</p>
<p>West Angelas Development Envelope Vegetation Significance Assessment (Biologic 2022f; Appendix D.7)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: West Angelas Revised Development Envelope.</p> <p>Type: Vegetation mapping significance assessment.</p> <p>Timing: 2022</p>	<p>No limitations identified</p>	<p>N/A - The consolidated vegetation units mapped and described within the Study Area were assessed against the Biological Significance Guidance. The Biological Significance Guidance table ranks vegetation units based on whether the unit supports significant environmental values.</p>
<p>West Angelas Beyond 2020 Deposit G Reconnaissance and Targeted Survey (Biologic 2022g; Appendix D.8)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0261</p>	<p>Survey Area: Previously unsurveyed riparian area within Approved Development Envelope.</p> <p>Type: Desktop assessment, reconnaissance and targeted flora and vegetation survey.</p> <p>Timing: February 2022.</p>	<p>No limitations identified</p>	<p>The survey was conducted in accordance with:</p> <p>Statement of Environmental Principles, Factors and Objectives (EPA 2021c)</p> <p>Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c)</p> <p>Environmental Factor Guideline: Flora and Vegetation (EPA 2016b)</p>
<p>West Angelas Development Envelope Consolidated Vegetation Mapping (Angelo River) (Biologic 2022h; Appendix D.9)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: Southern section of Proposed Mt Ella East and Deposit J previously unsurveyed areas. Mt Ella East (East) and Deposit J have been removed from the scope of the proposal.</p>	<ul style="list-style-type: none"> The consolidation of previous mapping involved a level of interpretation as these processes were done through desktop methods alone, and without ground-truthing via vegetation sampling to verify classification, therefore a degree of error 	<ul style="list-style-type: none"> N/A – Vegetation mapping is a review the consolidated mapping undertaken by Biologic (2021a) against the floristic data collected for Stage 2 of Angelo River where it overlaps with the West Angelas Area.

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>(Spatial data included in IBSA-2023-0383)</p>	<p>Data is used as a reference and to support impact assessment.</p> <p>Type: Desktop assessment, detailed and targeted flora and vegetation survey from recent survey to support future project.</p> <p>Timing: 2022</p>	<p>may occur for some areas where large scale extrapolation has occurred</p> <ul style="list-style-type: none"> • There is a lower confidence in the confirmation of certain vegetation types identified by desktop mapping due to the difficulties in accurately delineating a landform from other landforms of similar appearance in aerial imagery, particularly at the broad scale of mapping implemented (e.g., cracking clay habitat). • The confidence in the vegetation descriptions and in general terms, the mapping, was relatively high, however, the descriptions and mapped extent of several vegetation types would benefit from ground-truthing to confirm the extent and description. 	
<p>2021 and 2020</p>			
<p>West Angelas Development Envelope Consolidated Vegetation Mapping (Biologic 2021a) (Appendix D.10)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0383</p>	<p>Survey Area: West Angelas Revised Development Envelope.</p> <p>Type: Vegetation mapping consolidation and extrapolation.</p> <p>Timing: August 2021.</p>	<p>As above</p>	<p>N/A - Vegetation mapping has previously been undertaken for the Proposal Area as part of the West Angelas Revised Proposal flora and vegetation survey completed in 2019 (Biota 2020). Additionally, vegetation mapping also exists for sections of the Approved Development Envelope from numerous surveys, ranging from detailed (formerly Level 2), reconnaissance (Level 1) and native vegetation clearing permit (NVCP) surveys. Combined, previous vegetation mapping has been completed over approximately 98% (40,547.87 ha) of the Revised Development Envelope (Biologic 2021a).</p> <p>Vegetation mapping (Biologic 2021a) is a consolidation of previous mapping and extrapolation of mapping across areas where mapping has not previously occurred to</p>

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
			<p>produce a single consolidated mapping layer of vegetation types present.</p> <p>All the studies used for consolidation and extrapolation were conducted per EPA guidance, as listed in the following part of this table.</p>
<p>West Angelas Beyond 2020 Detailed Flora and Vegetation Survey: Phases 1 and 2 (Biota 2020) (Appendix D.11)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0255</p>	<p>Survey Area: Western Hill, Deposit F North, Deposit H, Deposit J and Mt Ella East.</p> <p>Type: Desktop assessment and two-phase detailed flora and vegetation survey.</p> <p>Timing: August/September 2018 and April 2019.</p>	<p>The timing of the Phase 2 survey was planned to follow the typical wet season in the Pilbara, however only 10% of the long-term median rainfall was received during the three months prior to the survey (January to March), resulting in below average conditions.</p>	<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c) • Environmental Factor Guideline: Flora and Vegetation (EPA 2016b) • No limitations or constraints have been identified.
Supporting Studies and Surveys			
<p>West Angelas Targeted <i>Tetratheca fordiana</i> Survey (Astron 2018)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: 263,186 ha to the south, west and north-west of the West Angelas operations.</p> <p>Type: Targeted flora survey.</p> <p>Timing: November 2018.</p>		<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> • Terrestrial Biological Surveys as an Element of Biodiversity Protection: Position Statement No. 3 (EPA 2002) • Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
			<p>Impact Assessments in Western Australia (EPA 2004b)</p> <ul style="list-style-type: none"> • Technical Guidance – Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c) <p>The following limitations and constraints have been identified:</p> <ul style="list-style-type: none"> • Areas of moderate to the low likelihood of supporting the presence of <i>Tetratheca fordiana</i> were unable to be surveyed • Access was considered a minor limiting factor of this survey as it restricted where ground surveys and specimen collections could take place.
<p>Rio Tinto Greater West Angelas Vegetation and Flora Assessment (Ecologia 2013a)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2020-0537</p>	<p>Survey Area: Greater West Angelas study area (Deposits C, D, D extension, G, F, H and Mt Ella).</p> <p>Type: Two-Phase Detailed Flora and Vegetation survey.</p> <p>Timing: July 2012 and August 2013.</p>		<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> • Terrestrial Biological Surveys as an Element of Biodiversity Protection: Position Statement No. 3 (EPA 2002) • Guidance Statement 51: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessments in Western Australia (EPA 2004b) <p>The following limitations and constraints have been identified:</p> <ul style="list-style-type: none"> • Access limitations in some areas may have reduced total flora inventory to a minor degree • Some tussock grasses collected were dry and lacked reproductive material, which resulted in identification difficulties

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>Ngarlawangga TEK – Ethnobotanical Survey 1 August 2021 – Interim Report (vla83_21R-Rev0-151021) Prepared for Ngarlawangga Aboriginal Corporation</p>	<p>Survey Area: Ngarlawangga Native Title Determination Area Type: Consultation including on-country assessment Timing: August 2021</p>		<p>N/A - NAC with the support of the Proponent has begun to record the TEK associated with flora in the Revised Development Envelope and surrounding region. Ngarlawangga wish to continue to develop these TEK projects and consider it essential that this knowledge be incorporated into mine design and rehabilitation (Section 6).</p> <p>The primary purpose of the TEK survey is to develop a written record of existing knowledge and known language names of plants as provided by the Ngarlawangga people, for use within their community and ranger programme. The secondary purpose was to gain an understanding of plants that are traditionally and culturally important to the past and current lives of the Ngarlawangga people, and how these plants may be impacted by both singular and cumulative mining developments in order that these may be mitigated to some extent.</p>
<p>Report of an Yinhawangka Ethnobotanical Survey of the Deposits C and D at West Angelas (2018_31_WACD Project) Prepared for: Rio Tinto Iron Ore and Yinhawangka Aboriginal Corporation</p>	<p>Survey Area: West Angelas Deposits C and D Type: Consultation including on-country assessment Timing: 31st March – 4th April 2019</p>		<p>N/A - Ethnobotany is a cross-disciplinary endeavour, involving traditional knowledge and botanists, and often social scientists. This survey team comprises traditional knowledge holders, an experienced botanist, and experienced heritage professionals. The work draws on traditional knowledge of useful or culturally significant plants and on botanical knowledge for plant identification. The ethnobotanical field team visited 42 locations, and recorded a sample name (archaeological site and control samples), coordinates and vegetation unit identified by Ecologia (2013)</p> <p>The team travelled together to various points, including 42 botanical sample areas, around Deposits C and D at West Angelas. The entire</p>

Studies/Survey/Prepared For	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
			field team assisted each other in the tasks that each researcher considered practical.
Vegetation and Flora Survey of West Angelas Deposits E and F (Biota 2005a) Prepared for Rio Tinto	Survey Area: Deposits E and F. Type: Two-Phase Detailed Flora and Vegetation survey. Timing: 2004-05.		Not assessed due to age of survey; survey results used for contextual information and to inform consolidated vegetation mapping by Biologic.
Flora and vegetation surveys of Orebody A and Orebody B in the West Angela Hill area (Trudgen and EcAus 1998) Prepared for Rio Tinto	Survey Area: Greater West Angelas study area (Deposits C, D, D extension, G, F, H and Mt Ella). Type: Two-Phase Detailed Flora and Vegetation survey. Timing: 1995; April – July/Sep 1997; 1998.		Not assessed due to age of survey; survey results used for contextual information and to inform consolidated vegetation mapping by Biologic.

Figure 8-1: Key Flora and Vegetation Studies within and Surrounding the Revised Development Envelope

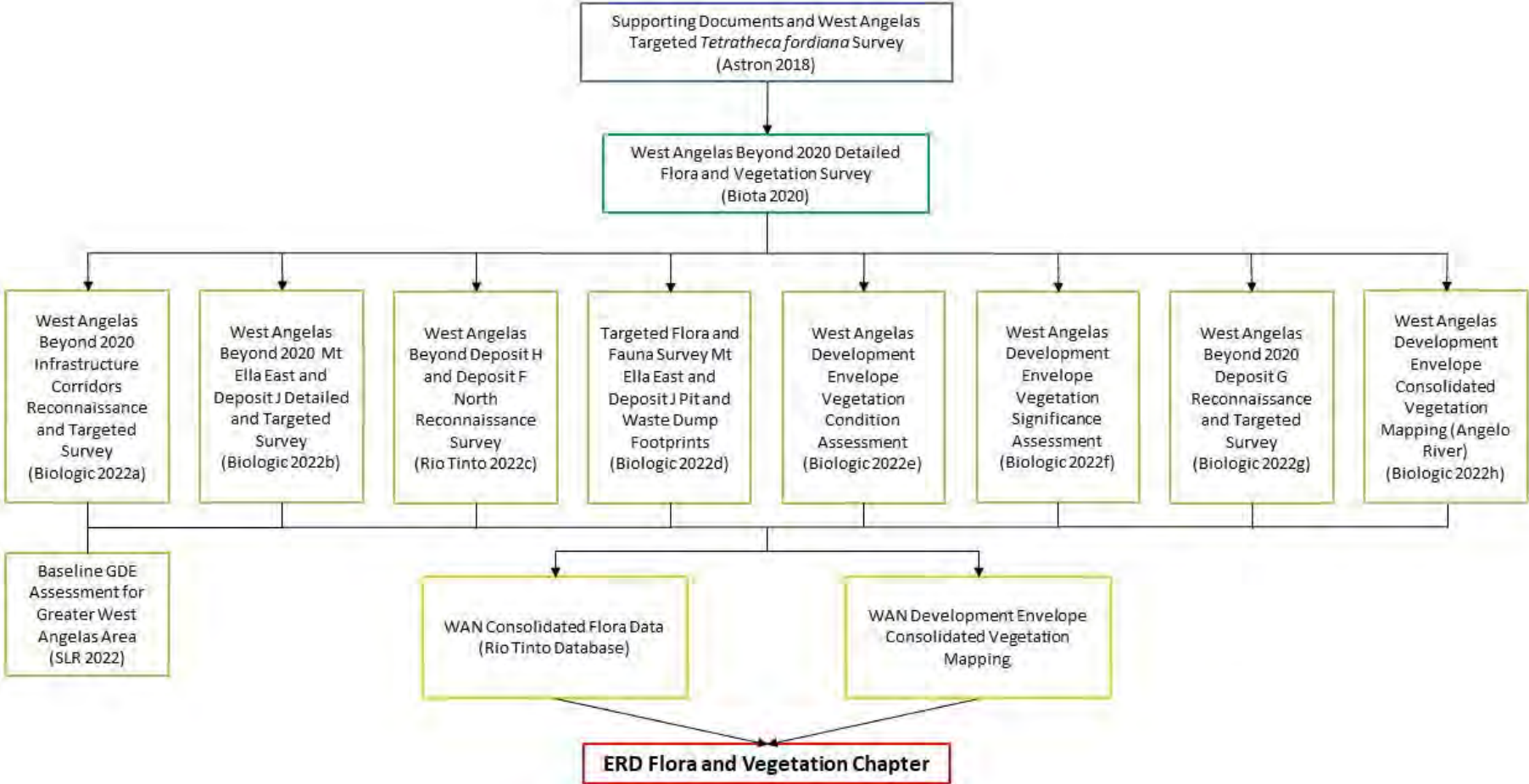
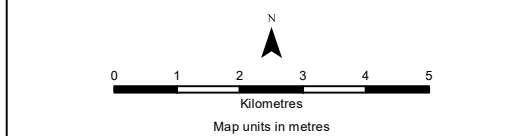
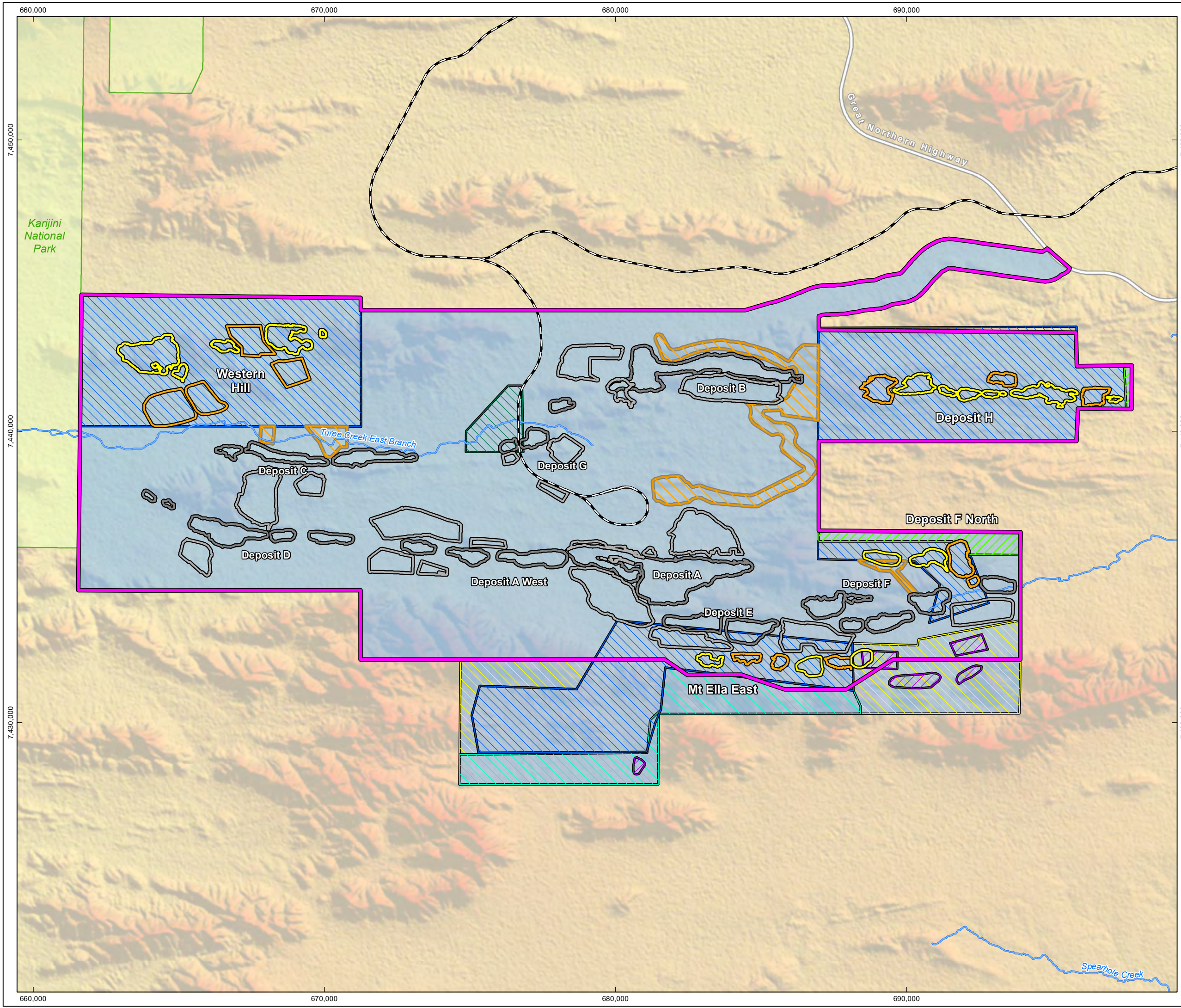


Figure 8-2
Spatial Extent of Flora and
Vegetation Surveys Conducted
for the Proposal

Drawn: A.D.
Plan: PDE00952724v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Proposed Conceptual Layout
 - Pit
 - Waste Landform
- Approved Conceptual Layout
 - Pit
 - Waste Landform
- Targeted Flora and Fauna Survey Mt Ella East and Deposit J Pit and Waste Dump Footprints (Biologic 2022c)
- West Angelas Beyond 2020 Dep H and Dep F North Reconnaissance Survey (Rio Tinto 2022)
- West Angelas Beyond 2020 Deposit G Reconnaissance and Targeted Survey (Biologic 2022a)
- West Angelas Beyond 2020 Detailed Flora and Vegetation Survey: Phases 1 and 2 (Biota, 2020)
- West Angelas Beyond 2020 Infrastructure Corridors Reconnaissance and Targeted Survey (Biologic 2022a)
- West Angelas Beyond 2020 Mt Ella East and Dep J Detailed and Targeted Survey (Biologic 2022)
- West Angelas Development Envelope Consolidated Vegetation Mapping (Angelo River) (Biologic 2022d)
- West Angelas Development Envelope Consolidated Vegetation Mapping (Biologic 2021)
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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8.3.2. Vegetation

8.3.2.1. Pre-European Vegetation

The Revised Development Envelope intersects three vegetation associations mapped by Beard (1975). The vegetation associations were defined from the broadscale (1:1,000,000 and 1:250,000) vegetation mapping of WA, completed by Beard (1975). The mapping was reassessed and updated by Shepherd *et al.* (2002) to account for clearing in the intensive land use zone of WA and to divide some of the larger vegetation associations. Table 8-3 and Figure 8-3 show pre-European vegetation associations within the Revised Development Envelope.

8.3.2.2. Local Vegetation Types

Forty-seven (47) vegetation types have been described within the Revised Development Envelope (Biologic 2021a) (Table 8-4, Figure 8-4). The most widespread vegetation types are:

- **M1:** *Acacia aneura*, *Acacia pruinocarpa* low open woodland/*A. aneura*, *A. catenulata* subsp. *occidentalis* and/or *A. pruinocarpa* low woodland to low open forest - *Eremophila forrestii* subsp. *forrestii* open shrubland *Triodia pungens* open hummock grassland/*T. pungens* very open hummock grassland (occupying 5,352 ha (15%) of the Revised Development Envelope and 1,303 ha (15%) of the Extension Areas). This type is a mosaic of P3 and P6 vegetation types, of which a further 665 ha (P3) and 80 ha (P6) have been mapped within the Revised Development Envelope
- **H4:** *Acacia inaequilatera* scattered tall shrubs *Triodia wiseana* open hummock grassland (occupying 3,755 ha (10%) of the Revised Development Envelope and 1021 ha (12%) of the Extension Areas)
- **H7:** *Eucalyptus leucophloia* subsp. *leucophloia* scattered low trees *Acacia maitlandii* scattered shrubs *Triodia vanleeuwenii*, *T. pungens* open hummock grassland (occupying 2,283 ha (6%) of the Revised Development Envelope but only 143 ha (2%) of the Extension Areas).

Of the vegetation types recorded in the Revised Development Envelope, 45 were broadly associated with four major landforms: Drainage Lines (11 vegetation types); Gullies/Gorges (three vegetation types); Stony Hillslopes, Hill Crests and Foothills (15 vegetation types); and Stony Plains, Sand Plains and Clay Plains (16 vegetation types). The remaining two vegetation types are considered a mosaic of the others (Biologic 2021a).

None of the vegetation types mapped for the Proposal represented Threatened Ecological Communities (TEC), and none were considered to be restricted to the study area (Biota 2020).

The conservation significance of the vegetation is discussed below.

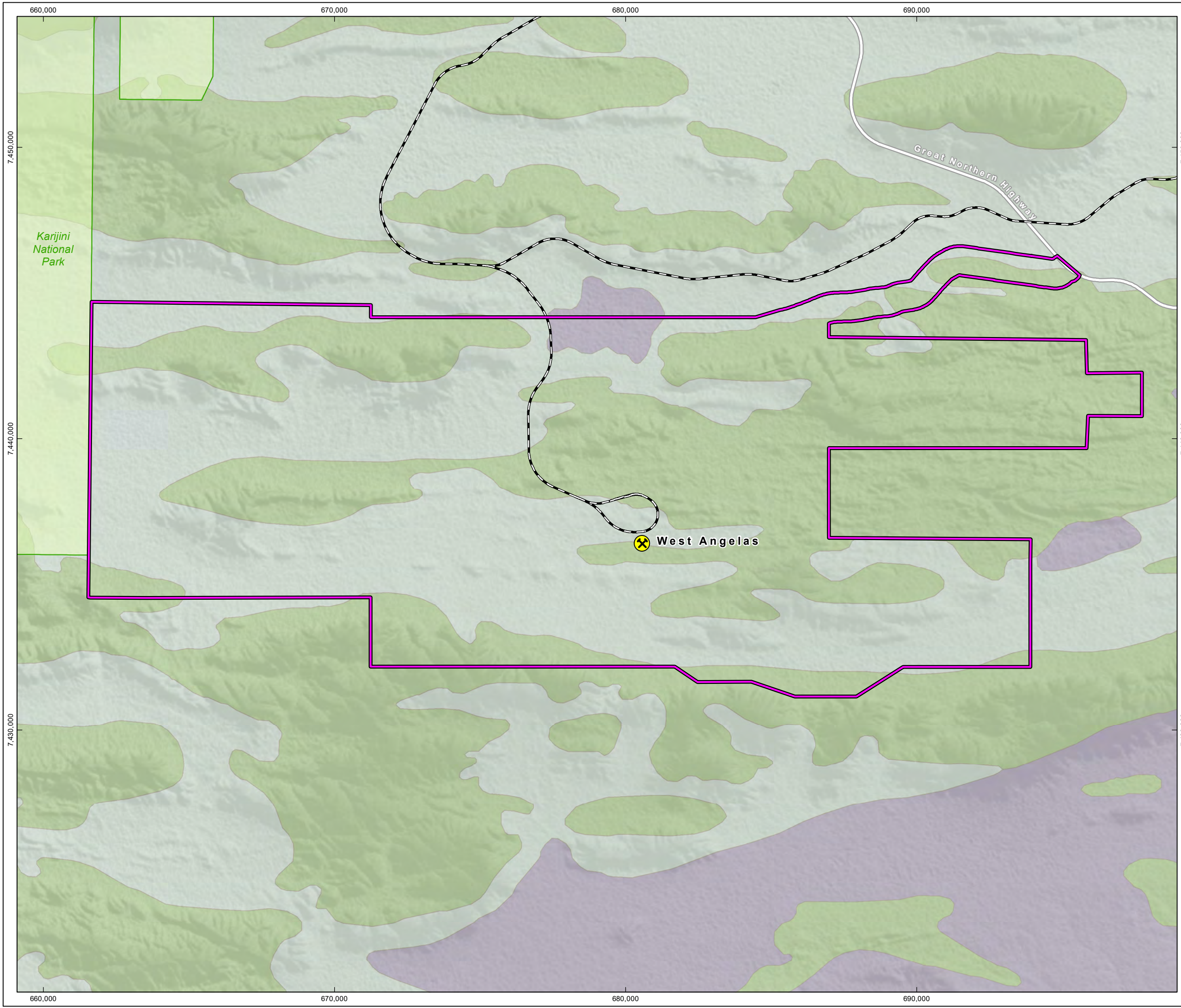
Table 8-3: Pre-European Vegetation Associations within the Revised Development Envelope

Vegetation Association and Description	Extent Within the Hamersley Subregion			Pre-European Extent with Formal Protection	Extent Within Revised Development Envelope ha (% of DE)
	Pre-European (ha)	Current (ha)*	% Remaining		
Hamersley_18 Low woodland; mulga (<i>Acacia aneura</i>)	581,246	576,541	99	19%	19,127 (52)
Hamersley_29 Mulga <i>Acacia aneura</i> and associated species	172,083	170,748	99	11%	442 (1.2)
Hamersley_82 Hummock grassland, low tree steppe; snappy gum over <i>Triodia wiseana</i>	2,177,574	2,165,224	99	12%	17,210 (47)
Total					36,779

*Extent rounded up to nearest ha. The information presented in the table is accurate as of 2019 (Government of Western Australia 2019a)

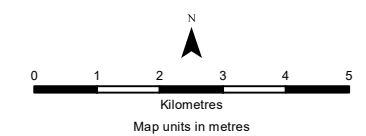
Figure 8-3
Pre-European
Vegetation Associations

Drawn: GIS Team
Plan: PDE0186397v4
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Rio Tinto Mine
- Revised Development Envelope
- Vegetation Association (Beard 1970)**
 - Hamersley 18
 - Hamersley 29
 - Hamersley 82
- Rio Tinto Railway
- Highway
- National Park



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Table 8-4: Vegetation Types

Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
Drainage Lines						
D2	<i>Eucalyptus victrix</i> low open woodland <i>Acacia citrinoviridis</i> tall open shrubland over <i>Tephrosia rosea</i> var. Fortescue Creeks (M.I.H. Brooker 2186) scattered low shrubs <i>Themeda triandra</i> very open tussock grassland over <i>Triodia pungens</i> scattered hummock grasses to very open hummock grassland.	160	160	0.44	12	0.14
D3	<i>Eucalyptus xerothermica</i> and/or <i>Corymbia hamersleyana</i> low open woodland <i>Petalostylis labicheoides</i> , <i>Acacia pyrifolia</i> tall open shrubland over <i>Tephrosia rosea</i> var. Fortescue Creeks (M.I.H. Brooker 2186) low open shrubland <i>Themeda triandra</i> very open tussock grassland over <i>Triodia pungens</i> very open hummock grassland to scattered hummock grasses.	178	70	0.19	0	0
D4	<i>Acacia 'aneura'</i> , <i>A. catenulata</i> subsp. <i>occidentalis</i> , <i>A. pruinocarpa</i> low woodland <i>Triodia pungens</i> very open hummock grassland.	6	6	0.02	5	0.06
D5	<i>Corymbia hamersleyana</i> low open woodland <i>Petalostylis labicheoides</i> , <i>Acacia monticola</i> tall shrubland over <i>Tephrosia rosea</i> var. Fortescue Creeks (M.I.H. Brooker 2186) low open shrubland <i>Themeda triandra</i> very open tussock grassland over <i>Triodia pungens</i> very open hummock grassland.	18	18	0.05	17	0.20
D6	<i>Corymbia hamersleyana</i> and/or <i>Corymbia deserticola</i> subsp. <i>deserticola</i> low open woodland <i>Acacia 'aneura'</i> , <i>Petalostylis labicheoides</i> tall open shrubland <i>Triodia pungens</i> open hummock grassland.	312	312	0.85	20	0.24

Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
D7	<i>Corymbia hamersleyana</i> low open woodland <i>Acacia monticola</i> tall shrubland <i>Themeda triandra</i> very open tussock grassland over <i>Triodia pungens</i> very open hummock grassland.	70	45	0.12	27	0.32
D8	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>Corymbia hamersleyana</i> low open woodland <i>Petalostylis labicheoides</i> , <i>Gossypium robinsonii</i> , <i>Acacia monticola</i> open shrubland <i>Themeda triandra</i> tussock grassland over <i>Triodia pungens</i> open hummock grassland.	5	5	0.01	5	0.06
D9	<i>Eucalyptus trivalva</i> low mallee woodland <i>Triodia pungens</i> very open hummock grassland.	27	27	0.07	1	0.01
D10	<i>Eucalyptus xerothermica</i> , <i>Acacia 'aneura'</i> low woodland <i>Androcalva luteiflora</i> open shrubland over <i>Isotropis iophyta</i> (formally <i>Isotropis</i> sp. Arid zone (G. Byrne 2775)) low open shrubland <i>Themeda triandra</i> tussock grassland.	4	4	0.01	4	0.05
D11	<i>Eucalyptus xerothermica</i> and/or <i>Acacia 'aneura'</i> low open woodland over <i>E. trivalva</i> low open mallee woodland <i>Petalostylis labicheoides</i> , <i>Androcalva luteiflora</i> open shrubland <i>Eulalia symonii</i> and/or <i>Themeda triandra</i> very open tussock grassland with <i>Triodia pungens</i> very open hummock grassland.	153	153	0.42	49	0.58
D12	<i>Eucalyptus xerothermica</i> and/or <i>E. victrix</i> scattered low trees to low open woodland <i>Melaleuca bracteata</i> , (<i>M. glomerata</i>) tall open shrubland over <i>Androcalva luteiflora</i> open shrubland <i>Themeda triandra</i> tussock grassland over <i>Triodia longiceps</i> , <i>T. pungens</i> very open hummock grassland.	5	5	0.01	5	0.06

Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
D13*	<i>Acacia 'aneura'</i> , <i>Callitris columellaris</i> and/or <i>Corymbia ferricola</i> low woodland <i>Capparis mitchellii</i> scattered tall shrubs over <i>Ptilotus obovatus</i> low open shrubland <i>Eriachne mucronata</i> and/or <i>Aristida burbidgeae</i> very open tussock grassland with <i>Triodia pungens</i> scattered hummock grasses.	72	0	0	0	0
D14	<i>Acacia. pyrifolia</i> var. <i>pyrifolia</i> , <i>Petalostylis labicheoides</i> tall sparse to tall open shrubland over <i>Indigofera georgei</i> , <i>Ptilotus obovatus</i> , <i>Solanum lasiophyllum</i> low isolated to low open shrubland	646	646	1.76	35	0.41
Gullies and Gorges						
G1	<i>Acacia 'aneura'</i> , <i>A. pruinocarpa</i> , <i>Corymbia ferricola</i> low open forest <i>Dodonaea pachyneura</i> tall open shrubland over <i>Harnieria kempeana</i> subsp. <i>muelleri</i> , (<i>Ptilotus obovatus</i>) low shrubland <i>Triodia pungens</i> very open hummock grassland.	5	5	0.01	5	0.06
G2	<i>Acacia 'aneura'</i> , <i>Callitris columellaris</i> and/or <i>Corymbia ferricola</i> low woodland <i>Capparis mitchellii</i> scattered tall shrubs over <i>Ptilotus obovatus</i> low open shrubland <i>Eriachne mucronata</i> and/or <i>Aristida burbidgeae</i> very open tussock grassland with <i>Triodia pungens</i> scattered hummock grasses.	111	45	0.12	12	0.15
G3	<i>Corymbia ferricola</i> low open woodland <i>Acacia monticola</i> tall open shrubland <i>Themeda triandra</i> very open tussock grassland over <i>Triodia pungens</i> scattered hummock grasses.	27	27	0.07	2	0.03

Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
Stony Hillslopes, Hillcrests and Foothills						
H1	<i>Acacia 'aneura'</i> and/or <i>A. ayersiana</i> , (<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i>) low woodland <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>E. latrobei</i> subsp. <i>latrobei</i> scattered shrubs <i>Triodia pungens</i> , <i>T. wiseana</i> very open hummock grassland.	100	100	0.27	83	0.98
H2	<i>Acacia 'aneura'</i> low woodland <i>Eremophila jucunda</i> subsp. <i>pulcherrima</i> , <i>E. phyllopoda</i> subsp. <i>obliqua</i> , (<i>E. cuneifolia</i> , <i>E. oppositifolia</i> subsp. <i>angustifolia</i>) open shrubland <i>Triodia pungens</i> very open hummock grassland.	457	457	1.24	154	1.82
H3	<i>Acacia catenulata</i> subsp. <i>occidentalis</i> , (<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> , <i>A. 'aneura'</i>) low open forest <i>Triodia pungens</i> open hummock grassland.	179	54	0.15	23	0.27
H4	<i>Acacia inaequilatera</i> scattered tall shrubs <i>Triodia wiseana</i> open hummock grassland.	3,755	3,755	10.21	1021	12.08
H5*	<i>Corymbia hamersleyana</i> , <i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland <i>Acacia maitlandii</i> open heath over <i>Halganina gustafsenii</i> var. Mid-West (G. Perry 370) low open shrubland <i>Triodia pungens</i> , <i>T. wiseana</i> hummock grassland.	326	0	0	0	0
H6	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland <i>Acacia bivenosa</i> open shrubland <i>Triodia pungens</i> open hummock grassland.	152	152	0.41	152	1.80
H7	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> scattered low trees <i>Acacia maitlandii</i> scattered shrubs <i>Triodia vanleeuwenii</i> , <i>T. pungens</i> open hummock grassland.	2,283	2,283	6.21	143	1.70

Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
H8	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and/or <i>Corymbia deserticola</i> subsp. <i>deserticola</i> low open woodland <i>Acacia pruinocarpa</i> scattered tall shrubs <i>Triodia vanleeuwenii</i> and/or <i>T. pungens</i> open hummock grassland.	2,074	2,074	5.64	750	8.87
H9	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> and/or <i>Corymbia deserticola</i> subsp. <i>deserticola</i> low open woodland over <i>E. gamophylla</i> low open mallee woodland <i>Triodia vanleeuwenii</i> open hummock grassland.	1,537	318	0.86	119	1.41
H10	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> scattered low trees over <i>E. gamophylla</i> low open mallee woodland <i>Acacia maitlandii</i> , <i>Petalostylis labicheoides</i> open shrubland <i>Triodia vanleeuwenii</i> , <i>T. wiseana</i> open hummock grassland.	1,532	1,532	4.17	982	11.61
H11	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> scattered low trees over <i>E. kingsmillii</i> low open mallee woodland <i>Acacia hamersleyensis</i> scattered tall shrubs <i>Triodia vanleeuwenii</i> , <i>T. wiseana</i> open hummock grassland.	76	76	0.21	76	0.90
H12	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> scattered low trees <i>Eremophila fraseri</i> subsp. <i>fraseri</i> low open shrubland <i>Triodia pungens</i> and/or <i>T. wiseana</i> open hummock grassland.	27	27	0.07	27	0.32
H13	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland over <i>Eucalyptus</i> spp. low open mallee woodland <i>Triodia wiseana</i> , <i>T. sp.</i> Mt Ella (M.E. Trudgen 12739) open hummock grassland.	320	9	0.02	9	0.10
H14	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> scattered low trees <i>Triodia brizoides</i> , (<i>T. wiseana</i>) open hummock grassland.	293	293	0.80	80	0.94

Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
H15	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland <i>Triodia pungens</i> and/or <i>T. wiseana</i> open hummock grassland.	3424	1,729	4.70	343	4.06
H16	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland <i>Triodia vanleeuwenii</i> , <i>T. pungens</i> and/or <i>T. sp.</i> Mt Ella (M.E. Trudgen 12739) open hummock grassland.	1,884	1,884	5.12	674	7.96
Mosaics						
M1	<i>Acacia 'aneura'</i> , <i>Acacia pruinocarpa</i> low open woodland/ <i>Acacia 'aneura'</i> , <i>A. catenulata</i> subsp. <i>occidentalis</i> and/or <i>Acacia pruinocarpa</i> low woodland to low open forest - / <i>Eremophila forrestii</i> subsp. <i>forrestii</i> open shrubland <i>Triodia pungens</i> open hummock grassland/ <i>Triodia pungens</i> very open hummock grassland.	5,352	5,352	14.55	1303	15.41
M2	<i>Eucalyptus trivalva</i> , <i>E. repullulans</i> , <i>E. socialis</i> subsp. <i>eucentrica</i> low open mallee woodland <i>Acacia inaequilatera</i> scattered tall shrubs/- <i>Triodia wiseana</i> open hummock grassland/ <i>Triodia wiseana</i> , (<i>T. angusta</i> , <i>T. pungens</i> , <i>T. longiceps</i>) open hummock grassland.	242	242	0.66	242	2.86
Stony Plains, Sand Plains and Clay Plains						
P1	<i>Acacia 'aneura'</i> , <i>A. ayersiana</i> , <i>A. pruinocarpa</i> low open woodland <i>Triodia vanleeuwenii</i> , <i>T. pungens</i> open hummock grassland.	156	156	0.42	5	0.06
P2	<i>Acacia 'aneura'</i> , <i>A. ayersiana</i> low open woodland <i>Eremophila forrestii</i> subsp. <i>forrestii</i> open shrubland <i>Triodia melvillei</i> open hummock grassland.	391	391	1.06	26	0.31

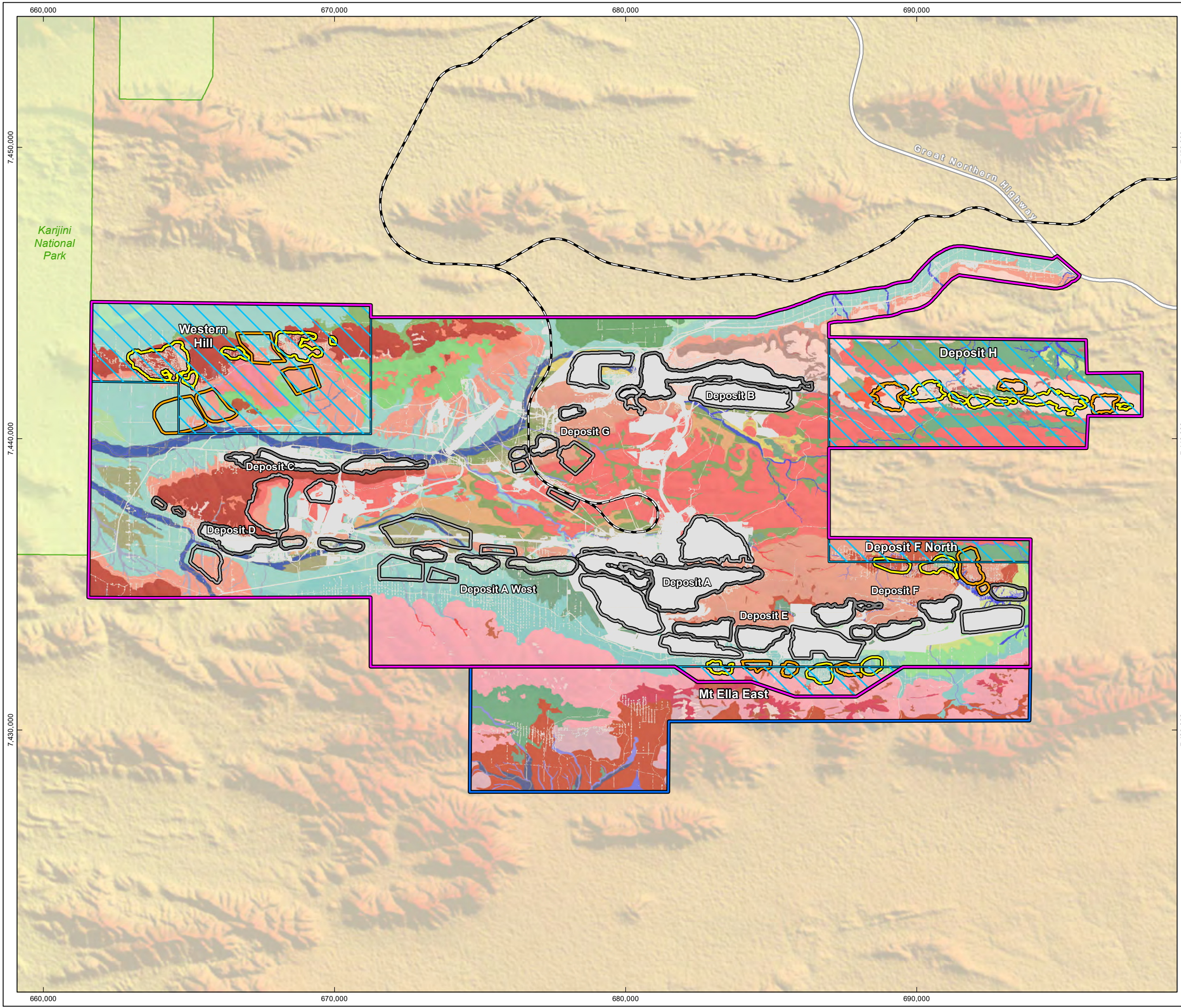
Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
P3	<i>Acacia 'aneura'</i> , <i>A. catenulata</i> subsp. <i>occidentalis</i> and/or <i>Acacia pruinocarpa</i> low woodland to low open forest <i>Eremophila forrestii</i> subsp. <i>forrestii</i> open shrubland <i>Triodia pungens</i> very open hummock grassland	610	610	1.66	0	0
P4	<i>Acacia 'aneura'</i> , <i>A. pruinocarpa</i> , <i>A. ayersiana</i> woodland <i>Triodia pungens</i> open hummock grassland.	328	275	0.75	9	0.11
P5	<i>Acacia 'aneura'</i> and/or <i>A. pruinocarpa</i> low woodland to low open forest <i>Eremophila forrestii</i> subsp. <i>forrestii</i> open shrubland <i>Triodia pungens</i> very open hummock grassland.	356	336	0.91	10	0.12
P6	<i>Acacia 'aneura'</i> , <i>A. pruinocarpa</i> low open woodland <i>Triodia pungens</i> open hummock grassland.	79	79	0.21	0	0
P7	<i>Acacia 'aneura'</i> , <i>Eucalyptus xerothermica</i> scattered low trees to low open woodland <i>Eremophila forrestii</i> subsp. <i>forrestii</i> and/or <i>E. longifolia</i> very open shrubland <i>Themeda triandra</i> scattered tussock grasses over <i>Triodia wiseana</i> and/or <i>T. pungens</i> open hummock grassland.	1,207	1,207	3.28	121	1.43
P8	<i>Acacia 'aneura'</i> scattered tall shrubs <i>Themeda triandra</i> scattered tussock grasses to tussock grassland with <i>Aristida contorta</i> scattered bunch grasses to bunch grassland over <i>Triodia pungens</i> scattered hummock grasses.	159	159	0.43	88	1.04
P9	<i>Acacia pruinocarpa</i> scattered tall shrubs over <i>A. wanyu</i> open shrubland <i>Triodia vanleeuwenii</i> and/or <i>T. pungens</i> open hummock grassland.	224	224	0.61	114	1.35
P10	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland <i>Acacia tenuissima</i> , <i>A. dictyophleba</i> , <i>A. maitlandii</i> open shrubland <i>Triodia wiseana</i> hummock grassland.	33	33	0.09	33	0.39

Vegetation Type	Description	Extent within the West Angelas Area (ha)*	Total Extent within Revised Development Envelope (ha)*	Total % of Revised Development Envelope	Total Extent within Extension Areas (ha)	Total % of Extension Areas
P11	<i>Eucalyptus leucophloia</i> subsp. <i>leucophloia</i> low open woodland <i>Triodia longiceps</i> and/or <i>T. wiseana</i> , <i>T. pungens</i> open hummock grassland.	663	663	1.80	217	2.56
P12	<i>Eucalyptus gamophylla</i> low open mallee woodland <i>Triodia pungens</i> and/or <i>T. vanleeuwenii</i> open hummock grassland.	1,581	1,410	3.83	115	1.36
P13	<i>Eucalyptus repullulans</i> , <i>E. socialis</i> subsp. <i>eucentrica</i> low open mallee woodland <i>Melaleuca eleuterostachya</i> low open shrubland <i>Triodia wiseana</i> , <i>T. angusta</i> very open hummock grassland.	41	41	0.11	41	0.49
P14	<i>Eucalyptus trivalva</i> , <i>E. repullulans</i> , <i>E. socialis</i> subsp. <i>eucentrica</i> low open mallee woodland <i>Triodia wiseana</i> , (<i>T. angusta</i> , <i>T. pungens</i> , <i>T. longiceps</i>) open hummock grassland.	1,367	928	2.52	915	10.82
P15	<i>Astrebla pectinata</i> , <i>Astrebla elymoides</i> and <i>Aristida latifolia</i> open tussock grassland	433	433	1.18	0	0
P16	<i>Acacia 'aneura'</i> tall open shrubland <i>Eremophila forrestii</i> subsp. <i>forrestii</i> , <i>Rhagodia eremaea</i> open shrubland <i>Chrysopogon fallax</i> scattered tussock grasses	112	112	0.30	0	0
Total	Mapped Vegetation Types	233,552	328,922	478.64	58074	695.47
Disturbed						
Disturbed	<i>Native vegetation cleared or completely degraded</i>	7,931	7,857	21.36	383	4.53
Total		41,483	36,779	100	8457	100

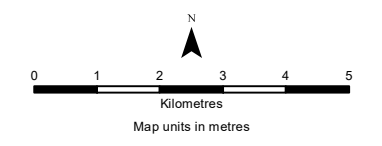
* - Not found within the Revised Development Envelope; however, was found in West Angelas Area and is used to inform impact assessment. West Angelas Area includes the Revised Development Envelope and Deposit J and Mt Ella East reference areas.

Figure 8-4
Vegetation types within the
Revised Development
Envelope

Drawn: A.D.
Plan: PDE0186395v5
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



- Legend**
- Revised Development Envelope
 - Extension Area
 - West Angelas Area
 - Proposed Conceptual Layout*
 - Pit
 - Waste Landform
 - Approved Conceptual Layout*
 - Pit
 - Waste Landform
 - National Park
 - Rio Tinto Railway
 - Highway



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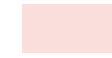










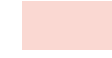






Figure 8-4
Vegetation types within
the Revised Development
Envelope

Drawn: A.D.
Plan: PDE0186395v5
Date: March 2023














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Legend - Vegetation Type



Hills

-  G1, AanApCfDpHARkPTp
-  G2, AanCALcCfCAPmPToERImARbTp
-  G3, CfAmoTHtTp
-  H1, AanAayEIERfoERlaTpTw
-  H2, AanERsppTp
-  H3, AcaEIAanTp
-  H4, AiTw
-  H5, ChElAmHAgTpTw
-  H6, ElAbTp
-  H7, ElAmTvTp
-  H8, ElCdApTvTp
-  H9, ElCdEgTv
-  H10, ElEgAmPITvTw
-  H11, ElEkAhTvTw
-  H12, ElERfTpTw
-  H13, ElEspTpTw
-  H14, ElTbrTw
-  H15, ElTpTw
-  H16, ElTvTpTsm


Drainage

-  D2, EvAcTERTHtTp
-  D3, ExChPIApyTERTHtTp
-  D4, AanAcaApTp
-  D5, ChPIAmoTERTHtTp
-  D6, ChCdAanPITp
-  D7, ChAmoTHtTp
-  D8, ElChPIGOrAmoTHtTp
-  D9, EtTp
-  D10, ExAanANIISsTHt
-  D11, ExAanEtPIANIEUsTHtTp
-  D12, ExEvMbMgANITHtTloTp
-  D13, ExPIAppTtEmu
-  D14, AcAapApyPITpTHtEENICYa

Cracking Clays

-  P15, ASpASeARla
-  P16, AanERfoCHf

Plains

-  M1, AanApTp/AanAcaApERfoTp
-  M2, AiTw/EtERsTspp
-  P1, AanAayApTvTp
-  P2, AanAayERfoTm
-  P3, AanAcaApERfoTp
-  P4, AanApAayTp
-  P5, AanApERfoTp
-  P6, AanApTp
-  P7, AanExERfoERloTHtTwTp
-  P8, AanTHtARcTp
-  P9, ApAwTvTp
-  P10, ElAtenAdAmTw
-  P11, ElTspp
-  P12, EgTpTv
-  P13, ErEsMeTwTa
-  P14, EtERsTspp

Other

-  Disturbed

8.3.2.3. Significant Vegetation

Threatened Ecological Communities

No TECs as defined by the BC or EPBC Act occur within the Revised Development Envelope. The closest TEC is the Ethel Gorge Aquifer Stygobiont Community, located approximately 110 km east of the Revised Development Envelope.

Priority Ecological Communities

The Revised Development Envelope includes mapped areas of the 'West Angelas Cracking-Clays' P1 Priority Ecological Communities (PEC) (Figure 8-5), represented by the vegetation type P15 (Table 8-4). This PEC is restricted to the West Angelas area. It is described as 'Open tussock grasslands of *Astrelba pectinata*, *A. elymoides*, *Aristida latifolia*, in combination with low scattered shrubs of *Sida fibulifera*, on basalt (Jerrinah formation) derived cracking clay loam depressions and flow lines'. Approximately 433 ha of the Priority 1 'West Angelas Cracking Clays' PEC is mapped within the Revised Development Envelope. This PEC was not recorded within the Extension Areas. The major risks facing this PEC are mining, weed invasion and changes to fire regimes (DBCA 2022).

Riparian Vegetation

Eleven local vegetation types within the Revised Development Envelope are associated with drainage lines (Table 8-4); however, not all types support riparian flora, particularly those associated with minor creeklines that are considered to only experience occasional flows. In the Pilbara, riparian vegetation is typically represented by increasingly dense vegetation, which establishes surrounding the low flow channel of moderate to major sized drainage systems. The overstorey typically comprises keystone tree species such as *Eucalyptus camaldulensis*, *E. victrix* and to a lesser extent other common riparian tree species such as *E. xerothermica* (Rio Tinto 2020c, Lyons 2015). Of the eleven vegetation types, five represent riparian vegetation, extending across 392 ha (Table 8-5).

Vegetation type D10 (Deposit H) is restricted in extent (Figure 8-5) and supports a low woodland of *E. xerothermica* and *A. aneura*, over a middle stratum dominated by *Isotropis iophyta* (formally *Isotropis* sp. Arid zone (G. Byrne 2775)) and a dense cover of *Themeda triandra* at ground level. Vegetation type D12 is also restricted, possesses the perennial mesophyte *Melaleuca bracteata* and was only recorded at Deposit H in minor drainage lines with a calcareous component in their substrates (Biota 2020). The other riparian vegetation types are not restricted within the Revised Development Envelope (Figure 8-5).

Table 8-5: Vegetation Types Within the Revised Development Envelope Identified to Support Riparian Vegetation

Vegetation Type and Species Code	Riparian Species Present	Drainage System	Extent within West Angelas Area (ha)	Extent within Revised Development Envelope (ha)	Extent within Extension Areas (ha)
D2: EvAcTErTHtTp	<i>Eucalyptus victrix</i> and <i>Eragrostis tenella</i>	Major/ Moderate	160	160	12
D3: ExChPIApyTErTHtTp	<i>Eucalyptus xerothematica</i>	Major	178	70	0
D10: ExAanANIISsTHt	<i>Eucalyptus xerothematica</i>	Minor/ Moderate	4	4	4
D11: ExAanEtPIANIEUsTHtTp	<i>Eucalyptus xerothematica</i>	Minor	153	153	49
D12: ExEvMbMgANITHtTloTp	<i>Eucalyptus victrix/E. xerothematica</i> , <i>Melaleuca glomerata</i> , <i>M. bracteata</i> , <i>Cyprus vaginatus</i> and <i>Abutilon amplum</i>	Minor	5	5	5
Total	NA	NA	500	392	70

1. Identification of vegetation types supporting riparian vegetation was based on Lyons 2015

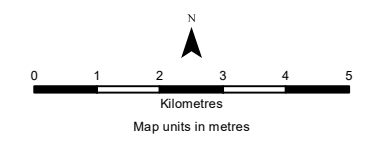
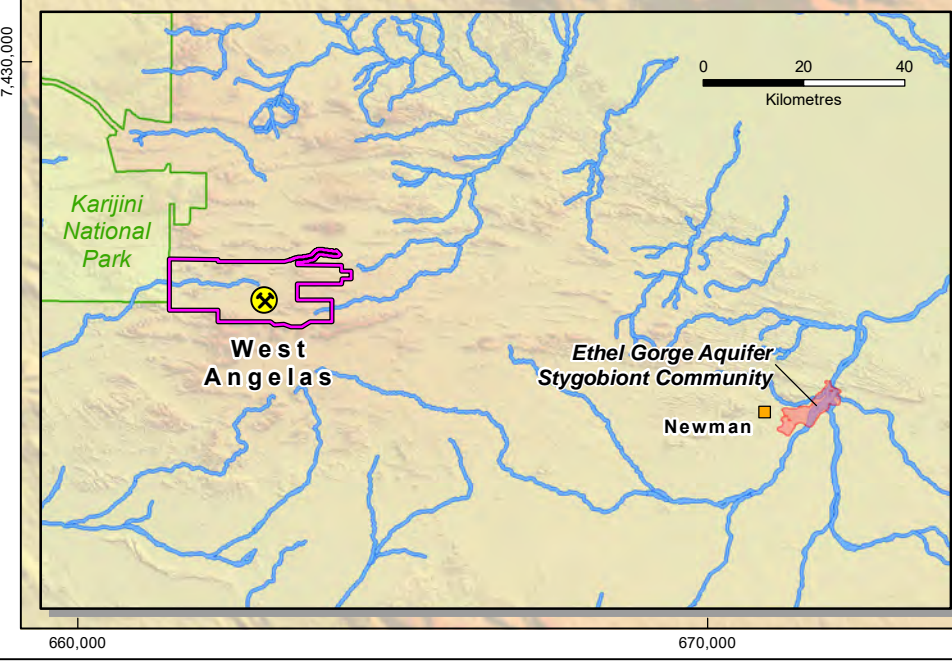
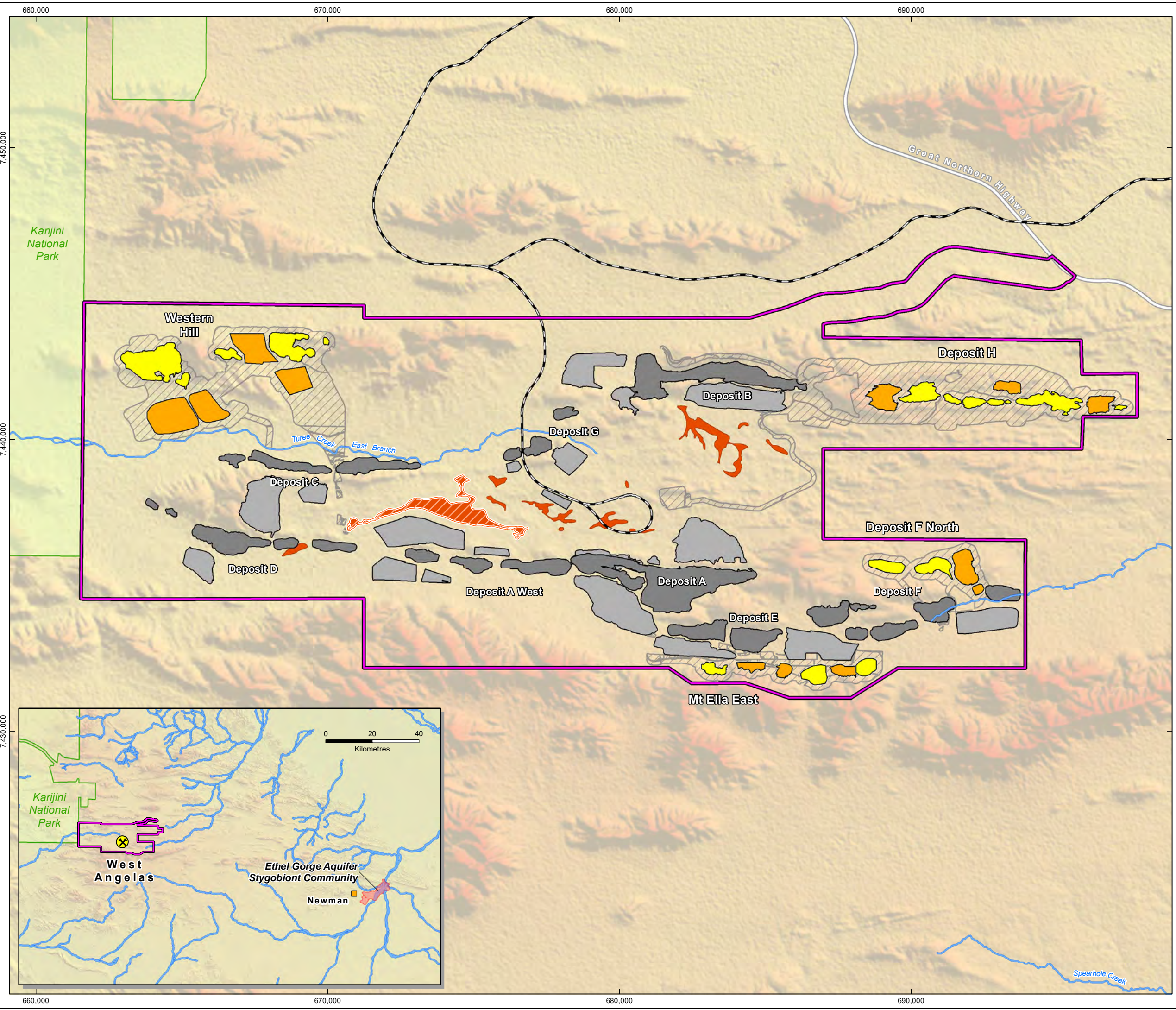
Figure 8-5
Priority Ecological Communities
within the Revised Development
Envelope

Drawn: A.D.
Plan: RTIO-0213520v4
Date: August 2023

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

Legend

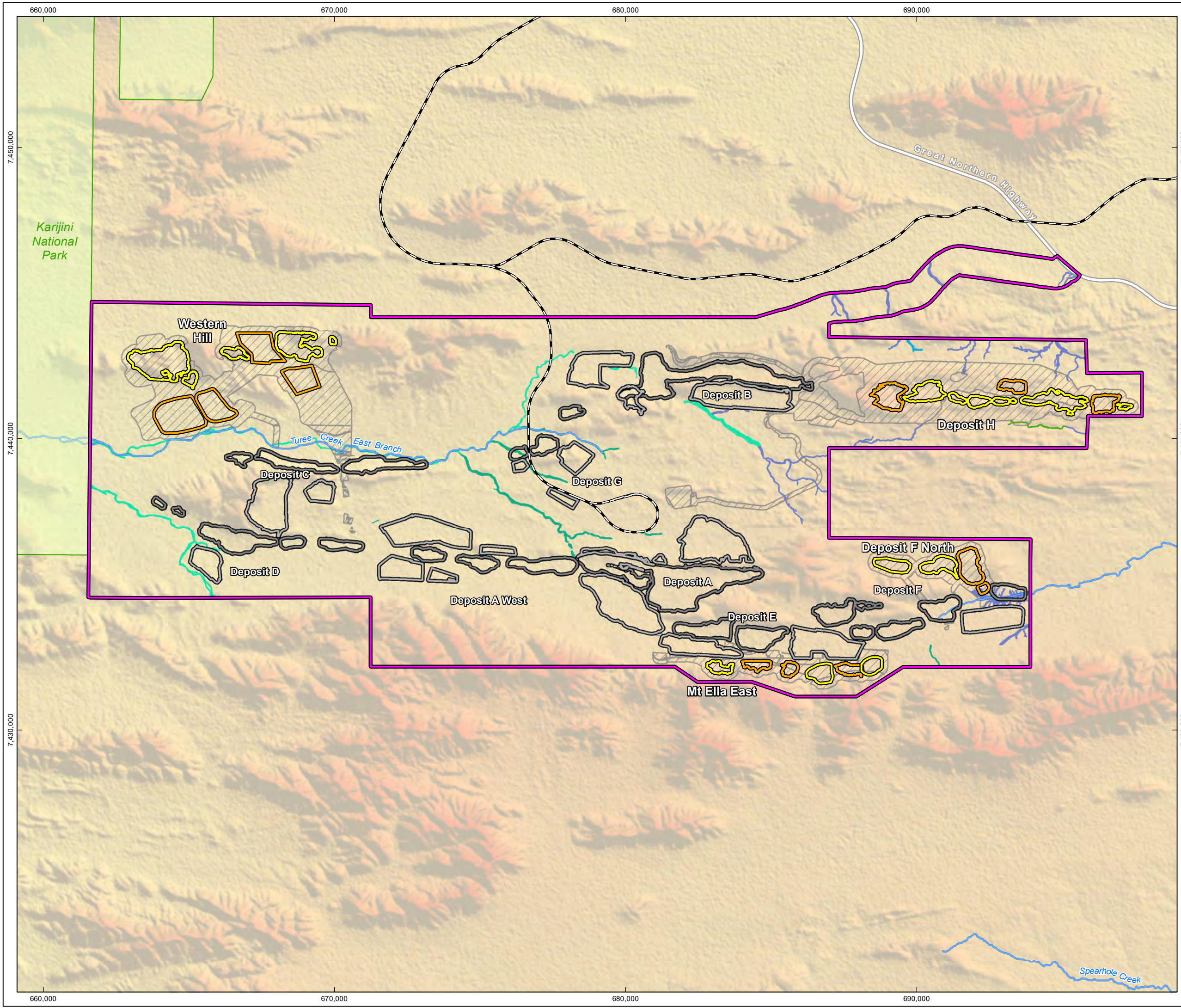
- Rio Tinto Mine
- Town
- Revised Development Envelope
- Conceptual Footprint
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Ethel Gorge Aquifer Stygobiont Community
- Cracking Clays P1 (2015-5)
- Cracking Clays P1
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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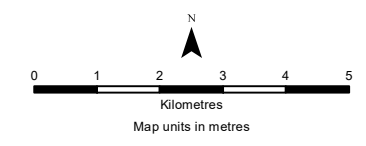
Figure 8-6
Riparian Vegetation in the
Revised Development
Envelope

Drawn: A.D.
Plan: RTIO-0955911v5
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
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Legend

- Revised Development Envelope
- Conceptual Footprint
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Riparian Vegetation**
 - D2
 - D3
 - D10
 - D11
 - D12
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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Groundwater Dependent Ecosystems

GDEs are defined as ecosystems that require groundwater to persist. Terrestrial ecosystems that are classified as GDEs are typically indicated by those that comprise flora species that are dependent on groundwater, known as phreatophytic species, and which form GDV (Biologic 2021b). These species are obligate (highly reliant) or facultative (opportunistic) phreatophytes based on their groundwater reliance and water use characteristics.


The framework for assessing 'Environmental Water requirements of Groundwater Dependent Ecosystems' published by REM, CSIRO and SKM (2007) defines facultative GDEs as plants that require access to groundwater in some landscapes, but in other landscapes can utilise alternate sources of water to maintain ecosystem function, i.e. the presence or absence of groundwater is not critical in determining ecosystem occurrence (compared with obligate GDEs). This definition supports the outcomes of RTIO riparian studies, that not all riparian vegetation in the study area is groundwater dependent as many of the species present are either facultative phreatophytes or vadophytes.



Within the Revised Development Envelope and Proposal Area, only one example of potential GDV (Vegetation type D2) was identified as part of the detailed flora and vegetation survey, predominantly due to its association with Turee Creek and the presence of *E. victrix*. A subsequent GDE assessment was commissioned, using multiple lines of biological and ecological evidence (including remote sensing) and basic hydrologic evidence to identify and assess relevant vegetation features for the purpose of assigning a groundwater dependence likelihood rating as well as a significance (or consequence) rating (SLR 2022). The Groundwater dependence and significance ratings utilised, covered 10 hierarchical gradations; 'Very high', 'High-very High', 'High+', 'High', 'Moderate-high', 'Moderate', 'Low-moderate', 'Low', 'Very low' and 'Negligible'.

A total of 45 vegetation features were identified as representing enhanced riparian vegetation with an NDVI persistence¹⁰ indicative of features potentially accessing an alternative water source. Of these features, none were found to have a 'high' or 'very high' likelihood of dependence on groundwater based on biological evidence. Four vegetation features within and around the Proposal Area were found to exhibit either a 'Low-moderate' or 'Moderate' likelihood of groundwater dependence based on the utilised biological and hydrological evidence, as described in Table 8-6, and all remaining features were considered to be 'low' to 'negligible' likelihood of groundwater dependence (SLR 2022, Figure 8-7).

¹⁰ NDVI persistence was used as a primary indicator of enhanced cover/stability and water status. Live green vegetation absorbs solar radiation in key bands of the visible spectrum, whilst reflecting light in the near-infrared spectrum. This pattern of light absorption is unique to living vegetation and NDVI is an index that quantifies this. Consistently high NDVI values throughout the year and interannually in seasonally dry environments can indicate communities that have access to water sources other than those arising directly from rainfall, such as groundwater (SLR 2022).

Table 8-6: Features with Moderate or Low-Moderate Groundwater Dependence Likelihood

Feature	Extent	Likelihood of Groundwater Dependence	Description	Likelihood of Impact	Photo
1a	19 ha	Low-moderate	<p><i>E. camaldulensis</i> woodland over <i>E. xerothermica</i> low open woodland associated with an upper tributary of Turee Creek between Western Hill and Deposit H</p> <p>Thought to be accessing a relatively small scale perched (potentially seasonally) groundwater source located in a local clay feature; inferred depth to regional groundwater >45 m.</p>	<p>Negligible</p> <p>This feature overlies basaltic parent rock which possesses generally negligible hydraulic conductivity, therefore any drawdown related to the proposal is highly unlikely to be able to propagate into this area.</p>	Not supplied
12a ('Turtle Pool' – see section 7)	>1 ha	Low-moderate (perched)	<p>Woodland of <i>E. victrix</i> and <i>E. camaldulensis</i> co-dominant, <i>E. xerothermica</i> also common over <i>Acacia</i> shrublands; located outside of the Revised Development Envelope to the east of Deposit H; inferred depth to regional groundwater >50 m.</p>	<p>Very Low</p> <p>This feature appears to be accessing a perched water resource that is predominantly surface water fed.</p>	

Feature	Extent	Likelihood of Groundwater Dependence	Description	Likelihood of Impact	Photo
14	14.6 ha	Low-moderate (local surficial)	Woodland of <i>E. victrix</i> and <i>E. camaldulensis</i> co-dominant, <i>E. xerothematica</i> also common over <i>Acacia</i> shrublands; located outside of the Revised Development Envelope to the north of Deposit H where the inferred depth to regional groundwater is >50 m.	Very Low Vegetation appears severely water limited, indicating association with at least a seasonal water resource, probably a local perched aquifer.	
22	43	Moderate	Located outside the Revised Development Envelope to the west, within Karijini National Park and associated with Turee Creek East (EPA 2019a). Characterised by shallow groundwater thought to be recharged by ephemeral surface water flows along Turee Creek East and other tributaries to the north, attenuated through a topographically confined channel profile and ponded behind Mount McRae Shale observed outcropping at the surface of Turee Creek East. Detailed investigation and mapping of this feature was included in the previous proposal for West Angelas (Deposits C, D and G, Rio Tinto 2018a) and consequently protection of groundwater at the boundary of and within Karijini National Park is the subject of existing Conditions in MS 1113 and DN 2018/8299 (Condition 6-1 of MS 1113 and Condition 3 of DN 2018/8299).	Negligible Potential impacts to this pGDE from the Approved Proposal are being managed via the Managed Aquifer Recharge scheme (MAR) and associated Groundwater Environmental Management Plan (Rio Tinto 2022d). As drawdown from supply abstraction at Western Hill is not modelled to propagate towards Karijini National Park, the Proposal is not anticipated to impact groundwater that may be relied on by this pGDE.	

None of these features are considered likely to be reliant to any extent on the groundwater resources that will be impacted by the Proposal (Section 6.3).

An assessment of groundwater dependence was also completed by the Proponent in 2017 and informed the previous proposal at the West Angelas Operations (Deposits C, D and G, Rio Tinto 2018a). The 2017 survey used a basal area¹¹ calculation to determine groundwater dependence rather than groundwater dependent species (*Melaleuca argentea* (obligate phreatophyte), *Eucalyptus camaldulensis* subsp. *refulgens* (facultative phreatophyte), and *Eucalyptus victrix* (facultative phreatophyte or potential vadophyte) as the most reliable indicator of the potential presence of shallow groundwater and associated groundwater dependent vegetation. A threshold basal area of 9 m²/ha was chosen for this study to indicate vegetation reliance on groundwater to meet a substantial proportion of environmental water requirements (EWR) (per unit of area).

Five ‘zones’ of potentially groundwater dependent vegetation were defined throughout the 2017 survey area of which only one was identified as a potential GDE (Zone C; Feature 22) in the more recent (SLR 2022) survey (Table 8-7; Figure 8-7). As drawdown from supply pumping at Western Hill is not modelled to propagate westwards towards Karijini National Park and impacts from the Approved Proposal are currently managed (via the conditions of MS 1113), the risk of impact to potential groundwater dependent vegetation in ‘Zone C (Feature 22)’ (and other zones identified in Rio Tinto (2017)) is considered negligible.

Table 8-7: Potentially Groundwater Dependent Vegetation Zones Identified along Turee Creek East within Karijini National Park

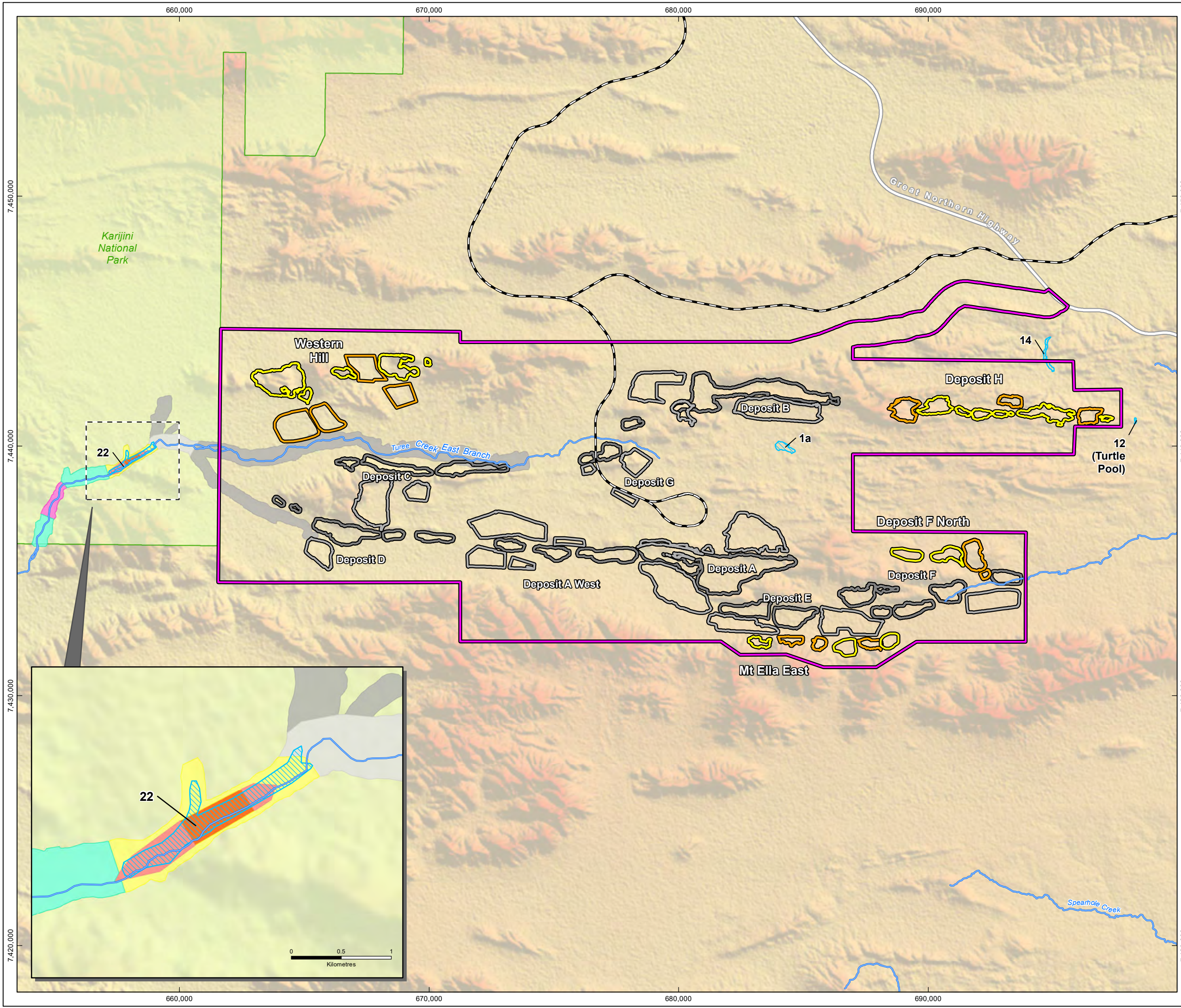
Zone	Basal Area	Description	Potential GDE (SLR 2022)
A	1 m ² /ha to 5 m ² /ha	A ‘scattered’ to ‘low open woodland’ of <i>Eucalyptus victrix</i> was common within riparian vegetation communities within this zone, often co-occurring with <i>Eucalyptus xerothematica</i> and <i>Acacia citrinoviridis</i> . Worst case modelled drawdown intersects Zone A, however, groundwater elevation beneath these riparian vegetation communities is typically between 20 m and 70 m bgl, and therefore, inaccessible to <i>Eucalyptus victrix</i> and risk of impact to potential groundwater dependent vegetation is considered negligible.	No
B	1 m ² /ha to 6 m ² /ha	The basal area recorded in ‘Zone B’ was below the basal area threshold of 9 m ² /ha such that the potential for groundwater dependence to meet water demand, was considered ‘Very Low’ to ‘Low’.	No
C	6 m ² /ha to 16 m ² /ha	Corresponds with feature 22 as identified in the more recent assessment which was identified as a low to moderate pGDE (SLR 2022; Figure 8-12). In general, ‘Zone C’ is characterised by shallow groundwater thought to be recharged by ephemeral surface water flows along Turee Creek East attenuated through a topographically confined channel profile and ponded behind Mount	Yes

¹¹ Basal area (an index of standing biomass, which can be inferred to represent a quantitative measure of water demand per unit of area), was investigated as an additional quantitative indicator for assessments of potential groundwater dependency of riparian vegetation communities. Studies in arid environments have demonstrated there is often a relationship between basal area and groundwater, whereby a basal area of less than 5 – 10 m²/ha is often associated with a depth to groundwater greater than 15 m. Alternatively, a basal area of greater than 10 m²/ha is often associated with a depth to groundwater less than 10 m. Based on the relationship indicated by such studies, a threshold basal area of 9 m²/ha was chosen for this study to indicate vegetation reliance on groundwater to meet a substantial proportion of environmental water requirements (EWR) (per unit of area).

Zone	Basal Area	Description	Potential GDE (SLR 2022)
		McRae Shale observed outcropping at the surface of Turee Creek East (Rio Tinto 2017). The basal area recorded in 'Zone C' could indicate potential for groundwater dependence to meet water demand. Based on this stand density, the Proponent conservatively assessed that approximately 22 ha of relatively dense riparian vegetation communities of Turee Creek East within Karijini National Park (the C3B community), represents a potential GDE.	
D	6 m ² /ha to 16 m ² /ha	<i>Eucalyptus victrix</i> was common in riparian vegetation communities within this zone at densities which could suggest groundwater dependence. However, the extent of groundwater drawdown is limited beyond 'Zone E' given the presence of the impermeable Mount McRae Shale and other intrusive geological formations (such as dolerite dykes).	No
E	4 m ² /ha to 9 m ² /ha	The basal area recorded in 'Zone E' could indicate some potential for groundwater dependence to meet water demand.	No

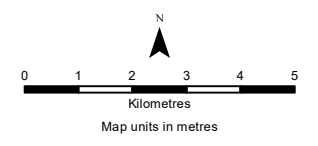
Figure 8-7
Potential GDV Within and
Surrounding the Revised
Development Envelope

Drawn: A.D.
Plan: RTIO-0983568v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:140,000 @A3
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Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Potential GDE
- Potentially Groundwater Dependent Vegetation Zones**
 - Zone A
 - Zone B
 - Zone C-1
 - Zone C-2
 - Zone C-3
 - Zone D
 - Zone E
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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Local Significant Vegetation

Three vegetation types (including D11, classified as riparian) within the Revised Development Envelope are considered to have high local significance due to their role as habitat for Priority (P2-3) flora (Biologic 2022f). All three have been recorded within the Extension Areas. These are identified in Table 8-8 and displayed in Figure 8-8. Seventeen of the 45 vegetation types identified in the Revised Development Envelope are considered to have moderate local significance due to the presence and supporting habitat for Priority 2 and 3 flora species. Vegetation types with moderate local significance are listed in Table 8-9 and shown in Figure 8-8.

The significance ranking for all vegetation types within the Revised Development Envelope is provided in Appendix D.7 (Biologic 2022f).

Table 8-8: High Locally Significant Vegetation Types within the Revised Development Envelope

Vegetation Type and Species Code	Priority Species Present	Extent within West Angelas Area (ha)	Extent within Revised Development Envelope (ha)	Extent within Extension Areas (ha)
D11: ExAanEtPIANIEUsTHtTp (included in Riparian vegetation)	Supports an extensive population of the P2 <i>Aristida lazaridis</i> within one of the mapped polygons. A single specimen of the P3 flora <i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684) was found on red clays described in this vegetation type in 2014 but has not been recorded since.	153	153	49
H15: EITpTw	Supports an extensive record of P2 taxa <i>Tetradlea fordiana</i> , <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) and <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725) as well as the extensive records of P3 taxa <i>Eremophila naaykensis</i> , <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739), <i>Indigofera gilesii</i> , <i>Solanum kentrocaule</i> , <i>Acacia subtiliformis</i> and <i>Pilbara trudgenii</i> .	3,424	1,729	343
P8: AanTHtARcTp	Extensive records of <i>Eremophila pusilliflora</i> (P2) in this unit northwest within the Revised Development Envelope.	159	159	88

Table 8-9: Moderate Local Significant Vegetation Types within the Revised Development Envelope

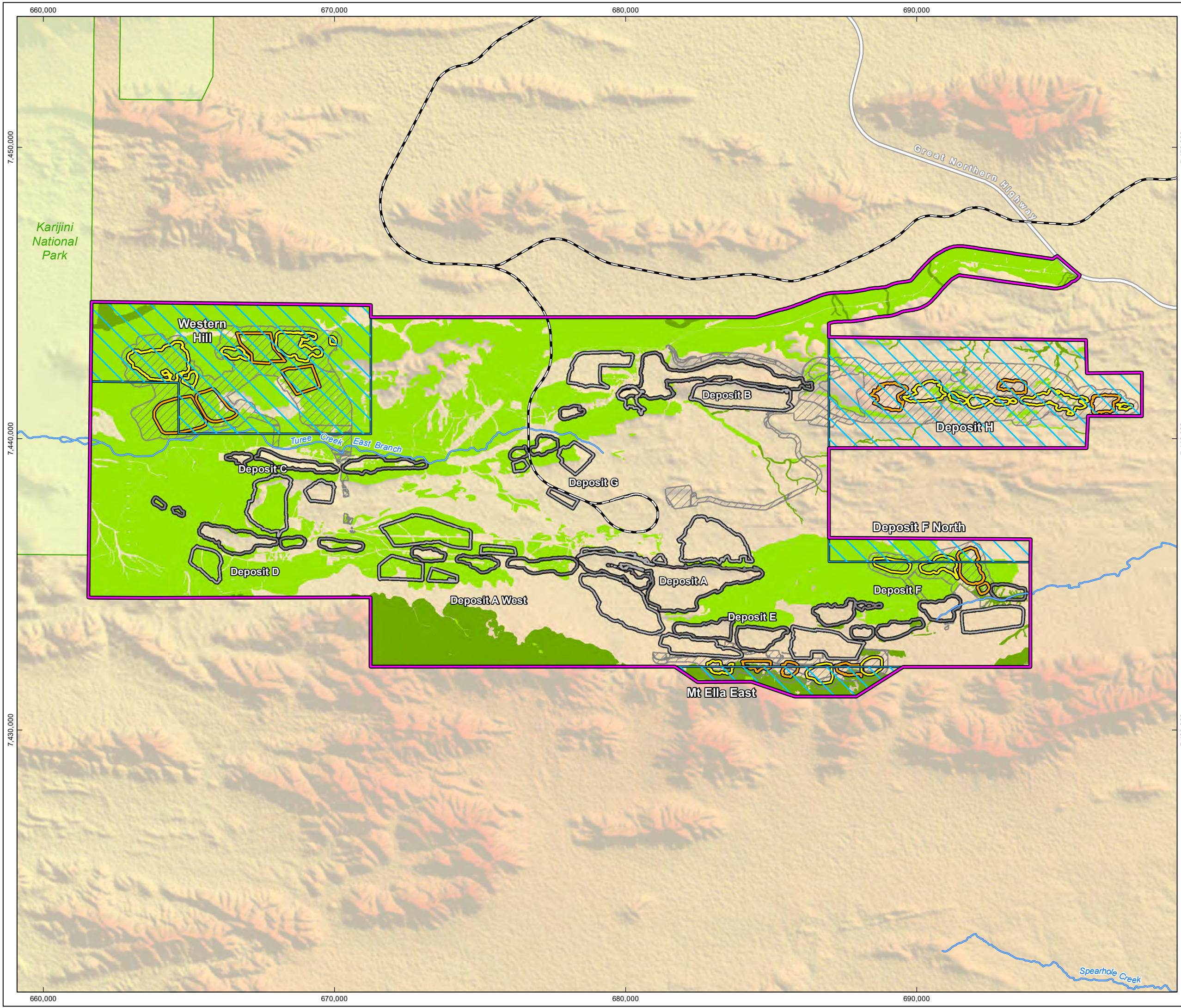
Vegetation Code	Flora Present	Extent within West Angelas Area (ha)	Extent within Revised Development Envelope (ha)	Extent within Extension Areas (ha)
D2	Presence of <i>Eucalyptus victrix</i> and potential GDV on moderate drainage. No other significant flora present.	160	160	12
D12	Supports a sizeable occurrence (approx. 50 plants) of the P2 <i>Aristida lazardis</i> and potential GDV.	5	5	5
D14	Numerous occurrences of <i>Aristida lazardis</i> (P2) and a single occurrence of <i>Eremophila pusilliflora</i> (P2). Numerous occurrences of P3 taxa <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431).	646	646	35
G1	Two occurrences of P2 <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) occur along the boundary of the unit. Three P3 taxa occur, <i>Eremophila naaykensis</i> (numerous occurrences), <i>Solanum kentrocaule</i> , <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794).	5	5	5
G2	Two P2 taxa, <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725), <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708). Five P3 taxa, Pilbara <i>trudgenii</i> , <i>Eremophila naaykensis</i> , <i>Solanum kentrocaule</i> , <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739), <i>Grevillea saxicola</i> .	111	45	12
G3	Two P2 taxa, <i>Tetradlea fordiana</i> and <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708). Two P3 taxa, <i>Indigofera gilesii</i> and <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739).	27	27	2
H1	Isolated occurrences of two P3 taxa: <i>Aristida jerichoensis</i> subsp. <i>subspinulifera</i> and <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), and one P4 taxa: <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642).	100	100	83
H2	Supports the only population of the P2 <i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068) in the DE. Two P2 taxa, <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725) and <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708). Five P3 taxa, <i>Grevillea saxicola</i> , <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Aristida jerichoensis</i> subsp. <i>subspinulifera</i> , <i>Eremophila naaykensis</i> , <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739).	457	457	154

Vegetation Code	Flora Present	Extent within West Angelas Area (ha)	Extent within Revised Development Envelope (ha)	Extent within Extension Areas (ha)
H6	One occurrence of the P2 <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) along the boundary of the unit. Four P3 taxa, <i>Grevillea saxicola</i> , <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Eremophila naaykensis</i> and <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	152	152	152
H7	Two P3 taxa, <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739), <i>Indigofera gilesii</i> , One P4 taxon, <i>Acacia bromilowiana</i> .	2283	2283	143
H8	One P2 taxa <i>Eremophila pusilliflora</i> , with a second (<i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708)) occurring as one location on the boundary. Six P3 taxa: <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Solanum kentrocaule</i> , <i>Eremophila naaykensis</i> , <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) and <i>Isotropis parviflora</i> .	2074	2074	750
H9	Five P3 taxa, <i>Indigofera gilesii</i> , <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Isotropis parviflora</i> and <i>Aristida jerichoensis</i> subsp. <i>subspinulifera</i> One P4 taxa, <i>Acacia bromilowiana</i> .	1537	318	119
H13	Numerous occurrences of the P2 <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708). Two P3 taxa, <i>Solanum kentrocaule</i> , <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	320	9	9
H14	Several occurrences of P2 <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708). Three P3 taxa, <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739), <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) and <i>Aristida jerichoensis</i> subsp. <i>subspinulifera</i> (and others adjacent to the boundary).	293	293	80
H16	Three P2 taxa, <i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068), <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725), <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) Extensive records of P3 taxa, <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739), , <i>Eremophila naaykensis</i> , <i>Indigofera gilesii</i> , <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), <i>Grevillea saxicola</i> , <i>Solanum kentrocaule</i> , <i>Pilbara trudgenii</i> Two P4 taxa, <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642), <i>Lepidium catapycnon</i> .	1885	1885	674

Vegetation Code	Flora Present	Extent within West Angelas Area (ha)	Extent within Revised Development Envelope (ha)	Extent within Extension Areas (ha)
M1	Occurrences of P2 taxa <i>Eremophila pusilliflora</i> , and <i>Aristida lazaridis</i> . Extensive occurrences of P3 taxon <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794), with isolated (or on boundaries) occurrences of <i>Aristida jerichoensis</i> subsp. <i>subspinulifera</i> , <i>Eremophila naaykensis</i> , <i>Isotropis parviflora</i> and <i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	5352	5352	1303
P2	One occurrence of P2 <i>Aristida lazaridis</i> . Several occurrences of <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) (P3).	391	391	26
P3	One occurrence of P2 <i>Eremophila pusilliflora</i> . Occasional occurrences of two P3 taxa, <i>Aristida jerichoensis</i> subsp. <i>subspinulifera</i> and <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794). One occurrence of P4 <i>Goodenia nuda</i>	610	610	0

Figure 8-8
Vegetation Types with High and Moderate Local Significance within the Revised Development Envelope

Drawn: A.D.
Plan: RTIO-0955905v3
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Extension Area
- Conceptual Footprint

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

- Pit
- Waste Landform

Vegetation Significance

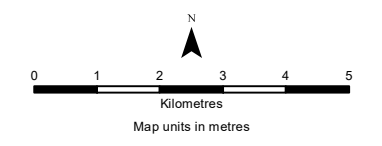
- High
- Moderate

National Park

Rio Tinto Railway

Highway

Major Creek



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8.3.2.4. Vegetation Condition

Vegetation condition within the Revised Development Envelope ranges from excellent to completely degraded, with the majority classified as being in either excellent (15,571 ha, 42.3%) or very good (11,612 ha, 31.6%) condition (Plate 8-1, Figure 8-9, Biota 2020, Biologic 2022f). Native vegetation within the Revised Development Envelope is largely considered to be in better condition than other areas of the Pilbara, based on the lack of historical pastoral activities and associated disturbance (Biota 2020). Most of the vegetation within the Extension Areas is classified as either excellent (6,546 ha, 77.4%) or very good (1,528 ha, 18.1%).

Approximately 28,907 ha (78.6%) of vegetation within the Revised Development Envelope is in ‘good to excellent condition’ and 7,857 ha (21.4%) is classified as being completely degraded due to impacts from Existing Operations, including clearing undertaken for mining exploration activities for the Proposal. Approximately 383 ha (4.5%) of the Extension Areas is classified as being Completely Degraded.

A summary of the vegetation condition within the West Angelas Area, Revised Development Envelope and Extension Areas is provided in Table 8-10 and shown in Figure 8-9.



Plate 8-1: Vegetation in Excellent Condition (Left) and Very Good Condition (Right)

Source: Biota 2020

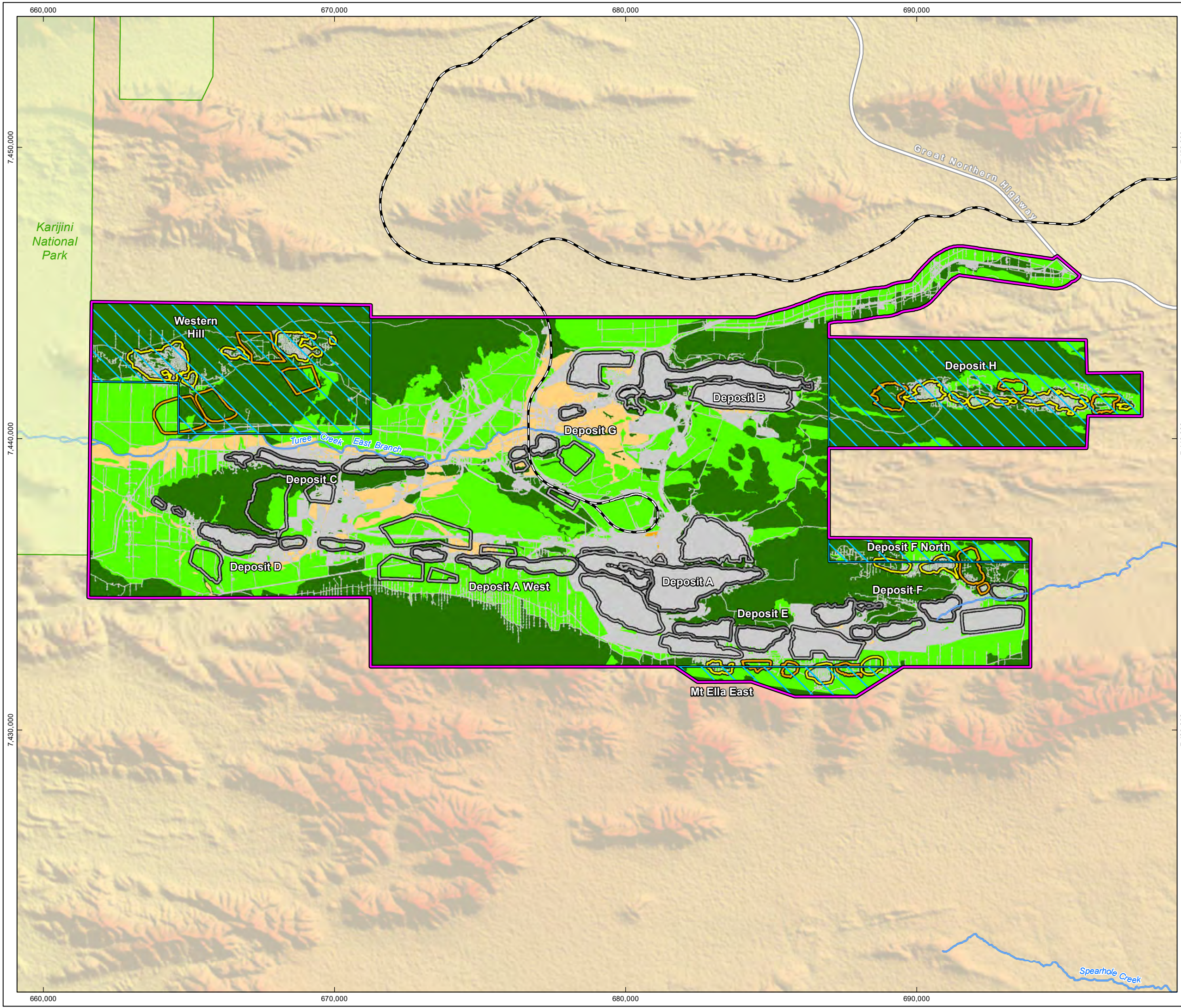
Table 8-10: Vegetation Condition for Remnant Vegetation in the Revised Development Envelope

Vegetation Condition	Extent within West Angelas Area (ha)		Extent within Revised Development Envelope		Extent within Extension Areas	
	Area (ha)*	%	Area (ha)*	%	Area (ha)	%
Excellent	18,858	45.5	15,571	42.3	6,546	77.4
Very Good	12,955	31.2	11,612	31.6	1,528	18.1
Good	1,724	4.2	1,724	4.7	0	0
Poor	15	<0.1	15	<0.1	0	0
Completely Degraded/Cleared	7,931	19.1	7,857	21.4	383	4.5
Total	41,483	100	36,779	100	8,457	100

* Rounded to the nearest whole ha.

Figure 8-9
Vegetation Condition within
the Revised Development
Envelope

Drawn: A.D.
Plan: PDE0186396v3
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Extension Area

Proposed Conceptual Layout

- Pit
- Waste Landform

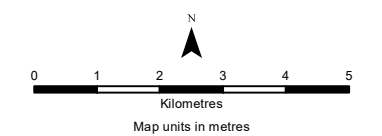
Approved Conceptual Layout

- Pit
- Waste Dump

Vegetation Condition

- Excellent
- Very Good
- Good
- Poor
- Completely Degraded

- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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8.3.3. Flora

A total of 812 taxa have been recorded within the Revised Development Envelope of which 260 taxa were recorded in the Extension Areas. These taxa represent:

- A total of 62 families and 221 genera in the Revised Development Envelope
- A total of 57 families and 192 genera in the Extension Areas.
- Dominant families recorded included Fabaceae, Poaceae and Malvaceae.

There are flora species within the Revised Development Envelope of significance to Traditional Owners such as the Honey bee tree (*Eucalyptus leucophloia*) – which supplies the Indigenous community with *janduru* (or *maliya*) - honey. Only certain trees are suitable for the establishment of hives – but the bees feed widely from the nectar of most flowering trees and other plants in the area.

8.3.3.1. Threatened Flora

No Threatened flora species listed under the EPBC Act or the BC Act have been recorded within the Revised Development Envelope. None were considered to have the potential to occur within the Revised Development Envelope owing to the absence of suitable habitat (Biota 2020, Biologic 2022a, b, c, d, e and g).

8.3.3.2. Priority Flora

No P1 species have been recorded in any flora surveys conducted for the Proposal. One P1 flora species was identified as likely to be present within the Revised Development Envelope (Biologic 2022d) but not in the Extension Areas due to lack of suitable habitat (cracking clays).

Twenty-eight Priority taxa; P2 (7), P3 (17) and P4 (4) taxa have been recorded within the Revised Development Envelope, as listed in Table 8-13 and shown in Figure 8-10 to Figure 8-10d. Of these, 17 were recorded within the Extension Areas, comprising P2 (4), P3 (10) and P4 (3) species. Priority flora that has not been recorded but may be present within the Revised Development Envelope (based on nearby records and habitat suitability) are listed in Table 8-11.

Table 8-11: Priority Flora Potentially Present within the Revised Development Envelope (Biota 2020; Biologic 2022d)

Priority Flora	Potential Habitat
Possibly Occurring	
<i>Rhodanthe ascendens</i> (P1)	Clay and roadside verges
<i>Euphorbia stevenii</i> (P3)	Clay soils.
<i>Geijera salicifolia</i> Schott (P3)	Skeletal soils, stony soils. Massive rock scree, gorges.
<i>Rostellularia adscendens</i> var. <i>latifolia</i> (P3)	Various; creeks, plains, low hills.
<i>Xerochrysum boreale</i> (P3)	Mulga vegetation on clay plains.

7* Does not include species found within the Revised Development Envelope

8.3.3.3. Unresolved and Potential New Taxa

Within the Revised Development Envelope, three undescribed/unresolved taxa were recorded, and one species is a possible range extension (*Peripleura hispidula* var. *hispidula*). Each taxon is described in Table 8-12.

Table 8-12: Unresolved and Potential New Taxa Recorded within the Revised Development Envelope

Unresolved and Potential New Taxa	Description
<i>Aristida</i> aff. <i>nitidula</i>	This taxon is a tufted perennial that can grow up to 70 cm in height and predominately grows on stony hills with sandy loam substrates. It is morphologically similar to <i>Aristida nitidula</i> , which is also present in the Pilbara bioregion; however, this species differs in its leaf and spikelet structure. Seven specimens have been vouchered with the Western Australian Herbarium, all collected between Newman and Tom Price (WA Herbarium 2022). The wide range of the species suggests that it is unlikely to be of conservation significance (Biota 2020).
<i>Hibiscus sturtii</i> var. aff. <i>truncates</i>	The <i>Hibiscus sturtii</i> var. aff. <i>truncates</i> were recorded on the plains and low hills (M1 and P9 vegetation types) within the Revised Development Envelope. The taxon shares similar characteristics with the <i>Hibiscus sturtii</i> var. <i>truncates</i> but distinct differences in the leaf lobes. Biota previously recorded it near West Turner and Eliwana, where it was found locally abundant. Due to this abundance, it is unlikely to be of conservation significance.
<i>Eriachne</i> aff. <i>mucronata</i>	The taxon was recorded on the steep south-facing hillslopes (vegetation type G2) in the eastern section of Western Hill. The taxon has a very close affinity to <i>Eriachne mucronata</i> , which is known to be highly variable in its physical morphology. The conservation significance of this taxon could not be determined at this time. However, given that the <i>Eriachne mucronata</i> is already known to be a large and complex taxon it is unlikely for the <i>Eriachne</i> aff <i>mucronata</i> to be of conservation significance (Biota 2020).
<i>Peripleura hispidula</i> var. <i>setosa</i>	<i>Peripleura hispidula</i> var. <i>setosa</i> was recorded from 24 locations across the Revised Development Envelope. It has most commonly been recorded from Queensland and New South Wales. Recently, the taxon has been identified near the Yandi mining operations and Hardy River near Tom Price. Vouchers for these collections have been submitted to the WA Herbarium but are believed to be in the specimen backlog. The furthest of the records, at Hardey River, is some 102 km northwest of the study area. The taxon is believed to be more widespread than records suggest and is unlikely to be of conservation significance (Biota 2020).

Table 8-13: Significant Flora Species Recorded in the Revised Development Envelope

Taxon	Proposed Conceptual Footprint	Revised Development Envelope	West Angelas Area	State-Wide (Regional)
	No. of Individuals*	No. of Individuals*	No. of Individuals*	No. of Individuals*
Priority 2				
<i>Aristida lazaridis</i>	259	906	906	10,912
<i>Eremophila pusilliflora</i>	19	266	266	9,191
#? <i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068)	0	53	53	973
<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>	0	10	10	3,176
# <i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET15708)	287	1,604	2,190	6,068
# <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725)	5	243	385	643
<i>Tetratheca fordiana</i>	0	3,808	4,428	27,025
Priority 3				
<i>Acacia effusa</i>	12	220	220	9,512
<i>Acacia subtiliformis</i>	0	250	354	188,715
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	221	2,075	2,075	13,574
<i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	0	2	2	8,580
<i>Eremophila naaykensis</i> (A.L.Curtis & K.R.Thiele)	1,571	6,010	6,220	14,355
<i>Euphorbia clementii</i>	0	10	10	10
<i>Grevillea saxicola</i>	68	335	335	5,447
<i>Indigofera gilesii</i>	646	1,339	1,923	10,789
<i>Isotropis parviflora</i>	324	4,803	4,842	6,568
<i>Olearia mucronata</i>	1	1	2	284
<i>Pilbara trudgenii</i>	0	529	801	1,304
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	576	1,195	1,217	107,919
<i>Solanum kentrocaule</i>	31	478	1,136	1,716
<i>Swainsona thompsoniana</i>	0	7	7	1,794
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	0	5,822	5,822	156,336
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	24,971	61,935	101,075	156,712
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	0	1	1	13,291
Priority 4				
<i>Acacia bromilowiana</i>	1	68	191	4,000
<i>Eremophila magnifica</i> subsp. <i>magnifica</i>	0	29	140	15,197

Taxon	Proposed Conceptual Footprint	Revised Development Envelope	West Angelas Area	State-Wide (Regional)
	No. of Individuals*	No. of Individuals*	No. of Individuals*	No. of Individuals*
<i>Lepidium catapycnon</i>	0	34	138	39,772
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)	239	309	309	13,373

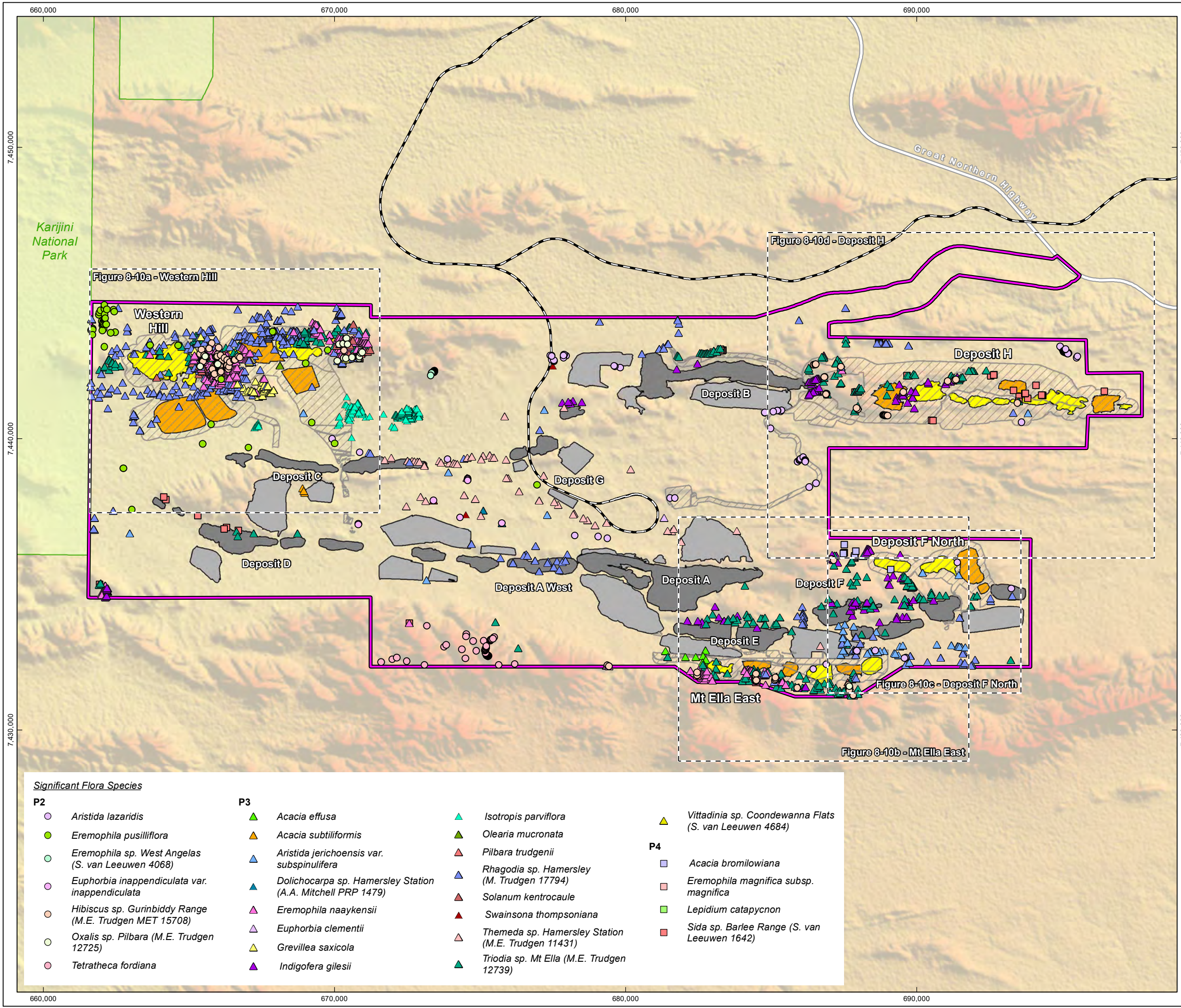
* Source: Rio Tinto database

Overview

Drawn: A.D.
Plan: PDE0186398v4
Date: August 2023

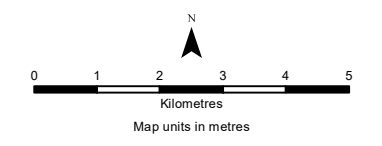
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

- Legend**
- Revised Development Envelope
 - Conceptual Footprint
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - National Park
 - Rio Tinto Railway
 - Highway



Significant Flora Species

- | | | | |
|--|---|---|--|
| <p>P2</p> <ul style="list-style-type: none"> ● <i>Aristida lazaridis</i> ● <i>Eremophila pusilliflora</i> ● <i>Eremophila sp. West Angelas (S. van Leeuwen 4068)</i> ● <i>Euphorbia inappendiculata var. inappendiculata</i> ● <i>Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)</i> ● <i>Oxalis sp. Pilbara (M.E. Trudgen 12725)</i> ● <i>Tetradlea fordiana</i> | <p>P3</p> <ul style="list-style-type: none"> ▲ <i>Acacia effusa</i> ▲ <i>Acacia subtiliformis</i> ▲ <i>Aristida jerichoensis var. subspinulifera</i> ▲ <i>Dolichocarpa sp. Hamersley Station (A.A. Mitchell PRP 1479)</i> ▲ <i>Eremophila naaykensis</i> ▲ <i>Euphorbia clementii</i> ▲ <i>Grevillea saxicola</i> ▲ <i>Indigofera gilesii</i> | <ul style="list-style-type: none"> ▲ <i>Isotropis parviflora</i> ▲ <i>Olearia mucronata</i> ▲ <i>Pilbara trudgenii</i> ▲ <i>Rhagodia sp. Hamersley (M. Trudgen 17794)</i> ▲ <i>Solanum kentrocaule</i> ▲ <i>Swainsona thompsoniana</i> ▲ <i>Themeda sp. Hamersley Station (M.E. Trudgen 11431)</i> ▲ <i>Triodia sp. Mt Ella (M.E. Trudgen 12739)</i> | <ul style="list-style-type: none"> ▲ <i>Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)</i> <p>P4</p> <ul style="list-style-type: none"> ■ <i>Acacia bromilowiana</i> ■ <i>Eremophila magnifica subsp. magnifica</i> ■ <i>Lepidium catapycnon</i> ■ <i>Sida sp. Barlee Range (S. van Leeuwen 1642)</i> |
|--|---|---|--|



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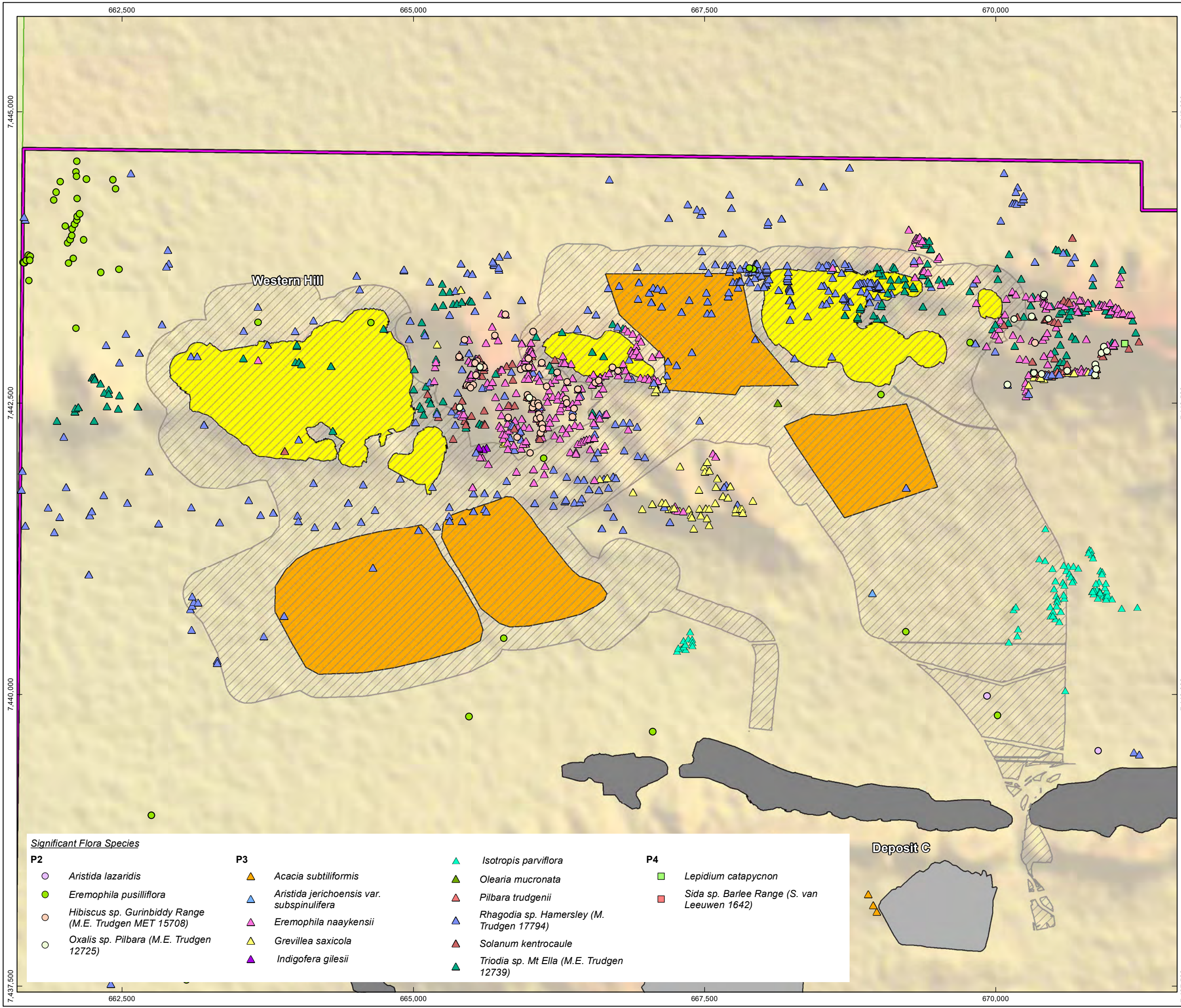
Figure 8-10a
Priority Flora Records at
Western Hill

Drawn: GIS Team
Plan: PDE0186398v4
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:30,000 @A3
GIS.Team@riotinto.com

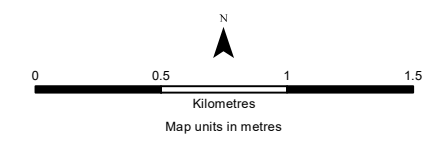
Legend

- Revised Development Envelope
- Conceptual Footprint
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- National Park



Significant Flora Species

- | | | | |
|---|--|--|---|
| <p>P2</p> <ul style="list-style-type: none"> <i>Aristida lazaridis</i> <i>Eremophila pusilliflora</i> <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725) | <p>P3</p> <ul style="list-style-type: none"> <i>Acacia subtiliformis</i> <i>Aristida jerichoensis</i> var. <i>subspinulifera</i> <i>Eremophila naaykensis</i> <i>Grevillea saxicola</i> <i>Indigofera gilesii</i> | <ul style="list-style-type: none"> <i>Isotropis parviflora</i> <i>Olearia mucronata</i> <i>Pilbara trudgenii</i> <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794) <i>Solanum kentrocaule</i> <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) | <p>P4</p> <ul style="list-style-type: none"> <i>Lepidium catapycnon</i> <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) |
|---|--|--|---|



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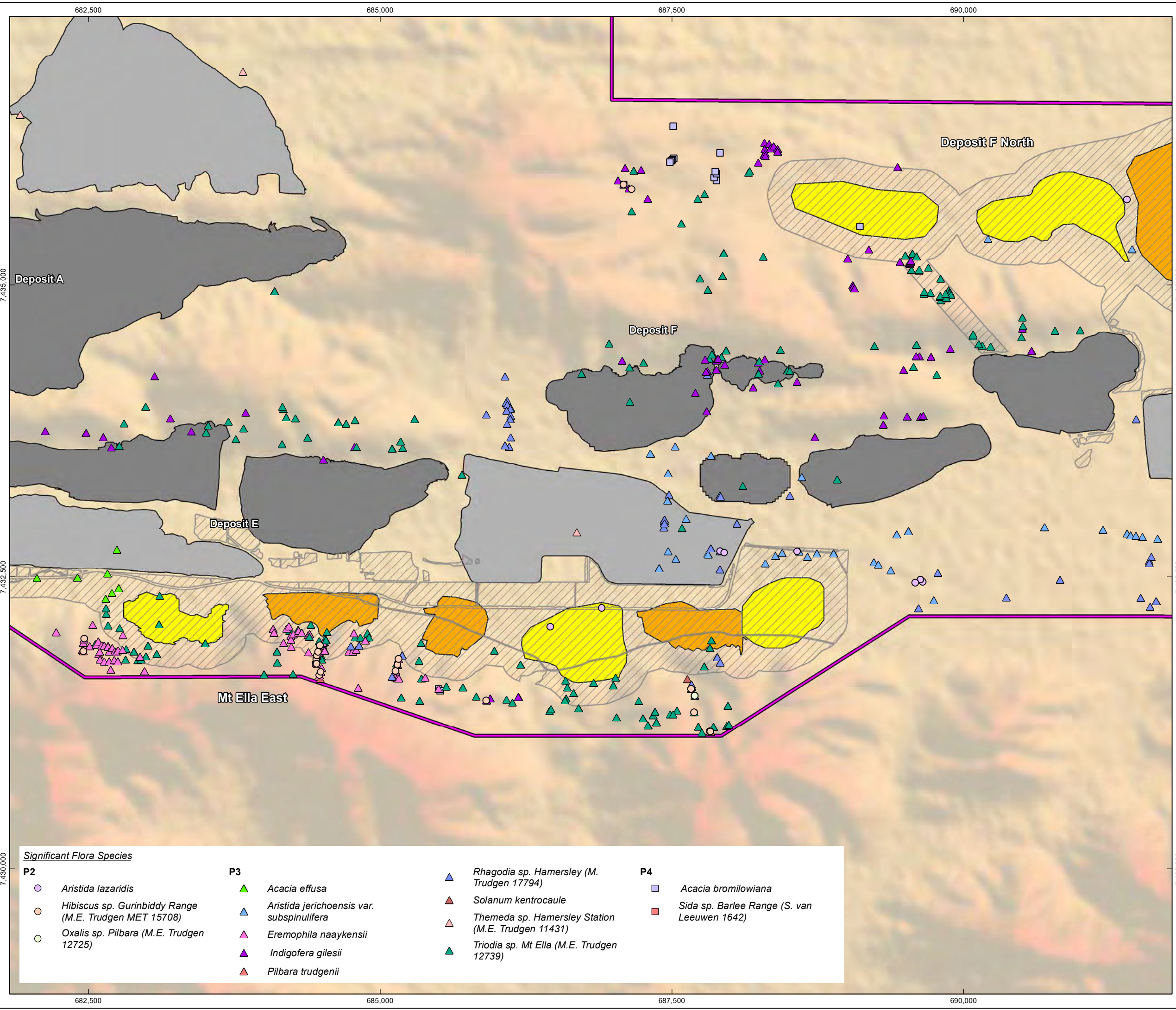
Figure 8-10b
Priority Flora Records at Mt Ella East

Drawn: GIS Team
Plan: PDE0186398v4
Date: August 2023















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Scale: 1:30,000 @A3
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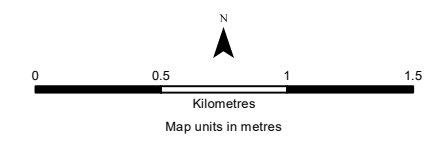
Legend

-  Revised Development Envelope
-  Conceptual Footprint
- Proposed Conceptual Layout**
-  Pit
-  Waste Landform
- Approved Conceptual Layout**
-  Pit
-  Waste Landform



Significant Flora Species

- | | | | |
|---|--|--|---|
| <p>P2</p> <ul style="list-style-type: none">  <i>Aristida lazaridis</i>  <i>Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)</i>  <i>Oxalis sp. Pilbara (M.E. Trudgen 12725)</i> | <p>P3</p> <ul style="list-style-type: none">  <i>Acacia effusa</i>  <i>Aristida jerichoensis var. subspinulifera</i>  <i>Eremophila naaykensis</i>  <i>Indigofera gilesii</i>  <i>Pilbara trudgenii</i> | <ul style="list-style-type: none">  <i>Rhagodia sp. Hamersley (M. Trudgen 17794)</i>  <i>Solanum kentrocaule</i>  <i>Themeda sp. Hamersley Station (M.E. Trudgen 11431)</i>  <i>Triodia sp. Mt Ella (M.E. Trudgen 12739)</i> | <p>P4</p> <ul style="list-style-type: none">  <i>Acacia bromilowiana</i>  <i>Sida sp. Barlee Range (S. van Leeuwen 1642)</i> |
|---|--|--|---|



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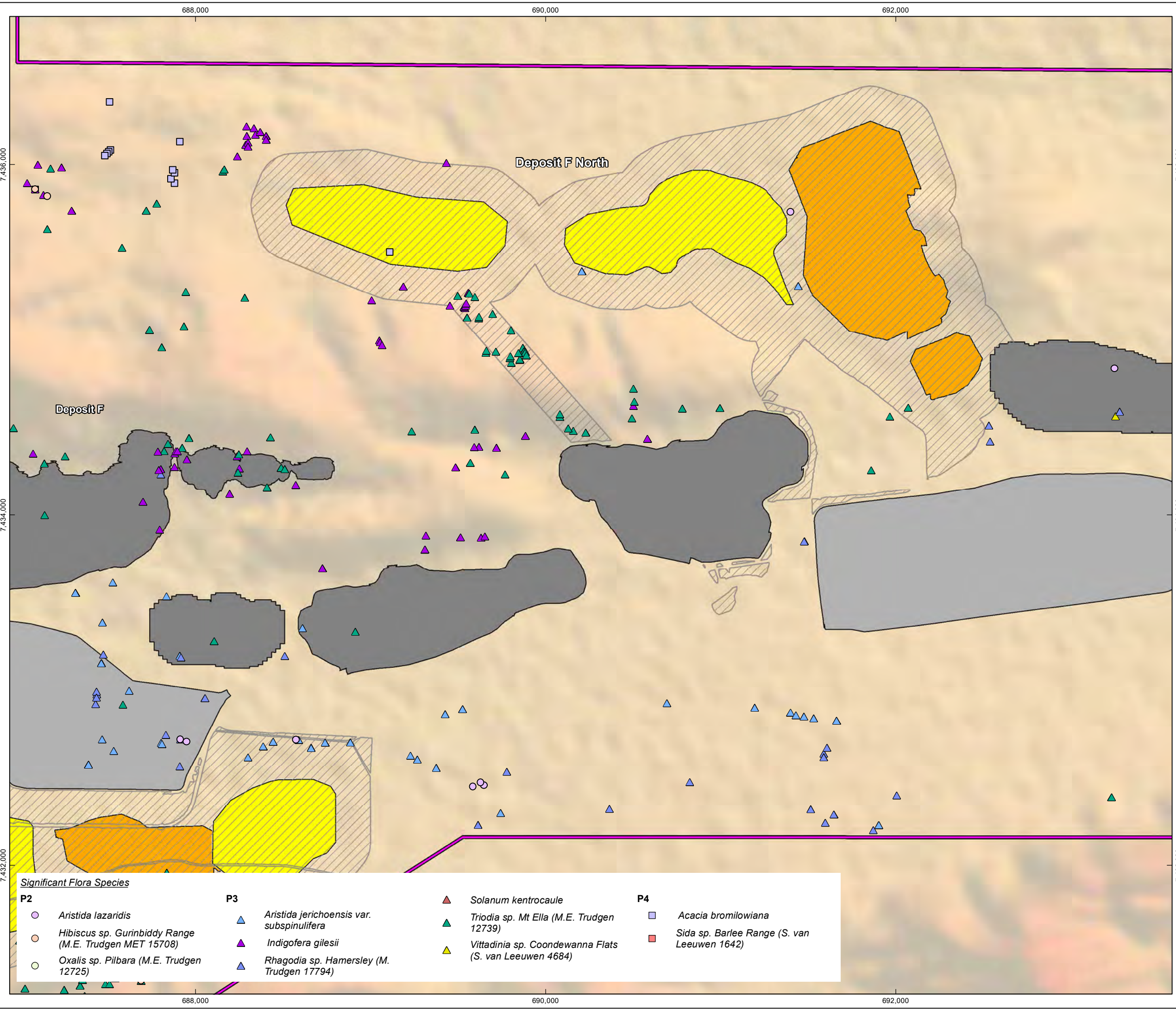
Figure 8-10c
Priority Flora Records at
Deposit F North

Drawn: GIS Team
Plan: PDE0186398v4
Date: August 2023












Proj: GDA 1994 MGA Zone 50
Scale: 1:20,000 @A3
GIS.Team@riotinto.com

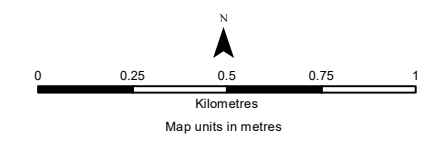
Legend

-  Revised Development Envelope
-  Conceptual Footprint
- Proposed Conceptual Layout**
-  Pit
-  Waste Landform
- Approved Conceptual Layout**
-  Pit
-  Waste Landform



Significant Flora Species

- | | | | |
|---|--|--|---|
| <p>P2</p> <ul style="list-style-type: none">  <i>Aristida lazaridis</i>  <i>Hibiscus sp. Gurinbiddy Range (M.E. Trudgen MET 15708)</i>  <i>Oxalis sp. Pilbara (M.E. Trudgen 12725)</i> | <p>P3</p> <ul style="list-style-type: none">  <i>Aristida jerichoensis var. subspinulifera</i>  <i>Indigofera gilesii</i>  <i>Rhagodia sp. Hamersley (M. Trudgen 17794)</i> | <ul style="list-style-type: none">  <i>Solanum kentrocaule</i>  <i>Triodia sp. Mt Ella (M.E. Trudgen 12739)</i>  <i>Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684)</i> | <p>P4</p> <ul style="list-style-type: none">  <i>Acacia bromilowiana</i>  <i>Sida sp. Barlee Range (S. van Leeuwen 1642)</i> |
|---|--|--|---|











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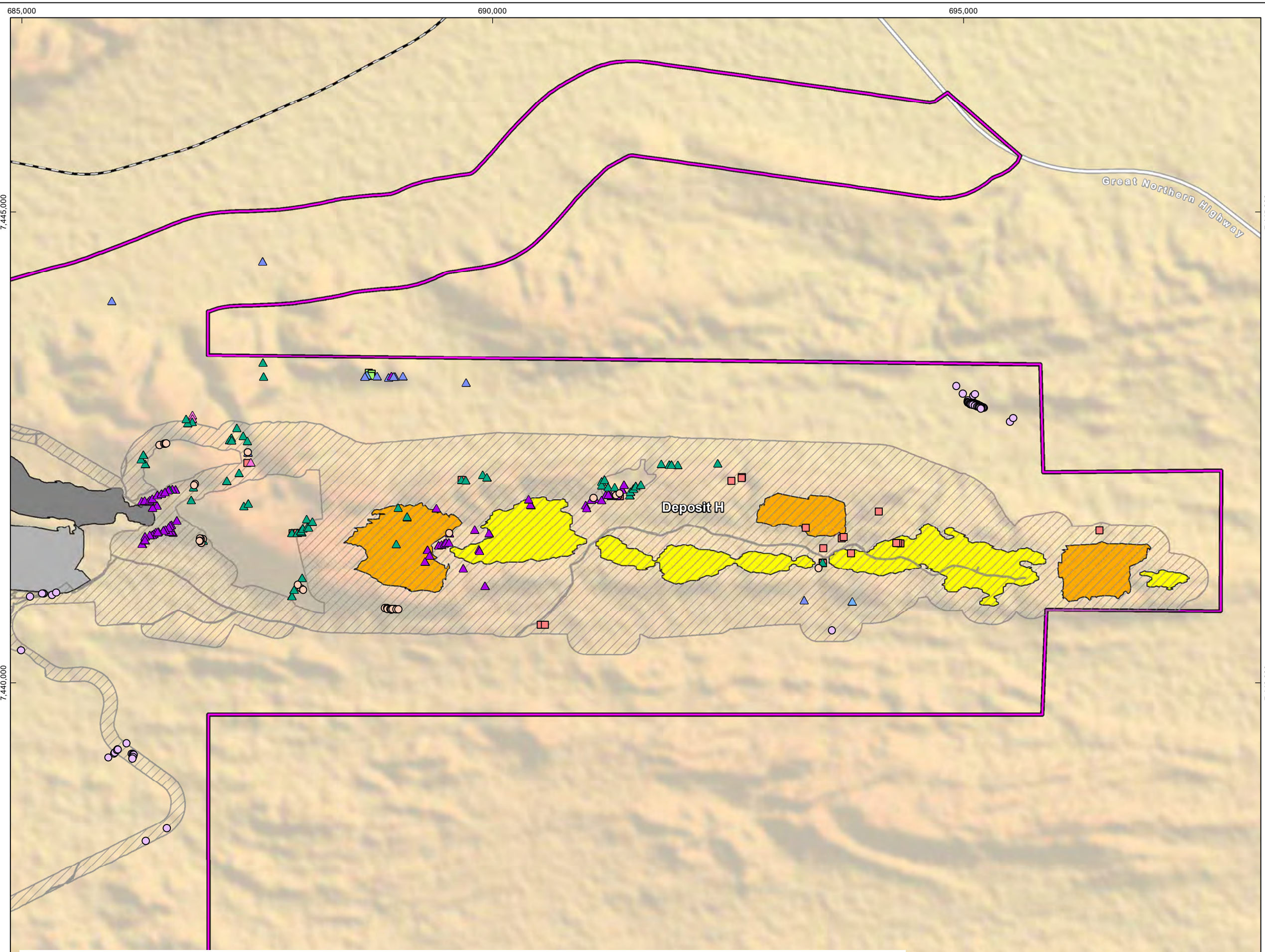
Figure 8-10d
Priority Flora Records at
Deposit H

Drawn: GIS Team
Plan: PDE0186398v4
Date: August 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
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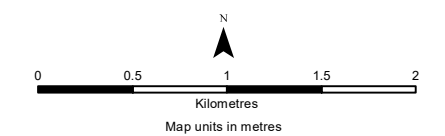
Legend

-  Revised Development Envelope
-  Conceptual Footprint
- Proposed Conceptual Layout**
-  Pit
-  Waste Landform
- Approved Conceptual Layout**
-  Pit
-  Waste Landform
-  Rio Tinto Railway
-  Highway



Significant Flora Species

- | | | | |
|---|---|---|---|
| <p>P2</p> <ul style="list-style-type: none">  <i>Aristida lazaridis</i>  <i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708) | <p>P3</p> <ul style="list-style-type: none">  <i>Aristida jerichoensis</i> var. <i>subspinulifera</i>  <i>Eremophila naaykensis</i>  <i>Indigofera gilesii</i> | <ul style="list-style-type: none">  <i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)  <i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739) | <p>P4</p> <ul style="list-style-type: none">  <i>Acacia bromilowiana</i>  <i>Lepidium catapycnon</i>  <i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642) |
|---|---|---|---|



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8.3.3.4. Introduced Flora (Weeds)

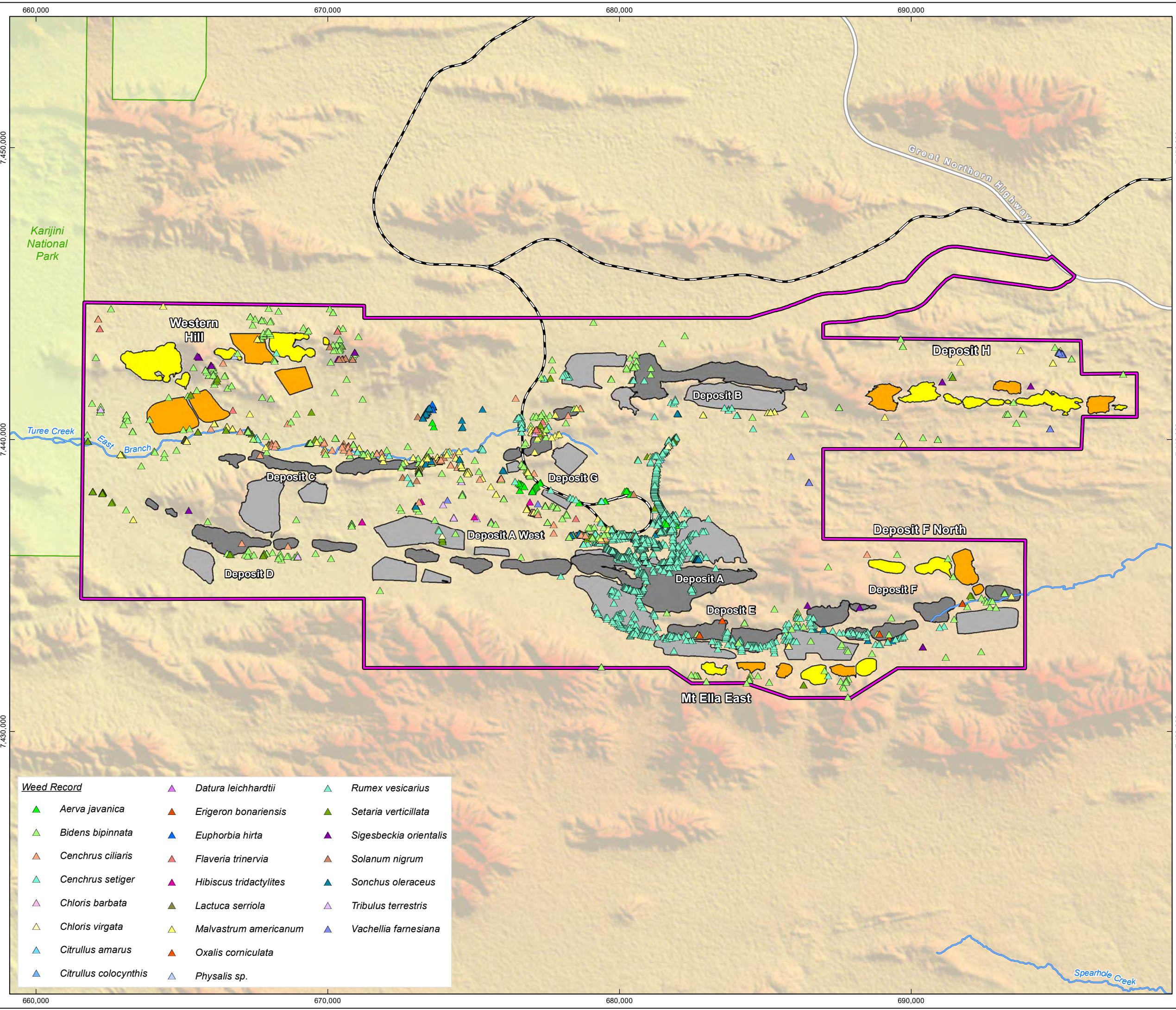
A total of 24 weed species have been recorded within the Revised Development Envelope of which 12 were recorded within the Extension Areas (Biota 2020, Biota 2021 and ecologia 2013). None of the recorded species are listed as declared pests under the WA *Biosecurity and Agriculture Management Act 2007* (BAM Act) or a Weed of National Significance (WoNS) on the Western Australian Organism List database. The most common species recorded were **Bidens bipinnata* (Bippinnate Beggartick), **Setaria verticillata* (Whorled Pigeon Grass) and **Malvastrum americanum* (Spiked Malvastrum). Weed records, indicative locations and abundance are provided in the key flora and vegetation surveys (Appendix D.1 to D.11) and shown in Figure 8-11.

Figure 8-11
Weed Records within the
Revised Development
Envelope

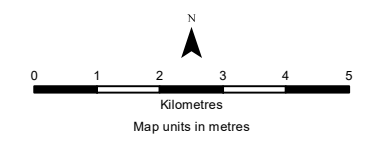
Drawn: GIS Team
Plan: PDE0186399v4
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



Weed Record		
▲ <i>Aerva javanica</i>	▲ <i>Datura leichhardtii</i>	▲ <i>Rumex vesicarius</i>
▲ <i>Bidens bipinnata</i>	▲ <i>Erigeron bonariensis</i>	▲ <i>Setaria verticillata</i>
▲ <i>Cenchrus ciliaris</i>	▲ <i>Euphorbia hirta</i>	▲ <i>Sigesbeckia orientalis</i>
▲ <i>Cenchrus setiger</i>	▲ <i>Flaveria trinervia</i>	▲ <i>Solanum nigrum</i>
▲ <i>Chloris barbata</i>	▲ <i>Hibiscus tridactylites</i>	▲ <i>Sonchus oleraceus</i>
▲ <i>Chloris virgata</i>	▲ <i>Lactuca serriola</i>	▲ <i>Tribulus terrestris</i>
▲ <i>Citrullus amarus</i>	▲ <i>Malvastrum americanum</i>	▲ <i>Vachellia farnesiana</i>
▲ <i>Citrullus colocynthis</i>	▲ <i>Oxalis corniculata</i>	
	▲ <i>Physalis sp.</i>	



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8.3.4. Key Flora and Vegetation Values

The key environmental values associated with Flora and Vegetation within the Revised Development Envelope and which are the subject of the assessment including cumulative impacts are:

- **Native vegetation in good to excellent condition (29,907 ha)**
- **One Priority 1 PEC - 'West Angelas Cracking-Clays' (433 ha)**
- **Vegetation of high local significance:**
 - **D11, H15 and P8 and vegetation types**
- **Riparian vegetation (392 ha):**
 - **D2, D3, D10, D11 and D2 vegetation types**
- **One potential GDE within the Revised Development Envelope (feature 1a) and three potential GDEs outside of the Revised Development Envelope (Features 12a, 14 and 22)**
- **Priority flora (P2 – P4) – 28 species**

8.4. Potential Environmental Impacts

8.4.1. Direct Impacts

Potential direct impacts of the Proposal on Flora and Vegetation have been identified as:

- Clearing of native vegetation (including riparian vegetation)
- Clearing of individuals of Priority flora species.

Clearing is related to mining, waste management, access and associated activities such as power (including diesel generation and renewables [solar]), water and transport infrastructure (including land bridges), as detailed in Section 2.1.

8.4.1.1. Clearing of Native Vegetation (including Riparian Vegetation)

This section describes the disturbance of vegetation based on the Conceptual Footprint; however, as the footprint is 'conceptual' the Proposal includes flexibility to alter the location of Proposal elements within the Revised Development Envelope without exceeding the total proposed disturbance extent of 5,350 ha. To ensure environmental impacts are not greater than assessed, the Proponent has proposed upper clearing limits for identified significant vegetation values including the Priority 1 PEC and riparian vegetation (Table 8-14).

This Proposal has minimised direct disturbance to the regionally significant West Angelas Cracking Clay (P1) PEC; however, some clearing is required to facilitate ore transportation. As such, an upper clearing limit of 2 ha is proposed. In addition to the approved clearing under MS 1113 of 20 ha, a total of 22 ha of clearing is proposed within this PEC. As per Condition 5-1 of MS 1113 no direct or indirect disturbance will occur within representation 2015-5¹² of this PEC (Figure 8-5).

The Proposal also includes clearing of up to 35 ha of riparian vegetation, resulting in a proposed increase in the riparian vegetation clearing limit (Condition 1 of MS 1113) from 25 ha to a combined upper limit of 60ha.

The approximate clearing extents for all other vegetation types are presented in Table 8-15.

¹² Representation 15-5 of the West Angelas Cracking Clay (P1) PEC is an area of approximately 230 ha that was excluded from any direct and indirect impacts from the Revised Proposal approved under MS 1113.

Table 8-14: Proposal Indicative Disturbance – PEC, Riparian Vegetation and High Local Significance Vegetation Types

Vegetation Code	Mapped Vegetation Extent*		Proposal Upper Limit of Vegetation Disturbance (ha)	Impact from Proposal within Revised Development Envelope (%)	Authorised Clearing for Approved Proposal (ha)	Estimated Clearing for Revised Proposal (ha)
	West Angelas Area (ha)	Revised Development Envelope (ha)				
PEC						
P15 (Priority 1 - West Angelas Cracking Clay)	433	433	2	0.5	20	22
Riparian Vegetation						
D2, D3, D10, D11, D12	500	392	35	9	25	60

*Area rounded to nearest ha

Table 8-15: Indicative Disturbance –Moderate to Negligible Significance Vegetation Type

Vegetation Code	Mapped Vegetation Extent		Approximate Impact from the Proposal (ha)	Impact from Proposal within Revised Development Envelope (%)
	West Angelas Area (ha)	Revised Development Envelope (ha)		
High Local Significance (excluding riparian vegetation types)				
H15	3,424	1,729	146	8.4
P8	159	159	14	8.8
Moderate Local Significance (excluding riparian vegetation types)				
D14, G1, G2, G3, H1, H2, H5, H6, H7, H8, H9, H13, H14, H16, M1, P2, P3	16,568	14,645	2,248	15.3

Vegetation Code	Mapped Vegetation Extent		Approximate Impact from the Proposal (ha)	Impact from Proposal within Revised Development Envelope (%)
	West Angelas Area (ha)	Revised Development Envelope (ha)		
Low Local Significance (excluding riparian vegetation types)				
D4, D6, D7, D8, D9, D13 H3, H4, H10, H11, P1, P4, P5, P6, P7, P9, P10, P11, P12, P14, P16	12,139	11,235	2,446	21.8
Negligible Local Significance (excluding riparian vegetation types)				
D5, H12, M2, P13	328	328	45	13.7
Disturbed	7,931	7,857	428	5.4
Total All Vegetation Types (including Disturbed, PEC and Riparian vegetation)	41,483	36,779	5,350	14.5

Vegetation Condition

Vegetation considered to be in very good to excellent condition will be impacted by clearing for the Proposal (Table 8-16).

Table 8-16: Indicative Disturbance by Vegetation Condition

Vegetation Condition	Mapped Vegetation Extent		Approximate Percentage of Vegetation in Revised Development Envelope Impacted by the Proposal (%)
	Revised Development Envelope (ha)	Approximate Impact from the Proposal	
Excellent	15,571	3,339	9.1
Very Good	11,612	1,560	4.2
Good	1,724	23	0.1
Poor	15	0	0
Completely Degraded	7,857	428	1.2
Total	36,779	5,350	14.6

8.4.1.2. Fragmentation due to Land Clearing

Fragmentation of vegetation occurs when pockets of vegetation become isolated through clearing for infrastructure. The resultant potential impacts of the creation of fragmented or islands of vegetation including:

- Increased degradation as a result of 'edge effect' where cleared areas become vectors for weeds, changes to surface drainage and dust deposition. This degradation may indirectly result in reduction of habitat quality for other flora and fauna
- Reduced floral reproduction and genetic diversity resulting from the reduction of corridors for pollinators to travel between islands.

8.4.1.3. Clearing of Individual Priority Flora Species

Direct impacts to significant flora records within the Conceptual Footprint are presented in Table 8-17. Of the 28 Priority species recorded within the Revised Development Envelope, 16 species are expected to be impacted by the Proposal.

Table 8-17: Impacts on Priority Flora Species from the Proposal

Taxon	Proposal Conceptual Footprint		Revised Development Envelope	West Angelas Area	State-Wide (Regional)	Total Predicted Impact (%) of Recorded Individuals in State	Total Predicted Impact (%) of Recorded Individuals in Revised Development Envelope
	No. of Individuals*	Plus 10% Footprint Buffer#	No. of Individuals*	No. of Individuals*	No. of Individuals*		
Priority 2							
<i>Aristida lazardis</i>	259	285	906	906	10,912	2.61	31.4
<i>Eremophila pusilliflora</i>	19	21	266	266	9,191	0.23	7.9
#? <i>Eremophila</i> sp. West Angelas (S. van Leeuwen 4068)	0	0	53	53	973	0.00	0.0
<i>Euphorbia inappendiculata</i> var. <i>inappendiculata</i>	0	0	10	10	3,176	0.00	0.0
# <i>Hibiscus</i> sp. Gurinbidy Range (M.E. Trudgen MET15708)	287	316	1,604	2,190	6,068	5.20	19.7
# <i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725)	5	6	243	385	643	0.86	2.3
<i>Tetradlea fordiana</i>	0	0	3,808	4,428	27,025	0.00	0.0
Priority 3							
<i>Acacia effusa</i>	12	13	220	220	9,512	0.14	6.0
<i>Acacia subtiliformis</i>	0	0	250	354	188,715	0.00	0.0
<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	221	243	2,075	2,075	13,574	1.79	11.7
<i>Dolichocarpa</i> sp. Hamersley Station (A.A. Mitchell PRP 1479)	0	0	2	2	8,580	0.00	0.0
<i>Eremophila naaykensis</i> (A.L.Curtis & K.R.Thiele)	1,571	1,728	6,010	6,220	14,355	12.04	28.8
<i>Euphorbia clementii</i>	0	0	10	10	10	0.00	0.0
<i>Grevillea saxicola</i>	68	75	335	335	5,447	1.37	22.3

Taxon	Proposal Conceptual Footprint		Revised Development Envelope	West Angelas Area	State-Wide (Regional)	Total Predicted Impact (%) of Recorded Individuals in State	Total Predicted Impact (%) of Recorded Individuals in Revised Development Envelope
	No. of Individuals*	Plus 10% Footprint Buffer#	No. of Individuals*	No. of Individuals*	No. of Individuals*		
<i>Indigofera gilesii</i>	646	711	1,339	1,923	10,789	6.59	53.1
<i>Isotropis parviflora</i>	324	356	4,803	4,842	6,568	5.43	7.4
<i>Olearia mucronata</i>	1	1	1	2	284	0.35	100.0
<i>Pilbara trudgenii</i>	0	0	529	801	1,304	0.00	0.0
<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	576	634	1,195	1,217	107,919	0.59	53.0
<i>Solanum kentrocaule</i>	31	34	478	1,136	1,716	1.99	7.1
<i>Swainsona thompsoniana</i>	0	0	7	7	1,794	0.00	0.0
<i>Themeda</i> sp. Hamersley Station (M.E. Trudgen 11431)	0	0	5,822	5,822	156,336	0.00	0.0
<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	24,971	27,468	61,935	101,075	156,712	17.53	44.3
<i>Vittadinia</i> sp. Coondewanna Flats (S. van Leeuwen 4684)	0	0	1	1	13,291	0.00	0.0
Priority 4							
<i>Acacia bromilowiana</i>	1	1	68	191	4,000	0.03	1.6
<i>Eremophila magnifica</i> subsp. <i>Magnifica</i>	0	0	29	140	15,197	0.00	0.0
<i>Lepidium catapycnon</i>	0	0	34	138	39,772	0.00	0.0
<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)	239	263	309	309	13,373	1.97	85.1

* Source: Rio Tinto Database

10% has been added to predicted impacts to Priority flora to allow for project flexibility.

8.4.2. Indirect Impacts

Potential indirect impacts of the Proposal on Flora and Vegetation have been identified as:

- Degradation or alteration of vegetation as a result of altered hydrological/hydrogeological regimes
- Degradation of vegetation condition due to increased abundance and diversity of weeds
- Degradation of vegetation from dust deposition and the potential increase in bushfire risk.

Degradation of Country, and sites of social, cultural and heritage significance in regard to flora along with interference with cultural obligations and spiritual beliefs tied to flora is discussed in Section 6.

8.4.2.1. Degradation or Alteration of Vegetation as a Result of Altered Hydrological/Hydrogeological Regimes

West Angelas Cracking-Clays' Priority 1 Ecological Community

The West Angelas Cracking Clay PEC is recognised as being dependent on natural patterns of surface water flow, such as incident rainfall and surface water (sheet) flow from local catchments (Rio Tinto 2018b). The Proponent has previously mapped and modelled the surface water flow channels that interact with the PEC (Rio Tinto 2018b) and ensures that sufficient culverts are installed as part of any linear infrastructure that interacts with those channels. The Proposal Conceptual Footprint, including the linear infrastructure, does not significantly interact with catchments associated with the PEC and is unlikely to impact flow channels. Culverts will be constructed where required to ensure no indirect impacts to the PEC.

Surface Water Discharges to Ephemeral Creeks

Dewatering associated with the Proposal deposits is minimal and is restricted to Deposit H and Deposit F North. All mine dewater from these deposits is proposed to be used for operational purposes. In the event of excessive stormwater ingress into Proposal pits, management will be required which may involve discharge to Turee Creek East, however in accordance with the Water Management Hierarchy, other options for use will be prioritised. As such, there are no changes proposed to the current approved surplus water discharge volume or extent to Turee Creek East as a result of this Proposal (Section 6).

Discharge in relation to the Approved Proposal will continue to be managed to meet the requirements of existing approvals, including Condition 5 of MS 1113, which requires the Proponent to ensure there is no irreversible impact, as a result of the discharge of surplus water, to the health of riparian vegetation of Turee Creek East and other secondary approvals under Part V of the EP Act and RiWI Act.

Acknowledging that groundwater is proposed to be abstracted, Traditional Owners have discussed whether excess water that may otherwise be discharged (or 'wasted') could be utilised to create plant and animal refuge habitats to offset the loss of habitat in disturbance areas, while noting that no additional discharge is currently within the scope of this Proposal.

Catchment Reduction to Creek Systems – Across Revised Development Envelope

The Revised Development Envelope intersects three major catchments, all supporting ephemeral drainage systems (Section 7.2). Implementation of the Proposal will reduce catchment sizes and impact the natural flow of surface water; however, the scale of impacts in relation to this is minimised due to the proposed pits and WRL being designed to be located largely outside of the 1:100-year ARI floodplain. Consequently, when considered in the context of the seasonal and highly variable nature of the local flow regimes, it is highly unlikely that the Proposal will result in the degradation or alteration of vegetation communities in this regard.

Reduction of catchment to Deposit H Waterhole – Deposit H

Development of Deposit H will reduce the size of a local catchment that flows through a surface water fed ephemeral pool (Deposit H Waterhole) to the north by up to a maximum of 88% (Section 7). As a result, there will be a significant reduction in surface water flows delivered to the pool and the associated gully ecosystem. Assessment of the pool filling regime is provided in Section 7. An assessment of the potential impacts on the associated ecosystem is described below.

The proposed reduction in the catchment reporting to the ephemeral pool and the drainage line downstream will see a significant reduction in the volume of surface water runoff which flows into the pool and beyond following rainfall events and therefore an associated reduction in the frequency of alluvium rehydration events within the reporting fluvial environments. The substrates upstream of the pool predominantly consist of skeletal soils and outcropping of BIF. Such substrates will quickly shed the majority of incident rainfall, allowing for most larger rainfall events to exceed the holding capacity of the catchment and thus leading to surface water flows.

The drainage channel upstream of the Deposit H Waterhole has been confirmed to support vegetation containing or dominated by species such as *Corymbia ferriticola*, *Mulga* spp, *Acacia pruinocarpa*, *A. monticola*, *A. pyrifolia*, *Dodonaea viscosa*.

The vegetation immediately around the pool is described as '*Corymbia ferriticola*, *Mulga* spp, *Acacia pruinocarpa* open woodland to woodland over mixed open shrubland of *Acacia monticola*, *Dodonaea viscosa*, *Acacia pyrifolia* over *Aristida burbidgeae* and *Eriachne tenuiculmis* very open tussock grassland'. The following mesophytes were also identified in the area at relatively low abundance:

- **Pandorea pandorana*
- *Ficus brachypoda*
- *Ehretia saligna*
- *Clerodendrum floribundum* subsp. *floribundum*
- *Alternanthera nodiflora*.

These species can be considered 'low level' mesophytes, i.e., they are occurring in habitats with soil moisture availability or surface water availability that is ephemeral, but tending towards persistent-ephemeral. The nature of the Deposit H Waterhole and gully may be contributing to the abundance of these 'low-level' mesophytes. Noting that these species may be present in low numbers in many similar habitats, regardless of the availability of persistent-ephemeral water.

The vegetation that occurs downstream of the pool is not comprised of phreatophytic or generally mesic vegetation. Two species that could be considered low level mesophytes occur in the gully; *Corymbia ferriticola* & *Dodonaea viscosa*. Similar vegetation is found in drainage systems in the local area that occur in similar incised gully habitats where the reporting catchment is smaller (and at times larger) than that of Deposit H Waterhole. This variability in catchment size, while still supporting similar vegetation types, suggests that the flow regimes and ecophysical setting, rather than the volumes, are more influential on community composition and structure. This in turn suggests that such vegetation is capable of persisting in habitats with lower reporting catchment size and potentially lower water availability.

Overall, the reduction in catchment size may result in a small-moderate decrease over time in the abundance of flora species and thus a change in vegetation density downstream of the ephemeral pool. This altered water balance is likely to result in changes in vegetation abundance and density, however changes in vegetation composition are unlikely, due to the low risk profile held by the species present within the downstream gully. Further investigation is being carried out in relation to the potential impacts on the downstream gully and will be used in consultation with Traditional Owners (Ngarlawangga People) to reach agreement on the nature and extent of mining that is supported at Deposit H. Investigations include an ecohydrologic assessment of the gully and similar gullies in the area to

determine and quantify expected changes to the gully as a result of impact on the catchment and visual assessment and representation of expected changes to vegetation within the Deposit H gully.

Reduction of Turee Creek East flows on a potential GDE

Feature 22 (SLR 2022), Zone C (Rio Tinto 2017) (Figure 8-7) is thought to be recharged by ephemeral surface water flows along Turee Creek East attenuated through a topographically confined channel profile and ponded behind Mount McRae Shale observed outcropping at the surface of Turee Creek East.

The local catchment contributing to potential groundwater dependent vegetation in 'Zone C' (within Karijini National Park; Figure 8-7) is approximately 570 km², attributable to the confluence of the eastern and north-western tributaries of Turee Creek East. This catchment is relatively small compared to the catchment of most named creeks in the Hamersley Ranges (Turee Creek, Seven Mile Creek, Marillana Creek, Bungaroo Creek, Duck Creek and Beasley River have catchments of more than 2,000 km²) and would typically be considered unlikely to support dense or structurally complex GDEs.

The density of *Eucalyptus victrix* within 'Zone C' (basal area up to 16 m²/ha and often above the basal area threshold of 9 m²/ha) likely indicates reliance on groundwater to meet water demand. However, surface water flows from both the eastern and north-western tributaries (channel profiles of 350 – 500 m) are channelled through topographically confined local gorge features (channel profile of 150 m), attenuating flows, resulting in the formation of surface water pools that may persist for an extended period following flow events, depending on climatic conditions (e.g. evaporation rates). The increased and concentrated nature of surface water flows contributing to the potential groundwater dependent vegetation within Karijini National Park are thought likely to at least partially account for this density.

It is also considered likely that ephemeral surface water flows along Turee Creek East are naturally ponded behind the Mount McRae Shale (which represents a natural barrier to groundwater flow) observed outcropping at the surface on the south east bank of Turee Creek East at the downstream end of 'Zone C-1' following flow events. Surface water flows naturally ponded in alluvials behind the Mount McRae Shale result in increased localised groundwater recharge and / or replenishment of the vadose soil water resources that are thought likely to persist for extended periods following flow events, depending on climatic conditions (e.g. evaporation rates).

Calcite deposits, observed precipitating at the surface further support groundwater ponding, and small-scale discharge / overtopping of the Mount McRae Shale. Increased surface water driven recharge of shallow groundwater influences the distribution of potentially groundwater dependent vegetation. This contributes to the distribution and density of potentially groundwater dependent vegetation upstream and restricting the distribution of potentially groundwater dependent vegetation downstream.

Groundwater Drawdown – Western Hill and Deposit H

Groundwater throughout the West Angelas region is naturally deep and is not expected to support groundwater dependent/phreatophytic vegetation. Feature 22 (Figure 8-7) is thought to be supported via surface recharge of groundwater from Turee Creek East flows and impacts from changes to surface water flows on this feature are described in the preceding section.

The modelled most conservative drawdown (simulation P80) does not propagate west of Western Hill Pit 1 and is limited by the dolerite dyke to the east of the Western Hill Pit 3, and as such, is highly unlikely to impact groundwater levels at the boundary of or within Karijini National Park or potential groundwater dependent vegetation zones identified (Rio Tinto 2017; Figure 8-12).

Zones B to E (Figure 8-7) occur west of the Revised Development Envelope and beyond the modelled extent of drawdown impacts. However, drawdown has been modelled to intersect an area of 'Zone A' within the Revised Development Envelope at ~6.5 m drawdown contour (Figure 8-12). The modelled drawdown is unlikely to have a significant impact on potential GDE in this area due to the depth of the

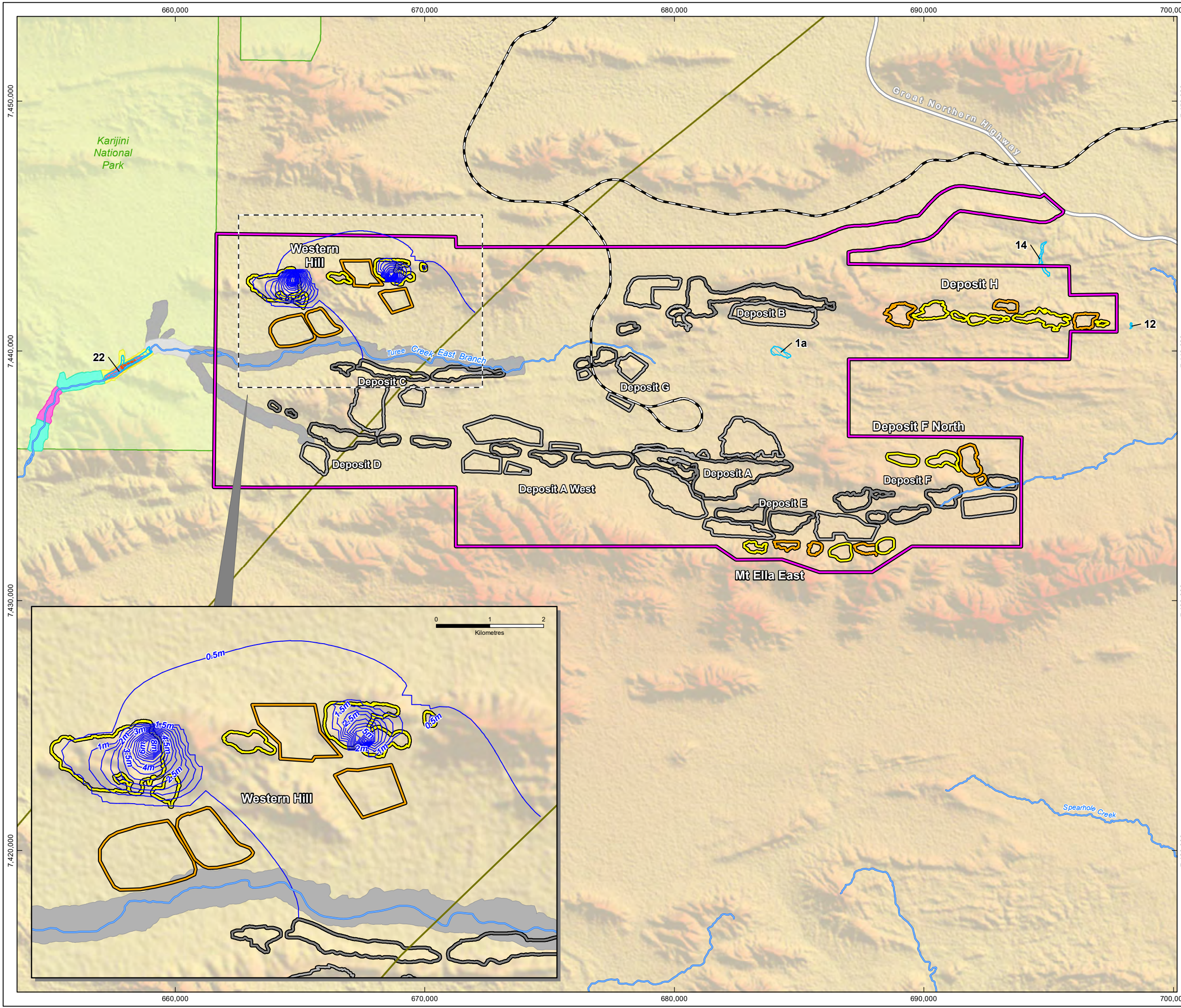
groundwater (20 m – 70 m). Modelled drawdown does not intersect other key riparian or potential GDE zones and as such these are considered to be at negligible risk of impact by the Proposal.

Some lowering of the groundwater table is also expected at Deposit H and Deposit F North; however, the hydrogeology of these deposits restricts the extent of drawdown, while the natural depth to groundwater (>50 m) precludes reliance by vegetation (refer to Section 7 for further detail).

There are no confirmed GDE supported by regional groundwater sources within the Proposal Area or Revised Development Envelope, and potential GDE's are highly unlikely to be impacted as a result of the Proposal. The Proposal's potential to impact groundwater levels is discussed in detail in Section 7.4.

Figure 8-12
Riparian vegetation zone mapping (P80 modelling simulation)

Drawn: A.D.
Plan: RTIO-0983569v2
Date: March 2023
Proj: GDA 1984 MGA Zone 50
Scale: 1:140,000 @A3
GIS.Team@riotinto.com



Legend

Revised Development Envelope

Proposed Conceptual Layout

Pit
Waste Landform

Approved Conceptual Layout

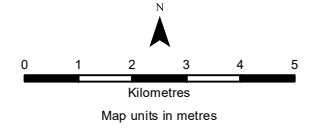
Pit
Waste Landform

Dolerite Dyke
Drawdown (m)
Potential GDE

Potentially Groundwater Dependent Vegetation Zones

Zone A
Zone B
Zone C-1
Zone C-2
Zone C-3
Zone D
Zone E

National Park
Rio Tinto Railway
Highway
Major Creek



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8.4.2.2. Degradation of Vegetation Condition due to Increased Abundance and Diversity of Weeds

Weeds can spread by several mechanisms, including wind, water, vehicles, machinery and fauna (including native fauna and livestock). Historically, weeds in the Pilbara have been introduced through pastoral activities (EPA 2014). However, weeds can often also rapidly invade locations subject to disturbance, land clearing and/or altered hydrological regimes. This can result in the replacement of native species and the simplification of natural ecosystems.

No weed species considered to be Declared Pests as defined by the BAM Act or WoNS were identified within the Revised Development Envelope.

The most relevant mechanisms for weed spread or introduction concerning the Proposal's implementation are vehicle and earthmoving activities and surplus water discharge, the latter of which there is no change as a result of this Proposal (refer to Section 8.5.1).

8.4.2.3. Degradation of Vegetation from Dust Deposition and Potential Increase in Bushfire Risk

Dust deposition from the Proposal is expected throughout the life of the operation; however, mostly during vegetation clearing activities and some activities with the mine operation, such as vehicle, heavy haulage, machinery movements, blasting, crushing and conveying. Dust modelling has been conducted for the Proposal (ETA 2022), with modelled dust deposition rates outside of operational areas being well below ecological impact criteria. Accordingly, vegetation degradation from dust deposition is not expected to significantly increase due to the Proposal.

The Revised Development Envelope has a history of fire. Given the increase in ignition sources (i.e. vehicle movement, clearing and railway maintenance), there is the potential for increased fire risk. However, ignition sources and fire incidents are generally effectively managed on mine sites and it is unlikely that there will be an increased frequency of uncontrolled fires in mining areas compared to the surrounding areas.

8.4.3. Cumulative Impacts

The Proposal will contribute to the following cumulative impacts at a regional scale:

- Clearing of native vegetation
- Clearing of Priority flora individuals
- Impacts to regionally significant vegetation unit (P15) representing the 'West Angelas Cracking-Clays' Priority 1 PEC.

Projects included in cumulative impact assessment are detailed in Section 2.3.10 (Table 2-7).

8.4.3.1. Cumulative Impacts on Native Vegetation

Cumulative impacts to regional vegetation have been considered within the Hamersley IBRA subregion based on an assessment of all major mining projects (current and foreseeable future projects) located within the same pre-European vegetation associations as the Revised Development Envelope.

The assessment of cumulative impacts on local vegetation types has only been conducted for the Revised Development Envelope, due to the detail of vegetation mapping. Further, impacts from pastoral and/or grazing activities have not been quantified and, therefore, have not been included in the cumulative impact calculations.

The Proposal will clear up to 5,350 ha of native vegetation within the Revised Development Envelope. The (2019) extent of vegetation within the Pilbara bioregion and Hamersley subregion is 17.7 million ha and 5.6 million ha, respectively (Government of Western Australia 2019a). Based on the predicted impacts from the Proposal, the cumulative impact will contribute approximately 0.03% and 0.1% to vegetation clearing in the bioregion and subregion, respectively.

The Proposal will potentially impact three vegetation associations in the Hamersley subregion: Hamersley 18, Hamersley 29 and Hamersley 82. As shown in Table 8-18, the cumulative impacts of this Proposal and other projects on the three vegetation associations are unlikely to impact their regional and subregional representation. All three vegetation associations have more than 10% of their pre-European extent protected within formal reserves (Table 8-3).

8.4.3.2. Cumulative Impacts on Conservation Significant Flora

Of the 28 Priority Flora species mapped within the Revised Development Envelope, 16 have been identified as being impacted by existing or foreseeable surrounding projects within the Hamersley subregion and therefore have the potential to be impacted cumulatively by the Proposal (Table 8-19). The estimate of the number of plants potentially impacted by other projects includes all individuals within their Development Envelopes, rather than the disturbance footprints indicated by publicly available information. Therefore, they are considered very conservative estimates.

The cumulative impacts on significant flora species are summarised in Table 8-19.

Table 8-18: Cumulative Impacts on Beard (1975) Vegetation Associations within the Hamersley Subregion

Vegetation Association	Pre-European Extents (ha)	Current Extent (ha)	Extent within the Revised Development Envelope (ha; % of Current Extent)	Clearing from this Proposal (ha; % of Current Extent)	Approved Clearing Footprint from other Mining Projects (ha; % of Current Extent)	Cumulative Clearing (ha; % of Current Extent)
Hamersley 18	581,246	576,541	19,127 (3.3)	2,024 (0.4)	87,521 (15)	89,545 (15.5)
Hamersley 29	172,083	170,748	442 (0.3)	0	80,514 (47)	80,514 (47)
Hamersley 82	2,177,574	2,165,224	17,210 (0.8)	3,326 (0.15)	140,528 (6.5)	143,854 (6.7)
Total	2,930,903	2,912,513	36,779	5,350	308,563	313,913 (11)

**Extent rounded up to the nearest ha*

Table 8-19: Cumulative Impacts on Priority Flora Species

Status	Species	Project	No. of Individuals Potentially to be Disturbed*	Total Potential Cumulative Impact	No. of Recorded Individuals in the State	Cumulative Impact to Recorded Individuals (%)
Priority 2	<i>Aristida lazaridis</i>	Proposal	285	1,057	10,912	9.7
		BHP Pilbara Strategic Expansion	83			
		Hope Downs 2	395			
		BHP Mining Area C	90			
		West Angelas C, D and G	204			
	<i>Eremophila pusilliflora</i>	Proposal	21	23	9,191	0.2
		West Angelas C, D and G	2			
	<i>Hibiscus</i> sp. Gurinbiddy Range (M.E. Trudgen MET 15708)	Proposal	316	654	6,068	10.8
		Baby Hope	35			
		BHP Pilbara Strategic Expansion	2			
		Hope Downs 2	301			
	<i>Oxalis</i> sp. Pilbara (M.E. Trudgen 12725)	Proposal	6	14	643	2.1
		BHP Pilbara Strategic Expansion	8			
Priority 3	<i>Acacia effusa</i>	Proposal	13	494	9,512	5.2
		BHP Pilbara Strategic Expansion	2			
		FMG Solomon Expansion	479			
	<i>Aristida jerichoensis</i> var. <i>subspinulifera</i>	Proposal	243	455	13,574	3.4
		Brockman Syncline	1			
		BHP Pilbara Strategic Expansion	37			

Status	Species	Project	No. of Individuals Potentially to be Disturbed*	Total Potential Cumulative Impact	No. of Recorded Individuals in the State	Cumulative Impact to Recorded Individuals (%)
		BHP Mining Area C	166			
		FMG Solomon Expansion	8			
	<i>Eremophila naaykensis</i> (A.L.Curtis & K.R.Thiele)	Proposal	1,728	1,922	14,355	13.4
		Baby Hope	12			
		Hope Downs 2	182			
	<i>Grevillea saxicola</i>	Proposal	75	1,088	5,447	20.0
		Brockman Syncline	137			
		BHP Pilbara Strategic Expansion	3			
		FMG Eliwana	58			
		Greater Paraburdoo	547			
		Hope Downs 2	143			
		BHP Mining Area C	3			
		Western Turner Syncline	122			
	<i>Indigofera gilesii</i>	Proposal	711	838	10,789	7.8
		Brockman Syncline	59			
BHP Pilbara Strategic Expansion		35				
FMG Solomon Expansion		33				
Priority 3	<i>Isotropis parviflora</i>	Proposal	356	386	6,568	5.9
		BHP Pilbara Strategic Expansion	27			
		FMG Eliwana	1			

Status	Species	Project	No. of Individuals Potentially to be Disturbed*	Total Potential Cumulative Impact	No. of Recorded Individuals in the State	Cumulative Impact to Recorded Individuals (%)
		Koodaideri	2			
	<i>Olearia mucronata</i>	Proposal	1	5	284	1.8
		BHP Pilbara Strategic Expansion	4			
	<i>Rhagodia</i> sp. Hamersley (M. Trudgen 17794)	Proposal	634	1,998	107,919	1.9
		BHP Pilbara Strategic Expansion	405			
		Brockman Syncline	51			
		FMG Eliwana Railway	19			
		Hope Downs 2	56			
		Hope Downs 4	4			
		BHP Mining Area C	401			
		West Angelas C, D and G	147			
		FMG Solomon Expansion	33			
	<i>Solanum kentrocaule</i>	Proposal	34	37	1,716	2.2
		BHP Pilbara Strategic Expansion	3			
	<i>Triodia</i> sp. Mt Ella (M.E. Trudgen 12739)	Proposal	27,468	32,285	156,712	20.6
		BHP Pilbara Strategic Expansion	139			
		Hope Downs 2	3,877			
		BHP Mining Area C	136			
		West Angelas C, D and G	665			

Status	Species	Project	No. of Individuals Potentially to be Disturbed*	Total Potential Cumulative Impact	No. of Recorded Individuals in the State	Cumulative Impact to Recorded Individuals (%)
Priority 4	<i>Acacia bromilowiana</i>	Proposal	1	1,247	4,000	31.2
		Brockman Syncline	700			
		FMG Eliwana	170			
		Hope Downs 2	202			
		BHP Mining Area C	4			
		BHP Pilbara Strategic Expansion	170			
	<i>Sida</i> sp. Barlee Range (S. van Leeuwen 1642)	Proposal	263	3,393	13,373	25.4
		BHP Pilbara Strategic Expansion	39			
		Brockman Syncline	2411			
		Greater Paraburdoo	576			
		Koodaideri	40			
		BHP Mining Area C	32			
		West Angelas C, D and G	32			

9* - based on impact within conceptual footprint plus 10%

8.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids or minimises, where practicable, impacts on flora and vegetation values within and around the Revised Development Envelope. The Proponent commits to continue implementing a progressive rehabilitation program across disturbed areas as they become available to ensure that as many of these values, as far as practicable, are returned to the landscape.

8.5.1. Mitigation Hierarchy

The Proponent has applied the mitigation hierarchy (avoid, minimise and rehabilitate) during the Proposal design process to address the potential impacts on the key flora and vegetation values within the Revised Development Envelope. The mechanisms applied to each key value and potential impact is discussed below and summarised in Table 8-20.

8.5.2. Avoidance and Minimisation

8.5.2.1. Priority Ecological Communities

West Angelas Cracking Clay PEC (P1) is the only PEC present within the Revised Development Envelope. The Proposal has been designed to minimise any new impacts to this community, with an upper disturbance limit of 2 ha in addition to the existing approved limit of 20 ha for a total combined clearing limit of 22 ha. Representation 2015-5 of this PEC (Figure 8-5) will not be cleared and there is no change to the existing mining exclusion over this area as a result of this Proposal.

8.5.2.2. Riparian Vegetation

The Proposal has avoided and minimised as far as practicable direct and indirect impacts to riparian vegetation by implementing the following measures:

- Preferential location of supporting infrastructure outside of areas containing riparian vegetation
- Ensuring creek crossings include sufficient culverts to avoid impacts associated with altered flow regimes effectively
- Continuing to restrict the surface water wetting front, along Turee Creek East by managing discharge rates in accordance with Table 2 of Attachment 3 of MS 1113
- Limiting impact to Deposit H Waterhole catchment to retain pool filling frequency and level and to limit downstream impacts on vegetation (EMP, Appendix A.8).

The Proposal includes an upper riparian vegetation clearing limit of 35 ha, bringing the Revised Proposal total from 25 ha (Condition 1 of MS 1113) to a combined 60 ha.

8.5.2.3. Groundwater Dependent Ecosystems

The single potential GDE within the Revised Development Envelope (Feature 1a, Figure 8-7) is not at risk of direct or indirect disturbance owing to its distance from the Western Hill and Deposit H footprints, and underlying hydrogeology.

The other three GDEs outside the Revised Development Envelope (shown in Figure 8-7) are highly unlikely to experience indirect impacts as a result of the Proposal:

- Feature 12a and Feature 14 are both assessed to be independent of the regional aquifer and are outside the zone of influence of mine dewatering at Deposit H (Table 8-6)
- Feature 22 lies within the boundary of Karijini National Park and is the subject of existing groundwater controls stipulated in MS 1113 (Section 6) and mitigation measures in relation to the Proposal as listed:
 - No BWT mining proposed at Western Hill deposit to minimise risk of impact to groundwater level at Karijini National Park. Groundwater abstraction is limited to water supply only at this deposit
 - Implementation of the approved MAR project in relation to Deposits C and D
 - Implementation of the MAR and management and monitoring measures for drawdown near Karijini National Park are documented in the Groundwater Environmental Management Plan.

8.5.2.4. Other Significant Vegetation

The Proposal has limited direct and indirect impacts to the three local vegetation types of high local significance; H15, P8 and D11 (note D 11 is included in riparian vegetation) to the greatest extent practicable, largely by preferentially locating supporting infrastructure outside of areas containing the vegetation types.

8.5.2.5. Priority Flora

Proposed impacts to Priority flora will be minimised where possible, noting there are no Priority 1 flora within the Revised Development Envelope. Impacts to Priority flora are indicated in Table 8-17 with an additional 10% impact 'buffer' included as part of this assessment to allow for project flexibility.

8.5.2.6. Vegetation Quality

The introduction and spread of weeds and increased bushfires can cause a decline in the quality of the vegetation in the Revised Development Envelope. The Proponent has developed several management strategies, guidelines and programs to minimise the potential impact of the Proposal on the vegetation values within the Revised Development Envelope, which are detailed in the EMP (Appendix A.8). In relation to vegetation quality, these include:

- **Dust Suppression Strategy** – this describes the techniques to minimise dust deposition within the Revised Development Envelope. This will include the use of water carts
- **Weed Management Strategy** – this describes actions that minimise the likelihood of weed species being introduced or spread within the Revised Development Envelope. The key actions include the periodic spraying of cleared areas, particularly higher risk areas (such as sensitive receptors), and the management of vehicle, machinery and equipment hygiene
- **Fire management strategy** - to minimise the likelihood of activities associated with the Proposal resulting in the outbreak of bushfires. These measures include monitoring and managing hot works, vehicle movement and provision of firefighting equipment in vehicles and infrastructure.

These mitigation measures, developed with reference to the EPA's mitigation hierarchy, are described in Table 8-20.

8.5.3. Rehabilitation and Closure

8.5.3.1. Mitigation Risks at Closure

The proposed end land use post-mining is rehabilitation to create a safe, stable and non-polluting landscape revegetated with native species, which considers environmental and cultural heritage outcomes and ensures the site does not adversely impact on the current surrounding land use. Due to the nature of the mining activity, the final landform will include large voids and WRL. Therefore, it will unlikely support pastoral activities in the immediate disturbed areas. However, it is recognised that surrounding areas are likely to remain subject to pastoral activity. The final land use will be confirmed before closure during the final planning phases and in consultation with Traditional Owners and relevant stakeholders.

The West Angelas Revised Proposal MCP has been prepared to address closure requirements for the Proposal (Appendix A.5).

The MCP includes objectives to ensure that vegetation on rehabilitated land consists of self-sustaining native species and is compatible with the post-mining land use; that final landforms are stable and consider ecological and hydrological factors and do not represent a significant ecological risk.

General rehabilitation practices will include:

- Undertake progressive rehabilitation to minimise the extent of cleared areas using recovered topsoil Local provenance seed and propagated material will be used (if required) to rehabilitate disturbed areas
- Inclusion of culturally significant flora species as appropriate in rehabilitation areas to facilitate cultural use, and fauna return
- Weed spraying will occur after areas are rehabilitated over the LoM as required
- Indicative closure completion criteria include:
 - Seed used in rehabilitation works is of local provenance
 - Native plants within rehabilitated areas are observed to flower and/or fruit
 - Recruitment of native perennial plants is observed
 - Species richness of native perennial plants within rehabilitated areas is not less than reference sites
- Any weed species recorded within rehabilitation areas are present within the local area
- Pits will be backfilled to prevent the formation of pit lakes post closure and will minimize potential impacts on potential groundwater dependent ecosystems.

The Proponent has included a progressive rehabilitation summary regarding current practice and outcomes for the Approved Proposal within the MCP (Appendix A.5). Rehabilitation for the Approved Proposal is conducted in accordance with the Proponent's standard procedures. Cleared areas are rehabilitated to create a safe, stable and non-polluting landscape vegetated with native species of local provenance, to maximise environmental and cultural heritage outcomes, and ensure the site is compatible with the surrounding and proposed post-mining land use. Local undisturbed vegetation guides rehabilitation activities such as seed list development and rehabilitation quality assessment.

8.5.4. Summary of the Application of the Mitigation Hierarchy

As described above, the Proposal has been designed to avoid and mitigate impacts. Table 8-20 summarises the mitigation hierarchy for this Proposal.

Table 8-20: Application of the Mitigation Hierarchy for Flora and Vegetation

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Clearing of Native Vegetation	Measures to Minimise			
	<p>The proposed clearing has been minimised through project optimisation to reduce the total extent of clearing as far as practicable.</p> <p>Total extent of clearing required reduced from 7,200 ha (as referred) to 5,350 ha and Revised Development Envelope from 41,484 ha (as referred) to 36,779 ha (amended via s.43A)</p> <p>To minimise the impact on native vegetation, the Proponent will:</p> <ul style="list-style-type: none"> • Implement an upper clearing limit of 2 ha for the regionally significant vegetation; West Angelas Cracking Clays Priority 1 PEC, for the Proposal as detailed in the West Angelas EMP (Appendix A.8) • Implement upper clearing limit of 35 ha for riparian vegetation for the Proposal as detailed in the West Angelas EMP (Appendix A.8) • Ensure clearing occurs only in approved areas through continued implementation of the Proponent's Approvals Request System • Utilise existing disturbed areas wherever practicable • Conduct a site induction program to provide information on vegetation protection and ground disturbance authorisation procedures 	Proposal specific		<ul style="list-style-type: none"> • The use of upper clearing limits for significant vegetation will ensure that the Proposal's impact on these vegetation types does not exceed proposed limits to ensure impacts do not exceed those presented in this ERD • Clearing limits are successfully used at current operations to minimise impacts on flora and vegetation • Clearing limits are considered to be an effective mitigation strategy for minimising impacts on flora and vegetation • The Proponent's Approval Request System is a well-established mechanism for prioritising the avoidance of higher value areas and is considered an effective control

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Rehabilitate			
	<ul style="list-style-type: none"> • Prepare an MCP following DMIR’s Guidelines for Preparing MCPs (Appendix A.5) • The Proponent commits to undertaking progressive rehabilitation to minimise the extent of cleared areas as well as restore vegetation using recovered topsoil and seed of local provenance where possible • Consult with Yinhawangka on Backfilling pits at Mt Ella East, and adhere to any management actions agreed to in the SCHMP • Ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use – including: <ul style="list-style-type: none"> ○ Topsoil to be re-spread over rehabilitated areas to act as a seed source ○ Local provenance seed and propagated material will be used (if required) to rehabilitate disturbed areas 	<p>A Proposal specific MCP has been developed, based on RTIO standard approach to closure planning, that includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use</p>	<p>Yes – DMIRS for implementation of the MCP (Appendix A.5)</p>	<ul style="list-style-type: none"> • Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a, b). The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b) • Rehabilitation success across other Rio Tinto Projects in the Pilbara has been variable to date. Some areas indicate positive performance and very good rehabilitation, but some other historical areas have poor rehabilitation outcomes. In response and in consultation with DMIRS, the Proponent has recently undertaken extensive revisions of mine closure planning (for all its Pilbara operations) to ensure, among other things, improved detail is provided on how closure objectives, such as those related to progressive rehabilitation, will be achieved successfully
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	
	Upper clearing limits for West Angelas Cracking Clays Priority 1 PEC, riparian vegetation		Ministerial condition with upper clearing limits for regionally significant vegetation	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Clearing of Priority Flora Species	Measures to Minimise			
	<p>The Proponent will minimise impacts to Priority flora species within the Revised Development Envelope, as far as practical. Proposed clearing based on the conceptual footprint is detailed in Table 8-17.</p> <ul style="list-style-type: none"> Ensure clearing occurs only in approved areas through continued implementation of the Proponent's Approvals Request System Utilise existing disturbed areas wherever practicable 	Proposal specific	No	<ul style="list-style-type: none"> These Management Strategies have been implemented across the Proponent's operations in the Pilbara and are regarded as having a high level of certainty There is a high degree of certainty in relation to this mitigation The Proponent's Approval Request System is a well-established mechanism for prioritising the avoidance of higher value areas and is considered an effective control
	Measures to Rehabilitate			
	<p>The Proponent commits to undertake progressive rehabilitation to minimise cleared areas' extent and restore vegetation using recovered topsoil and seed of local provenance, where practicable</p>	<p>A Proposal specific MCP has been developed based on RTIO standard approach to closure planning, that includes a Closure Objective to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use</p>	Yes – DMIRS for implementation of the MCP (Appendix A.5).	<ul style="list-style-type: none"> The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b) Moderate certainty. Rehabilitation will be required to provide a stable landform with habitat features. However, the uncertainty in relation to the recreation of habitat values such that Priority flora will return following mining is acknowledged. Therefore, clearing is treated as long-term or permanent impact for this assessment
Indirect Impacts				
Degradation of Vegetation Condition due to Increased	Measures to Minimise			
	<p>The Proponent will avoid introducing new weed species listed as WoNS entering the Revised Development Envelope through implementation of</p>	Standard business practice and Proposal specific	No	<ul style="list-style-type: none"> Implementation of the West Angelas EMP to date has been effective for management of factors managed by the

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
<p>Abundance and Diversity of Weeds</p>	<p>the West Angelas EMP (Appendix A.8) which may include:</p> <ul style="list-style-type: none"> • Equipment hygiene and inspection certificate required for all earth moving vehicles, heavy machinery and drill rig equipment entering and leaving the Revised Development Envelope or moving between identified weed infestation areas to areas that are not infested • No transfer or relocation of material potentially harbouring weeds/weed seeds is permitted from identified weed infested areas to areas with no/low weed infestation (e.g., transfer of topsoil from identified weed infested areas to areas with no/low weed infestation) • Infested or potentially infested material will be quarantined to areas with existing infestations • A baseline weed and introduced species survey will be commissioned to inform the survey and control program • The survey and control program will include a review to identify and target high risk areas (e.g., environmental value, existing weed presence, status of weeds that are present, and potential for further transfer/dispersal e.g., waterways and high trafficable areas) • Implement the targeted survey and control program at target high risk areas • Use the results of the survey and control program to inform targeted management • The results of the survey and outcomes of weed management will be reported annually in the Annual Compliance Assessment Report (including to DCCEEW) 			<p>EMP. Proposed management in the EMP is considered effective</p> <ul style="list-style-type: none"> • The management strategy will minimise the spread and introduction of weed species within the Revised Development Envelope • These Management Strategies have been implemented at other Proponent operations in the Pilbara (e.g. Greater Paraburdoo) and are regarded as having a high level of certainty (EMP; Appendix A.8)

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Rehabilitate			
	<ul style="list-style-type: none"> Undertake weed spraying during rehabilitation, especially during the LoM Include indicative closure completion criteria to ensure that the only weed species recorded within rehabilitation areas are also present within the local uncleared area If suitable species are identified through the ethnobotanical heritage surveys or other sources, the seed mixes will be detailed within the MCP with processes for consultation and involvement of Traditional Owners regarding MCPs to be included in the co-designed SCHMPs 	Standard business practise	Yes – DMIRS for implementation of the MCP (Appendix A.5)	<ul style="list-style-type: none"> Weed control during rehabilitation is an established standard practice within the mining industry The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020a) Rehabilitation will be required to provide a stable landform. However, there is uncertainty in relation to the recreation of habitat values following mining. Therefore, clearing is treated as a long-term or permanent impact for this assessment
	Proposed Limits on Impact to Ensure Environmental Outcomes	Mechanism for Limit		
	No WoNS introduced, attributable to the Proposal	Implementation of Weed Management Strategy as detailed in the EMP (Appendix A.8:		
Degradation or Alteration of Vegetation as a Result of Altered Hydrological Regimes	Measures to Avoid			
	<p>Deposits F North and H will avoid direct impacts to the natural flows of large creek systems and the vegetation communities supported by them by placing landforms and infrastructure outside the 1:100yr ARI floodplain extent.</p> <p>Riparian vegetation along the major creeklines is not proposed to be subject to additional surplus water discharge as a result of the Proposal. Continue to avoid discharge footprint (wetting front) within 2 km of KNP in accordance with requirements of MS 1113.</p>	Project specific	No	N/A

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	No BWT mining at Western Hill to ensure no significant GW drawdown risk to pGDE receptors in Karijini National Park.			
Measures to Minimise				
	<p>The Proponent will ensure that:</p> <ul style="list-style-type: none"> In accordance with the water use hierarchy, surplus water will be used for operational purposes, preferentially temporarily stored in suitable disused mine pits, (to be used for operational purposes), used in the MAR or discharged to Turee Creek East if excess to requirements (Section 6). Reduction of Turee Creek East flows from the development of Western Hill will be minimised through the design and construction of appropriate surface water management infrastructure to facilitate the natural flows as much as possible Limit impact to the Deposit H Waterhole catchment to ensure sufficient flows are maintained to facilitate filling of the pool in line with pre mining frequency and level, (refer to EMP; Appendix A.8) Limit impact to the Turtle Pool catchment to ensure sufficient flows are maintained to facilitate filling of the pool in line with pre mining frequency and level (refer to EMP; Appendix A.8) Groundwater Environmental Management Plan will be implemented to ensure no change to groundwater levels at the boundary of, or within Karijini National Park that are attributable to the Proposal as a result of 	Project specific	No	<p>The water use strategy was developed in conjunction with the water use hierarchy (refer to Section 6) and provides a robust decision-making framework to ensure outcomes are achieved, certainty and effectiveness of this measure is considered high</p> <p>These measures are well established practices in the mining industry and is regarded as having a high level of certainty</p>

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	supply abstraction to minimise potential impacts on PGDE within Karijini National Park			
	Measures to Rehabilitate			
	<p>The Proponent will implement an MCP following DMIRS Guidelines (DMIRS 2020a).</p> <p>The Proponent commits to undertaking progressive rehabilitation to minimise the extent of cleared areas as well as restore vegetation using recovered topsoil and seed of local providence where possible.</p>	Standard business practice	No	Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a. The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020a.
	Proposed Limits on Impact to Ensure Environmental Outcomes	Mechanism for Limit		
Implementation of monitoring and management in relation to flows to Deposit H surface water fed ephemeral pool as detailed in the Proposal EMP (Appendix A.8). Discussed further in Section 6.	Ministerial Conditions to ensure flows to Deposit H ephemeral pool are retained such that the pool fills with frequency and depth similar to pre-mining conditions. <ul style="list-style-type: none"> • Outcome-based provisions in the EMP (Appendix A.8) 			
Degradation of Vegetation from Dust Deposition and Potential Increase in Fire Risk	Measures to Minimise			
	<ul style="list-style-type: none"> • Implementation of dust suppression techniques such as sprayers on crushers and water trucks is expected to help minimise dust generation during construction and operation • Limiting the amount of disturbed land to as small as reasonable reducing the amount of dust producing surfaces • Continuation of fire management measures such as hot works permit system, vehicle movement (not leaving cleared tracks) and disposal of potential fire-starting waste [e.g. 	Standard business practise	No	<p>These measures have been developed to meet the current industry standards for managing dust suppression. The management strategy will minimise the amount of dust generated within the Revised Development Envelope as a result of the Proposal.</p> <p>These management strategies have been implemented across the Proponent's operations in the Pilbara and are regarded as having a high level of certainty.</p>

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>cigarette butts] is expected to minimise the risk of bushfires as a result of the Proposal</p> <ul style="list-style-type: none"> • Firefighting equipment will be located around the site and in vehicles. Fire response procedures and personnel training will also be provided, including site inductions on fire prevention and management 			
	Proposed Limits on Impact to Ensure Environmental Outcomes	Mechanism for Limit		
	No limits proposed – managed through industry standard practice	No limits proposed – managed through industry standard practice		
	Measures to Minimise			
Extend protection to non-listed species that are otherwise culturally important to Traditional Owner Groups	<p>Ethnobotanical / Traditional Ecological Knowledge surveys are being conducted and more planned with Traditional Owners to provide more information on native honeybees, honey trees and myriad other species of cultural importance.</p> <p>The Proponent will also work with Traditional Owners to ensure culturally important plants are considered for use in rehabilitation.</p> <p>Further work will occur to understand the potential use of these species in rehabilitation</p>	Standard business practise		<p>If suitable species are identified through the ethnobotanical surveys or other sources, the seed mixes will be detailed within the MCP (processes for consultation and involvement of Traditional Owners regarding MCP's are also expected to be included in the co-designed SCHMPs).</p> <p>Results will inform ongoing social, cultural and heritage management, closure planning and ongoing Traditional Owner consultation.</p>

8.6. Assessment and Significance of Residual Impact

8.6.1. Assessment of Direct Impacts

8.6.1.1. Clearing of Native Vegetation (including Riparian Vegetation)

The Proposal will clear up to an additional 5,350 ha of native vegetation within the Revised Development Envelope, of which 4,922 ha is of good to excellent condition. All vegetation within the Revised Development Envelope is represented in the surrounding region at the vegetation association and local vegetation type level of classification and mapping (Biota 2021).

Riparian Vegetation

The Proposal will clear an upper limit of 35 ha of riparian vegetation. This is in addition to the approved 25 ha (totalling an upper limit of 60 ha for the Revised Proposal) (Table 8-14). The local vegetation types that make up the 35 ha are: D2, D3, D10, D11, and D12 (Table 8-4). D2 is associated with major drainage lines and the other types are associated with minor to moderate drainage lines (Biota 2020). All watercourses and tributaries are highly ephemeral, and riparian vegetation supports higher fauna values (refer to Section 8.3).

High Local Significance Vegetation

Clearing includes two vegetation types (excluding D11 in which is addressed as riparian vegetation) considered to be of potential high local significance due to instances of Priority flora within their extents (maintenance of flora values is discussed in section 8.6.1.2).

Table 8-21: Assessment of Direct Impacts on Potential High Local Significance Vegetation

Vegetation Type	Extent in the Revised Development Envelope (ha)	Estimated impact within Revised Development Envelope (ha [%])	Assessment of Impacts
H15	1,729	146 (8.4)	<p>The vegetation hosts 10 Priority flora species (two - P2, six - P3 and two - P4); however, these species also occur in at least three other vegetation types within the Revised Development Envelope.</p> <p>The Proposal will remove approximately 146 ha of the mapped extent of this vegetation type in the Revised Development Envelope (approximately 8.4%). As such, the proposed clearing of this vegetation type is not expected to impact the vegetation type significantly.</p>
P8	159	14 (8.8)	<p>This vegetation type occurs sporadically in the Revised Development Envelope. It supports two P2 flora species and one P3 flora species; however, these species have also been recorded in at least three vegetation types within the Revised Development Envelope.</p> <p>The Proposal will remove approximately 14 ha (8.8%) of the mapped extent of this vegetation type; as such, the proposed clearing of this vegetation type is not expected to impact the vegetation type significantly.</p>

Vegetation Condition

The Proposal will result in clearing up to an additional 5,350 ha of native vegetation, of which approximately 4,922 ha is in good to excellent condition. This is considered a significant residual impact; therefore, the Proponent proposes to offset this clearing (Section 12).

8.6.1.2. Loss of Priority Flora Individuals

The Proponent has taken measures to avoid and minimise all impacts to Priority flora as practicable. No Threatened and P1 species have been recorded within the Revised Development Envelope (Table 8-3).

Clearing will result in direct impacts to individuals from four P2, ten P3 and two P4 flora taxa (Table 8-17). However, implementation of the Proposal is not expected to significantly impact any Priority flora species or cause change the conservation status of any Priority flora.

***Aristida lazaridis* (P2)**

A total of 906 individuals have been recorded within the Revised Development Envelope, of which approximately 285 (31.4% of records within the Revised Development Envelope) recorded individuals may be impacted by the Proposal (including Proposal flexibility) (Rio Tinto 2022c). These individuals account for only 2.6% of all recorded individuals within the state (approximately 10,912 individuals).

This species is widely distributed over a range of 133 km from near the Rangers Station in Karijini National Park southeast to near Hope Down 4 camp. There are currently 88 known location records of the species consisting of at least 849 individuals. Given the extent of the impact and representation of the species regionally, the Proponent does not anticipate that the Proposal will affect the conservation status or viability of the species; therefore, the Proposal is not expected to impact this species significantly.

***Eremophila pusilliflora* (P2)**

A total of 266 individuals have been recorded within the Revised Development Envelope, of which approximately 21 (7.9%) recorded individuals may be impacted by the Proposal (including Proposal flexibility). These individuals account for only 0.23% of all currently recorded individuals within the state (approximately 9,191 individuals) (Rio Tinto 2022c).

The remaining population of this species occurs across Augustus, Fortescue and Hamersley subregions. Given the extent of the impact and representation of the species regionally, the Proponent does not anticipate that the Proposal will affect the conservation status or viability of the species; therefore, the Proposal is not expected to impact this species significantly.

***Eremophila* sp. West Angelas (S. van Leeuwen 4068) (P2)**

A total of 53 individuals have been recorded within the Revised Development Envelope. This species is known to occur in the Hamersley subregion with 973 individuals currently recorded within the state.

The Proposal has been designed to avoid currently known records of this species and so the Proposal is not expected to significantly impact this species. Therefore, the Proponent does not anticipate that the Proposal will affect the conservation status or viability of the species.

***Hibiscus* sp. Gurninbiddy Range (M.E. Trudgen MET 15708) (P2)**

A total of 1,604 individuals have been recorded within the Revised Development Envelope, of which approximately 316 (19.7%) recorded individuals may be impacted by the Proposal (including Proposal flexibility). These individuals account for 5.2% of all recorded individuals within the state (approximately 6,068 individuals) (Rio Tinto 2022c). Given the extent of the impact and representation of the species regionally, the Proponent does not anticipate that the Proposal will affect the conservation status or viability of the species; therefore, the Proposal is not expected to impact this species significantly. In addition, 869 recorded individuals will be protected from disturbance within the proposed MEZs/MRZs.

***Oxalis* sp. Pilbara (M.E Trudgen 12725) (P2)**

A total of 243 individuals have been recorded within the Revised Development Envelope, of which approximately 6 (2.3%) recorded individuals may be impacted by the Proposal (including Proposal

flexibility). These individuals account for approximately 0.9% of all recorded individuals within the state (approximately 643 individuals) (Rio Tinto 2022c). Approximately 30 recorded individuals will be protected within the proposed MEZs/MRZs. Given the extent of the impact and representation of the species regionally, the Proponent does not anticipate that the Proposal will affect the conservation status or viability of the species; therefore, the Proposal is not expected to impact this species significantly.

***Tetratheca fordiana* (Priority 2)**

A total of 3,808 individuals have been recorded within the Revised Development Envelope, of which none of the current records occur within the Proposed conceptual footprint. This species is distributed within the Little Sandy Desert and Pilbara regions.

The Proponent does not anticipate that the Proposal will affect the conservation status or viability of the species.

Priority 3 and Priority 4 Species

The Revised Development Envelope contains 17 P3 and four P4 flora species. Implementation of the Proposal based on the current conceptual footprint is estimated to result in direct loss of individuals from approximately 10 P3 and two P4 flora species (Table 8-17).

Local Scale

The majority of the recorded P3 and P4 flora species will be impacted by the Proposal to some degree, ranging in impact from approximately 1.6% to 28.8% of the known records within the Revised Development Envelope. However, the Proposal will have a larger impact on the following five species:

- ***Indigofera gilesii*** (~711 individuals; 53.1%), most records of this species are from a range of 170 km through the eastern half of the Hamersley subregion, with other records 300 km south in the Murchison and over 800 km east in the Central Ranges and Tanami
- ***Olearia mucronata*** (~1 individual; 100%;), this species distribution extends over 850 km from the Pilbara to near Laverton
- ***Rhagodia* sp. Hamersley (M. Trudgen 17794)** (~634 individuals; 53%), distributed over a range of 300 km through the eastern half of the Hamersley and Fortescue subregions of the Pilbara; particularly common on clay flats between West Angelas and Hope Downs
- ***Triodia* sp. Mt Ella (M.E. Trudgen 12739)** (~27,468 individuals; 44.3%), most records of this species are from a range of 180 km through the southeastern section of the Pilbara, with a record from the northern Ashburton and one record over 220 km northeast at Rudall River
- ***Sida* sp. Barlee Range (S. van Leeuwen 1642)** (~263 individuals; 85.1%), this species is distributed over a range of 350 km through the Hamersley subregion, with records also from the northern Ashburton bioregion.

It should be noted that the percentages of the above species proposed to be cleared reflect the small population numbers recorded within the Revised Development Envelope (Table 8-17). Each of the five species listed above are known to have wide distribution ranges, (from 170 km to 850 km), suggesting that the population number for these species is likely to be significantly larger than the population that has been recorded to date. Given the extent of impact and wide distribution range of these species, the Proposal is therefore not expected to impact these species locally.

Regional Scale

At the regional scale, the total number of individuals for all P3 and P4 species present within the Revised Development Envelope represents less than 20% of the total number of individuals recorded within the

state (Table 8-17). For most of the P3 and P4 species, the individuals proposed to be cleared ranges from ~ 0.03% to ~12%.

One P3 flora species, *Triodia* sp. Mt Ella (M.E. Trudgen 12739), is expected to experience the greatest impact from the Proposal of ~17.5% reduction in recorded species. This species was recorded at 185 locations in the area from between Deposit F North and Western Hill, to south of Deposit J/ Mt Ella East. It also has a wide range of distribution of up to 180 km through the southeastern section of the Pilbara and over 220 km northeast at Rudall River.

This species typically occurs in Hill slopes and gullies which are also considered to be a high significance fauna habitat. These habitats are widely distributed across the Pilbara region and as a P3 species, this species has not been extensively surveyed. Nevertheless, given that there are 185 known location records containing 5,489 individuals and its preferred habitat is widely distributed in the region, it suggests that this species is widespread beyond what has been recorded to date. More individuals are expected to occur within the wider Pilbara region. Therefore, the Proposal is not expected to significantly impact the species at the regional scale.

8.6.2. Assessment of Indirect Impacts

8.6.2.1. Degradation or Alteration of Vegetation as a Result of Altered Hydrological Regimes

'West Angelas Cracking-Clays' Priority 1 Ecological Community

The Proposal will avoid indirect disturbance of the West Angelas Cracking Clay P1 PEC. Additionally, the Proponent's mitigation measures to ensure hydrological regimes of the PEC are maintained have proven to be reliable and satisfactory to meet the requirements of MS 1113.

Surface Water Discharges

The Proposal does not propose to discharge additional surplus water to creeklines and therefore is not expected to result in any additional impacts to vegetation due to surface water discharges. Existing approved discharge will remain unchanged and will be managed in accordance with the requirements of MS 1113 and the West Angelas EMP (Appendix A.8).

Reduction of Flows

The reduction in surface flows at local and catchment scales as a result of the Proposal is considered highly unlikely to cause significant degradation or alteration of vegetation communities. Creek flow regimes (such as flow pathways and water quality) will be similar to pre-mining regimes and impacts to any downstream riparian or potential GDE values associated with Turee Creek East (feature 22, zone C; refer to Table 8-6 and Table 8-7) and other identified potential GDE features (1a, 12a and 14; refer to Table 8-6) (Figure 8-7) are unlikely, particularly given the high variability in rainfall patterns in the Pilbara region and that such variability will likely be increasing as a result of seasonal and climate variability (Section 7.6.1.3). Feature 22 is also fed from a northern tributary which will be unaffected by the Proposal.

Alternative mining scenario's and potential management and monitoring with respect to development at Deposit H are the subject of ongoing consultation with Traditional Owners (Sections 6 and 7) in relation catchment impacts to maintain flows and filling regime of Deposit H Waterhole, and limit downstream impacts to vegetation and interim provisions are included in the West Angelas EMP (Appendix A.8) and the Ngarlawangga SCHMP (Appendix B.2.d) to be amended as consultation progresses.

No further mitigation specific to management of impacts to riparian or potential GDE values are proposed in relation to Deposit H Waterhole, the downstream gully or other potential GDE features, as no significant impacts to riparian or potential GDE features have been identified in this area.

Groundwater Drawdown

The Proposal's potential to impact groundwater dependant vegetation is highly constrained, owing to the naturally deep groundwater levels. There are no confirmed GDE supported by regional groundwater sources within the Proposal Area or Revised Development Envelope and limited potential GDE's within the Revised Development Envelope. Groundwater abstraction at Western Hill has been limited to water supply only (no BWT mining) and is highly unlikely to impact groundwater levels at the boundary of or within Karijini National Park or potential groundwater dependent vegetation zones identified (Rio Tinto 2017; Figure 8-12).

The Proponent will continue to ensure that the Proposal does not change groundwater levels or quality within or at the boundary of Karijini National Park in accordance with existing requirements (Condition 6-1 of MS 1113 and Condition 3 of DN 2018/8299).

The Western Hill deposit is located nearby to Karijini National Park and the orebody aquifer at this deposit which will be targeted for supply is expected to be somewhat connected to the regional Wittenoom aquifer which is located to the south of Western Hill at Deposits C and D and extends westwards into Karijini National Park. While BWT mining at Western Hill has been removed from the scope of this Proposal owing to its proximity to Karijini National Park, the abstraction of a small portion of groundwater (~0.37 GL/a) for water supply to meet operational requirements is required. Abstraction will be carried out to ensure the risk to groundwater levels at the Karijini National Park boundary is as low as reasonably practicable. The current Groundwater Environmental Management Plan will be updated and implemented prior to abstraction of water at Western Hill to ensure drawdown from supply abstraction at Western Hill does not impact groundwater at the boundary of or within Karijini National Park and the Proponent will continue to ensure that the Proposal does not change groundwater levels or quality within or at the boundary of Karijini National Park in accordance with existing requirements (Condition 6-1 of MS 1113 and Condition 3 of DN 2018/8299).

Some lowering of the groundwater table is also expected at Deposit H and Deposit F North; however, the hydrogeology of these deposits restricts the extent of drawdown, while the natural depth to groundwater precludes reliance by vegetation (refer to Section 7 for further detail). The West Angelas EMP will be implemented and includes monitoring and mitigation in relation to Deposit H Waterhole and Turtle Pool (EMP; Appendix A.8).

8.6.2.2. Degradation of Vegetation Condition due to Increased Abundance and Diversity of Weeds

The Proponent has well-established strategies for managing weeds at its Pilbara operations to minimise weeds and spread risks. This includes the management of weeds associated with the discharge of surplus water in creeklines. Weed monitoring and management strategies have been and will continue to be implemented to minimise the risk of weeds (refer EMP; Appendix A.8).

On this basis, the Proposal is not expected to significantly impact the condition of native vegetation through the spread or introduction of weed species. Any impacts are predicted to be localised to disturbed areas and will not impact vegetation in surrounding areas. As a result, no significant residual impacts on vegetation conditions from the spread of weeds are expected from the Proposal.

8.6.2.3. Degradation of Vegetation from Dust Deposition and Potential Increase in Bushfire Risk

Matsuki et al. (2016) conducted a study examining the impacts of dust on plant health in semi-arid environments. The study found no evidence of negative impacts on plant health for dust deposition rates up to 77 g/m²/month.

The Proponent has well-established strategies for managing dust emissions at its Pilbara operations to minimise the likelihood of weed species being introduced or spread as documented in the West Angelas EMP. These strategies will continue to be implemented to manage dust emissions. Strategies include actions. The key actions include the periodic spraying of cleared areas, particularly higher risk areas (such as sensitive receptors), and the management of vehicle, machinery and equipment hygiene.

With carefully managed and monitored hot works, vehicle movement, personnel training and disposal of potential fire-starting waste (e.g., cigarette butts), the Proposal is not expected to alter the fire regime within the area after implementing fire management measures.

The potential impacts from dust and altered fire regimes on vegetation are unlikely to be significant.

8.6.3. Assessment of Cumulative Impacts

8.6.3.1. Cumulative Impacts on Native Vegetation

The Proposal will clear up to 5,350 ha of native vegetation, of which approximately 4,922 ha is in good to excellent condition. Vegetation to be cleared within the Revised Development Envelope comprises three vegetation associations as mapped by Beard (Hamersley 18, Hamersley 29 and Hamersley 82). Each vegetation association within the Revised Development Envelope represents approximately 3.3%, 0.3% and 0.8% of the current pre-European extent within the Hamersley subregion (Table 8-18).

The assessment shows that the Proposal will have negligible cumulative effects at these scales, with 89% of pre-European extents remaining within the Hamersley subregion following the implementation of the Proposal and reasonably foreseeable projects. The maximum impact of clearing will be associated with Hamersley 18 at 15.5%, with the Proposal contributing 0.4%. There are no significant impacts to any vegetation associations from the cumulative disturbance of reasonably foreseeable projects. This is because less than 4% of each vegetation association in the Hamersley subregion is contained within the Conceptual Footprint of the Proposal and the relevant project development envelopes.

The National Objectives and Targets for Biodiversity Conservation include avoiding clearance of existing vegetation with a pre-European extent of below 30.0% (Commonwealth of Australia 2001). Following the implementation of the Proposal and cumulative impacts from approved projects, at least 89% of pre-European extent for each vegetation association will remain in the state (Table 8-18).

Clearing of vegetation in good to excellent condition is considered a significant impact even though the remaining extent of vegetation associations potentially impacted by the Proposal and their representation in areas managed for conservation indicates no significant residual impacts on vegetation at the regional scale. The clearing of vegetation in good to excellent condition is required to be offset by the Proponent via contributing to the Pilbara Environmental Offset Fund (PEOF), this is discussed in Section 12.

8.6.3.2. Cumulative Impacts on Priority Flora Individuals

As a result of the Proposal's implementation and reasonably foreseeable projects, it is expected that four P2 flora species within the Hamersley subregion will be impacted cumulatively. This includes (Table 8-19):

- ~1,057 individuals (9.7% of recorded individuals in the state) of *Aristida lazaridis* (P2)
- ~23 individuals (0.2% of the recorded individuals in the state) of *Eremophila pusilliflora* (P2)
- ~654 individuals (10.8% of the recorded individuals in the state) of *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2)
- ~14 individuals (2.1% of the recorded individuals in the state) of *Oxalis* sp. Pilbara (M.E. Trudgen 12725 a).

The recorded extents of these species have been calculated based on the Rio Tinto and DBCA database, which includes records of Priority flora species across the Pilbara region. Given that none of the Priority 2 species listed above will be impacted by more than 11% (based on conservative estimates), the cumulative impacts are not considered to be significant.

For P3 and P4 flora species, the cumulative impact (based on other projects' Development Envelopes) on each species ranges from 1.8% to 31.2% (Table 8-19). Given that at least around 70% of the species

records remain in the region, the cumulative impacts to these species are not considered to be significant.

Cumulative impacts to significant flora species within the Revised Development Envelope that also occur across multiple projects within the Hamersley subregion are unlikely to alter the conservation status of any of the Priority flora species within the Revised Development Envelope. Therefore, cumulative impacts on Priority species are not expected to be significant.

8.6.4. Significance of Residual Impacts

8.6.4.1. Non-Significant Residual Impacts

Direct Impacts

The proposed avoidance and management measures associated with the Proposal demonstrate non-significant residual impact to Flora and Vegetation, including:

- Estimated clearing of the following Priority flora species:
 - 285 recorded individuals of P2 *Aristida lazardis* (2.6% of known individuals in the state)
 - 21 recorded individuals of P2 *Eremophila pusilliflora* (0.23% of known individuals in the state)
 - 316 recorded individuals of P2 *Hibiscus* sp. Gurinbidy Range (M.E. Trudgen MET15708) (5.2% known individuals in the state)
 - 6 recorded individuals of P2 *Oxalis* sp. Pilbara (M.E. Trudgen 12725) (0.9% of known individuals in the state)
 - 13 recorded individuals of P3 *Acacia effusa* (0.14% of known individuals in the state)
 - 243 recorded individuals of P3 *Aristida jerichoensis* var. *subspinulifera* (1.8% of known individuals in the state)
 - 1,728 recorded individuals of P3 *Eremophila naaykensis* (A.L.Curtis & K.R.Thiele) (12% of known individuals in the state)
 - 75 recorded individuals of P3 *Grevillea saxicola* (1.4% of known individuals in the state)
 - 711 recorded individuals of P3 *Indigofera gilesii* (6.6% of known individuals in the state)
 - 356 recorded individuals of P3 *Isotropis parviflora* (5.4% of known individuals in the state)
 - 1 recorded individual of P3 *Olearia mucronata* (0.35% of known individuals in the state)
 - 634 recorded individuals of P3 *Rhagodia* sp. Hamersley (M. Trudgen 17794) (0.6% of known individuals in the state)
 - 34 recorded individuals of P3 *Solanum kentrocaule* (2% of known individuals in the state)
 - 27,468 recorded individuals of P3 *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (17.5% of known individuals in the state)
 - 1 recorded individual of P4 *Acacia bromilowiana* (0.03% of known individuals in the state)
 - 263 recorded individuals of P4 *Sida* sp. Barlee Range (S. van Leeuwen 1642) (2% of known individuals in the state)
- Estimated clearing of:
 - Approximately 9% of the Revised Development Envelope of other high local significance vegetation (H15 and P8; Section 8.5).

Indirect Impacts

- Degradation or alteration of vegetation as a result of altered hydrological regimes (Section 8.6.2.1)
- Degradation of vegetation condition due to increased abundance and diversity of weeds (Section 8.6.2.2)
- Degradation of vegetation from dust deposition and potential increase in bushfire risk (Section 8.6.2.3).

Cumulative Impacts

- Cumulative impacts on priority flora individuals (Section 8.6.3.2).

8.6.4.2. Significant Residual Impacts

After application of mitigation measures, the following significant residual impacts are predicted to Flora and Vegetation:

- Clearing of approximately 4,922 ha of native vegetation in good to excellent condition. This is considered a significant impact for the Proposal as per the EPAs cumulative environmental impacts of development in the Pilbara region (EPA 2014). This clearing is proposed to be offset as per Section 12
- Clearing of up to 2 ha vegetation type (P15) considered to represent the Priority 1 PEC - West Angelas Cracking-Clays (P1). This PEC is restricted to the West Angelas area
- Clearing of up to 35 ha of riparian vegetation.

8.6.5. Summary of Residual Impacts and Proposed Regulatory Mechanisms

A summary of the Flora and Vegetation residual impacts and the proposed conditions, EMP requirement and applicable DMA regulations is provided in Table 8-22.

Table 8-22: Significance of Residual Impacts

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
Significant Residual Direct Impacts		
Clearing of up to 5,350 ha of native vegetation, of which approximately 4,922 ha is in good to excellent condition (including riparian vegetation)	<ul style="list-style-type: none"> • The clearing associated with the Proposal represents 14.5% of the Revised Development Envelope • Clearing of an additional 35 ha of riparian vegetation may result in a significant residual impact where riparian vegetation is cleared, and is required to be offset (Section 12) • Clearing vegetation in good to excellent condition is considered a significant residual impact and is required to be offset (Section 12) 	Proposed to be regulated through implementation of: <ul style="list-style-type: none"> • Ministerial condition limiting the extent of clearing of native vegetation, including riparian vegetation • Ministerial condition requiring offset for clearing of good to excellent condition vegetation and riparian vegetation (Section13)
Clearing of regionally significant vegetation type	<ul style="list-style-type: none"> • Clearing up to an additional 2 ha (limit) of for the Priority 1 PEC (West Angelas Cracking-Clays) or vegetation type P15, (22 ha total) which is considered representative of this PEC is 	Proposed to be regulated through implementation of: <ul style="list-style-type: none"> • Ministerial condition requiring offset for clearing associated with PEC (vegetation unit P15)

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
	considered to have a significant residual impact	
Non-Significant Residual Direct Impacts		
Impact to Priority flora species	<ul style="list-style-type: none"> The Revised Development Envelope contains 28 Priority flora species (seven Priority 2, 17 Priority 3 and four Priority 4 flora species). Impacts to Priority flora (8.4.1) is not considered to have a significant residual impact 	<ul style="list-style-type: none"> No limits proposed
Clearing of high local significance vegetation types	<ul style="list-style-type: none"> Clearing of approximately 9% of Revised Development Envelope of other high local significance vegetation (H15 and P8; Section 8.5) is considered to have a significant residual impact 	
Non-Significant Indirect Impacts		
Degradation of Vegetation Condition due to Increased Abundance and Diversity of Weeds	<ul style="list-style-type: none"> The Proponent has proposed mitigation measures in the EMP to manage indirect impacts that weeds can have on vegetation These mitigation measures are expected to be consistent with the EPA's objectives 	<ul style="list-style-type: none"> Regulated by: The implementation of West Angelas EMP (Appendix A.8)
Degradation or Alteration of Vegetation as a Result of Altered Hydrological Regimes	<ul style="list-style-type: none"> No change to approved discharge to Turee Creek proposed The Proponent's avoidance and minimisation measures are considered to be sufficient to ensure the EPA objective is met 	<ul style="list-style-type: none"> Infrastructure preferentially located outside of 1:100 yr ARI event floodplain Infrastructure within the riparian zone will be removed as described in the MCP if no longer required
Degradation of Vegetation from Dust Deposition	<p>The Proponent has proposed mitigation measures, including:</p> <ul style="list-style-type: none"> Dust suppression techniques such as sprayers on crushers and water tanks utilising surplus water from groundwater abstraction Ensuring the amount of disturbed land is as small as reasonable, reducing the amount of dust generating surfaces Implementation of speed limits on unsealed roads and tracks to reduce dust generation <p>These mitigation measures are expected to be consistent with the EPA's objectives</p>	<ul style="list-style-type: none"> No limits proposed Dust emissions managed through West Angelas EMP (Appendix A.8) and Part V of the EP Act
Degradation of Vegetation from Potential Increase in Bushfire Risk	<p>The Proponent has proposed mitigation measures, including:</p>	<ul style="list-style-type: none"> No limits proposed Bushfire risk managed through West Angelas EMP (Appendix A.8) and Mine Safety Inspection Act 1994 and Bushfire Act 1954

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
	<ul style="list-style-type: none"> • No clearing activities are undertaken when fire danger rating is severe or above • Management and monitoring of hot works, vehicle movement and disposal of potential fire-starting waste • Firefighting equipment present around the site and within vehicles and fire response training for all personnel <p>These mitigation measures are expected to ensure outcomes consistent with the EPA's objectives</p>	

8.7. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

8.7.1. Proposal

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the **Proposal**, the anticipated environmental outcomes that apply to Flora and Vegetation are set out below.

- Clearing for the **Proposal** will not exceed:
 - 5,350 ha of native vegetation, which includes approximately 4,922 ha of vegetation in Good to Excellent condition
 - 2 ha of the West Angelas Cracking-Clays (P1) or vegetation type P15 mapped within the Revised Development Envelope
 - 35 ha of riparian vegetation
- No direct or indirect disturbance to the West Angelas Cracking Clay Priority Ecological Community (Representation PEC-2015-5) due to the Revised Proposal that results in an irreversible impact

8.7.2. Revised Proposal

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the **Revised Proposal**, the anticipated environmental outcomes that apply to Flora and Vegetation are set out below.

- Clearing for the **Revised Proposal** will not exceed:
 - 17,555 ha of native vegetation
 - 22 ha of the West Angelas Cracking-Clays (P1) or vegetation type P15 mapped within the Revised Development Envelope

- 60 ha of riparian vegetation
- No direct or indirect disturbance to the West Angelas Cracking Clay Priority Ecological Community (Representation PEC-2015-5) due to the Revised Proposal that results in an irreversible impact
- The Proponent will implement the West Angelas EMP as per Appendix A.8 to achieve these outcomes.

8.7.3. Summary

Subject to conditions recommended in Table 8-22 and implementation of offsets (Section 12), the Proponent considers the Proposal can be managed to meet the EPA's objective to protect Flora and Vegetation so that biological diversity and ecological integrity are maintained.

9. TERRESTRIAL FAUNA

9.1. EPA Environmental Factor and Objective

The EPA’s Statement of Environmental Principles, Factors and Objectives (EPA 2021c) lists the following objective for Terrestrial Fauna:

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained

For this EIA, terrestrial fauna are defined as animals living on land or using land for all or part of their lives. Terrestrial fauna includes vertebrates (birds, mammals including bats, reptiles and amphibians) and invertebrates (arachnids, crustaceans, insects, molluscs and worms) (EPA 2016d). No aquatic fauna are relevant to this Proposal and, therefore, not addressed further (see Section 7).

Fauna habitat is defined as the natural environment of an animal or assemblage of animals, including biotic and abiotic elements, that provides a suitable place for them to live (e.g., breed, forage, roost, or seek refuge (EPA 2016d).

All conservation significant terrestrial fauna species and habitat relevant to the Proposal are addressed in this chapter, and additional information specific to MNES species is provided in the MNES chapter (Section 13).

9.2. Relevant Policy and Guidance

Table 9-1 presents relevant policy and guidance for Terrestrial Fauna and demonstrates how they have been considered for the Proposal.

Table 9-1: Relevant Policy and Guidance for Terrestrial Fauna

Policy or Guidance	Explain How the Policy and Guidance has been Considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for terrestrial fauna forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d)	This assessment has considered the objective for the Terrestrial Fauna factor in its assessment.
Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a)	Considered in the design (methods and approach) of fauna surveys (previous guidelines were used where surveys were undertaken before current guidelines).
Technical Guidance: Sampling of Short-Range Endemic Invertebrate Fauna (EPA 2016e)	
Instructions on how to prepare an Environmental Review Document (EPA 2021b)	This document forms the basis of the headings and content provided in this ERD.
Instructions on how to prepare EP Act Part IV Environmental Management Plans (EPA 2021f)	Considered during the development of this document and the EMP.
Template for EP Act Part IV Reconciliation Procedures (2021j)	Considered during the development of this document and the IRP.

Policy or Guidance	Explain How the Policy and Guidance has been Considered
Other State or Commonwealth	
Mine Closure Plan Guidance – How to Prepare in accordance with Part 1 of the Statutory Guidelines (DMIRS 2020a)	The MCP has been prepared in accordance with the guidance and addresses matters related to terrestrial fauna (Appendix A.5).
Statutory Guidelines for Mine Closure Plans (DMIRS 2020b)	
WA Environmental Offsets Policy (GoWA 2011)	Considered in the determination of significant residual impacts and offset strategy for terrestrial fauna.
WA Environmental Offsets Guidelines (GoWA 2014).	
EPBC Act Environmental Offsets Policy (DSEWPaC 2012a)	
EPBC Act referral guideline for the endangered Northern Quoll (<i>Dasyurus hallucatus</i>) (DoE 2016b)	Considered in the design (methods and approach) of the fauna surveys.
Guidelines for surveys to detect the presence of Bilbies and assess the importance of habitat in Western Australia (DBCA 2017a)	
Interim guideline for the preliminary surveys of Night Parrot (<i>Pezoporus occidentalis</i>) in Western Australia (DPaW 2017)	
Survey guidelines for Australia's threatened bats (DEWHA 2010a)	
Survey guidelines for Australia's threatened birds (DEWHA 2010b)	
Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a)	
Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b)	
Survey guidelines for Australia's threatened frogs (DEWHA 2010c)	
Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DoE 2013)	Considered in the development of this document.

9.3. Receiving Environment

9.3.1. Studies and Survey Effort

9.3.1.1. Terrestrial Vertebrate Fauna

A total of 10 recent (within 5 years) and 7 historical studies for terrestrial vertebrate fauna have been undertaken within the Revised Development Envelope and surrounds between 2014 and 2021. Table 9-2 summarises the Proposal specific and other relevant fauna surveys and studies undertaken for Terrestrial Fauna. Recent studies and survey reports are provided in the Appendices D.4 and E.1 to E.9. Figure 9-1 illustrates how the surveys relate to each other for the Proposal. Figure 9-2 shows the key fauna surveys' spatial extent and survey effort.

9.3.1.2. Terrestrial Vertebrate Fauna Habitat Consolidation

Survey results and habitat mapping from historical terrestrial fauna surveys for previous Proposals undertaken in 2014 and recent surveys completed in 2021 within the Revised Development Envelope (Ecologia 2014; Biologic 2021c) (Figure 9-2) were reconciled and consolidated with methods and habitat classifications utilised in current studies undertaken within the Revised Development Envelope. Consolidation of fauna habitat mapping across the entire Revised Development Envelope and 20 km radius surrounds (Biologic 2021d) was undertaken to provide a high-level regional context. Minor gaps in on ground survey areas were extrapolated (taking into consideration the adjacent mapped fauna habitats, pre-European vegetation mapping, aerial imagery and topographic data) and were ground-truthed, where possible (Biologic 2021d).

9.3.1.3. SRE Invertebrate Fauna Surveys

A total of six SRE invertebrate fauna surveys have been conducted within the Revised Development Envelope and surrounds between 2012 and 2022 (Table 9-2). Invertebrate fauna records, including potential and confirmed SRE species records and habitat information have been consolidated from recent and historic surveys within and nearby the Revised Development Envelope, the West Australian Museum (WAM) databases, and the Proponent's internal invertebrate fauna database. Species identification was aligned as much as possible based on the available molecular and morphological information (Biologic 2022i).

Table 9-2: Summary of Technical Studies for Terrestrial Fauna Environmental Factor

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>Key Studies and Surveys</p> <p>Targeted Flora and Fauna Survey Mt Ella East and Deposit J pit and Waste Dump Footprints (Biologic Environmental Survey Pty Ltd (Biologic) 2022d; Appendix D.4)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0260</p>	<p>Survey Area: Mt Ella East and Deposit J covering approximately 237.9 ha of the Revised Development Envelope</p> <p>Type: A single season targeted survey for conservation significant flora and fauna and Short Range Endemics (SRE)</p> <p>Survey Methods: Habitat assessment, targeted searches, water feature and cave assessments, ultrasonic recordings and opportunistic observations</p> <p>Timing: August 2021</p>	<p>Survey Effort:</p> <ul style="list-style-type: none"> Targeted searches were undertaken at 14 locations for a total of 53.5 person-hours Targeted searches comprised 28.5 person-hours targeting Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, and 29 person-hours for Western Pebble-mound Mouse Ultrasonic bat recorders were deployed at six locations, including one in the Deposit J survey area and five within the Mt Ella East survey area. Recorders were deployed for three to four nights at each location for a total of 19 recording nights Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence <p>Limitations:</p> <ul style="list-style-type: none"> Some portions of Survey Area could not be traversed due to safety risk of steep terrain 	<p>Survey meets relevant EPA and EPBC Act policy and guidance. Survey approach and method undertook with consideration of the following:</p> <ul style="list-style-type: none"> Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) Survey guidelines for Australia's threatened bats (DEWHA 2010a) Survey guidelines for Australia's threatened birds (DEWHA 2010b) Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a) Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b) Interim guideline for preliminary surveys of Night Parrot (<i>Pezoporus occidentalis</i>) in Western Australia (DPaW 2017) EPBC Act referral guideline for the endangered Northern Quoll (<i>Dasyurus hallucatus</i>) (DoE 2016b)
<p>West Angelas Beyond 2020 Infrastructure Corridors Reconnaissance and Targeted Survey (Biologic 2022a; Appendix E.1)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: Proposed infrastructure corridors within the Approved Development Envelope</p> <p>Type: Desktop assessment, reconnaissance and targeted terrestrial fauna survey and SRE</p>	<p>Survey Effort:</p>	<p>The survey was conducted in accordance with:</p>

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>IBSA-2023-0252</p>	<p>Survey Method: Habitat assessment, active searches, bird census, targeted searches, water feature and cave assessments, ultrasonic recordings and opportunistic observations</p> <p>Timing: February 2022</p>	<ul style="list-style-type: none"> • Desktop Assessment to review previous fauna habitat mapping • Verification of fauna habitats previously mapped • Water feature and cave assessments • Targeted searched comprised 25 person-hours at 11 sites targeting Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, and Pilbara Olive Python, and Western Pebble-mound Mouse was opportunistically targeted • Ultrasonic bat recorders were deployed at five locations. Recorders were deployed for three consecutive nights at each location equating to a total of 15 recording nights • Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence <p>Limitations:</p> <ul style="list-style-type: none"> • Three caves within Deposit H could not be accessed during the field survey 	<ul style="list-style-type: none"> • Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) • Survey guidelines for Australia’s threatened bats (DEWHA 2010a) • Survey guidelines for Australia’s threatened birds (DEWHA 2010b) • Survey guidelines for Australia’s threatened mammals (DSEWPaC 2011a) • Survey guidelines for Australia’s threatened reptiles (DSEWPaC 2011b) • EPBC Act referral guideline for the endangered Northern Quoll (<i>Dasyurus hallucatus</i>) (DoE 2016b)
<p>West Angelas Beyond 2020 Mt Ella East and Dep J Detailed and Targeted Survey (Biologic 2022b; Appendix E.2)</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0257</p>	<p>Survey Area: Proposed Mt Ella East and Deposit J previously unsurveyed areas</p> <p>Type: Desktop assessment, detailed and targeted terrestrial fauna survey and SRE</p> <p>Survey Method: Methods included targeted searches, cave searches and assessments, dusk surveys, ultrasonic bat recordings, motion cameras, opportunistic</p>	<p>Survey Effort:</p> <ul style="list-style-type: none"> • Desktop Assessment to review previous fauna habitat mapping • Verification of fauna habitats previously mapped • Cave assessments • Targeted searched comprised 23.4 person-hours at 11 sites targeting Northern Quoll, 	<p>The survey was conducted in accordance with:</p>

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
	<p>observations and acoustic bird recordings</p> <p>Timing: July 2022</p>	<p>Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python</p> <ul style="list-style-type: none"> Ultrasonic bat recorders were deployed at nine locations including one cave. Each recorder was deployed for three consecutive nights, in accordance with EPA (2020), except the recorder located at a cave which was deployed for two nights, equating to a total of 26 recording nights during the field survey Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence <p>Limitations:</p> <ul style="list-style-type: none"> No material limitations identified 	<ul style="list-style-type: none"> Statement of Environmental Principles, Factors and Objectives (EPA 2021c) Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) Survey guidelines for Australia's threatened bats (DEWHA 2010a) Survey guidelines for Australia's threatened birds (DEWHA 2010b) Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a) Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b) Guidelines for surveys to detect the presence of bilbies and assess the importance of habitat in Western Australia (DBCA 2017a)
<p>West Angelas Beyond 2020 Deposit H and F North Reconnaissance Survey (Biologic 2022c; Appendix E.3) IBSA-2023-0251</p>	<p>Survey Area: Identified field survey coverage gap, eastern extent of Revised Development Envelope at Deposit H and northern extent of Revised Development Envelope at Deposit F North</p> <p>Type: Desktop assessment and single phase reconnaissance terrestrial fauna survey</p> <p>Survey Method: Methods included targeted searches, cave searches and assessments, dusk surveys, ultrasonic bat recordings, motion cameras, opportunistic</p>	<p>Survey Effort:</p> <ul style="list-style-type: none"> Desktop Assessment to review previous fauna habitat mapping Verification of fauna habitats previously mapped Habitat assessments to define and delineate fauna habitats Targeted searches for target species and suitable habitat comprised 5.5 person hours Camera trapping at one transect site for a total of 40 sampling hours and ultrasonic 	<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> Statement of Environmental Principles, Factors and Objectives (EPA 2021c) Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d)

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
	<p>observations and acoustic bird recordings</p> <p>Timing: July 2022.</p>	<p>bat recorders at 2 sites for a total of 6 recording nights</p> <ul style="list-style-type: none"> Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence <p>Limitations:</p> <ul style="list-style-type: none"> No material limitations identified 	
<p>West Angelas Deposit G Basic and Targeted Vertebrate Fauna Survey</p> <p>(Biologic 2022n; Appendix E.4)</p> <p>IBSA-2023-0385</p>	<p>Survey Area: Identified field survey coverage gap at Deposit G</p> <p>Type: Desktop assessment and single phase basic and targeted terrestrial fauna survey</p> <p>Survey Method: Methods included targeted searches, cave searches and assessments, ultrasonic bat recordings and opportunistic observations</p> <p>Timing: February 2022.</p>	<p>Survey Effort:</p> <ul style="list-style-type: none"> Desktop Assessment Study area comprised a single area covering 330.2 ha Habitat assessments undertaken at nine locations Active searches (9 person hours) 20 minute bird census at all habitat assessment locations Three ultrasonic recording nights <p>Limitations:</p> <ul style="list-style-type: none"> No limitations as outlined in EPA (2020a) were encountered 	<p>The survey was conducted in accordance with:</p> <ul style="list-style-type: none"> Statement of Environmental Principles, Factors and Objectives (EPA 2021c) Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) Survey guidelines for Australia's threatened bats (DEWHA 2010a) Survey guidelines for Australia's threatened birds (DEWHA 2010b) Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a) Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b)
<p>West Angelas Fauna Habitat Mapping (Biologic 2021d; Appendix E.5).</p> <p>Prepared for Rio Tinto.</p> <p>IBSA-2023-0384</p>	<p>Survey Area: West Angelas Revised Proposal Revised Development Envelope and 20 km radius around the Revised Development Envelope (herein the Regional Extrapolated Mapping Area)</p>	<p>Survey Effort:</p>	<p>The source materials used in the consolidation of historical mapping were generally prepared in accordance with EPA guidance relevant at the time of the original survey.</p>

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
	<p>Type: Desktop assessment to review and consolidate fauna habitats previously mapped within the Revised Development Envelope and extrapolate mapping in regional areas within a 20 km radius of the Revised Development Envelope</p> <p>Timing: August 2021</p>	<ul style="list-style-type: none"> • Desktop Assessment to review previous fauna habitat mapping • Make previously mapped area consistent with Biologic mapping, carried out as part of the Level 2 Fauna Assessment 2022 • Undertake Extrapolated mapping in regional areas within a 20 km radius of the Revised Development Envelope <p>Limitations:</p> <ul style="list-style-type: none"> • Mapping involved a high level of interpretation as it was done through desktop methods alone. For some areas where habitat features cannot be distinguished from aerial imagery, a degree of error may occur • Extrapolation of new habitats was limited to broad scale and as such does not necessarily depict fine scale habitat features or natural variations • Regional disturbance is not accurately delineated • The PEC (cracking clay) spatial data did not extend to the regional extrapolation mapping 	
<p>West Angelas Beyond 2020: Targeted Vertebrate Fauna Survey (Biologic 2021e; Appendix E.6).</p> <p>Prepared for Rio Tinto</p> <p>IBSA-2023-0262</p>	<p>Survey Area: Five iron ore deposits: Western Hill, Deposit J and Mt Ella East, Deposit F North and Deposit H, covering 11,762 ha of the WAN Revised Development Envelope</p> <p>Type: Targeted vertebrate fauna survey for MNES species, including Northern Quoll, Night Parrot, Greater Bilby, Pilbara Leaf-</p>	<p>Northern Quoll:</p>	<p>Survey meets relevant EPA and EPBC Act policy and guidance. Survey approach and method undertook with consideration of the following:</p>

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
	<p>nosed Bat, Ghost Bat, Pilbara Olive Python and Northern Brushtail Possum and SRE</p> <p>Survey Methods: Methods included targeted searches, cave searches and assessments, dusk surveys, ultrasonic bat recordings, motion cameras, opportunistic observations and acoustic bird recordings</p> <p>Timing: June and July 2019</p>	<ul style="list-style-type: none"> • Motion camera transects (8 transect sites with 10 motion cameras placed 100 m apart, completed over 320 sampling nights) • Single Motion Camera traps (40 locations completed over 139 sampling nights) • Long Term Camera traps (3 locations completed over 282 sampling nights) • Ghost Bat and Pilbara Leaf-nosed Bat: • Cave searches and Assessments (28 targeted searches over 100-person survey hours) • Ultrasonic Recorders (Eight locations over a total of 92 survey nights) <p>Night Parrot:</p> <ul style="list-style-type: none"> • Acoustic recordings (39 locations over a total of 320 recording nights) <p>Greater Bilby, Pilbara Olive Python and Northern Brushtail Possum:</p> <ul style="list-style-type: none"> • Opportunistic recordings of primary or secondary evidence of species • Motion Camera deployment for Northern Quoll utilised to detect these species • On-foot traversal of unexplored potential Greater Bilby habitat <p>Limitations:</p> <ul style="list-style-type: none"> • Unknown scats were found within carious caves and have not been able to be positively identified. Scats are not believed to belong to any species of interest to the survey. 	<ul style="list-style-type: none"> • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) • Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) • Survey guidelines for Australia's threatened bats (DEWHA 2010a) • Survey guidelines for Australia's threatened birds (DEWHA 2010b) • Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a) • Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b) • Interim guideline for preliminary surveys of Night Parrot (<i>Pezoporus occidentalis</i>) in Western Australia (DPaW 2017) • EPBC Act referral guideline for the endangered Northern Quoll (<i>Dasyurus hallucatus</i>) (DoE 2016b)

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2 (Biologic 2021c; Appendix E.7)</p> <p>Prepared for Rio Tinto.</p> <p>IBSA-2023-0256</p>	<p>Survey Area: Five iron ore deposits: Western Hill, Deposit J and Mt Ella East. Deposit F North and Deposit H, covering 11,762 ha of the WAN Revised Development Envelope</p> <p>Type: Two phase Level 2 vertebrate and SRE invertebrate fauna survey</p> <p>Survey Methods: 10 systematic sampling sites, including pitfall trapping, funnel traps, Elliot traps and cage traps, and avifauna census. Targeted sampling included targeted searches, ultrasonic bat recording using SongMeters, acoustic recordings, motion cameras and scat recording sheets.</p> <p>Timing: October 2018 and March 2019</p>	<p>Systematic Sampling:</p> <ul style="list-style-type: none"> • Systematic trapping using pit, funnel, Elliot, and cage traps across twelve trapping sites. At each site, ten pit traps were installed in parallel transects), one funnel trap, and two Sheffield traps. The collective trapping effort covered 7,088 trapping nights • Avifauna surveys were conducted for 20 minutes at ten sampling sites across eight days • Avifauna censuses were conducted at six other locations <p>Targeted Sampling:</p> <ul style="list-style-type: none"> • Targeted surveys were conducted at large crevasses, pools, caves, rocky habitats and sandy plains and comprised 16.5 person-hours • Ultrasonic bat recorders were deployed at 25 locations and recorded for 68 sampling nights. The sites consisted of prospective roost sites and foraging habitat • Acoustic recorders were deployed at 13 locations for a total of 30 sampling nights using Song Meter acoustic recorders • Single Motion cameras were deployed at 40 locations (within high significance habitat to MNES species), covering a total 139 sampling nights • Long-term motion cameras were deployed at three sites where Northern Quoll were 	<p>Survey meets relevant EPA and EPBC Act policy and guidance. Survey approach and method undertook with consideration of the following:</p> <ul style="list-style-type: none"> • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) • Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) • Technical Guidance: Sampling of Short-Range Endemic Invertebrate Fauna (EPA 2016e) • Survey guidelines for Australia’s threatened bats (DEWHA 2010a) • Survey guidelines for Australia’s threatened birds (DEWHA 2010b) • Survey guidelines for Australia’s threatened mammals (DSEWPaC 2011a) • Survey guidelines for Australia’s threatened reptiles (DSEWPaC 2011b). • Interim guideline for preliminary surveys of Night Parrot (<i>Pezoporus occidentalis</i>) in Western Australia (DPaW 2017) • EPBC Act referral guideline for the endangered Northern Quoll (<i>Dasyurus hallucatus</i>) (DoE 2016b)

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
		<p>likely to occur and recorded for 3,182 sampling nights</p> <ul style="list-style-type: none"> Scat collection sheets were deployed at three cave structures, with two sheets per cave, during phase one and retrieved during phase 2 of the survey <p>Opportunistic Records:</p> <ul style="list-style-type: none"> Any evidence pertaining to species not previously recorded during the survey was recorded. This included direct observations and observations of secondary evidence Track logs were used to record the efforts to search unique microhabitats encountered <p>Limitations:</p> <ul style="list-style-type: none"> No spotlighting was conducted during the surveys due to safety concerns. As many Australian species are nocturnal or crepuscular, spotlighting is a useful way to detect species that are not often trapped, and it is possible that spotlighting would increase the number of species known to occur in the Study Area Species accumulation curves suggest further sampling effort may increase the number of species known to occur within the Study Area, but that the majority of fauna present were detected 	
<p>West Angelas Revised Proposal Short-Range Endemic Invertebrate Fauna Environmental Impact Assessment (Biologic Environmental Survey Pty Ltd (Biologic) 2022); Appendix E.8)</p>	<p>Survey Area: Revised Development Envelope Type: Desktop - EIA Timing: October 2022</p>	<p>N/A</p>	<p>The source materials used in the EIA were generally prepared in accordance with EPA guidance relevant at the time of the original survey.</p>

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
Prepared for Rio Tinto			
West Angelas: Short-Range Endemic Invertebrate Fauna Risk Assessment (Biologic 2022i; Appendix E.9) Prepared for Rio Tinto	Survey Area: Revised Development Envelope Type: Desktop Risk assessment Timing: October 2022	N/A	The source materials used in the risk assessment were generally prepared in accordance with EPA guidance relevant at the time of the original survey.
Supporting Studies and Surveys			
Targeted Flora and Fauna Survey for the West Angelas Managed Aquifer Recharge (MAR) Area (Biologic 2021g) Prepared for Rio Tinto	Survey Area: MAR Area Type: Targeted flora and fauna survey for species of conservation significance, including Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, Pilbara Olive Python and Western Pebble-mound Mouse Survey Methods: Habitat assessments, targeted searches, cave assessments, ultrasonic recorded and opportunistic recordings Timing: February 2021		Survey meets relevant EPA and EPBC Act policy and guidance. Survey approach and methods undertaken with consideration of the following: <ul style="list-style-type: none"> • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) • Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) • Survey guidelines for Australia’s threatened bats (DEWHA 2010a) • Survey guidelines for Australia’s threatened birds (DEWHA 2010b) • Survey guidelines for Australia’s threatened mammals (DSEWPaC 2011a) • Survey guidelines for Australia’s threatened reptiles (DSEWPaC 2011b) • Guidelines for surveys to detect the presence of bilbies, and assess the importance of habitat in Western Australia (DBCA 2017a)
West Angelas Deposits C, D & G Targeted Fauna Survey (Biologic 2018 and Biologic 2019a)	Survey Area: Deposits C, D and G, covering approximately 26,689 ha of the Approved Development Envelope		Survey meets relevant EPA and EPBC Act policy and guidance. Survey approach and method undertook with consideration of the following:

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>and</p> <p>Addendum to West Angelas C, D & G Targeted Fauna Survey (Biologic 2019a)</p> <p>Prepared for Rio Tinto.</p>	<p>Type: Targeted fauna survey for Northern Quoll, Pilbara Olive Python, Ghost Bat and Pilbara Leaf-nosed Bat</p> <p>Survey Methods: Targeted searches, motion cameras, ultrasonic recordings and acoustic recordings</p> <p>Timing: October 2018</p>		<ul style="list-style-type: none"> • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) • Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) • Survey guidelines for Australia's threatened bats (DEWHA 2010a) • Survey guidelines for Australia's threatened birds (DEWHA 2010b) • Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a) • Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b) • Interim guideline for preliminary surveys of Night Parrot (<i>Pezoporus occidentalis</i>) in Western Australia (DPaW 2017) • EPBC Act referral guideline for the endangered Northern Quoll (<i>Dasyurus hallucatus</i>) (DoE 2016b)
<p>Karijini/Upper Turee Creek Targeted Pilbara Leaf-nosed Bat Survey (Bat Call WA 2018)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: Karijini National Park</p> <p>Type: Targeted Pilbara Leaf-nosed Bat survey</p> <p>Survey Methods: Analysis of acoustic recordings</p> <p>Timing: November 2018</p>		<p>Survey meets relevant EPA and EPBC Act policy and guidance. Survey approach and method undertook with consideration of the following:</p> <ul style="list-style-type: none"> • Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d) • Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020a) • Survey guidelines for Australia's threatened bats (DEWHA 2010a)

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
<p>Rio Tinto Iron Ore Greater West Angelas Terrestrial Fauna Assessment (Ecologia 2014)</p> <p>Prepared for Rio Tinto</p>	<p>Survey Area: Deposits C, D, D extension, G, F, H and Mt Ella</p> <p>Type: Two-phase vertebrate fauna and SRE survey</p> <p>Survey Methods: Systemic sampling, acoustic recorders, SRE leaf litter collection, opportunistic searches and motion camera trapping</p> <p>Timing: Spring 2012 and Autumn 2013</p>		<p>Survey meets relevant EPA and EPBC Act policy and guidance in place at the time. Survey approach and method undertaken in consideration of the following:</p> <ul style="list-style-type: none"> • Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b) • Terrestrial Biological Surveys as an Element of Biodiversity Protection: Position Statement No. 3 (EPA 2002) • Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2010) • Guidance Statement 20: Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (EPA 2009)
<p>Fauna Habitats and Fauna Assemblage of Deposits E and F at West Angelas (Biota 2005b)</p> <p>Prepared for Robe River Iron Associates</p>	<p>Survey Area: Deposits E and F</p> <p>Type: Systematic survey of fauna habitat and fauna assemblage</p> <p>Survey Methods: Systematic surveys, echolocation recordings, habitat searches for conservation significant species, opportunistic sightings</p> <p>Timing: May 2004</p>		<p>Survey approach and method undertaken in consideration of the following:</p> <ul style="list-style-type: none"> • Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004b) • Terrestrial Biological Surveys as an Element of Biodiversity Protection: Position Statement No. 3 (EPA 2002)
<p>Ghost Bats at West Angelas: 2002 Survey, Data Review and Future Directions (Biota 2002)</p> <p>Prepared for Robe River Mining Co.</p>	<p>Survey Area: Caves adjacent to Deposits B and F</p> <p>Type: Targeted survey for Ghost Bats</p> <p>Survey Methods: Survey of caves for evidence of Ghost Bat presence</p>		<p>The survey was undertaken per the relevant State and Commonwealth guidelines in place at the time of the survey.</p>

Studies/Survey/Prepared for	Study Area, Type and Timing	Survey Effort and Limitations	Consistency with Guidance
	Timing: November 2002		
<p>West Angelas Iron Ore Project Vertebrate Fauna Assessment Survey (Ecologia 1998a)</p> <p>Prepared for Robe River Mining Co</p>	<p>Survey Area: Mine and rail corridor</p> <p>Type: Detailed vertebrate fauna assessment</p> <p>Survey Methods: Systemic and opportunistic sampling</p> <p>Timing: June-October 1997</p>		<p>The survey was undertaken in accordance with the relevant EPA and DCCEEW (formerly CALM) guidelines in place at the time of the survey.</p>
<p>West Angelas Project Ghost Bat <i>Macroderma gigas</i> Assessment Survey (Ecologia 1998b)</p> <p>Prepared for Robe River Mining Co.</p>	<p>Survey Area: Gullies and hills adjacent to Deposits A, B, E and F</p> <p>Type: Targeted survey for Ghost Bats</p> <p>Survey Methods: Systematic surveys of caves</p> <p>Timing: August to September 1998</p>		<p>The survey was undertaken in accordance with the relevant EPA and DCCEEW (formerly CALM) guidelines in place at the time of the survey.</p>

Figure 9-1: Key Terrestrial Fauna Studies within and Surrounding the Revised Development Envelope

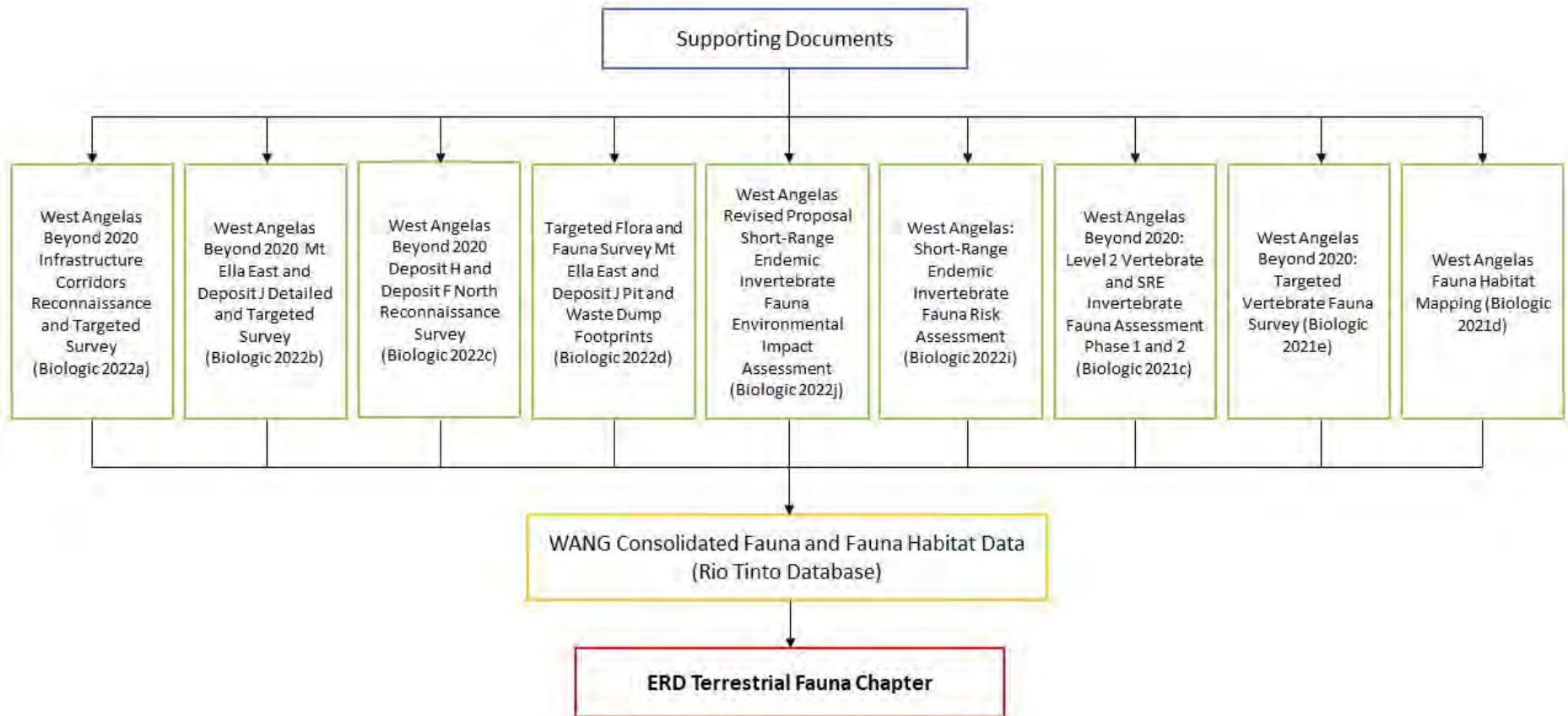


Figure 9-2
Spatial Extent of Key Terrestrial
Fauna Surveys within and
surrounding the Revised
Development Envelope

Drawn: A.D.
Plan: PDE0186400v5
Date: August 2023

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

Legend

Revised Development Envelope

Proposed Conceptual Layout

Pit
Waste Dump

Approved Conceptual Layout

Pit
Waste Landform

Targeted Flora and Fauna Survey for the West Angelas Managed Aquifer Recharge (MAR) Area (Biologic 2021)

Targeted Flora and Fauna Survey: Mt Ella East and Deposit J pit and waste dump footprints (Biologic 2021)

West Angelas Beyond 2020: Deposit H and F North Reconnaissance Survey (Biologic 2022)

West Angelas Beyond 2020: Infrastructure Corridors Reconnaissance and Targeted Survey (Biologic 2022)

West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2 (Biologic 2021)

West Angelas Beyond 2020: Mt Ella East and Dep J Detailed and Targeted Survey (Biologic 2022)

West Angelas Beyond 2020: Targeted Vertebrate Fauna Survey (Biologic 2021)

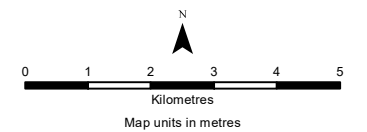
West Angelas Fauna Habitat Mapping (Biologic 2021)

National Park

Rio Tinto Railway

Highway

Major Creek



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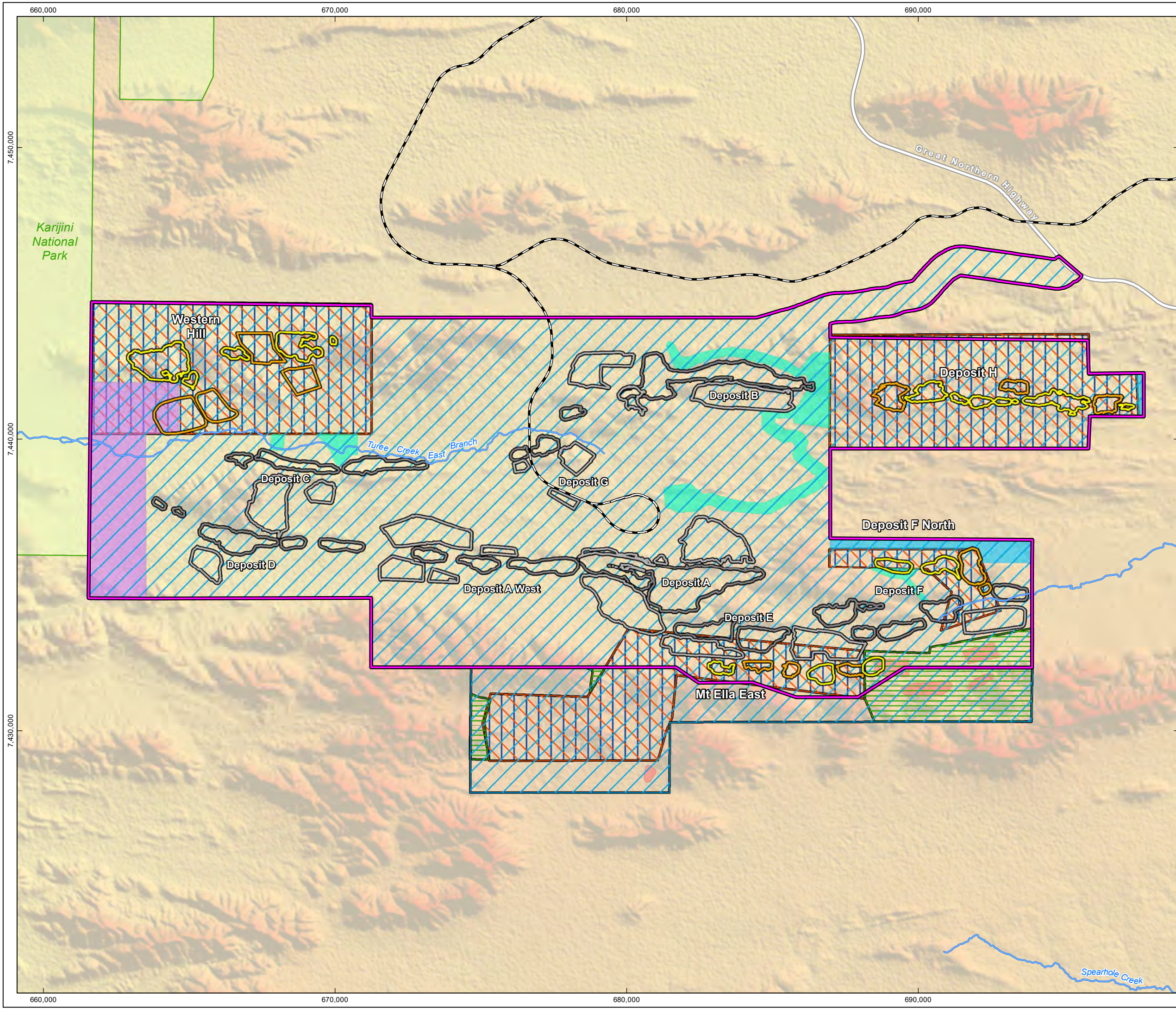
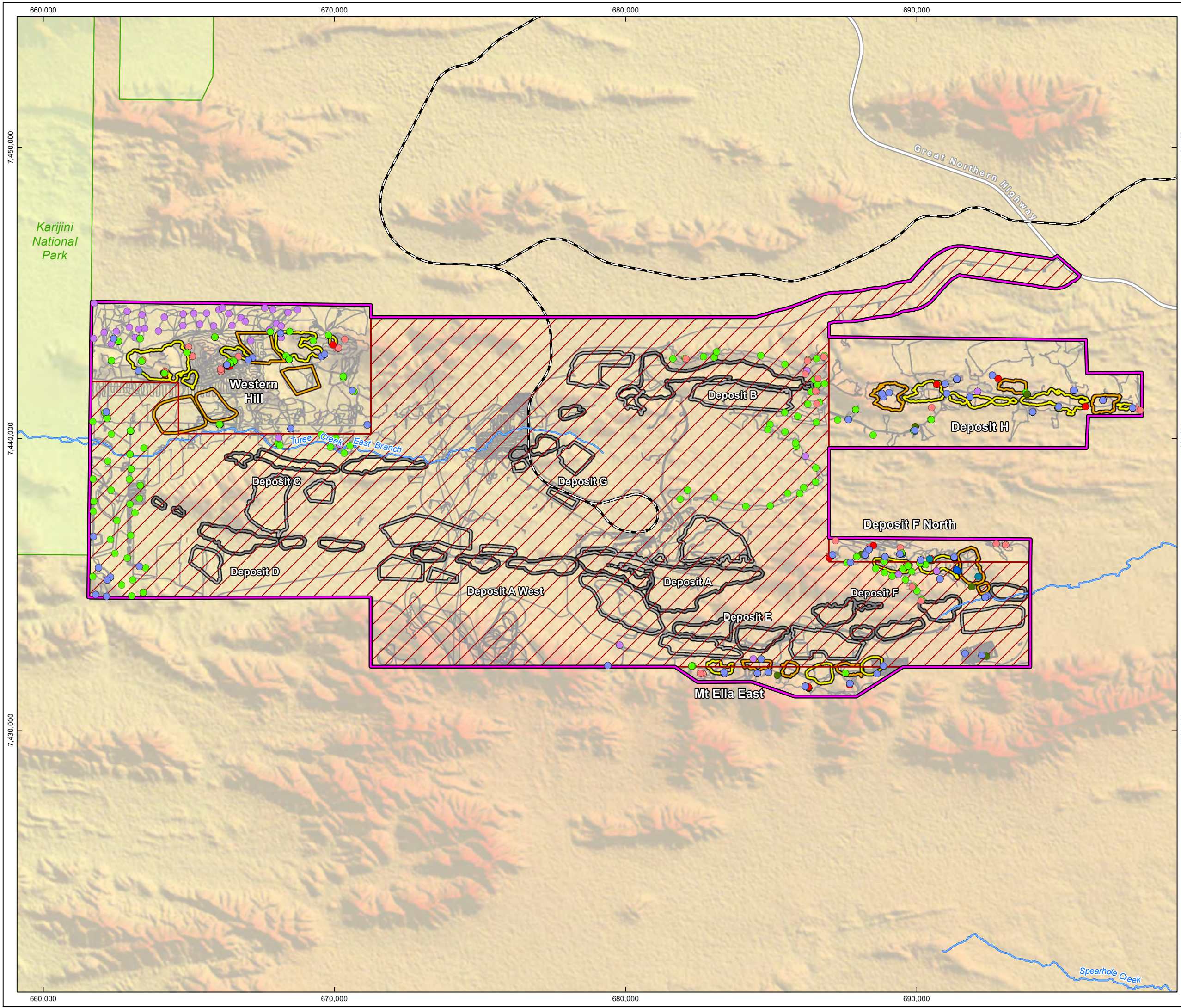


Figure 9-3
Terrestrial Fauna and Short Range
Endemics Sampling Effort within
the Revised Development Envelope

Drawn: A.D.
Plan: RTIO-0980522v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Approved Development Envelope - MS 1113 & DN 8299/2018

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

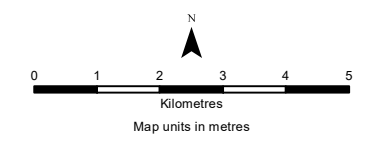
- Pit
- Waste Landform

Survey Track Log

Sampling Method

- Acoustic Recording
- Avifauna Census
- Echolocation Recording
- Habitat Assessment
- Motion Camera
- SRE Sampling
- Targeted Searches
- Trap Site

- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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9.3.2. Fauna Habitat

Six broad fauna habitat types were mapped across the Revised Development Envelope; Gorge/Gully; Drainage Line; Hillcrest/Hillslope; Mixed Acacia Woodland; Footslopes and Plain; and Cracking Clay (Biologic 2021d; Table 9-4; Figure 9-4). These habitats have been mapped based on ground truthing, fauna habitat assessments, vegetation mapping, topographic data and interpretation of aerial photography (Biologic 2021d). Disturbed areas were also mapped.

While the majority of habitats have some importance in supporting native fauna, habitats may be of particular importance if they:

- Support very diverse or unique faunal assemblages
- Are restricted or rare in the region (and therefore may support faunal assemblages that are rare or restricted)
- Are refugia (e.g. from drought or fire)
- Provide ecological linkage
- Support significant fauna.

9.3.2.1. Habitat Types and Significance

A detailed understanding of local species occurrence and habitat use within the Revised Development Envelope has been used to assign habitat significance ratings based on their value to Threatened fauna species listed under the EPBC Act or BC Act (Biologic 2021c). Table 9-3 describes the criteria used to inform the significance rating for each habitat.

Table 9-3: Fauna Habitat Significance Assessment Criteria

Significance	Criteria
High	Provides core breeding/refugia/shelter sites (i.e., denning, roosting or water sources) for significant fauna species. These habitats are considered critical ¹³ to the survival of MNES fauna species within the Revised Development Envelope.
Moderate	Provides foraging and dispersal habitat for significant fauna species. For MNES fauna species, these habitats are considered supporting ¹⁴ habitats when they are within the species' home range* but are not considered critical to their survival. These habitats are more widespread and of lower importance than the high significance (critical) habitats.
Low	Habitat does not directly support any significant fauna species but may represent limited foraging and dispersal habitat. Significant fauna species are not dependent on this habitat. This habitat is widespread in the local and regional areas.
Nil	Disturbed or cleared areas that do not provide any fauna habitat.

*Range is different for each species Source: Biologic 2021c and d)

For significant fauna species protected exclusively under State listings (not listed under the EPBC Act), **suitable** habitat is defined as where it provides breeding, refugia, shelter, foraging and/or dispersal opportunities for the species.

¹³ For the purposes of this assessment, "critical habitat" is defined as denning, roosting and/or shelter and water sources for MNES fauna species.



¹⁴ "Supporting habitat" is foraging and dispersal habitat within an MNES fauna species' range.

Of the six broad habitat types identified within the Revised Development Envelope, two fauna habitat types are considered to provide high significance habitat to terrestrial vertebrate fauna:



- **Gorge/Gully habitat:** This type of habitat occurs across 627 ha (2%) of the Revised Development Envelope and is considered high significance due to the microhabitats it provides, such as caves, deep rocky crevices and ephemeral pools (Biologic 2021c). The caves and rocky crevices provide opportunities for denning, shelter, roosting and foraging for significant fauna species such as the Northern Quoll (*Dasyurus hallucatus*; Endangered), Ghost Bat (*Macroderma gigas*; Vulnerable), Pilbara Leaf-nosed Bat (*Rhinonictis aurantia*; Vulnerable) and Pilbara Olive Python (*Liasis olivaceus barroni*; Vulnerable). It has the potential to support the Pilbara Flat-headed Blind-snake (*Anilius ganei*) and the Pilbara Barking Gecko (*Underwoodisaurus seorsus*; Priority 2) (Biologic 2021c).
- **Hillcrest/Hillslope:** This habitat occurs across 12,202 ha (33%) of the Revised Development Envelope and is considered high significance due to its microhabitats, such as caves and crevices. As with the Gorge/Gully habitat, this habitat (to a lesser extent) provides suitable habitat for denning, shelter, roosting and foraging for significant fauna species, such as Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python.



The remaining four fauna habitats within the Revised Development Envelope (Drainage Line; Mixed Acacia Woodland; Footslopes and Plain; and Cracking Clay) are considered moderate significance. None of the broad terrestrial fauna habitats are confined to the Revised Development Envelope and are widespread throughout the wider Hamersley subregion (Biologic 2021c; Table 9-4). No fauna habitats of low significance for terrestrial vertebrate fauna were recorded within the Revised Development Envelope.

Table 9-4: Fauna Habitat within the West Angelas Area and Revised Development Envelope and Extension Areas

Fauna Habitat Type	Fauna Habitat Description	Microhabitats within the Revised Development Envelope	Value for Significant Fauna ¹⁵	Mapped Extent*			Representative Photograph
				Extent within West Angelas Area**	Extent within Revised Development Envelope	Extent within Extension Areas	
High Significance							
Gorge/Gully	<p>Gorges and gullies are rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Drainage Line habitat or valleys). Caves and deep, rocky crevices are most often encountered in this habitat type, as are water pools. Vegetation can vary and can be dense and complex in areas of soil deposition or sparse and simple where exposed outcropping or erosion has occurred.</p> <p>Limited extent within the Revised Development Envelope and widely distributed across the Pilbara.</p>	Contains caves and deep, rocky crevices and ephemeral pools.	<p>Critical for:</p> <ul style="list-style-type: none"> Northern Quoll Ghost Bat Pilbara Olive Python <p>Supporting for:</p> <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat <p>Suitable for:</p> <ul style="list-style-type: none"> Pilbara Flat-headed Blind-Snake Pilbara Barking Gecko 	1082 ha (2.6%)	627 ha (1.7%)	178 ha (2.1%)	
Hillcrest/Hillslope	<p>Hillcrest/Hillslope habitat tends to be more open and structurally simple than other fauna habitats. A common feature of this habitat is a rocky substrate, often with exposed bedrock, and skeletal red soils. These can contain cracks and crevices, but not to the same extent as within rocky upland areas of Gorge/Gully habitat. This habitat is usually dominated by open Eucalyptus woodlands, Acacia and Grevillea scrublands and Triodia low hummock grasslands.</p> <p>Widespread within Revised Development Envelope and wider region. Significance rating presumes presence of caves considered critical for survival of Ghost Bat populations.</p>	May contain caves and crevices, but not to the same extent as Gorge or Gully.	<p>Critical for:</p> <ul style="list-style-type: none"> Ghost Bat <p>Supporting for:</p> <ul style="list-style-type: none"> Northern Quoll Pilbara Leaf-nosed Bat Pilbara Olive Python <p>Suitable for:</p> <ul style="list-style-type: none"> Peregrine Falcon Western Pebble-mound Mouse Pilbara Barking Gecko 	15,015 ha (36.2%)	12,202 ha (33.2%)	4,160 ha (49.2%)	

¹⁵ For the purposes of this assessment, “critical habitat” is defined as denning, roosting and/or shelter and water sources for significant species. “Supporting habitat” is foraging and dispersal habitat within a significant species’ range.

Fauna Habitat Type	Fauna Habitat Description	Microhabitats within the Revised Development Envelope	Value for Significant Fauna ¹⁵	Mapped Extent*			Representative Photograph
				Extent within West Angelas Area**	Extent within Revised Development Envelope	Extent within Extension Areas	
Moderate Significance							
Drainage Line	<p>Drainage Line habitat is variable in structure and condition. Temporary, semi-permanent – permanent water pools can occur within this habitat, usually after rainfall events. Vegetation within this habitat is often dominated by Eucalyptus or Melaleuca species over a variable understory comprising mixed small to medium shrubs (<i>Acacia</i> sp.) and tussock grasses over sandy creek beds. Vegetation adjacent to the main channel or channels is denser, taller and more diverse than adjacent terrain. The structure and condition of vegetation often varies seasonally, particularly following rainfall events. Vegetation condition often subject to heavy cattle grazing.</p> <p>Limited extent within the Revised Development Envelope but widespread in the surrounding region.</p>	Contains leaf litter and woody debris and small hollows.	<p>Supporting for:</p> <ul style="list-style-type: none"> Northern Quoll Ghost Bat Pilbara Leaf-nosed Bat Pilbara Olive Python Grey Falcon <p>Suitable for:</p> <ul style="list-style-type: none"> Peregrine Falcon 	493 ha (1.2%)	378 ha (1.0%)	157 ha (1.9%)	
Mixed Acacia Woodland	<p>Mixed Acacia Woodland habitat comprises areas where vegetation is a dense mix of Acacia, with a mixture of mulga (<i>Acacia aneura</i>), <i>Acacia maitlandii</i> and <i>Acacia pruinoarpa</i> over a mixture of sparse small shrubs and grasses, such as <i>Triodia</i> and <i>Senna</i> species and <i>Ptilotus</i> sp. Dense leaf litter, and woody debris is a common feature of this habitat type. The soils consist of loam clay with continuous layers of small ironstone pebbles on the surface. The habitat is mostly flat with no or very small drainage channels.</p> <p>Limited extent within the Revised Development Envelope but widespread through the Pilbara region.</p>	Contains leaf litter and woody debris and small hollows	<p>Supporting for:</p> <ul style="list-style-type: none"> Ghost Bat Grey Falcon <p>Suitable for:</p> <ul style="list-style-type: none"> Peregrine Falcon Short-tailed Mouse 	3,240 ha (7.8%)	3,229 ha (8.8%)	487 ha (5.8%)	

Fauna Habitat Type	Fauna Habitat Description	Microhabitats within the Revised Development Envelope	Value for Significant Fauna ¹⁵	Mapped Extent*			Representative Photograph
				Extent within West Angelas Area**	Extent within Revised Development Envelope	Extent within Extension Areas	
Footslopes and Plain	<p>Footslopes and Plain habitat comprises low-lying open plains and the rolling hills below upland areas. Vegetation within this habitat varies in composition; however, is generally dominated by scattered mulga and <i>Acacia pruinocarpa</i> forming an over-storey, with a mid-storey comprising <i>Eremophila</i> and <i>Ptilotus</i> spp., over low hummock grasslands of <i>Triodia wiseana</i>, <i>T. basedowii</i>, <i>T. longifolia</i> and <i>T. pungens</i>. Scattered <i>Corymbia hamersleyana</i>, <i>Eucalyptus leucophloia</i> and <i>E. gamophylla</i> were also present.</p> <p>Widespread within Revised Development Envelope and wider region.</p>		<p>Supporting for:</p> <ul style="list-style-type: none"> • Ghost Bat • Grey Falcon <p>Suitable for:</p> <ul style="list-style-type: none"> • Western Pebble-mound Mouse • Brush-tailed Mulgara • Short-tailed Mouse • Peregrine Falcon 	13,287 ha (32.0%)	12,051 ha (32.8%)	3,092 ha (36.6%)	
Cracking clay	<p>Cracking clay habitat is characterised by open and sparse low vegetation with approximately half of its area being bare ground. Isolated shrubs of <i>Salsola australis</i>, <i>Boerhavia paludosa</i> and <i>Ptilotus nobilis</i> subsp. <i>nobilis</i> occur over open tussock grassland of <i>Aristida</i> sp., <i>Brachyachne</i> sp. and <i>Astrebla pectinata</i>. The soil is often dark orange sand-clay to clay with an undulating surface caused by crabholes and gilgai. Rocks and pebbles are often very rare and when present, the rock type is consistently ironstone.</p> <p>Limited extent within Revised Development Envelope.</p>		<p>Supporting for:</p> <ul style="list-style-type: none"> • Ghost Bat <p>Suitable for:</p> <ul style="list-style-type: none"> • Short-tailed Mouse 	435 ha (1.0%)	435 ha (1.2%)	0	
Total Fauna Habitat				33,553 ha	28,922 ha	8,074 ha	
Disturbed/Cleared Areas	Cleared areas, or areas devoid of any vegetation	No value for fauna	N/A	7,931 ha (19.1%)	7,857 ha (21.4%)	383 ha (4.6%)	
Total Area				41,483 ha	36,779 ha	8,457 ha	

*Extent rounded to nearest ha **West Angelas Area includes the Revised Development Envelope, All Survey Areas and any References Sites

In addition to broad-scale regional fauna habitat mapping, desktop extrapolated fauna habitat mapping was completed within a 20 km buffer of the Revised Development Envelope to define the extent of additional potential habitat for significant fauna species extending beyond the Revised Development Envelope (Table 9-5). The Cracking Clay habitat type was not mapped outside the Revised Development Envelope within the extrapolated area.

Table 9-5: Extrapolated Fauna Habitat Mapping within 20 km of the Revised Development Envelope

Extrapolated Habitat Type	Extent within 20 km of the Revised Development Envelope (ha)	
	ha	%
Gorge/Gully	22,068	6.77
Hillcrest/Hillslope	111,051	34.06
Drainage Line	3,387	1.04
Mixed Acacia Woodland	1,053	0.32
Footslopes and Plain	185,014	56.80
Disturbed	3,427	1.05
Total	326,000	100

The current approval under the EPBC Act within the Revised Development Envelope for Deposits C, D and G (Decision Notice 2018/8299) specifies limits for clearing of Ghost Bat and Pilbara Leaf-nosed Bat habitat as shown in Table 9-6.

Table 9-6: Current Approved Habitat Clearing Limits (Decision Notice 2018/8922)

Fauna Habitat Type	DN 2018/8299 Clearing Limit within Revised Development Envelope (ha)~	MS 1113 Clearing Limit Within Revised Development Envelope (ha)
Gorge/Gully	2	NS
Hillcrest/Hillslope	484	NS
Drainage Line	21	NS
Mixed Acacia Woodland	NS	NS
Footslopes and Plain	NS	NS
Cracking Clay	NS	20^

~ Applies to Deposits C, D and G and Proposal only

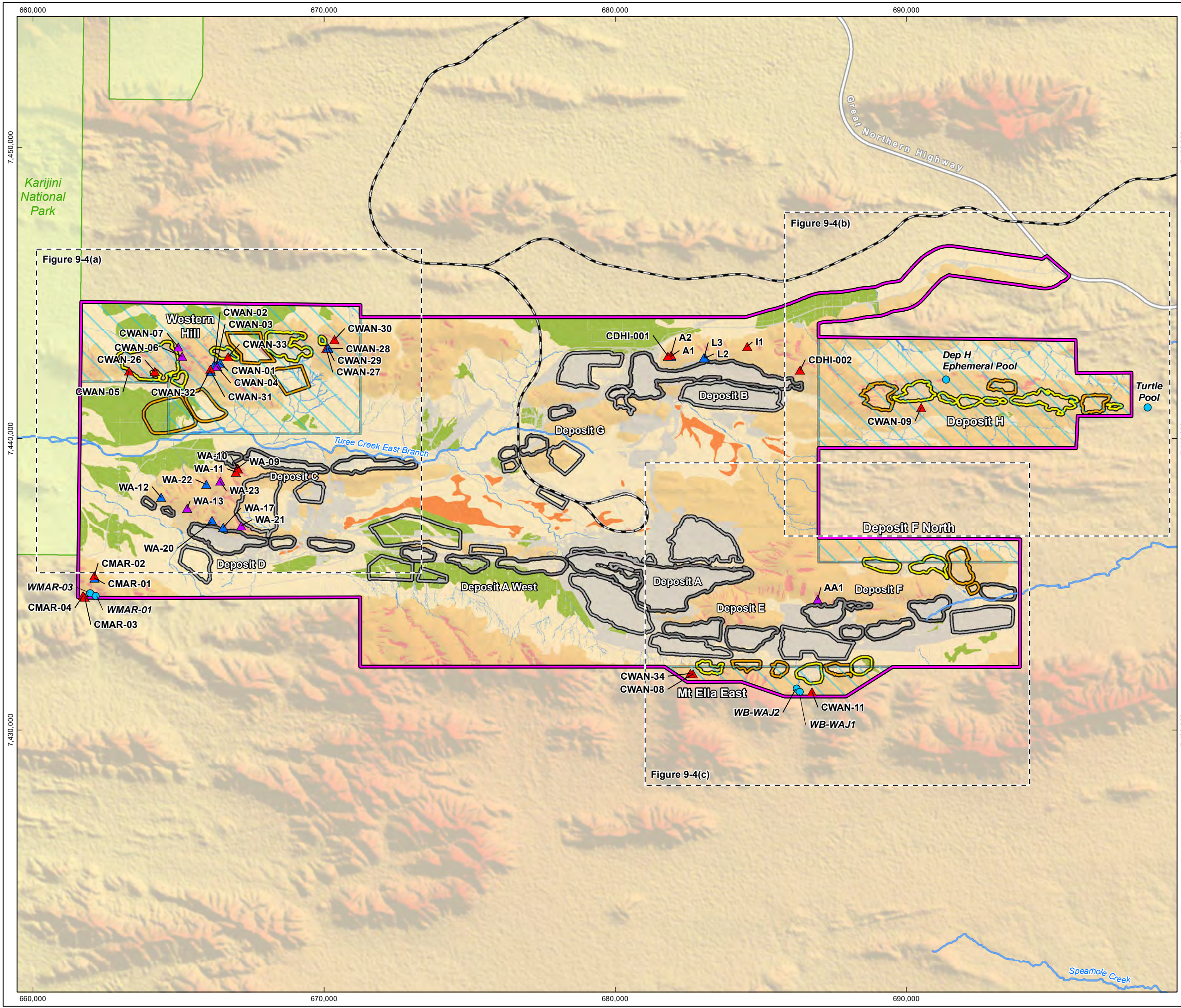
^ Applies to all activities within Revised Development Envelope

NS - None specified

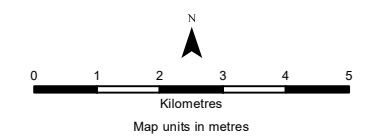
Figure 9-4
Fauna Habitat Types and Significant
Habitat Features within the Revised
Development Envelope - Overview

Drawn: A.D.
Plan: PDE0186401v2
Date: March 2023

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



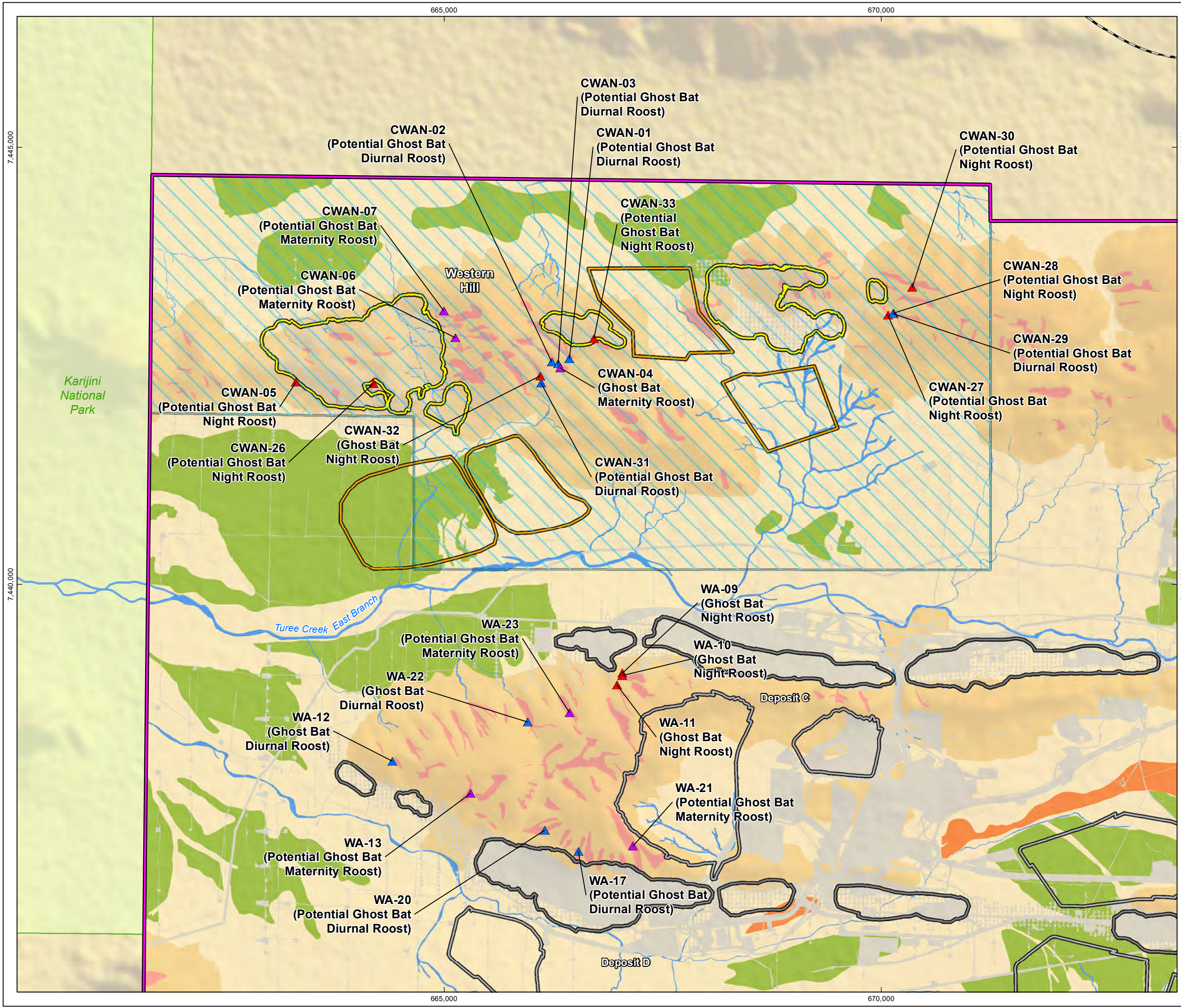
- Legend**
- Revised Development Envelope
 - Extension Area
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - Water Feature
 - Caves**
 - ▲ Category 2
 - ▲ Category 3
 - ▲ Category 4
 - Disturbed
 - High Significance Fauna Habitat**
 - Gorge/Gully
 - Hillcrest and Hillslope
 - Moderate Significance Fauna Habitat**
 - Drainage Line
 - Cracking Clay
 - Footslopes and Plains
 - Mixed Acacia Woodland
 - National Park
 - Rio Tinto Railway
 - Highway
 - Major Creek



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Figure 9-4(a)
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

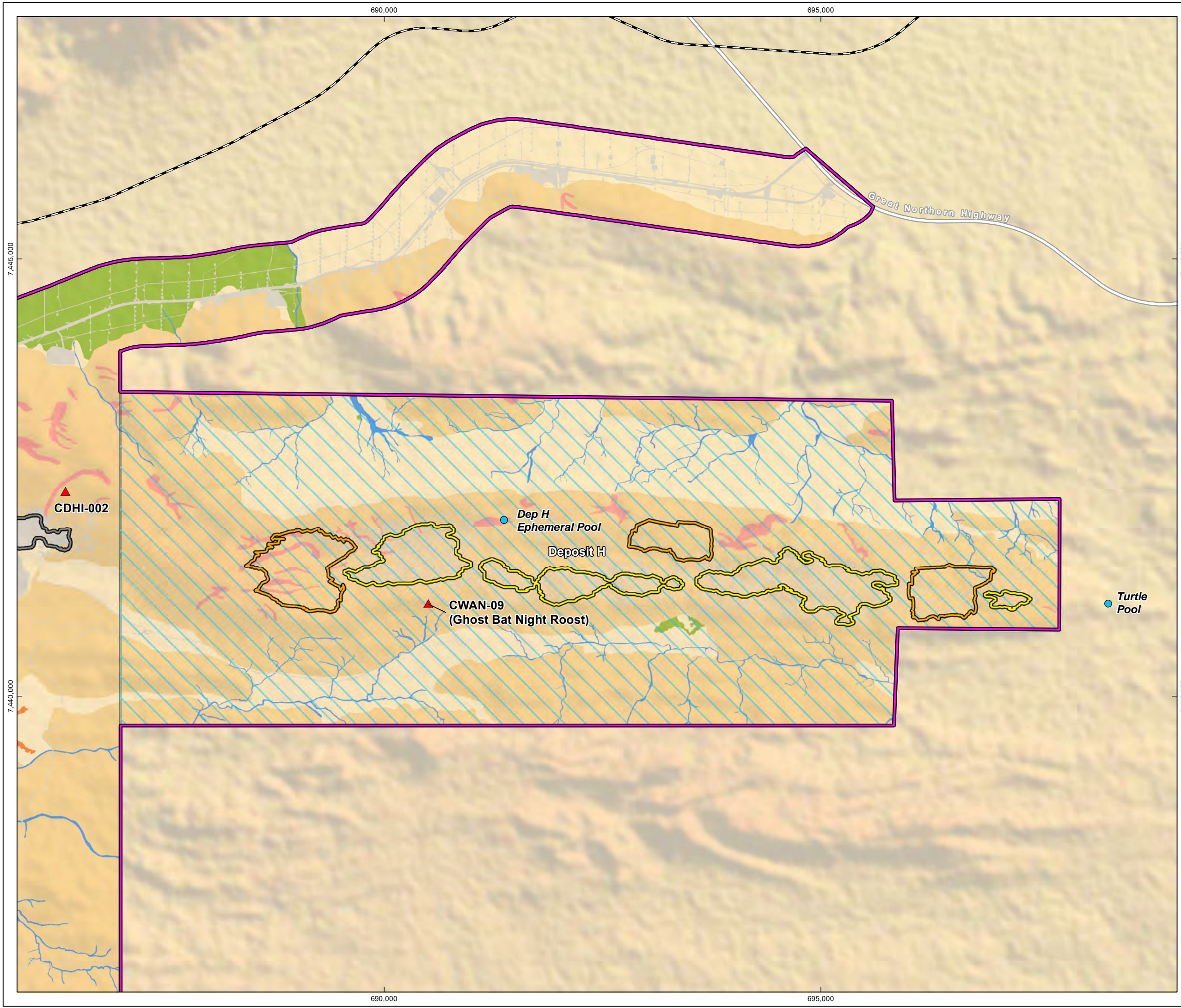
- National Park
- Rio Tinto Railway
- Major Creek

0 1 2
Kilometres
Map units in metres

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Figure 9-4(b)
Fauna Habitat Types and Significant
Habitat Features within the Revised
Development Envelope - Deposit H

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

Water Feature

Caves

- Category 4
- Disturbed

High Significance Fauna Habitat

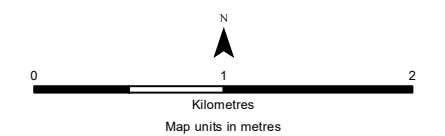
- Gorge/Gully
- Hillcrest and Hillslope

Moderate Significance Fauna Habitat

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

Rio Tinto Railway

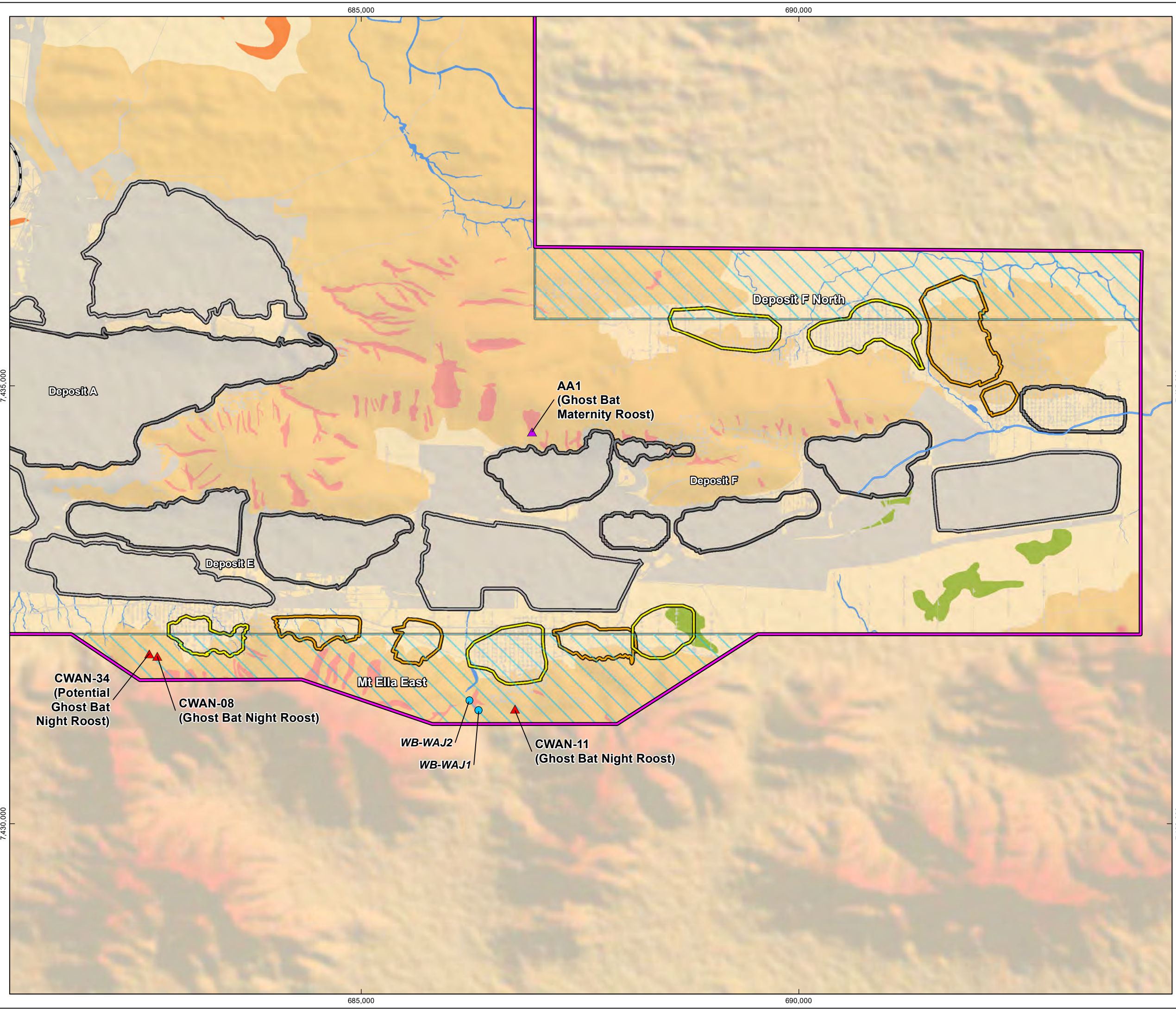
Highway



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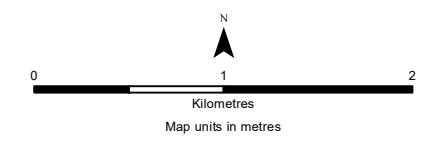
Figure 9-4(c)
Fauna Habitat Types and Significant
Habitat Features within the Revised
Development Envelope - Mount Ella
East & Deposit F North

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

- Revised Development Envelope
- Extension Area
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- Water Feature
- Caves**
 - Category 2
 - 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
- Rio Tinto Railway
- Major Creek



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9.3.2.2. Significant Habitat Features

Significant habitat features are elements within a broader fauna habitat that provide important microhabitats that support significant fauna species or have a highly diverse or abundant faunal assemblage. In the Pilbara, significant habitat features typically include caves and surface water expressions in the form of pools in drainage lines or gorges each of which is discussed in detail in subsequent sections.

Caves

Caves are considered important ecological habitat features in the Pilbara due to their stable microclimate and shelter to a range of fauna, including the significant species: Northern Quoll, Pilbara Olive Python Ghost Bat, Pilbara Leaf-nosed Bat.

Caves in the Pilbara provide potential roosting and foraging habitats for two significant bat species: Ghost Bat and Pilbara Leaf-nosed Bat. Extensive survey activity and research in the last decade has led to the identification of four roosting habitat categories for Ghost Bats in the Pilbara region (Bat Call WA 2021a):

- Category 1: Maternity/diurnal roost sites with permanent Ghost Bat occupancy
- Category 2: Maternity/diurnal roost caves with regular occupancy
- Category 3: Diurnal roost caves with occasional occupancy
- Category 4: Nocturnal roost caves with opportunistic usage.

Roosting habitats for the Pilbara Leaf-nosed Bat has been recently refined in *A review of Pilbara Leaf-nosed Bat ecology, threats and survey requirements* (Bat Call WA 2021b) as:

- Category 1 (P1): Permanent diurnal roosts are maternity roosts where seasonal presence of young is proven
- Category 2 (P2): Permanent diurnal roosts occupied year-round but without the proven presence of young
- Category 3 (P3): Semi-permanent diurnal roosts that are used diurnally during some part of the year, but not occupied year-round
- Category 4 (P4): Nocturnal refuge occupied or entered at night for resting, feeding or other purposes, with perching not a requirement.

Category 1 to 3 caves are considered a critical habitat for the Pilbara Leaf-nosed Bat's survival. In contrast, category 4 caves are not considered critical habitat but important for local persistence.

A total of 41 caves have been recorded within the Revised Development Envelope, 21 of which are located within the Proposal Area and 19 recorded within the Approved Development Envelope (Table 9-6). Overall, within the Revised Development Envelope, 19 caves occur within the Gorge/Gully habitat type, with the remaining 22 caves occurring in the Hillcrest/Hillslope habitat.

Of the 21 caves recorded within the Proposal Area:

- Three are category 2 Ghost Bat caves (of which one is a primary cave within an apartment block)
- Five are category 3 caves (of which three are secondary caves within apartment blocks)
- 13 are category 4 Ghost Bat caves.

All caves identified within the Proposal Area are category 4 roosts for Pilbara Leaf-nosed Bat. Of the 21 caves identified within the Proposal Area, 15 are located within Hillcrest/Hillslope habitat and six are located within Gorge/Gully habitat.

The Northern Quoll was recorded via secondary evidence (scats) at one cave location within the Revised Development Envelope and Proposal Area (cave CWAN-04). Scats of the Pilbara Olive Python were also recorded in cave CWAN-04 within the Western Hill deposit section of the Revised Development Envelope in Hillcrest/Hillslope habitat.

All of the 41 caves recorded in the Revised Development Envelope comprise Ghost Bat roost caves including two confirmed maternity roosts (category 2), five potential maternity roosts (category 2), three confirmed diurnal roosts (category 3), 10 potential diurnal roosts (category 3), 12 night roosts (category 4), and nine potential night roosts (category 4) (Table 9-6) (Bat Call WA 2021a). Evidence of the Ghost Bat was recorded in 29 caves (Table 9-6) throughout the Revised Development Envelope, within Gorge/Gully and Hillcrest/Hillslope habitat types. Echolocation calls have been recorded at four of these caves, and secondary evidence (scats) have been recorded at 18 caves. Two caves contained the remains of Ghost Bat pups, and a live Ghost Bat was sighted at two caves.

No category 1, 2 or 3 roosts for the Pilbara Leaf-nosed Bat were recorded within the Revised Development Envelope, with all 41 caves providing potential nocturnal refuges (category 4) which are not critical habitat but are considered important for the persistence of the species within the area for the Pilbara Leaf-nosed Bat (Table 9-6) (Bat Call WA 2021b). The Pilbara Leaf-nosed Bat has not been confirmed in any of the caves within the Revised Development Envelope, however echolocation calls have been recorded near cave CWAN-04.

A summary of the caves recorded in the Proposal Area and Revised Development Envelope and their respective categories for significant bat species (Ghost Bat and Pilbara Leaf-nosed Bat) are described in further detail in Section 9.3.4 and shown on Figure 9-4 to Figure 9-4(c).

Caves previously recorded in the Approved Development Envelope are subject to exclusions and management as specified in MS 1113 and summarised in Section 9.5.2.

Table 9-7: Caves Recorded within the Revised Development Envelope

ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
Caves Recorded within the Proposal Area					
CWAN-01	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 3 – in ‘apartment block’ Potential diurnal roost	10 Ghost Bat scats
CWAN-02	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 3 – in ‘apartment block’ Potential diurnal roost	No scats
CWAN-03	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 3 - in ‘apartment block’ Potential diurnal roost	20 Ghost Bat scats
CWAN-04*	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 2 - in ‘apartment block’ Confirmed maternity roost	~1,500 Ghost Bat scats recorded Dead Ghost Bat pup (skeleton) found Multiple Ultrasonic Calls
CWAN-05	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-06	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	~1,500 Ghost Bat scats recorded 1 Ghost Bat individual present Single Ultrasonic Call
CWAN-07	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	~5,000 Ghost Bat scats
CWAN-08	Hillcrest/Hillslope	Mount Ella East	Category 4 Potential nocturnal refuge	Category 4 Night roost	30 Ghost Bat scats
CWAN-09	Hillcrest/Hillslope	Deposit H	Category 4 Potential nocturnal refuge	Category 4 Night roost	7 Ghost Bat scats

ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
CWAN-11	Hillcrest/Hillslope	Mount Ella East	Category 4 Potential nocturnal refuge	Category 4 Night roost	1 Ghost Bat scat
CWAN-26	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-27	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-28	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Night roost	5 Ghost Bat scats
CWAN-29	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	5 Ghost Bat scats Remains of Ghost Bat
CWAN-30	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-31	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	No scats Deep, dark cave
CWAN-32	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Night roost	5 Ghost Bat scats
CWAN-33	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-34	Hillcrest/Hillslope	Mount Ella East	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CDHI-001#	Hillcrest/Hillslope	Deposit B	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No Ghost Bat scats

ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
CDHI-002#	Hillcrest/Hillslope	Deposit B	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No Ghost Bat scats
Caves within the Approved Development Envelope					
CMAR-01	Hillcrest/Hillslope	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	~300 old Ghost Bat scats
CMAR-02	Hillcrest/Hillslope	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	20 Ghost Bat scats
CMAR-03	Gorge/Gully	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	6 old Ghost Bat scats
CMAR-04	Gorge/Gully	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	1 old Ghost Bat scat
A1	Hillcrest/Hillslope	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Confirmed diurnal roost	Monitoring indicates cave is utilised by Ghost bat
A2	Hillcrest/Hillslope	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	Monitoring indicates cave is utilised by Ghost bat
I1	Hillcrest/Hillslope	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	Historical Ghost Bat scats
L2	Gorge/Gully	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	Monitoring indicates cave is utilised by Ghost bat

ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
L3	Gorge/Gully	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	Monitoring indicates cave is utilised by Ghost bat 1,000 Ghost Bat scats Ghost Bat ultrasonic calls recorded
AA1	Gorge/Gully	Deposit F; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Confirmed maternity roost	Monitoring indicates cave is utilised by Ghost bat
WA-09	Gorge/Gully	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	2 Ghost Bat scats
WA-10	Hillcrest/Hillslope	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	25 Ghost Bat scats
WA-11	Gorge/Gully	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	20 Ghost Bat scats
WA-12	Hillcrest/Hillslope	Deposit D; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Confirmed diurnal roost	170 Ghost Bat scats
WA-13	Gorge/Gully	Deposit D; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	1,500 Ghost Bat scats
WA-17	Gorge/Gully	Deposit D; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	36 Ghost Bat scats
WA-20	Gorge/Gully	Deposit D; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	250 Ghost Bat scats

ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
WA-21	Gorge/Gully	Deposit D; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	1,500 Ghost Bat scats
WA-22	Hillcrest/Hillslope	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Confirmed diurnal roost	20 Ghost Bat scats
WA-23	Gorge/Gully	Deposit C; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	2,000 Ghost Bat scats

* This cave also shows evidence of Northern Quoll historically Source: Biologic 2021 e), Bat Call WA 2021 a, Bat Call WA 2021 b

#These caves were recorded in the Approved Development Envelope in proximity to the Conceptual Footprint during recent surveys, as such are included in the Proposal Area for assessment

Water Features

The Revised Development Envelope does not contain any permanent water features such as pools and springs. Five ephemeral surface water features have been recorded within the Revised Development Envelope, two within the current Approved Development Envelope and three within the Proposal Area. Of the three features within the Proposal Area, two occur at Mt Ella East (WB-WAJ1 and WB-WAJ2) and one at Deposit H (WB-WAH1) (Figure 9-4). The two features within the Approved Development Envelope are located within the southwestern corner of the Revised Development Envelope (WMAR-01 and WMAR-03) and are protected from clearing under MS 1113 (Appendix A.3). These water features will not be affected by the Proposal (refer Section 7).

The three pools within the Proposal Area were recorded in Gorge/Gully fauna habitat in October following a typical dry season (Biologic 2021c). The water in these pools likely came from the high rainfall in June 2018, three months prior. Following the lack of rainfall between June 2018 and the survey the same year, the pools were drying up, indicating that they provide only temporary sources of water following periods of seasonal rain.



Surface water fed ephemeral water feature WB-WAH1 (Deposit H Waterhole; Table 9-8) was initially documented in August 2018 and by the time of the October survey the same year, it had dried up substantially. A motion camera and ultrasonic bat recorder were installed at the site for four nights in October 2018 as part of targeted sampling efforts; however, no bat species of significance were recorded at this location during this time. One Pilbara Olive Python has been recorded at this pool (Biologic 2021c). No other conservation significant fauna species have been recorded at the site or its immediate surrounds. No bat caves are located in close proximity to be dependent on the pool.


Surface water fed ephemeral water features WB-WAJ1 and WB-WAJ2 (Mt Ella East) were located in the same rocky gully. Ten motion cameras were deployed at these sites between October 2018 and March 2019 (Biologic 2021c). No terrestrial fauna species of significance were recorded on these cameras. When the cameras were retrieved, recent rain had created a series of small, interconnected pools within the gully.

A semi-permanent pool known as Turtle Pool is located in a tributary of Weeli Wolli Creek, outside the Revised Development Envelope, approximately 700 m east of Deposit H, downstream of the Proposal (Figure 9-4).

These pools may provide seasonal drinking and foraging resources for part of the year (after periods of rainfall) for various fauna species, including the following significant species; Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python.

Table 9-8: Ephemeral Water Features within the Proposal Area

ID	Habitat Type	Deposit	Description	Photo
WB-WAJ1	Gorge/Gully	Mt Ella East	<p>This surface water body is a small temporary rock pool located along the same rock gully as WB-WAJ2 which is fed by rainfall and surface water flows.</p> <p>No MNES species were recorded as occurring within or in the vicinity of the water body</p>	
WB-WAJ2	Gorge/Gully	Mt Ella East	<p>This surface water body is a small temporary rock pool located along the same rock gully as WB-WAJ1 which is fed by rainfall and surface water flows.</p> <p>No MNES species were recorded as occurring within or in the vicinity of the water body</p>	

ID	Habitat Type	Deposit	Description	Photo
WB-WAH1 (Deposit H Waterhole)	Gorge/Gully	Deposit H	<p>This surface water body is a small temporary rock pool that fills up with rainwater over the wet season and generally dries out within four months of the last rains of the year.</p> <p>Despite the transient nature of the pool, it is known to support the persistence of Pilbara Olive Pythons within the Revised Development Envelope.</p>	

9.3.3. Vertebrate Fauna Assemblage and Species Diversity

An initial desktop review by Biologic (2021c) identified 298 vertebrate fauna species that were either previously recorded or could occur within the vicinity of the Revised Development Envelope, including seven amphibians, 107 reptiles, 135 birds, and 49 mammals (including 41 native and eight introduced mammals). A total of 24 of these species are of significance. The review is provided in Appendix G of Biologic 2021c) in Appendix E.7.

During the recent and historical field surveys, 214 vertebrate fauna species comprising two amphibians, 80 reptiles, 103 birds, and 29 mammal species (23 native and six introduced mammals) have been recorded within the Revised Development Envelope. A total of seven significant fauna species have been recorded in the Revised Development Envelope: two reptiles, one bird and four mammals. The fauna assemblage recorded in the Revised Development Envelope is considered typical of the Hamersley subregion, with survey results comparable to other surveys in the Pilbara region of similar size and scale (Biologic 2021c).

9.3.3.1. Amphibians

Two amphibian species were recorded within the Revised Development Envelope, including the Little Red Tree Frog (*Litoria rubella*), recorded at water pool WB-WAH1, and the Sheep Frog (*Cyclorana maini*), recorded at Western Hill. Both are relatively common and neither are of conservation significance.

More amphibian species are likely to be present in the Revised Development Envelope; however, no conservation significant amphibians are known to occur within the Pilbara region (Biologic 2021c).

9.3.3.2. Birds

One-hundred and three (103) bird species have been recorded within the Revised Development Envelope. The most common species recorded were the Willie Wagtail (*Rhipidura leucophrys*) and Weebill (*Smicromnis brevirostris*). One significant bird species, the Fork-tailed Swift (*Apus pacificus*), listed as Migratory under the BC Act and EPBC Act, has been recorded in the Revised Development Envelope (Biologic 2021c) (refer to Section 9.3.4 and Section 13. The recent survey (Biologic 2021c) observed the highest diversity of bird species at Western Hill deposit section of the Revised Development Envelope within Drainage Line and Mixed Acacia Woodland habitat.

The bird assemblage recorded in the Revised Development Envelope is typical for Pilbara sites that do not contain permanent waterbodies. The most commonly recorded bird groups were those that inhabit woodlands, and these species are dependent on well-vegetated habitats such as Drainage Lines and Mixed Acacia Woodland habitat (Biologic 2021c).

9.3.3.3. Mammals

A total of 29 mammal species have been recorded within the Revised Development Envelope, including six introduced species (Biologic 2021c). The most common species recorded was the Common Rock Rat (*Zygomys argurus*). This species is known to be widespread in the Pilbara region.

Eleven bat species have been recorded from bat echolocation and acoustic recordings within the Revised Development Envelope (Biologic 2021c). Finlayson's Cave Bat (*Vespadelus finlaysoni*) was the most commonly recorded bat species. Five of the 11 bat species recorded (including the significant Ghost Bat (*Macroderma gigas*; Vulnerable) and Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*; Vulnerable) are dependent on caves and rocky crevices for roosting. The remaining six bat species recorded prefer to roost in tree hollows (Biologic 2021c).

Four significant mammal species were recorded within the Revised Development Envelope; Northern Quoll (*Dasyurus hallucatus*; listed as Endangered under the EPBC Act and BC Act), Pilbara Leaf-nosed Bat (listed as Vulnerable under the EPBC Act and BC Act), Ghost Bat (listed as Vulnerable under the

EPBC Act and BC Act), and Western Pebble-mound Mouse (listed as Priority 4 by DBCA) (described in Section 9.3.4).

Six feral fauna species have been recorded in the Revised Development Envelope: Cats (*Felis catus*), Dingo/Dogs (*Canis familiaris*), Dromedary Camels (*Camelus dromedarius*), Cattle (*Bos taurus*), European Rabbit (*Oryctolagus cuniculus*) and House Mouse (*Mus musculus*) (Biologic 2021c). These species are known from the region surrounding the Revised Development Envelope.

The Mixed Acacia Woodland, Drainage Line and Footslopes and Plain habitats supported the highest number and/or diversity of native mammals (Biologic 2021c).

9.3.3.4. Reptiles

A total of 80 reptile species have been recorded within the Revised Development Envelope. The most common reptile species recorded was the Leopard Ctenotus (*Ctenotus pantherinus*). The recent survey found the greatest diversity of reptiles within the Mixed Acacia Woodland and Drainage Line fauna habitats at Western Hill deposit (Biologic 2021c).

Two significant reptile species have been recorded within the Revised Development Envelope; the Pilbara Olive Python (listed as Vulnerable under the EPBC Act and BC Act) and the Pilbara Barking Gecko (listed as P2 by DBCA; refer to Section 9.3.4). These species are described in further detail in Section 9.3.4.

9.3.3.5. Introduced Fauna

Six feral fauna species have been recorded in the Revised Development Envelope: Cats (*Felis catus*), Dingo/Dogs (*Canis familiaris*), Dromedary Camels (*Camelus dromedarius*), Cattle (*Bos taurus*), European Rabbit (*Oryctolagus cuniculus*) and House Mouse (*Mus musculus*) (Biologic 2021c). These species are known from the region surrounding the Revised Development Envelope.

Cats are identified as key threats to native mammals identified as Confirmed or Likely to occur within the Revised Development Envelope, including significant fauna species recorded such as the Northern Quoll (DoE 2016b).

9.3.4. Significant Vertebrate Fauna

A total of 24 significant fauna species listed under the EPBC Act, BC Act or as Priority fauna by DBCA were identified as potentially occurring within the Revised Development Envelope based on database searches, including seven mammals, 13 birds and four reptiles (Biologic 2021c).

Of the 24 significant species identified from desktop assessment, seven have been recorded within the Proposal Area and Revised Development Envelope including:

- Northern Quoll – Endangered (EPBC and BC Acts)
- Ghost Bat – Vulnerable (EPBC and BC Acts)
- Pilbara Leaf-nosed Bat – Vulnerable (EPBC and BC Acts)
- Pilbara Olive Python – Vulnerable (EPBC and BC Acts)
- Fork-tailed Swift – Migratory Species (EPBC Act)
- Pilbara Barking Gecko – P2 (DBCA)
- Western Pebble Mound Mouse – P4 (DBCA).

Five terrestrial vertebrate fauna species are considered either likely to or possibly occur within the Proposal Area and Revised Development Envelope based on nearby records and suitable habitat presence and availability (Table 9-9; Biologic 2021c).

Three species are considered unlikely to occur due to a lack of suitable habitat and no records in proximity to the Revised Development Envelope (Biologic 2021c, e):

- Greater Bilby (*Macrotis lagotis*; Vulnerable – EPBC and BC Acts)
- Lined Soil-crevice Skink (*Notoscincus butleri*; Priority 4)
- Night Parrot (*Pezoporus occidentalis*: Endangered – EPBC Act and Critically Endangered - BC Act).

Nine species are considered highly unlikely to occur as the Revised Development Envelope occurs outside of their known distributions (Biologic 2021c).

Significant vertebrate fauna species that are unlikely or highly unlikely to occur in the Revised Development Envelope are described in Table 5.8 of Appendix E.7 (Biologic 2021c) but are not discussed further in this chapter.

Although the Night Parrot is considered unlikely to occur within the Revised Development Envelope, this MNES species has been determined as a controlling provision of the Proposal under the EPBC Act. This species is discussed further in Section 13.

Records of significant fauna species within the Revised Development Envelope and surrounds are shown in Figure 9-5 and each significant species is described in further detail in subsequent sections.

Table 9-9: Significant Fauna Recorded or Considered to Likely or Possibly Occur within the Revised Development Envelope

Species	Conservation Status	Broad Habitat Type	Presence within Proposal Area	Presence within Revised Development Envelope	Comment
Birds					
Fork-tailed Swift (<i>Apus pacificus</i>)	Migratory (EPBC Act and BC Act)	Variety of habitats This species is an aerial forager with no specific habitat requirements within the Revised Development Envelope.	Recorded	Recorded	Twenty individuals were recorded flying over the northwest section of the Revised Development Envelope at the Western Hill deposit. However, given that the species is largely aerial, it would not depend on any of the habitats present within the Revised Development Envelope.
Grey Falcon (<i>Falco hypoleucos</i>)	Vulnerable (EPBC Act and BC Act)	Timbered lowland plains, particularly Acacia shrublands that are near tree-lined watercourses. It has been observed in treeless areas and tussock grassland, open woodland (Garnett et al. 2011).	Likely	Likely	The species has not been recorded within the Revised Development Envelope; however, it was recorded within 3 km of the Revised Development Envelope in 1997 and within 10 km of the Revised Development Envelope in 2008. Supporting foraging habitat for this species may occur within Drainage Line, Mixed Acacia Woodland, Foothills and Plain habitat types. Suitable nesting habitat may occur where other birds have constructed nests in large trees or other structures within the Revised Development Envelope.
Peregrine Falcon (<i>Falco peregrinus</i>)	Other Specially Protected Fauna (OS; BC Act)	It is most often encountered in arid areas along cliffs above rivers, ranges and wooded watercourses where it hunts birds (Johnstone & Storr, 1998). It typically nests on rocky ledges on tall, vertical cliff faces between 25 m and 50 m high (Olsen <i>et al.</i> , 2004; Olsen & Olsen, 1989).	Likely	Likely	This species has not been recorded in the Revised Development Envelope. This species can utilise a wide variety of habitats and has been recorded within 10 km of the Revised Development Envelope. Suitable nesting habitat occurs within the Gorge/Gully and Hillcrest/Hillslope habitats, and suitable foraging habitat occurs within Drainage Line, Mixed Acacia Woodland and Foothills and Plain habitats.

Species	Conservation Status	Broad Habitat Type	Presence within Proposal Area	Presence within Revised Development Envelope	Comment
Mammals					
Northern Quoll <i>(Dasyurus hallucatus)</i>	Endangered (EPBC Act and BC Act)	Rocky habitats which provide protection from predators and are productive with regards to the availability of resources (Braithwaite and Griffiths 1994; Oakwood 2000). Den sites include caves and rocky crevices, particularly near water sources (Woinarski et al. 2008).	Recorded	Recorded	Northern Quoll scats were observed in a cave (CWAN-04) at Western Hill deposit within Gorge/Gully habitat. The Gorge/Gully habitat type within the Revised Development Envelope represents potential critical habitat for the Northern Quoll as it provides shelter, foraging and potential denning habitat for the species. Drainage Line and Hillcrest/Hillslope habitat types provide foraging and dispersal habitat for the Northern Quoll.
Pilbara Leaf-nosed Bat <i>(Rhinonicteris aurantia)</i>	Vulnerable (EPBC Act and BC Act)	Roosting sites include caves, deep fissures or abandoned mine shafts with warm and humid climates (Armstrong 2000, 2001; Baudinette et al. 2000). Foraging occurs widely across almost all productive and semi-productive habitats (Bat Call WA 2021b).	Recorded	Recorded	Echolocation calls have been recorded at five locations within the Revised Development Envelope during recent surveys. Two echolocation calls were recorded in the north- western section of the Revised Development Envelope at the at the Western Hill deposit, three echolocation calls were recorded in a cave (CWAN-04) located within Hillcrest/Hillslope habitat, and one call was recorded in the Footslopes and Plain habitat type (VWAW 87). Echolocation calls have also been recorded at Deposit A West, Deposit C and Deposit D areas of the Revised Development Envelope during historical surveys. Nocturnal roosting habitat for this species occurs within Gorge/Gully habitat. Foraging and dispersal habitat occurs within Hillcrest/Hillslope and Drainage Line habitat types.

Species	Conservation Status	Broad Habitat Type	Presence within Proposal Area	Presence within Revised Development Envelope	Comment
Ghost Bat (<i>Macrotis lagotis</i>)	Vulnerable (EPBC Act and BC Act)	Rocky gorges and outcrops with caves and crevices which are used as nocturnal, diurnal and maternity roosts. Foraging typically occurs up to 12 km from a diurnal roost (Bat Call WA 2021a).	Recorded	Recorded	<p>Evidence of the Ghost Bat was recorded in 29 caves (Table 9-7) throughout the Revised Development Envelope, within Gorge/Gully and Hillcrest/Hillslope habitat types. Echolocation calls have been recorded at four of these caves, and secondary evidence (scats) have been recorded at 18 caves. Two caves contained the remains of Ghost Bat pups, and a live Ghost Bat was sighted at two caves.</p> <p>Critical roosting habitat occurs within Gorge/Gully and Hillcrest/Hillslope habitat types. Foraging and dispersal habitat occurs in Drainage Line, Mixed Acacia Woodland, Foothills and Plain and Cracking Clay habitat types, and is considered supporting habitat when within 12 km of critical habitat (Category 2 caves and category 3 caves in apartment blocks).</p>
Western Pebble-mound Mouse (<i>Pseudomys chapmani</i>)	Priority 4 (DBCA)	Occurs on gentle slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Biologic 2021c).	Recorded	Recorded	<p>288 records from across the Revised Development Envelope.</p> <p>Suitable habitat occurs within stony slopes of Foothills and Plain and Hillcrest/Hillslope habitats, and the species may also utilise stony areas within other habitats.</p>

Species	Conservation Status	Broad Habitat Type	Presence within Proposal Area	Presence within Revised Development Envelope	Comment
Short-tailed Mouse (<i>Leggadina lakedownensis</i>)	Priority 4 (DBCAs)	The species occupies a diverse range of habitats, including spinifex and tussock grasslands, samphire and sedgelands, Acacia shrublands, tropical eucalypt and Melaleuca woodlands and stony ranges; however, the species is most commonly found in seasonally inundated habitats on red or white sandy-clay soils (Moro & Kutt 2008).	Possible	Possible	Marginally suitable habitat occurs within the Footslopes and Plain, Cracking Clay and Mixed Acacia Woodland habitats. In addition, records of this species occur within 5 km of the Revised Development Envelope. Given the proximity of nearby recent records and suitable habitat is only marginal, it is considered 'Possible' that this species could occur in the Revised Development Envelope.
Brush-tailed Mulgara (<i>Dasycercus blythi</i>)	Priority 4 (DBCAs)	Prefers spinifex <i>Triodia</i> spp. Grasslands on sand plains and the swales between low dunes (Pavey et al. 2012; Woolley 2006). Mature spinifex hummocks appear to be important for protection from introduced predators (Körtner et al. 2007).	Possible	Possible	This species has not been recorded in the Revised Development Envelope. Marginally suitable habitat occurs in the form of sandy plains within the Footslopes and Plain habitat types. In addition, there are 12 records of this species within 35 km of the Revised Development Envelope. Given the proximity of recent records to the Revised Development Envelope and that suitable habitat within the Revised Development Envelope is only marginal, it is considered 'Possible' that this species occurs.
Reptiles					
Pilbara Olive Python (<i>Liasis olivaceus barroni</i>)	Vulnerable (EPBC Act and BC Act)	Typically occurs in rocky ranges with permanent water holes and amongst riverine vegetation (Pearson 1993).	Recorded	Recorded	Recorded on a motion camera at a water feature in Gorge/Gully habitat (WB-WAH1) at Deposit H within the Revised Development Envelope. Scats were recorded in cave CWAN-04 within the Western Hill deposit section of the Revised Development Envelope in Hillcrest/Hillslope habitat.

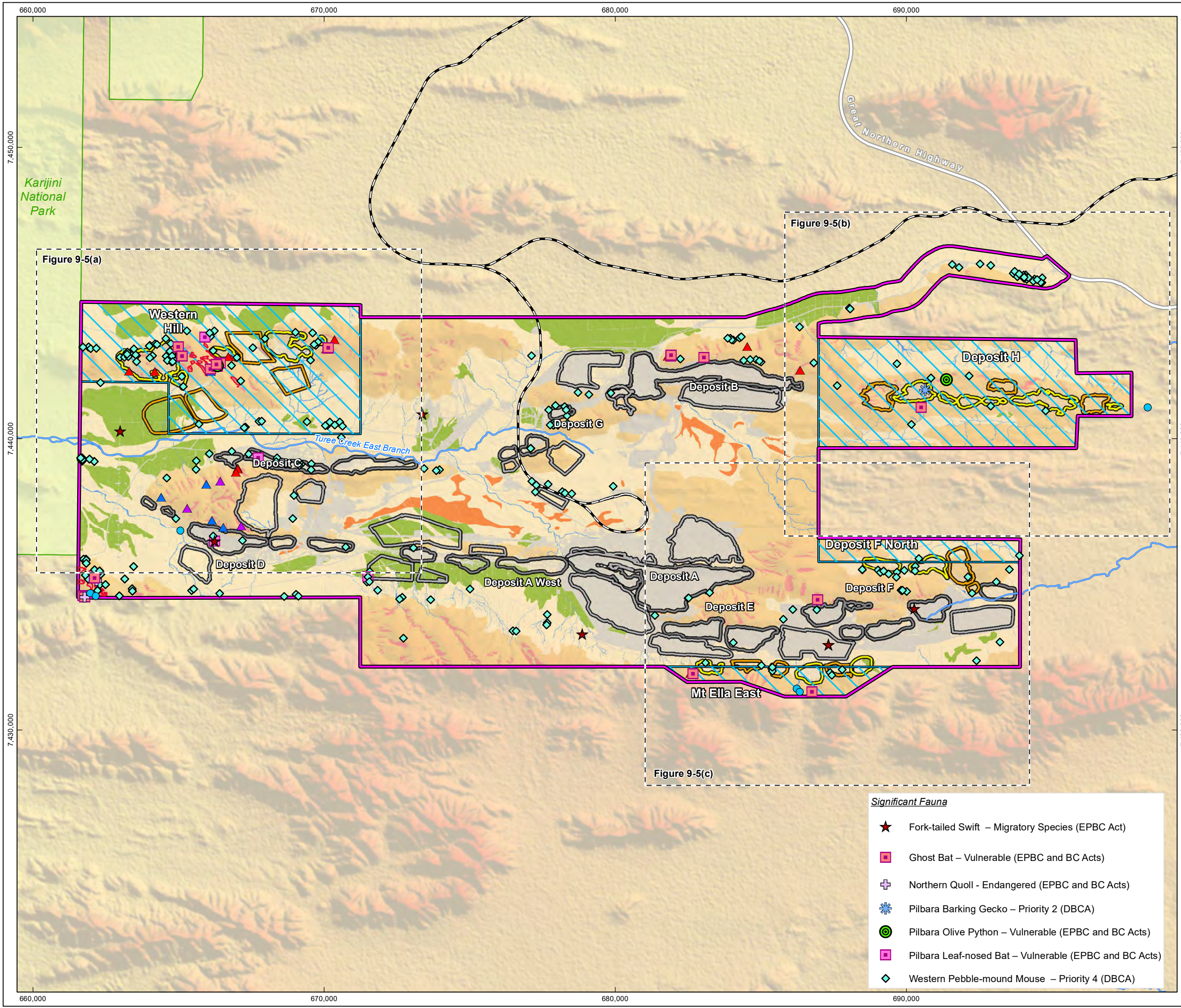
Species	Conservation Status	Broad Habitat Type	Presence within Proposal Area	Presence within Revised Development Envelope	Comment
					Gorge/Gully habitat within the Revised Development Envelope provides critical breeding, shelter and foraging habitat. Foraging and dispersal habitat occurs in the Hillcrest/Hillslope and Drainage Line habitat types.
Pilbara Flat-headed Blind-snake (<i>Anilius ganei</i>)	Priority 1 (DBCA)	Little is known about the ecology of the Pilbara Flat-headed Blind-snake. The species is possibly associated with moist soils and leaf litter within gorges and gullies and potentially within a wide range of other stony habitats (Wilson & Swan 2014). The species has been recorded from numerous habitats but is most likely to be present in rocky terrain and along drainage lines (DBCA 2018).	Likely	Likely	The Pilbara Flat-headed Blind-snake has not been recorded in the Revised Development Envelope. The nearest record of this species has been recorded approximately 2.3 km south of the Revised Development Envelope in Drainage Line habitat (Biologic 2021c). Suitable habitat occurs in Gorge/Gully habitat (where moist soil is present) and in rocky terrain within Drainage Line habitat.
Pilbara Barking Gecko (<i>Underwoodisaurus seorsus</i>)	Priority 2 (DBCA)	Little is known about the ecology of the Pilbara Barking Gecko, but the species is thought to prefer rocky areas with spinifex and low tree cover habitats (Wilson & Swan 2014).	Recorded	Recorded	Recorded in the Revised Development Envelope in 2014 from Deposit H in Hillcrest/Hillslope habitat type and a location outside of the Revised Development Envelope, approximately 2 km southwest of Deposit H. Suitable habitat occurs within Gorge/Gully and Hillcrest/Hillslope habitats.

Source: Biologic (2022 d), Biologic 2021 e, c

Figure 9-5
Records of Significant Fauna
within the Revised Development
Envelope - Overview

Drawn: L.Fuentes
Plan: RTIO-0980490v2
Date: November 2023

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



Legend

- Revised Development Envelope
- Extension

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

- Pit
- Waste Landform

- Water Feature

Caves

- Category 2
- Category 3
- Category 4

High Significance Fauna Habitat

- Gorge/Gully
- Hillcrest and Hillslope
- High Significance Northern Quoll Habitat

Moderate Significance Fauna Habitat

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

- National Park
- Rio Tinto Railway
- Highway
- Major Creek

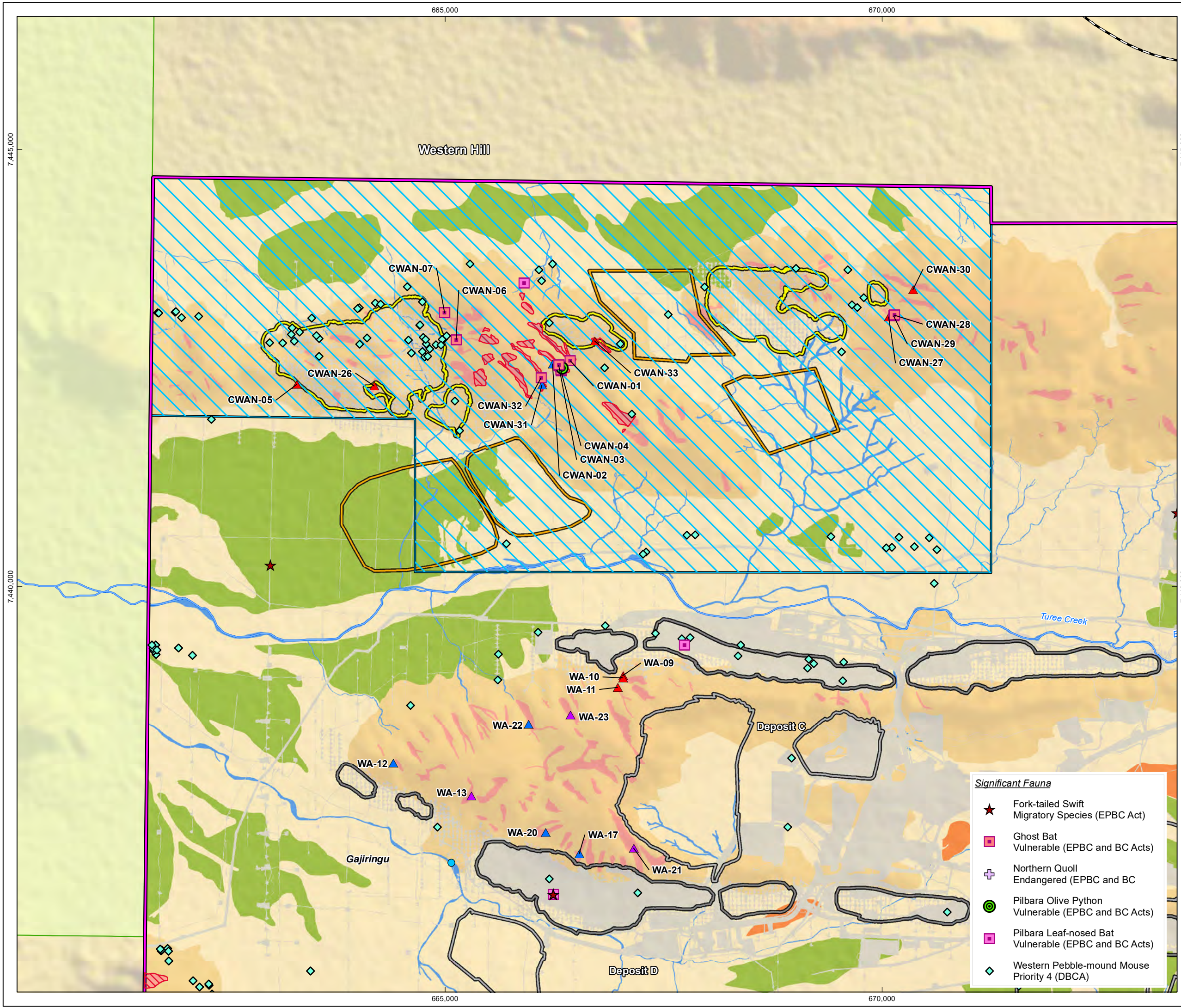
Significant Fauna

- Fork-tailed Swift – Migratory Species (EPBC Act)
- Ghost Bat – Vulnerable (EPBC and BC Acts)
- Northern Quoll - Endangered (EPBC and BC Acts)
- Pilbara Barking Gecko – Priority 2 (DBCAs)
- Pilbara Olive Python – Vulnerable (EPBC and BC Acts)
- Pilbara Leaf-nosed Bat – Vulnerable (EPBC and BC Acts)
- Western Pebble-mound Mouse – Priority 4 (DBCAs)

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Figure 9-5(a)
Records of Significant Fauna
within the Revised Development
Envelope - Western Hill

Drawn: L. Fuentes
Plan: RTIO-0980490v2
Date: November 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

- Water Feature

Caves

- Category 2
- Category 3
- Category 4

High Significance Fauna Habitat

- Gorge/Gully
- Hillcrest and Hillslope
- High Significance Northern Quoll Habitat

Moderate Significance Fauna Habitat

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

Significant Fauna

- Fork-tailed Swift Migratory Species (EPBC Act)
- Ghost Bat Vulnerable (EPBC and BC Acts)
- Northern Quoll Endangered (EPBC and BC)
- Pilbara Olive Python Vulnerable (EPBC and BC Acts)
- Pilbara Leaf-nosed Bat Vulnerable (EPBC and BC Acts)
- Western Pebble-mound Mouse Priority 4 (DBCAs)

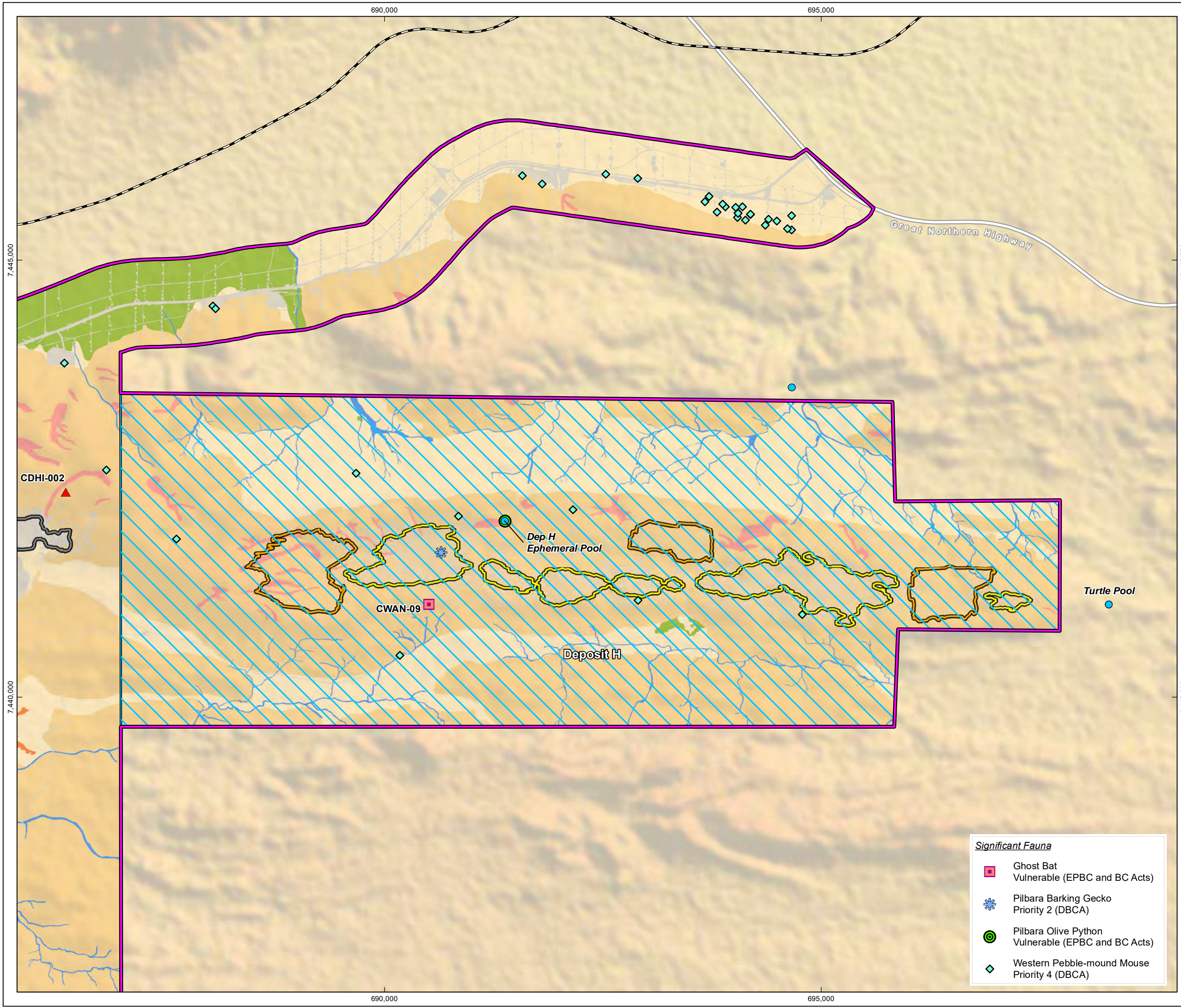
National Park
Rio Tinto Railway
Major Creek

0 1 2
Kilometres
Map units in metres

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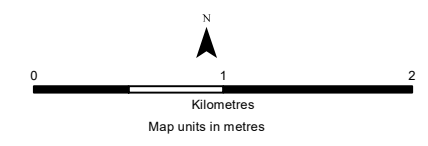
Figure 9-5(b)
Records of Significant Fauna
within the Revised Development
Envelope - Deposit H

Drawn: L. Fuentes
Plan: RTIO-0980490v2
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



- Legend**
- Revised Development Envelope
 - Extension
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Water Feature
 - Caves**
 - ▲ Category 4
 - High Significance Fauna Habitat**
 - Gorge/Gully
 - Hillcrest and Hillslope
 - Moderate Significance Fauna Habitat**
 - Drainage Line
 - Cracking Clay
 - Footslopes and Plains
 - Mixed Acacia Woodland
 - Disturbed
 - Rio Tinto Railway
 - Highway

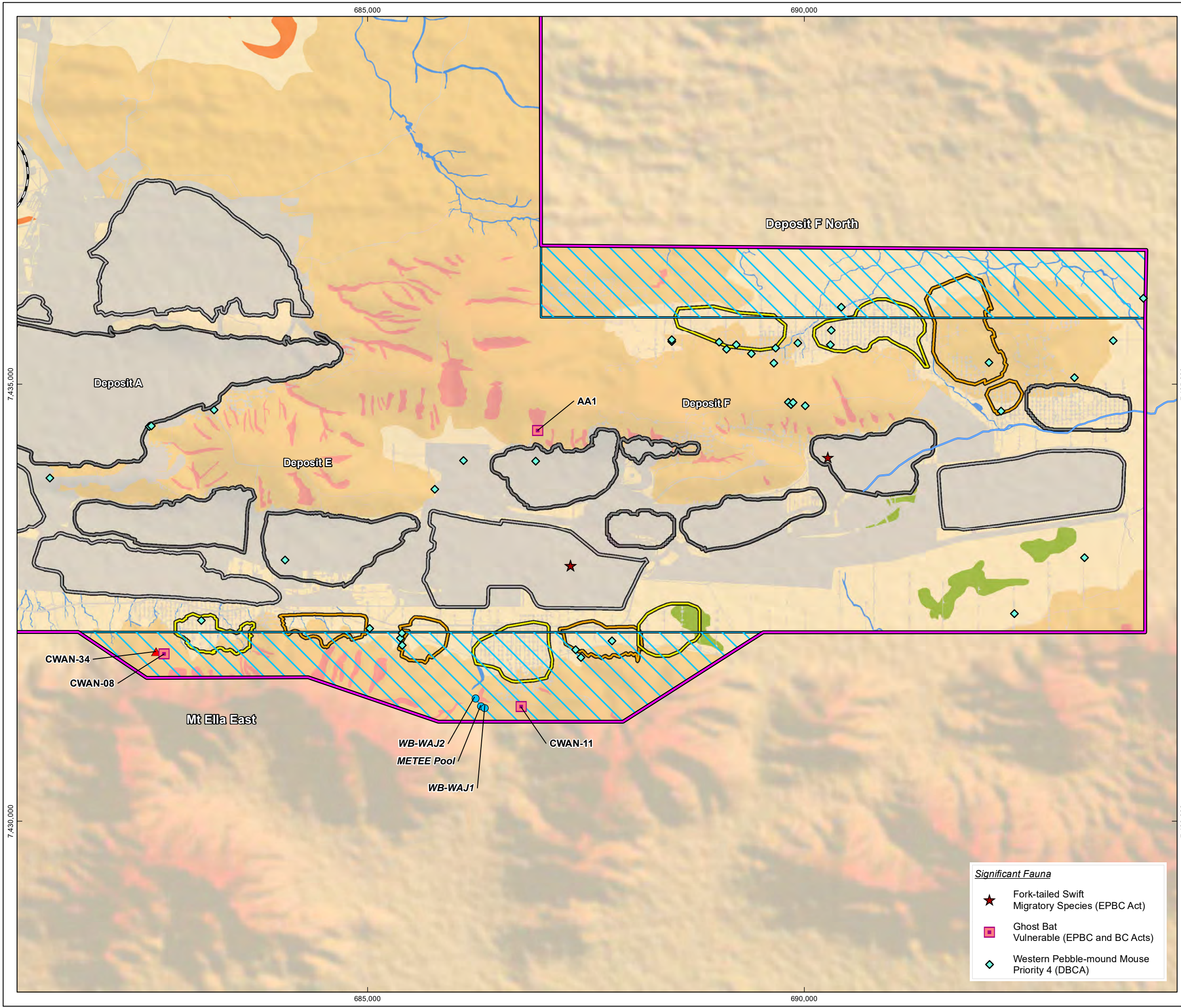
- Significant Fauna**
- Ghost Bat
Vulnerable (EPBC and BC Acts)
 - ✳ Pilbara Barking Gecko
Priority 2 (DBCAs)
 - ◎ Pilbara Olive Python
Vulnerable (EPBC and BC Acts)
 - ◆ Western Pebble-mound Mouse
Priority 4 (DBCAs)



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Figure 9-5(c)
Records of Significant Fauna
within the Revised Development
Envelope - Mt Ella East and
Deposit F North

Drawn: L.Fuentes
 Plan: RTIO-0980490v2
 Date: November 2023
 Proj: GDA 1994 MGA Zone 50
 Scale: 1:40,000 @A3
 GIS.Team@riotinto.com

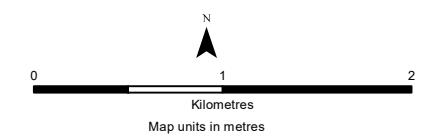


Legend

- Revised Development
- Extension
- Proposed Conceptual*
- Pit
- Waste Landform
- Approved Conceptual*
- Pit
- Waste Landform
- Water Feature
- Caves*
- ▲ Category 2
- ▲ Category 4
- High Significance Fauna*
- Gorge/Gully
- Hillcrest and Hillslope
- Moderate Significance Fauna*
- Drainage Line
- Cracking Clay
- Footslopes and Plains
- Mixed Acacia Woodland
- Disturbed
- Rio Tinto Railway
- Major Creek

Significant Fauna

- ★ Fork-tailed Swift
Migratory Species (EPBC Act)
- Ghost Bat
Vulnerable (EPBC and BC Acts)
- ◆ Western Pebble-mound Mouse
Priority 4 (DBCA)



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9.3.4.1. Significant Vertebrate Fauna Species Recorded in the Revised Development Envelope

Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll (Plate 9-1) is listed as Endangered under both the BC Act and EPBC Act. The species was originally found across northern Australia, from the Northwest Cape of Western Australia to southeast Queensland; however, in recent years its distribution has contracted significantly, with core populations now occurring in central and north Queensland, northern parts of the Northern Territory, throughout the Pilbara and Kimberly regions of Western Australia, as well as some offshore islands (DoE 2022).



Nature 2018

Plate 9-1: Northern Quoll

The Northern Quoll population within the Pilbara is genetically distinct from the population in the Kimberley due to the physical separation created by the Great Sandy Desert resulting in the prevention of gene flow between the two populations (Dunlop *et. al.* 2019).

The EPBC Act referral guideline defines critical habitat for the Northern Quoll as '*habitat within the modelled distribution for the species that provide shelter for breeding, refuge from fire and/or predation and potential predation poisoning from Cane Toad*' (DoE 2016b). The Gorge/Gully habitat type within the Revised Development Envelope represents potential critical habitat for the Northern Quoll as it provides shelter, foraging and potential denning habitat for the species (Biologic 2021e). This habitat is considered critical to the survival of the Northern Quoll, as defined by the National Recovery Plan (Hill and Ward 2010).

The referral guidelines (DoE 2016a) include dispersal and foraging habitat associated with or connecting important populations as critical habitat. However, these habitats are of greatest importance when near rocky denning habitat; therefore, foraging and dispersal habitat within 1 km of critical breeding habitat is

defined as supporting habitat for Northern Quoll. The Drainage Line and Hillcrest/Hillslope habitat types have been classified by Biologic (2021e) as supporting habitat for the Northern Quoll when within 1 km of critical breeding habitat. These habitat types provide dispersal and foraging habitat, which support populations or provides connectivity between populations and are important to the species' long-term survival (DoE 2016b).

All other habitat types within the Revised Development Envelope are considered to be of low significance for the Northern Quoll and do not represent critical or supporting habitat (Biologic 2021e).

Across the Revised Development Envelope 14 Northern Quoll camera transects have been deployed (Biologic 2022b, 2022c, 2021c, 2021e), which include 10 motion cameras deployed for a minimum of four nights (up to 145 nights) and baited with either universal bait or a non-reward scent lure as per the referral guidelines for the species (DoE 2016b). The Northern Quoll transects equated to 3,380 camera nights across the Revised Development Envelope. To supplement the data from the camera transects, single baited cameras were deployed during the baseline survey in 42 locations for a total of 421 camera nights (Biologic 2021c).

The Northern Quoll has been recorded at one location within the Proposal Area (cave CWAN-04) located in Hillcrest/Hillslope habitat at Western Hill via secondary evidence (approximately 200 scats; Figure 9-6; Biologic 2021c, e). The scats were recorded towards the back of cave CWAN-04, in a grass-lined cavity (Biologic 2021c). The condition of the scats indicated that an individual had not visited this site for at least 12 months (Biologic 2021c).

Despite considerable sampling effort throughout the Revised Development Envelope to date, records of the species are relatively sparse with just three other records of old scats in two caves (CMAR-01 and CMAR-03) and a rocky ledge in the southwest corner of the Revised Development Envelope. The scats recorded at cave CWAN-04 may indicate a population of Northern Quoll occurs in the area; however, despite camera monitoring at the entrance of the cave over a five-month period, no Northern Quolls were recorded (Biologic 2021c). Under the EPBC Act Referral Guideline for Northern Quoll (DoE 2016b), this would be deemed a 'low density' population if present (i.e., where trapping has captured no individuals, but there is latrine evidence). Low-density populations do not represent important populations as defined in the species Recovery Plan (Hill and Ward 2010).

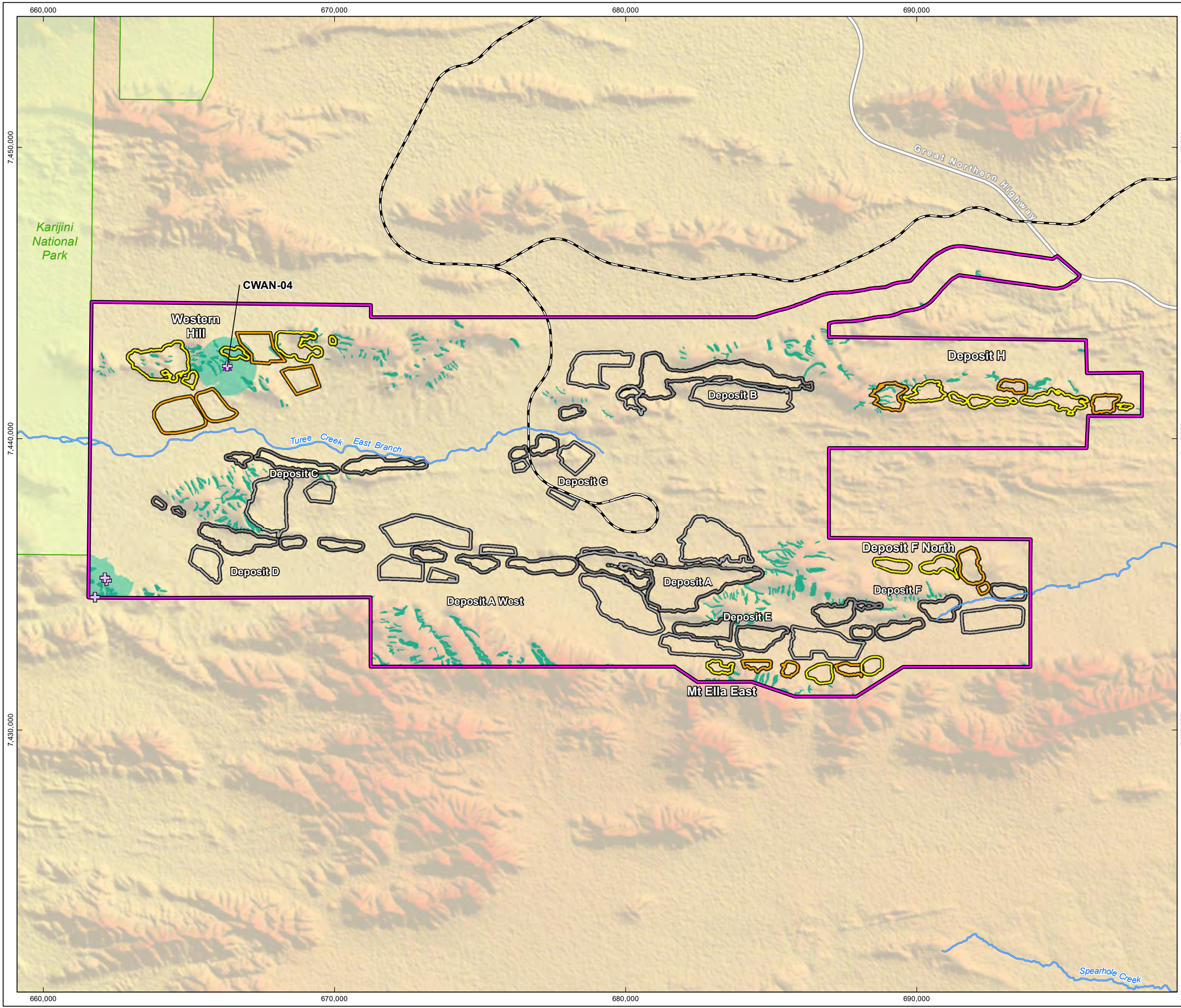
For the remainder of the Revised Development Envelope, the species is considered to possibly occur due to the presence of suitable habitat; however, the species has not been sighted throughout the period of existing operations and only old scats recorded despite numerous surveys undertaken over multiple years (Biologic 2022d; Biologic 2021e; Biologic 2021c).

The species is known to occur within Karijini National Park (records approximately 71 km to the west of the Revised Development Envelope) and in the Hope Downs 1 and Hope Downs 2 development envelopes, which are approximately 17 km and 10 km away, respectively (Biologic 2021c and Astron 2019).

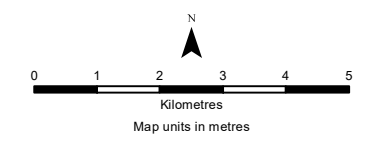
This species is listed as an MNES and is discussed in further detail in Section 13.

Figure 9-6
Northern Quoll Records and
Habitat within and surrounding the
Revised Development Envelope

Drawn: A.D.
Plan: RTIO-0968638v3
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
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- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout*
 - Pit
 - Waste Landform
 - Approved Conceptual Layout*
 - Pit
 - Waste Landform
 - Cave
 - Significant Fauna*
 - Northern Quoll (Critical Habitat)
 - Habitat Value*
 - Potential Critical Habitat
 - Supporting Habitat
 - National Park
 - Rio Tinto Railway
 - Highway
 - Major Creek



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Pilbara Leaf-nosed Bat (*Rhinoicteris aurantia* 'Pilbara form')

The Pilbara Leaf-nosed Bat (Plate 9-2) is listed as Vulnerable under the EPBC Act and BC Act. This species occurs across the north of the Australian continent, with populations recorded in northern Western Australia (Pilbara and Kimberly bioregions), the northernmost part of the Northern Territory, several bioregions across the Gulf of Carpentaria in the Northern Territory and north-western Queensland. (TSSC 2016a). The Pilbara population represents a single interbreeding population comprising multiple colonies (TSSC 2016a).



Source: Rio Tinto

Plate 9-2: Pilbara Leaf-nosed Bat

Within the Pilbara bioregion, the species generally roosts in underground caves formed in gorges, characterised by their depth, high levels of humidity and stable temperatures, and usually close to semi-permanent water bodies (Churchill 2008). Within the Hamersley sub-region, the species generally forages around rocky areas, particularly the ironstone hills of the Hamersley Ranges. They have also been observed foraging within *Triodia* hummock grasslands covering low rolling hills and shallow gullies, with scattered *Eucalyptus camaldulensis* along creeks (Churchill 2008 and Armstrong 2001). The species is considered to forage widely and utilises almost all productive and semi-productive habitats (Bat Call WA 2021b).

Although caves are common in the ironstone terrain and some other landscapes of the Pilbara, most are shallow overhangs or are shelters or caves not deep enough to support warm, humid microclimates. As a result, long-term roosting opportunities for the Pilbara Leaf-nosed Bat are restricted to underground caves or mines at a small number of locations (Bat Call WA 2021b).

Several historical underground/disused mines support permanent Pilbara Leaf-nosed Bat diurnal roosts, including Bow Bells, Copper Hills and Lalla Rook, and another two known roosts which are not permanent, Klondyke Queen and East Turner River-Birthday Gift (Bat Call WA 2021b). The closest known roost is the Turee Creek Roost site located approximately 13 km to the west of the Revised Development Envelope. There are several natural caves within the Pilbara's Hamersley Range and the

eastern Pilbara district that support permanent diurnal roosts, including at Rio Tinto's Gudai-Darri project, Hope Downs 5 deposit, Paraburdoo project and Brockman 4 project, APIM WPIOP Stage 1 project, BHP Cattle Gorge project, and Atlas Iron's Corunna Downs project and Mt Webber project. Currently, there are 48 confirmed permanent diurnal (category 1 and 2) roost sites within the Pilbara region. (Bat Call WA 2021b).

Many roosts that are occupied for much of the year are important for reproduction and daily survival. Category 1 to 3 roosts (semi-permanent - permanent diurnal roosts and potential maternity roosts) are considered critical habitat for the survival of the Pilbara Leaf-nosed Bat, whereas category 4 roosts (nocturnal refuge) are not considered critical habitat but are important for persistence of the species in a local area.

The Pilbara Leaf-nosed Bat has been recorded foraging widely and utilising almost all types of productive and semi-productive habitats within the Pilbara (Bat Call WA 2021b). Supporting habitat for the species is considered to be foraging habitat within 10 km of a diurnal roost (TSSC 2016a). The quality of these various habitat types has been classified by a foraging habitat rating, presented in Table 9-10.

Survey effort for the Pilbara Leaf-nosed Bat included:

- West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2 (Biologic 2021c): echolocation recorders were deployed across Western Hill, Deposit J & Mt Ella East, Deposit F North and Deposit equating to 25 different echolocation sampling sites and a total of 68 sampling nights across both post wet and dry seasons (6 months apart)
- Supplementary single season deployment of echolocation recorders in targeted surveys (Biologic 2022a, b, c, n; 2021e) equating to an additional 25 sites and 74 sampling nights. All echolocation recorders were deployed for a minimum of 2 nights.

The Pilbara Leaf-nosed Bat has been recorded at 12 locations surrounding the Revised Development Envelope; and five locations within the Revised Development Envelope, two within the Proposal Area (Biologic 2021c; Figure 9-7). Recent recordings of the species originate from the area surrounding Cave CWAN-04, located within Hillcrest/Hillslope habitat at Western Hill (Figure 9-7). 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 Revised Development Envelope, foraging within the Revised 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 this cave indicate that it is likely to be a permanent diurnal roost for the species (Biologic 2021c).

All of the 41 caves recorded within the Revised Development Envelope have the required attributes to act as nocturnal refuges (category 4) for the Pilbara Leaf-nosed Bat; however, none of the caves has the usage frequency or structural characteristics to represent critical habitat for the species (category 1 to 3). The above survey effort, along with ongoing cave monitoring required for MS 1113 compliance and historic sampling outside of the Revised 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).

No habitat within the Revised Development Envelope is considered critical to the survival of the Pilbara Leaf-nosed Bat, as there are no category 1, 2 or 3 caves recorded.

The Gorge/Gully, Drainage Line and Hillcrest/Hillslope habitat types provide foraging and dispersal opportunities for the species (Biologic 2021c), but are unlikely to represent supporting habitat for the Pilbara Leaf-nosed Bat given the distance from any diurnal roosts.

Permanent water sources (such as pools) located near diurnal roosts are critical to the Pilbara Leaf-nosed Bat, as they provide drinking water and attract many invertebrates on which the bats forage (Bat

Call WA 2021b). Three surface water fed ephemeral pools have been recorded within the Revised Development Envelope, and all occur within the Gorge/Gully habitat. During multiple surveys, no Pilbara Leaf-nosed Bat individuals were recorded at any of these pools. As such, it is considered unlikely that the species rely on these water sources; however, they could potentially be used opportunistically (Biologic 2021e).

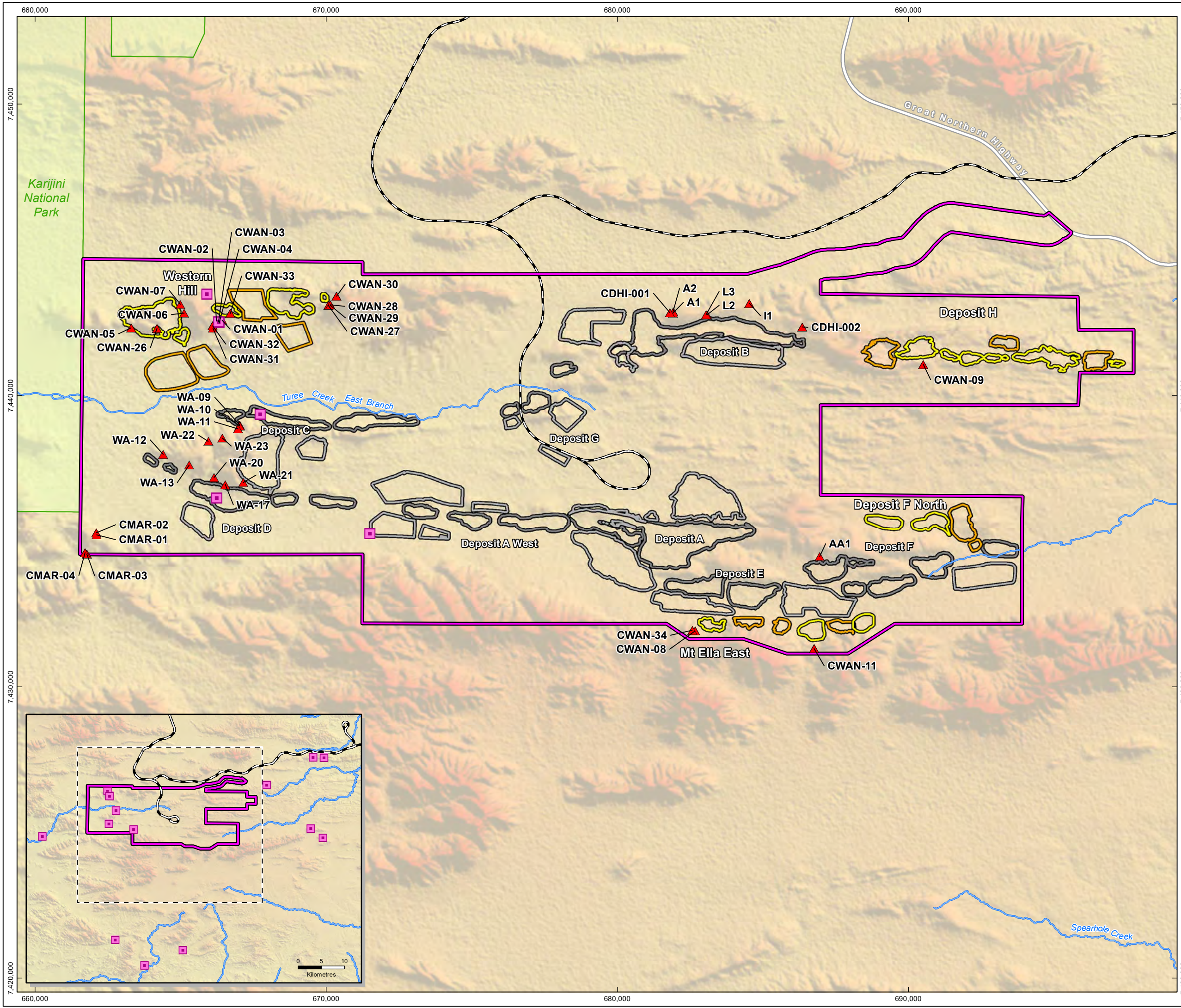
This species is listed as an MNES and is discussed in further detail in Section 13.

Table 9-10: Pilbara Leaf-nosed Bat Habitat Types and Rating Scale (Bat Call WA 2021b)

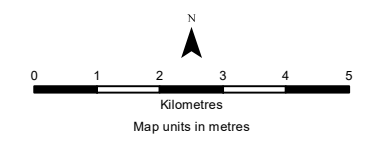
Habitat Rating (HR)	Description	Habitat Type		
		Plains and Low Hills	Gullies, Ridgelines and Mesas	Deep Gorges
0 (Poor)	Pilbara Leaf-nosed Bats are unlikely to be detected in these areas.	Bare open ground such as salt pans and clay pans without vegetation	Bare mesa and ridge line tops	N/A
1 (Low)	Pilbara Leaf-nosed Bats are unlikely to forage in these areas but may traverse while crossing to more productive areas.	Open plain with one layer of vegetation structure (excluding scattered trees) Two layer, not complex, vegetation structure (excluding scattered trees)	Mesa and ridge line tops. Mesa side or long ridge line with simple geology and minimal caves and overhangs present. Sparse vegetation cover. Shallow non-incised gullies. Spinifex cover to gully floor	N/A
2 (Moderate)	Pilbara Leaf-nosed Bat may occasionally forage in these areas due to the presence of suitable vegetation, seasonal water and may also use areas as a flyway.	Two layer, not complex, vegetation structure (excluding scattered trees). Includes ephemeral watercourse. Open mine shaft entrances.	Mesa side or long ridge line with deeply incised gullies in weathered strata (45° sloping walls). Caves and overhangs present. Shrubs in gully base. Ephemeral watercourse in gully or nearby	N/A
3 (High)	Pilbara Leaf-nosed Bat are likely to forage in these areas if in range of a roost. They may be detected passing along creeklines, vegetation lines, rock faces or foraging in most productive areas.	Three-layer, complex vegetation structure. Includes ephemeral watercourse Includes mine adit or decline in dry locations.	Mesa side or long ridge line with deeply incised gullies in weathered strata (45° sloping walls). Caves and overhangs present. Shrubs in gully base. Ephemeral watercourse in gully or nearby	Dry deeply incised gorge into a ridge or mountain Complex 3-layer vegetation structure. Ephemeral water course
4 (Very High)	Pilbara Leaf-nosed Bats are very likely to forage and/or drink in these areas if in range of roost	Includes watercourses and other sites with semi-permanent or permanent surface water (natural or anthropogenic). Three layers in vegetation structure. Includes caves entrance or mine adits/declines with water nearby.	Mesa side or long ridge line with south, east or west facing, deeply incised gullies with vertical walls. Cave entrance or mine adit. Vegetation is complex. Semi-permanent or permanent water pools present Also north facing gullies with permanent water	Wet 'open' gorge with hills to the side. Wet 'closed' gorge with one or two vertical walls Complex 3-layer, dense vegetation structure. Semi-permanent or permanent
5 (Outside Diurnal Roosts)	Pilbara Leaf-nosed Bat are present pertinently and will be detected nightly.	Areas immediately outside a diurnal roost entrance.	Areas immediately outside a diurnal roost entrance.	Areas immediately outside a diurnal roost entrance.

Figure 9-7
Pilbara Leaf-nosed Bat Records, High Value Habitat and Caves within and surrounding the Revised Development Envelope

Drawn: A.D.
Plan: RTIO-0968646v2
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
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- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout*
 - Pit
 - Waste Landform
 - Approved Conceptual Layout*
 - Pit
 - Waste Landform
 - Caves**
 - Category 4 (Supporting Habitat)
 - Significant Fauna**
 - Pilbara Leaf-nosed Bat
 - National Park
 - Rio Tinto Railway
 - Highway
 - Major Creek



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Ghost Bat (*Macroderma gigas*)

The Ghost Bat (Plate 9-3) is listed as Vulnerable under both the EPBC and BC Act. The species range across Australia is fragmented, with geographically separate colonies in Queensland, the Northern Territory and Western Australia (within the Pilbara and Kimberly regions; TSSC 2016b). Within the Pilbara bioregion, the estimated population of the Ghost Bat is between 1,300 and 2,000 individuals (TSSC 2016b) and within the Hamersley subregion, the population has been estimated as being approximately 350 individuals.



Source: Perth Zoo 2022

Plate 9-3: Ghost Bat

Ghost Bats occupy rocky gorges and outcrops that contain caves and crevices. They generally require a range of these cave sites which they move between seasonally or based on weather conditions (TSSC 2016b). The caves are generally near (within 2 km) to plains or riparian drainage lines, providing good foraging opportunities. Within the Hamersley Range, the preferred roosting sites are found beneath bluffs of low round hills composed of Marra Mamba geology and larger hills of Brockman Iron Formation (TSSC 2016b).

Survey effort for the Ghost Bat included:

- West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2 (Biologic 2021c): echolocation recorders were deployed across Western Hill, Deposit J & Mt

Ella East, Deposit F North and Deposit equating to 25 different echolocation sampling sites and a total of 68 sampling nights across both post wet and dry seasons (6 months apart)

- Supplementary single season deployment of echolocation recorders in targeted surveys (Biologic 2022a, b, c, n; 2021e) equating to an additional 25 sites and 74 sampling nights. All echolocation recorders were deployed for a minimum of 2 nights
- A total of 172.4 person hours spent undertaking targeted searches across the recent surveys (Biologic 2022a, b, c, n; 2021c, d, e).

Extensive survey activity and research in the last decade has led to the identification of four roosting habitat categories for Ghost Bats in the Pilbara region (refer to Section 9.3.1). Category 2 caves (maternal/diurnal roosts with regular occupancy) are considered critical habitat for the species. The grouping of category 3 (diurnal roosts with occasional occupancy) and 4 (nocturnal roosts with opportunistic usage) caves immediately surrounding these caves is also considered critical and described as “apartment blocks” that support the viability of category 2 caves. Isolated category 3 or 4 caves are not considered critical habitat, as these caves are used opportunistically.

There are no known category 1 caves within the Revised Development Envelope.

Of the 41 Ghost Bat caves known within the Revised Development Envelope (refer to Table 9-7), two are confirmed maternity roosts (category 2), five are potential maternity roosts (category 2), three are confirmed diurnal roosts (category 3), ten are potential diurnal roosts (category 3), 12 confirmed night roosts (category 4), and nine potential night roosts (category 4) (Table 9-7 and Table 9-11). Within the Proposal Area, one is a confirmed maternity roost (category 2), two are potential maternity roosts (category 2), five are potential diurnal roosts (category 3), five are confirmed night roosts (category 4) and eight are potential night roosts (category 4).

Evidence of the species has been recorded within 29 of the 41 caves, via scats, direct sightings, echolocation calls and skeletal remains within the Revised Development Envelope (Table 9-7).

Due to the prevalence of caves, Gorge/Gully and Hillcrest/Hillslope habitats within the Revised Development Envelope are considered potential critical habitat for the Ghost Bat. Ghost Bats are known to forage across a range of habitats, as such, foraging and dispersal habitat occurs within all six fauna habitat types present within the Revised Development Envelope (i.e. Gorge/Gully, Hillcrest/Hillslope, Drainage Line, Foothills and Plain, Mixed Acacia Woodland and Cracking Clay). Drainage Line, Foothills and Plain, Mixed Acacia Woodland and Cracking Clay habitat is considered supporting habitat for the Ghost Bat when within 12 km of critical habitat (Category 2 caves and category 3 caves in apartment blocks).

A summary of the suitable Ghost Bat caves and habitat present within the Revised Development Envelope is provided in Figure 9-11.

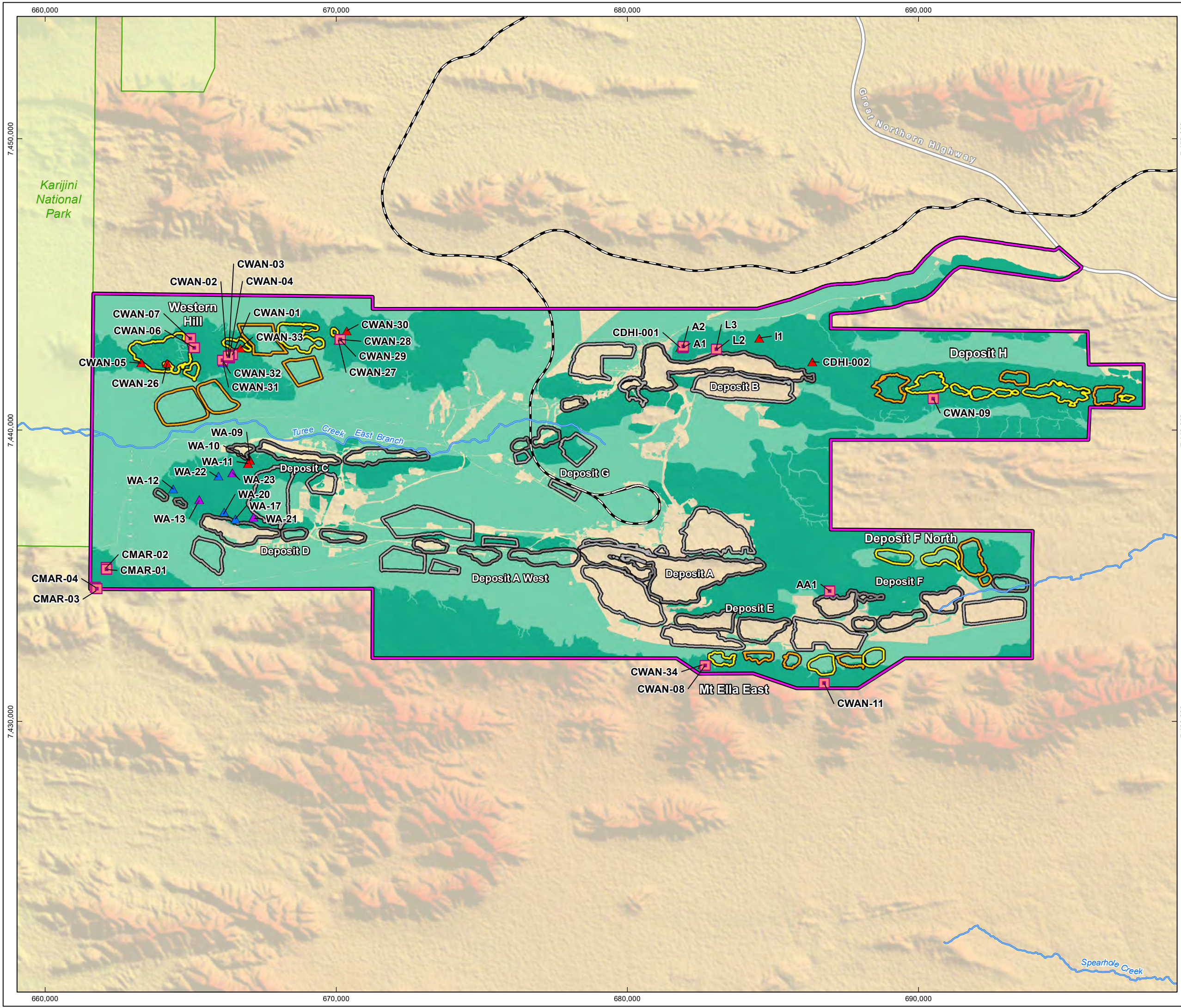
This species is listed as an MNES and is discussed in further detail in Section 13.

Table 9-11: Summary of Ghost Bat Habitat within the Revised Development Envelope and Proposal Area

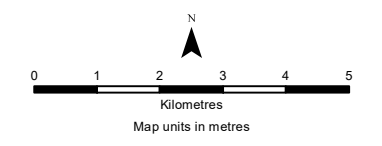
Habitat Type	Significance for Ghost Bats	Roost within Habitat Type	
		Revised Development Envelope	Proposal Area
Gorge/Gully	Potential critical habitat - (Provides roosting and foraging habitat)	<p>One confirmed maternity roost (category 2) (AA1)</p> <p>Four potential maternity roosts (category 2) (CWAN-07, WA-13, WA-21 and WA-23)</p> <p>Seven potential diurnal roosts (category 3) (CWAN-03, CWAN-29, CWAN-31, L2, L3, WA-17 and WA-20)</p> <p>Six confirmed night roosts (category 4) (CWAN-28, CWAN-32, WA-09, WA-11, CMAR-03 and CMAR-04)</p> <p>One potential night roost (category 4) (CWAN-33)</p>	<p>One potential maternity roost (category 2) (CWAN-07)</p> <p>Three potential diurnal roosts (category 3) (CWAN-03, CWAN-29 and CWAN-31)</p> <p>Two confirmed night roosts (category 4) (CWAN-28, CWAN-32)</p> <p>One potential night roost (category 4) (CWAN-33)</p>
Hillcrest/Hillslope	Potential critical habitat - (Provides roosting and foraging habitat)	<p>One confirmed maternity roost (category 2) (CWAN-04)</p> <p>One potential maternity roost (category 2) (CWAN-06)</p> <p>Three confirmed diurnal roosts (category 3) (WA-12, A1 and WA-22)</p> <p>Three potential diurnal roosts (category 3) (CWAN-01, CWAN-02 and CMAR-01)</p> <p>Six confirmed night roosts (category 4) (CWAN-08, CWAN-09, CWAN-11, A2, WA-10 and CMAR-02)</p> <p>Eight potential night roosts (category 4) (I1, CWAN-05, CWAN-26, CWAN-27, CWAN-30, CWAN-34, CDHI001 and CDHI002)</p>	<p>One confirmed maternity roost (category 2) (CWAN-04)</p> <p>One potential maternity roost (category 2) (CWAN-06)</p> <p>Two potential diurnal roosts (category 3) (CWAN-01 and CWAN-02)</p> <p>Three confirmed night roosts (category 4) (CWAN-08, CWAN-09 and CWAN-11)</p> <p>Seven potential night roosts (category 4) (CWAN-05, CWAN-26, CWAN-27, CWAN-30, CWAN-34, CDHI001 and CDHI002)</p>
Drainage Line	Supporting habitat - (Provides foraging and dispersal habitat when within 12 km of critical habitat)	None	None
Footslopes and Plain		None	None
Mixed Acacia Woodland		None	None
Cracking Clay		None	None
Disturbed	Negligible (Provides limited habitats)	None	None

Figure 9-8
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



- 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



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Figure 9-8a
Ghost Bat Records, Habitat and
Caves within the Revised
Development Envelope - Western Hill

Drawn: A.D.
Plan: RTIO-0970589v3
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:34,000 @A3
GIS.Team@riotinto.com

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

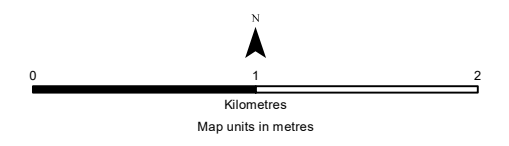
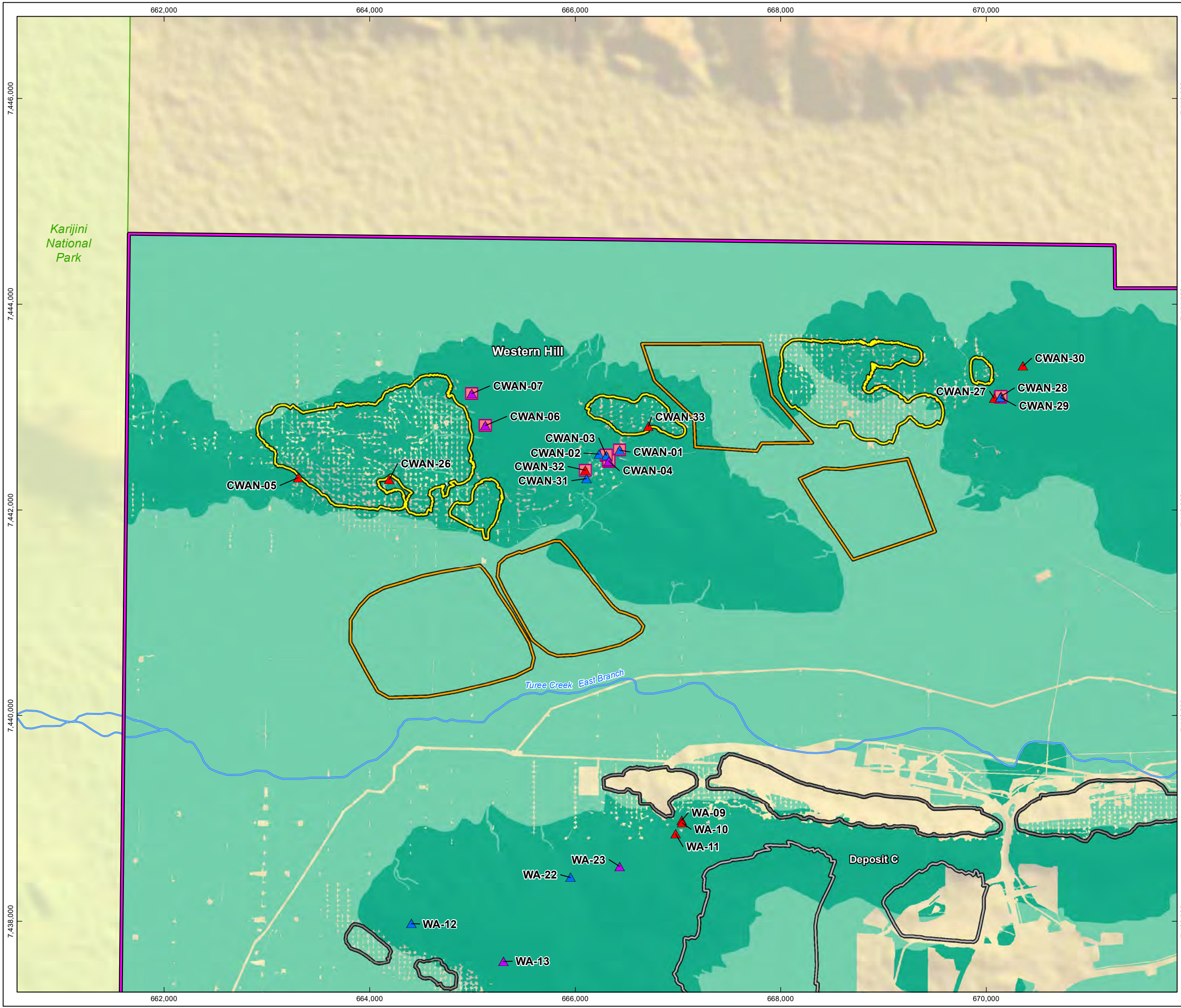
Habitat Value

Potential Critical Habitat

Supporting Habitat

National Park

Major Creek



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Western Pebble-mound Mouse (*Pseudomys chapmani*)

The Western Pebble-mound Mouse (*Pseudomys chapmani*) is listed by the DBCA as a Priority 4 species. The species is distributed from the Gibson Desert to the east through the Great Sandy Desert's eastern edge and is endemic to the Pilbara region (Biologic 2021c).

The Western Pebble-mound Mouse almost exclusively occurs on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Biologic 2021c). The species most likely occurs within habitats that provide suitable material for the construction of mounds, such as Footslopes and Plains or the stony slopes of Hillcrest/Hillslope habitats. The Western Pebble-mound Mouse is also likely to utilise other habitats adjacent to these areas for foraging, such as Drainage Lines (Biologic 2021c).

There are 288 records of the Western Pebble-mound Mouse throughout all areas of the Revised Development Envelope, of which 129 were within Hillcrest/Hillslope and 107 were within Footslopes and Plain habitat types, 45 in Disturbed, five in Mixed Acacia Woodland and two records in Gorge/Gully. Of the 288 records, 225 are mounds or burrows (Table 9-9). Of these records, 86 were located within the Extension Areas of all four Proposal deposits inside and outside the Conceptual Footprint and is distributed widely throughout the Proposal Area and Revised Development Envelope.

Pebble-mound Mouse has high cultural significance to the Yinhawangka People, and management targets, actions, and monitoring will be outlined within the respective SCHMP.

Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python (Plate 9-4) is listed as Vulnerable under the EPBC Act and the BC Act. The Pilbara Olive Python is only known to occur within the Pilbara bioregion of Western Australia and the Dampier Archipelago off the state coast (DEWHA 2008a). The species has a widespread distribution throughout the bioregion; however, the current population size is difficult to determine due to its cryptic nature. The species generally favours water holes and deep gorges, spending the winter months in caves and rock crevices, but moving widely amongst water holes and rocky outcrops in the summer (DEWHA 2008a). Within the Hamersley region, the species is typically found amongst riverine vegetation or rocky ranges with water holes (Biologic 2021e).



Source: Rio Tinto

Plate 9-4: Pilbara Olive Python

The Proposal Area and Revised Development Envelope contains suitable habitat for the Pilbara Olive Python, including habitat potentially critical for the species' survival (DoE 2013; Biologic 202 c, e). Gorge/Gully habitat within the Proposal Area and Revised Development Envelope is potential critical habitat for the Pilbara Olive Python as it provides important denning, shelter, foraging and dispersal habitat for the species and includes the presence of water features, caves and crevices (Biologic 2021c; Biologic 2021e). The Drainage Line habitat within the Proposal Area and Revised Development Envelope lacks the permanent water features required by the species to meet the criteria of critical habitat for the Pilbara Olive Python. Both Drainage Line and Hillcrest/Hillslope habitat types are considered supporting habitat within 1 km of Pilbara Olive Python records. All other fauna habitats within the Revised Development Envelope are of low value to the species.

To adequately survey for Pilbara Olive Python 172.4 hours of targeted searched in appropriate habitats (Gorge/Gully, inside caves and water pools) was undertaken (Biologic 2022a, b, c, n; 2021c, d, e) which included searching for the presence of individuals, scats, remains and shed skins. Motion cameras

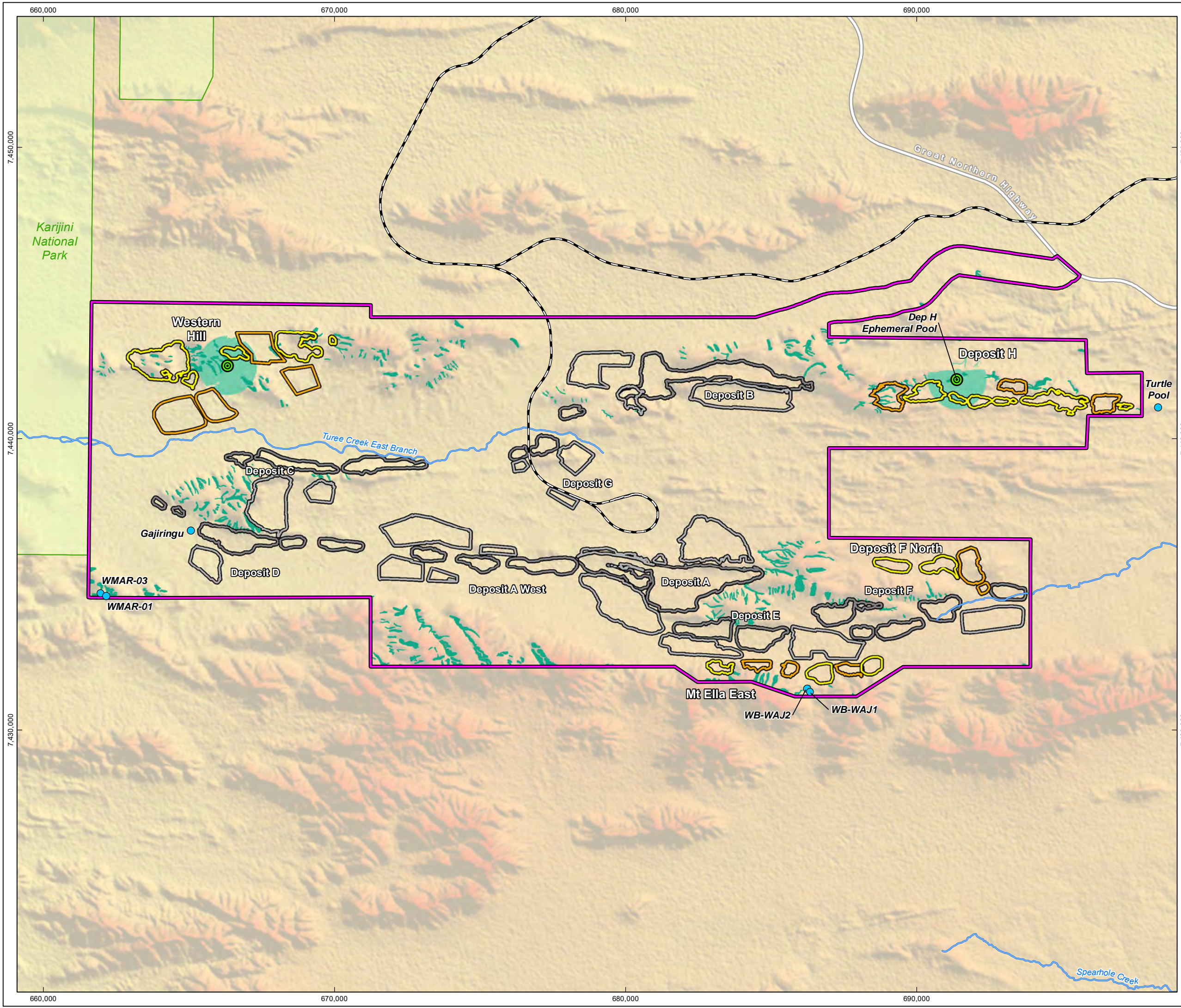
(totalling 3,801 camera nights) across these surveys also provided supplementary sampling for the Pilbara Olive Python.

The Pilbara Olive Python has been recorded twice within the Proposal Area, with one record via scat sample at the Western Hill deposit in Hillcrest/Hillslope habitat and the other record via motion camera at a water feature (WB-WAH1) located in Gorge/Gully habitat, within Deposit H (Biologic 2021e; Figure 9-9). Due to the species' highly cryptic nature, more individuals likely reside within the Proposal Area and wider Revised Development Envelope, where the species may be a permanent resident (Biologic 2021e).

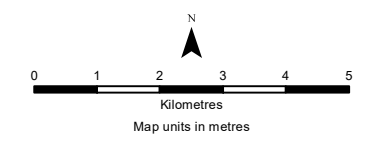
This species is listed as an MNES and is discussed in further detail in Section 13.

Figure 9-9
Pilbara Olive Python Records
and Habitat within the Revised
Development Envelope

Drawn: GIS Team
Plan: RTIO-0971786v2
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
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- Legend**
- Revised Development Envelope
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - Water Feature
 - Significant Fauna**
 - ⊙ Pilbara Olive Python (Critical Habitat)
 - Habitat Value**
 - Potential Critical Habitat
 - Supporting Habitat
 - National Park
 - Rio Tinto Railway
 - Highway
 - Major Creek



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Pilbara Barking Gecko (*Underwoodisaurus seorsus*)

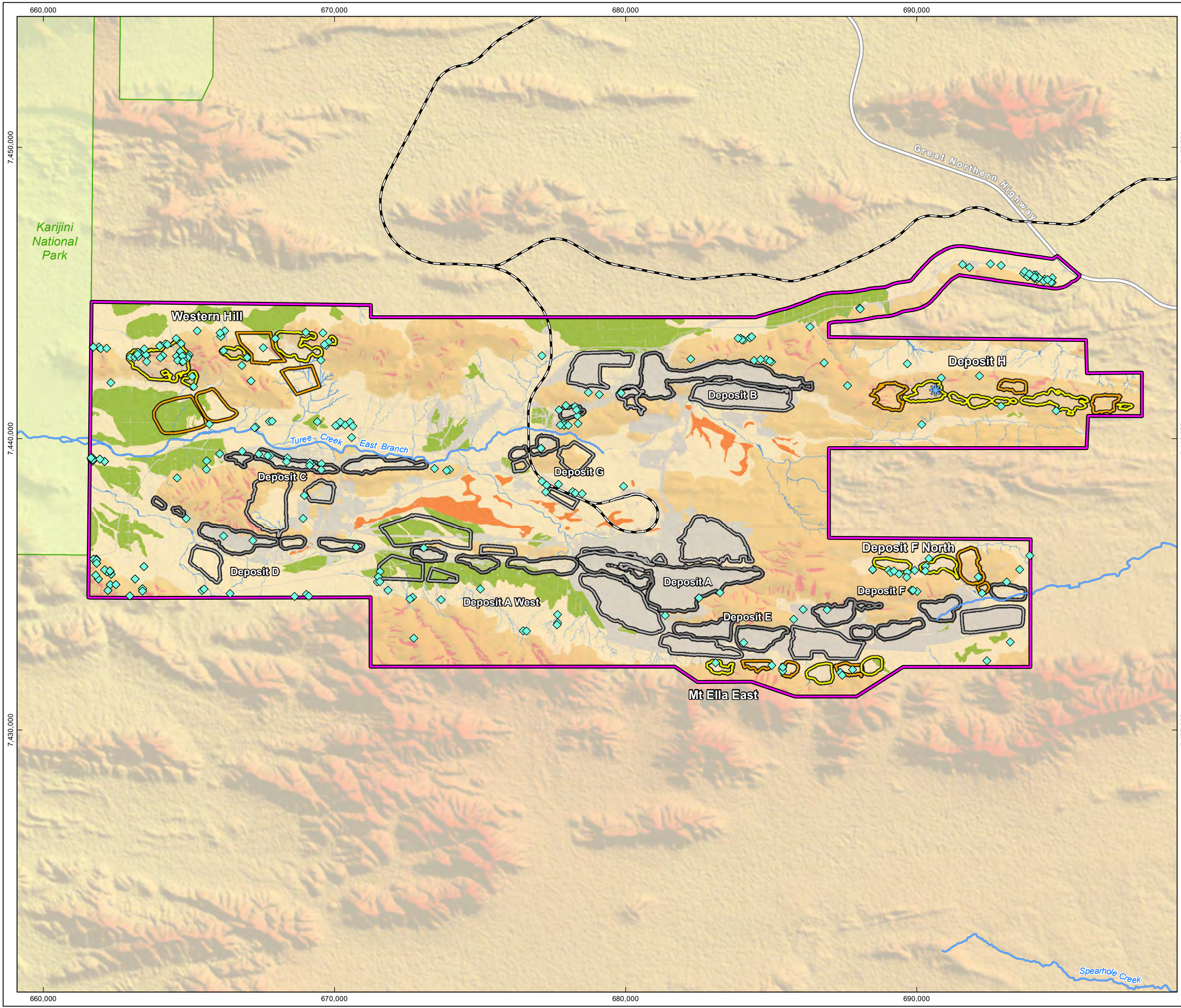
The DBCA lists the Pilbara Barking Gecko as a Priority 2 species. The species is only known from a small area of the Hamersley Range, distributed from north of Tom Price to the West Angelas Revised Proposal area (Biologic 2021c).

Suitable habitats for this species within the Proposal Area and Revised Development Envelope include Gorge/Gully and Hillcrest/Hillslope habitats (Biologic 2021c).

The Pilbara Barking Gecko has been recorded within the Proposal Area in 2014 from Deposit H in Hillcrest/Hillslope habitat type and a location outside of the Revised Development Envelope, approximately 2 km southwest of Deposit H (Table 9-9; Figure 9-10; Biologic 2021c).

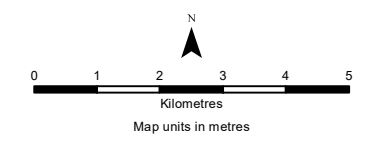
Figure 9-10
Priority Fauna Records within
the Revised Development
Envelope

Drawn: GIS Team
Plan: PDE0186402v3
Date: February 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
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Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- Priority Fauna Record**
- Pilbara Barking gecko
- Western Pebble-mound Mouse
- High Significance Fauna Habitat**
- Gorge/Gully
- Hillcrest and Hillslope
- Moderate Significance Fauna Habitat**
- Drainage Line
- Cracking Clay
- Footslopes and Plains
- Mixed Acacia Woodland
- Disturbed
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift (*Apus pacificus*) is listed as Migratory under the EPBC Act and BC Act and is a non-breeding visitor to all states and territories of Australia. In WA, the species is widespread in coastal and subcoastal areas between Augusta and Carnarvon, including some on nearshore and offshore islands (DAWE 2022). There are scattered records of the Fork-tailed Swift along the coast from the southwest Pilbara to the north and east Kimberley region, near Wyndham; with more records occurring in the north and north-west Gascoyne Region, north through much of the Pilbara Region and the south and east Kimberley (DAWE 2022). This species occurs in various habitats but does not rely on any foraging or breeding, given that it is a non-breeding visitor and entirely aerial in nature, where it forages for flying insects and even sleeps on the wing.

The Fork-tailed Swift has been recorded flying over the Proposal Area at the Western Hill deposit (Biologic 2021c).

This species is listed as an MNES and is discussed in further detail in Section 13.

9.3.4.2. Significant Vertebrate Fauna Species Likely to Occur in the Revised Development Envelope**Grey Falcon (*Falco hypoleucos*)**

The Grey Falcon (*Falco hypoleucos*) is listed as Vulnerable under the EPBC Act and BC Act. The species mainly occurs in arid and semi-arid Australia, including the Murray-Darling Basin, Eyre Basin, central Australia and Western Australia and is mainly found where annual rainfall is less than 500 mm (TSSC 2020).

The preferred habitat for the species is timbered lowlands, particularly acacia shrublands, which have tree-lined water courses. The species also inhabit treeless tussock grasslands and open woodlands (TSSC 2020). Woodlands and watercourses (permanent and ephemeral) are of high importance for the species as they nest almost exclusively in tall trees.

The Proposal Area and Revised Development Envelope contain habitat types of moderate significance for the Grey Falcon, including the Drainage Line, Footslopes and Plain and Mixed Acacia Woodland habitat types. The Drainage Line habitat type provides potential nesting trees, while the other two habitat types provide potential foraging habitat for the species (Biologic 2021c).

Despite extensive survey efforts (168 people survey days, 68.7 hours of bird census and opportunistic records), the Grey Falcon was not recorded in the Revised Development Envelope. However, there are species records within 10 km of the Revised Development Envelope, one of which occurs in Karijini National Park adjacent to the west of the Revised Development Envelope (Biologic 2021c and Biologic 2021e). Grey Falcons (including in the Pilbara) often nest in telecommunication towers (radio towers, powerlines and mobile phone towers) (TSSC 2020). The existing telecommunication towers in the West Angelas area and mine sites are not currently nor have historically been used as nest sites for this species. Grey Falcons also reuse the same successful nest site for multiple years with young often staying with the parents for up to 12 months after fledging (TSSC 2020). As such, the indication of nesting in an area can be assessed via the presence of records/individuals over multiple years, the presence of juveniles along with parents and of course the identification of nests being used. None of which have occurred during the recent or historic ecological surveys.

Based on the proximity of nearby records and suitable habitat, including potential foraging habitat, the Grey Falcon is considered likely to occur in the Proposal Area and Revised Development Envelope (Table 9-9).

Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon is listed as 'other specially protected fauna' (OS) under the BC Act, which means that special protection is required to ensure its conservation (Biologic 2021c). The species is typically

distributed throughout Australia. It is most often encountered in arid areas along cliffs above rivers, ranges and wooded watercourses and typically nests on rocky ledges and/or within tall trees occurring along major drainage lines (Biologic 2021c).

The Peregrine Falcon inhabits many habitats, including forests, woodlands, wetlands and open country. Individuals have a home range of up to 30 km². They nest in recesses of cliff faces, tree hollows and along rivers. Hillcrest/Hillslope habitats within the Revised Development Envelope offer potential nesting sites for the Peregrine Falcon, whilst the Drainage Line, Mixed Acacia Woodland, and Foothills and Plain habitats provide suitable foraging habitat. Given nearby records and suitable habitat availability.

The species has not been recorded within the Revised Development Envelope; however, there are records within 10 km of the Revised Development Envelope. Given the proximity of nearby records and presence of suitable habitat for the species, the Peregrine Falcon is considered likely to occur in the Proposal Area and wider Revised Development Envelope (Table 9-9).

9.3.4.3. Significant Vertebrate Fauna Possibly Occurring in the Revised Development Envelope

Pilbara Flat-headed Blind-snake (*Anilos gane*)

The DBCA lists the Pilbara Flat-headed Blind-snake as a Priority 1 species. Little is known about the behaviour and ecology of the Pilbara Flat-headed Blind-snake given its cryptic and fossorial nature. It is known to be insectivorous, feeding on termites and their eggs, as well as the larvae and pupae of ants, and is generally associated with moist gorges and gullies and potentially within other stony habitats (Biologic 2021c).

The species has not been recorded within the Revised Development Envelope; however one individual of the Pilbara Flat-headed Blind-snake was recorded approximately 2.3 km south of the Revised Development Envelope (Biologic 2021c; Table 9-9; Figure 9-10). The species is considered likely to occur within the Proposal Area and Revised Development Envelope and is most likely to utilise Gorge/Gully and Drainage Line habitats (Biologic 2021c).

Short-tailed Mouse (*Leggadina lakedownensis*)

The DBCA lists the Short-tailed Mouse as a Priority 4 species. The species has a discontinuous distribution from Cape York in northern Queensland to the Pilbara in Western Australia and is endemic to northern Australia (Moro & Kutt 2008).

The species is nocturnal and is found in various habitats, including open tussock and hummock grasslands, samphire and sedgeland, Acacia shrublands, Eucalyptus and Melaleuca woodlands and stony ranges; however, the preferred habitat comprises seasonally inundated habitats or areas.

Drainage Line, Cracking Clay, Foothills and Plain and Mixed Acacia Woodland habitats are likely to provide suitable habitat for the species within the Proposal Area and Revised Development Envelope.

The Short-tailed Mouse has not been recorded within the Revised Development Envelope; however, records exist within 5 km of the Revised Development Envelope. Given the presence of suitable habitat and proximity to nearby records of the species, the Short-tailed Mouse is considered to Possibly occur within the Proposal Area and Revised Development Envelope (Biologic 2021c).

Brush-tailed Mulgara (*Dasycercus blythi*)

The DBCA lists the Brush-tailed Mulgara as a Priority 4 species. In Western Australia, the species generally occurs through the Pilbara and Western Deserts, with a few records in the Murchison region. The species is generally found in sandy habitats and gibber plain (Biologic 2021c).

Mixed Acacia Woodland and Foothills and Plain habitats within the Proposal Area and Revised Development Envelope may provide some marginal habitat for the species.

Whilst the species has not been recorded within the Revised Development Envelope, there are records of the species approximately 35 km to the south (Biologic 2021c). Given the occurrence of nearby records and the presence of some marginal habitat, the species is considered to Possibly occur within the Proposal Area and Revised Development Envelope (Biologic 2021c).

9.3.5. Short-range Endemic Invertebrate Fauna

9.3.5.1. Regional Context

Short-range endemism refers to the restriction of a species at a local scale. It is influenced by several factors, including life history, physiology, habitat requirements, dispersal capabilities, biotic and abiotic interactions and historical conditions (Biologic 2022j). These life traits influence not only the distribution of a species but also the tendency for differentiation and speciation. Harvey (2002) proposed a range criterion for terrestrial short-range endemic (SRE) species at less than 10,000 km² (or 100 km x 100 km), which regulatory authorities have adopted in Western Australia (EPA 2016e).

Better-known SRE invertebrate fauna species have been listed under State or Commonwealth legislation or as Priority species by the DBCA; however, most SRE species have not been listed, often due to a lack of knowledge or paucity of data (Biologic 2022j). In the absence of formal listings, SRE fauna are assigned an SRE status category: Confirmed SRE, Potential SRE or widespread (i.e., not an SRE; Table 9-12). This categorisation indicates the potential for range restriction and, thus informal conservation significance. These groupings are based on the Western Australian Museum’s (WAM) categorisation for SRE invertebrates (Biologic 2022j). As many SRE invertebrate fauna are taxonomically poorly known, the majority of morphospecies are assigned as ‘Potential SREs’ and invariably fall within one (or several) of the five ‘Potential SRE’ sub-categories described in Table 9-12 (i.e., data deficient, habitat indicators, morphology indicators, molecular evidence and/or research/expertise).

Table 9-12: SRE Categorisation Used by WAM Taxonomists

Distribution	Taxonomic Certainty	Taxonomic Uncertainty
Distribution <10,000 km ²	<p>Confirmed SRE:</p> <p>A known distribution of <10,000 km²</p> <p>Taxonomy well known group is well represented in collections and/or via comprehensive sampling</p>	<p>Potential SRE:</p> <ul style="list-style-type: none"> • Patchy sampling resulting in incomplete knowledge of geographic distribution • Incomplete taxonomic knowledge • Group not well represented in collections • Category applies where there are significant knowledge gaps <p>Potential SRE sub-categories (may apply):</p> <ul style="list-style-type: none"> • Data deficient • Habitat indicators • Morphology indicators • Molecular evidence • Research and expertise
Distribution >10,000 km ²	<p>Widespread (not an SRE):</p> <p>A known distribution of >10,000 km²</p> <p>Taxonomy well known group is well represented in collections and/or via comprehensive sampling</p>	NA

Source: *Biologic 2021c*

9.3.5.2. SRE Invertebrate Fauna Habitat

Of the six habitat types mapped within the Revised Development Envelope, one habitat type (Gorge/Gully) is considered high significance for SRE invertebrate fauna due to high levels of shade and stable detrital microhabitats (Table 9-13). The Drainage Line, Hillcrest/Hillslope and Mixed Acacia Woodland habitat type have moderate significance to SRE invertebrate fauna as they provide shelter and microhabitats, such as leaf litter and woody debris. Still, they tend to be less isolated and have lower stability in areas seasonally disturbed by rain events (Table 9-13). The Footslopes and Plain and Cracking Clay habitat types are low significance for SRE invertebrate fauna as suitable microhabitats, shade, and shelter are scarce (Table 9-13; *Biologic 2021c*). The SRE habitats and their extent within the Revised Development Envelope are summarised in Table 9-13 and shown in Figure 9-11.

Most of the SRE fauna habitats are well represented within the Revised Development Envelope, except for Gorge/Gully and Mixed Acacia Woodland habitats which both have a limited extent within the Revised Development Envelope. All habitats are common throughout the Pilbara region (*Biologic 2021c, 2021d*).

Table 9-13: Significance of Fauna Habitats within the Revised Development Envelope for SREs

Habitat Type	Extent within the Extension Areas (ha)	Extent within the Revised Development Envelope (ha)	SRE Habitat Description
High Significance			
Gorge/Gully	178	627	The Gorge/Gully habitat provides consistent shade and complex microhabitats, offering shelter and fire protection. Dense pockets of vegetation with stable detrital microhabitats occur in areas where water can be retained long after rainfall. Where these landform and vegetation factors combine, particularly when highly fragmented or isolated, they often provide the most suitable habitats for SRE invertebrate fauna.
Moderate Significance			
Mixed Acacia Woodland	487	3,229	The dense patches of vegetation are structurally distinct from the surrounding landscape and provide a high degree of shelter, detrital microhabitats (such as leaf litter and woody debris), and deep clay-loam soils. However, some areas are more open and have a lower vegetation complexity, which lowers the value from high to moderate.
Drainage Line	157	378	Similar in structure and complexity to the Mixed Acacia Woodland habitat, however, it is generally less isolated due to connectivity with other drainage habitats, facilitating the dispersal of many SRE invertebrate groups. The detrital microhabitats and surface soil structure of drainage habitats tend to be less stable in the long-term due to being seasonally inundated or disturbed, which reduces the value for SREs, particularly for long-lived species such as trapdoor spiders.

Habitat Type	Extent within the Extension Areas (ha)	Extent within the Revised Development Envelope (ha)	SRE Habitat Description
Hillcrest/Hillslope	4,160	12,202	Rocky habitats within this habitat type, such as outcroppings, ridges and gullies, can provide moderate-value microhabitats; however, the slopes and crests of skeletal soils and open vegetation are less suitable as they are mostly devoid of microhabitats that provide shade and shelter.
Low Significance			
Footslopes and Plains	3,092	12,051	This habitat has low value for SRE species as, typically, microhabitats are scarce, and the habitat is not restricted or isolated.
Cracking Clay	0	435	This habitat has low value for SRE species as it is typically open bare ground and microhabitats are scarce.

9.3.5.3. SRE Invertebrate Fauna Assemblage and Species Diversity

A total of 328 invertebrate specimens have been collected within the Revised Development Envelope, including 42 mygalomorph spiders, one selenopid spider, 74 pseudoscorpions, 56 scorpions, 24 myriapods, 31 gastropods and 100 isopods (Biologic 2021c). Of these, 199 were collected within the Extension Areas across all four deposits, comprising 26 mygalomorph spiders, 60 pseudoscorpions, 25 scorpions, 21 myriapods, 22 gastropods, and 45 isopods.

In total, 75 unique taxa have been recorded within the Revised Development Envelope (31 of which were recorded within the Extension Areas). No confirmed SRE invertebrate taxa were collected from the Revised Development Envelope. Thirty eight (38) of these taxa are considered Potential SREs (Table 9-14; Figure 9-11; Biologic 2021c). An additional 19 potential SRE taxa were recorded within the Revised Development Envelope that could not be identified to species or subspecies level. All of these specimens were collected in multiple or widespread habitats and are not considered further in this assessment. The remaining 18 taxa are widespread species (Biologic 2021c). The widespread taxa are not described further.

9.3.5.4. Significant SRE Invertebrate Fauna Records

None of the potential SRE species recorded are listed under State or Commonwealth legislation or as Priority species by the DBCA.

The majority of potential SRE species recorded are considered unlikely to be restricted to the Revised Development Envelope as they were recorded from multiple sites and in habitats that are widespread or have low suitability for SREs. This indicates that they are likely to have larger distributions than the sample area and are unlikely to be habitat specialists (Biologic 2021c). However, 19 potential SRE species have only been recorded within the Revised Development Envelope and of these, 13 have been recorded within the Proposal Area only (Biologic 2022i; Table 9-14).

Table 9-14: Potential SRE Species Recorded within the Revised Development Envelope

Taxon	Habitat Type	Deposit
Spiders		
<i>Aname</i> `sp. Biologic-ARAN050`	Footslopes and Plain	Deposit F
<i>Kwonkan</i> `MYG197`	Footslopes and Plain	Deposit D
<i>Kwonkan</i> `MYG380`	Footslopes and Plain	Western Hill
<i>Conothele</i> `MYG002`	Footslopes and Plain, Mixed Acacia Woodland	Deposit B, D and G
Pseudoscorpions		
<i>Austrochthonius</i> `sp. Biologic-PSEU101`	Hillcrest/Hillslope	Deposit H*
<i>Tyrannochthonius</i> `sp. Biologic-PSEU104`	Hillcrest/Hillslope	Deposit H*
<i>Tyrannochthonius</i> `sp. Biologic-PSEU107`	Hillcrest/Hillslope	Mt Ella East*
<i>Austrohorus</i> `sp. Biologic-PSEU103`	Gorge/Gully	Deposit H*
<i>Beierolpium</i> `sp. 8/3`	Hillcrest/Hillslope	Deposit F North and H
<i>Beierolpium</i> `sp. 8/4`	Hillcrest/Hillslope	Deposit H
<i>Beierolpium</i> `sp. Biologic-PSEU087`	Gorge/Gully	Deposit H*
<i>Beierolpium</i> `sp. Biologic-PSEU088`	Hillcrest/Hillslope	Deposit H*
<i>Beierolpium</i> `sp. Biologic-PSEU092`	Footslopes and Plains	Deposit F North
<i>Euryolpium</i> `sp. Biologic-PSEU086`	Gorge/Gully	Deposit H*
<i>Euryolpium</i> `sp. Biologic-PSEU093`	Footslopes and Plains	Deposit F North and Western Hill
<i>Euryolpium</i> `sp. Biologic-PSEU102`	Gorge/Gully	Deposit F*
<i>Indolpium</i> `sp. Biologic-PSEU017`	Various	Deposit F North, Mt Ella East and Deposit C
<i>Indolpium</i> `sp. WAM-PSE118`	Various	Deposit H and Mt Ella East
<i>Olpidae</i> `sp. Biologic-PSEU072`	Hillcrest/Hillslope	Mt Ella East
<i>Olpidae</i> `sp. Biologic-PSEU084`	Footslopes and Plains	Western Hill*
<i>Olpidae</i> `sp. Biologic-PSEU085`	Hillcrest/Hillslope	Western Hill*
<i>Xenolpium</i> `sp. Biologic-PSEU091`	Hillcrest/Hillslope	Deposit F North
Scorpions		
<i>Lychas</i> `bituberculatus complex`	Footslopes and Plains	Deposit D and F North
<i>Lychas</i> `hairy tail complex`	Hillcrest/Hillslope	Deposit H
<i>Lychas</i> `harveyi complex`	Various	Western Hill, Deposits C and F
Isopods		
<i>Armadillidae</i> Gen. nov. `sp. nov. 1`	Footslopes and Plains, Cracking Clay, Mixed Acacia Woodland	Deposit C

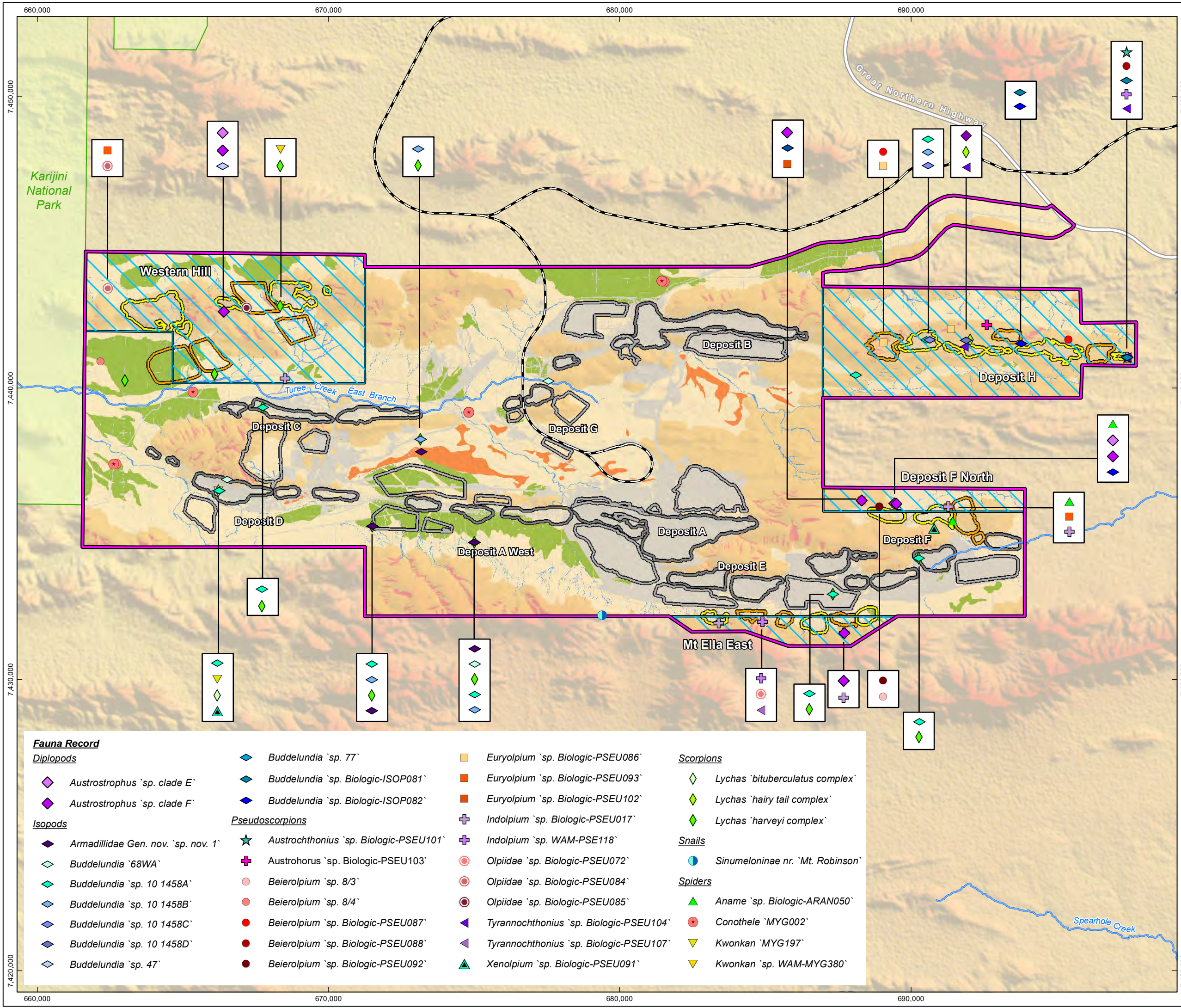
Taxon	Habitat Type	Deposit
<i>Buddelundia</i> `sp. 10 1458A`	Footslopes and Plains, Hillcrest and Hillslope, Mixed Acacia Woodland	Deposits C, D, E, F and H
<i>Buddelundia</i> `sp. 10 1458B`	Hillcrest and Hillslope, Footslopes and Plains, Mixed Acacia Woodland	Deposits A and H
<i>Buddelundia</i> `sp. 10 1458C`	Hillcrest/Hillslope	Deposit H*
<i>Buddelundia</i> `sp. 10 1458D`	Hillcrest/Hillslope	Deposit H*
<i>Buddelundia</i> `sp. 47`	Gorge/Gully	Western Hill
<i>Buddelundia</i> `sp. 68WA`	Footslopes and Plains,	Deposits B and D
<i>Buddelundia</i> `sp. 77`	Hillcrest/Hillslope	Deposit H
<i>Buddelundia</i> `sp. Biologic-ISOP081`	Hillcrest/Hillslope	Deposit H
<i>Buddelundia</i> `sp. Biologic-ISOP082`	Hillcrest/Hillslope	Deposit F North and H*
Diplopods		
<i>Austrostrophus</i> `sp. clade E`	Gorge/Gully	Western Hill
<i>Austrostrophus</i> `sp. clade F`	Hillcrest/Hillslope	Deposit F North, Mt Ella East
Snails		
Sinumeloninae nr. `Mt. Robinson`	Gorge/Gully	Mt Ella East

Note: Taxa in blue are known only from within the Revised Development Envelope

*Recorded only in Proposal Area

Figure 9-11
Potential SRE Invertebrate Fauna
Records and Habitat within the
Revised Development Envelope

Drawn: GIS Team
Plan: RTIO-0981837v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



- Legend**
- Revised Development Envelope
 - Extension Area
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - Fauna Habitat**
 - Drainage Line
 - Cracking Clay
 - Gorge/Gully
 - Footslopes and Plains
 - Hillcrest and Hillslope
 - Mixed Acacia Woodland
 - Disturbed
 - National Park
 - Rio Tinto Railway
 - Highway
 - Major Creek

Fauna Record

Diplopods

- Austrostromphus `sp. clade E`
- Austrostromphus `sp. clade F`

Isopods

- Armadillidae Gen. nov. `sp. nov. 1`
- Buddelundia `68WA`
- Buddelundia `sp. 10 1458A`
- Buddelundia `sp. 10 1458B`
- Buddelundia `sp. 10 1458C`
- Buddelundia `sp. 10 1458D`
- Buddelundia `sp. 47`

- Buddelundia `sp. 77`
- Buddelundia `sp. Biologic-ISOP081`
- Buddelundia `sp. Biologic-ISOP082`

Pseudoscorpions

- Austrochthonius `sp. Biologic-PSEU101`
- Austrohorus `sp. Biologic-PSEU103`
- Beierolpium `sp. 8/3`
- Beierolpium `sp. 8/4`
- Beierolpium `sp. Biologic-PSEU087`
- Beierolpium `sp. Biologic-PSEU088`
- Beierolpium `sp. Biologic-PSEU092`

- Euryolpium `sp. Biologic-PSEU086`
- Euryolpium `sp. Biologic-PSEU093`
- Euryolpium `sp. Biologic-PSEU102`
- Indolpium `sp. Biologic-PSEU017`
- Indolpium `sp. WAM-PSE118`
- Olpiidae `sp. Biologic-PSEU072`
- Olpiidae `sp. Biologic-PSEU084`
- Olpiidae `sp. Biologic-PSEU085`
- Tyrannochthonius `sp. Biologic-PSEU104`
- Tyrannochthonius `sp. Biologic-PSEU107`
- Xenolpium `sp. Biologic-PSEU091`

Scorpions

- Lychas `bituberculatus complex`
- Lychas `hairy tail complex`
- Lychas `harveyi complex`

Snails

- Sinumeloninae nr. `Mt. Robinson`

Spiders

- Aname `sp. Biologic-ARAN050`
- Conothele `MYG002`
- Kwonkan `MYG197`
- Kwonkan `sp. WAM-MYG380`

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9.3.6. Key Terrestrial Fauna Values

The key environmental values associated with Terrestrial Fauna within the Revised Development Envelope and which are the subject of the assessment including cumulative impacts are:

- **Conservation listed fauna:**
 - Northern Quoll (Endangered EPBC and BC Acts)
 - Ghost Bat (Vulnerable EPBC and BC Acts)
 - Pilbara Leaf-nosed Bat (Vulnerable EPBC and BC Acts)
 - Fork-tailed Swift (Migratory EPBC Act)
 - Western Pebble-mound Mouse (DBCA P4)
 - Pilbara Barking Gecko (DBCA P2)
- **Potential critical and supporting habitat within the Revised Development Envelope for conservation listed fauna:**
 - **Potential critical denning, roosting, breeding/shelter and foraging habitats:**
 - Gorge/Gully habitat – high significance (627 ha)
 - Hillcrest/Hillslope habitat – high significance (12,202 ha)
 - **Supporting foraging and dispersal habitats:**
 - Drainage Line habitat – moderate significance (378 ha)
 - Mixed Acacia Woodland – moderate significance (3,229 ha)
 - Foothills and Plains habitat – moderate significance (12,051 ha)
 - Cracking Clay habitat – moderate significance (435 ha)
- **Suitable habitat for Grey Falcon (VU), Peregrine Falcon (OS), Pilbara Flat-headed Blind-snake (P1), Pilbara Barking Gecko (P2), Western Pebble-mound Mouse (P4), Short-tailed Mouse (P4) and Brush-tailed Mulgara (P4)**
- **Forty-one (41) category 4 caves (non-critical) for the Pilbara Leaf-nosed Bat**
- **Seven category 2 caves (critical), 13 category 3 caves (critical) and 21 category 4 caves (non-critical) for the Ghost Bat**
- **Approximately 627 ha of Gorge/Gully habitat with the Revised Development Envelope considered to be of high significance to potential SRE species**

9.4. Potential Environmental Impacts

9.4.1. Direct Impacts

Potential direct impacts of the Proposal to terrestrial fauna have been identified:

- Clearing of vertebrate fauna habitat and habitat fragmentation as a result of construction of linear infrastructure, infrastructure and mining operations
- Loss of vertebrate fauna individuals as a result of ground disturbance, infrastructure and mining operations
- Clearing of SRE supporting habitat and Loss of SRE invertebrate fauna individuals as a result of clearing, infrastructure and mining operations
- Fauna as considered with respect to Social Surroundings is addressed in Section 6).

Clearing is related to mining, waste management, access and associated activities including power (including diesel generated and renewables (solar)), water and transport infrastructure (including land bridges) as detailed in Section 2.1.

9.4.1.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

Clearing of habitat can lead to the direct mortality of individuals, forced relocation of fauna and reduction of breeding and foraging habitat. The Proposal will clear up to 5,350 ha (14.5%) of native fauna habitat within a 36,779 ha Revised Development Envelope (Figure 9-12) across all six mapped fauna habitat types. Upper limits are proposed for clearing high significance fauna habitats. As shown in Table 9-15 of the two high significance fauna habitats within the Revised Development Envelope, the Proposal will clear up to:

- 126 ha Gorge/Gully habitat
- 3,731 ha of Hillcrest/Hillslope habitat.

Moderate significance fauna habitat clearing is shown in Table 9-16.

The clearing associated with the Proposal will result in impacts to several habitat features:

- Removal of up to four caves within the Proposal Area (CWAN-05, CWAN-09, CWAN-26 and CWAN-33), all of which are category 4 (non-critical) Pilbara Leaf-nosed Bat roosts (potential nocturnal roosts) and category 4 (non-critical) Ghost Bat roosts (night and potential night roosts)
- Catchment size reduction for one surface water pool (Deposit H waterhole) located north of Deposit H, which may provide an opportunistic water source for fauna including significant fauna.

Fragmentation, the process by which contiguous areas of habitat are interrupted and/or separated into two or more smaller areas, can result in the following impacts to terrestrial fauna:

- Altered movement patterns and/or reduced ability to disperse and recolonise
- Genetic isolation
- Increased competition for resources
- Habitat degradation
- Reduced species richness.

The development of linear infrastructures, such as haul roads, has the potential to restrict fauna movement and contribute to fragmentation unless appropriately managed.

Table 9-15: Estimated Proposal Disturbance – High Significance Fauna Habitat Types

Fauna Habitat Type	Mapped Fauna Habitat Extent ¹⁶		Proposal Impact (Upper Limit for Flexibility) (ha) ¹⁷
	West Angelas Area (ha) ¹⁸	Revised Development Envelope (ha)	
Gorge/Gully	1,082	627	126
Hillcrest/Hillslope	15,015	12,202	3,731
Total	16,097	12,829	3,856

Table 9-16: Indicative Disturbance - Moderate Significance Fauna Habitat Types

Fauna Habitat Type	Mapped Fauna Habitat Extent ¹²		
	West Angelas Area (ha) ¹⁴	Revised Development Envelope (ha)	Proposal Impact Approximate (ha) ¹³
Drainage Line	493	378	79
Mixed Acacia Woodland	3,240	3,229	374
Footslopes and Plain	13,287	12,051	1,787
Cracking Clay	435	435	2
Total	17,455	16,093	2,242
Disturbed (Nil Significance)	7,931	7,857	430

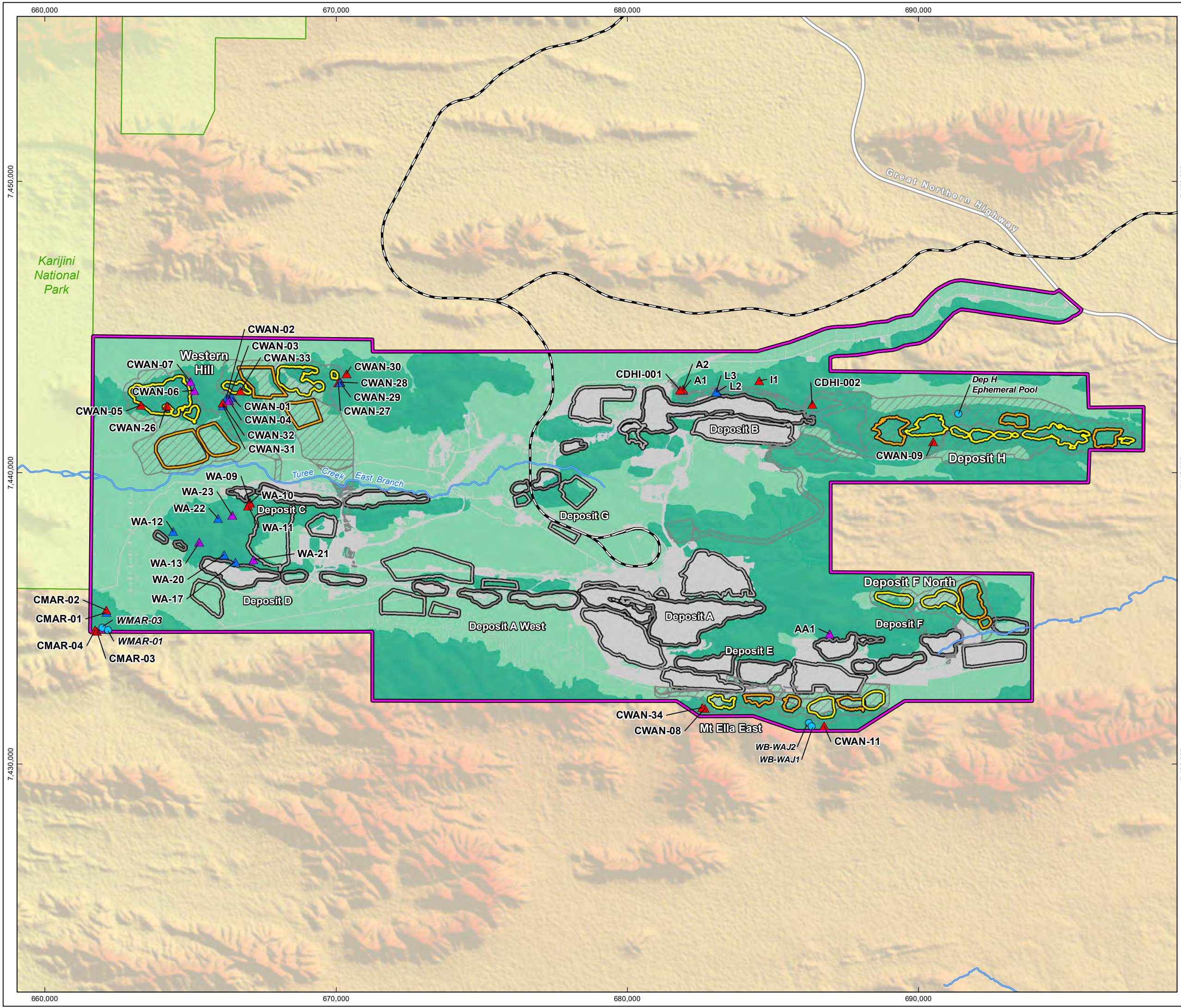
¹⁶ Area rounded to the nearest ha.

¹⁷ Total clearing for the Proposal will not exceed 5,350 ha

¹⁸ Includes Revised Development Envelope and Reference Areas surveyed (Dep J and Mt Ella East)

Figure 9-12
Conceptual Footprint in the
Context of Mapped Fauna Habitat
Types and Significant Features

Drawn: A.D.
Plan: RTIO-0955057v3
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



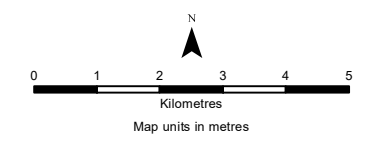
Legend

- Revised Development Envelope
- Conceptual Footprint
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform

- Water Feature
- Caves**
 - Category 2
 - Category 3
 - Category 4

- Fauna Habitat**
 - High Significance
 - Moderate Significance
 - Disturbed

- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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9.4.1.2. Fragmentation of Fauna Habitats due to Land Clearing

Fragmentation, the process by which contiguous areas of habitat are interrupted or separated into two or more smaller areas, can result in the following impacts on fauna:

- Altered movement patterns or reduced ability to disperse and recolonise
- Genetic isolation
- Increased competition for resources
- Habitat degradation
- Reduced species richness.

9.4.1.3. Loss of Fauna Individuals

Injury and mortality of fauna can result from construction, operation and closure activities, potentially decreasing local fauna abundance, particularly species that are attracted to roads for basking or foraging activities. This includes:

- Vertebrate and invertebrate fauna being killed/injured during clearing activities or from collisions with vehicles/machinery
- Entrapment within excavations
- Entanglement in fencing.

Due to the direct interface between vehicle and machinery movement and fauna habitats, vertebrate fauna would be most at risk of death or injury during clearing activities. Species at risk of vehicle strike include slow-moving animals, easily startled species, and nocturnal animals. Vehicles at night are more likely to strike native fauna when visibility is reduced and more animals move through the landscape. Species such as birds of prey are also likely to feed off dead carcasses on roads and may become victims of vehicle strikes.

Trenches, excavations, and water storage structures often have steep, slippery sides which prevent fauna that fall into them from escaping. Fauna may also be attracted to waste storage bins or domestic waste facilities and become trapped. Entrapment may lead to fauna injury or death from starvation, dehydration, drowning, bogging or injury.

Bat species (especially Ghost Bats) and some birds can become entangled in barbed wire fences, causing injury and death.

9.4.1.4. Clearing of SRE Habitat and Loss of SRE Individuals

Proposed clearing will directly impact up to 126 ha (24%) of high significance SRE invertebrate fauna habitat (Gorge/Gully) within the Revised Development Envelope and approximately 4,184 ha (31%) of moderate significance SRE invertebrate fauna habitat (Drainage Line, Hillcrest/Hillslope and Mixed Acacia Woodland) within the Revised Development Envelope.

The level of impact to significant habitat or populations of SRE taxa from mining activities in a particular area can be assessed by considering the taxa recorded for an area and the level to which significant habitats have been surveyed. Table 9-17 describes the level of risk from impact based on what is known of a particular taxon's range, the habitat that it occurs in and the amount of that habitat that will be impacted by mining activities, i.e the proposed footprint. This is of particular relevance to taxa that, to date, have been collected from single sites within the Revised Development Envelope.

Table 9-17: Definition of Level of Risk for SRE Invertebrate Fauna and Habitats

Category	Description
High	Taxonomic factors indicate that a species is likely to be restricted in range based on what is known of the genus or species, it has been collected from a restricted habitat type and a significant proportion of the known or likely habitat that it occurs in will be removed by mining activities (inside proposed footprint).
Medium	Taxonomic factors indicate that a species is possibly restricted in range based on what is known of the genus or species, it has been collected from a restricted habitat type and a significant proportion of the known or likely habitat that it occurs in will be removed by mining activities (inside proposed footprint).
Low	Taxonomic factors indicate that a species is possibly restricted in range based on what is known of the genus or species, it has been collected from a widespread habitat type.

Of the 38 potential SRE species recorded within the Revised Development Envelope, 26 have been recorded within the Conceptual Footprint and may be directly impacted by clearing (Table 9-18). Of these 26 species, 13 were collected at least once from outside the Revised Development Envelope and are considered not at risk from the Proposal. The remaining 13 species have been assessed as having some level of risk from the Proposal (Table 9-18; Biologic 2022i). An additional five species only recorded within the Revised Development Envelope but not in the Conceptual Footprint have also been assessed as having some level of risk from the Proposal. These are discussed in further detail in Section 6.8.

Table 9-18: Potential Short-Range Endemic Species within the Conceptual Footprint

Class	Order	Family	Species	Risk Level
Arachnida	Araneae	Anamidae	<i>Aname</i> `sp. Biologic-ARAN050`	Not at Risk
			<i>Kwonkan</i> `MYG380`	Not at Risk
	Pseudoscorpions	Chthoniidae	<i>Austrochthonius</i> `sp. Biologic-PSEU101`	Low
			<i>Tyrannochthonius</i> `sp. Biologic-PSEU104`	Medium
			<i>Tyrannochthonius</i> `sp. Biologic-PSEU107`	Medium
		Oplidae	<i>Austrohorus</i> `sp. Biologic-PSEU103`	Medium
			<i>Beierolpium</i> `sp. 8/3`	Not at risk
			<i>Beierolpium</i> `sp. Biologic-PSEU087`	Medium
			<i>Beierolpium</i> `sp. Biologic-PSEU088`	Medium
			<i>Beierolpium</i> `sp. Biologic-PSEU092`	Not at risk
			<i>Euryolpium</i> `sp. Biologic-PSEU086`	Low
			<i>Indolpium</i> `sp. Biologic-PSEU017`	Not at risk
			<i>Indolpium</i> `sp. WAM-PSE118`	Not at risk
Oplidae `sp. A`	Not at risk			
Oplidae `sp. Biologic-PSEU072`	Not at risk			

Class	Order	Family	Species	Risk Level
			Olpiidae `sp. Biologic-PSEU085`	Low
	Scorpiones	Buthidae	<i>Lychas</i> `bituberculatus complex`	Not at risk
			<i>Lychas</i> `hairy tail complex`	Not at risk
			<i>Lychas</i> `harveyi complex`	Not at risk
Malacostraca	Isopoda	Armadillidae	<i>Buddelundia</i> `sp. 10 1458A`	Low
			<i>Buddelundia</i> `sp. 10 1458B`	Low
			<i>Buddelundia</i> `sp. 10 1458C`	Low
			<i>Buddelundia</i> `sp. 10 1458D`	Low
			<i>Buddelundia</i> `sp. 77`	Not at risk
			<i>Buddelundia</i> `sp. Biologic-ISOP081`	Not at risk
			<i>Buddelundia</i> `sp. Biologic-ISOP082`	Low

Note: Taxa in blue are only known from within the Revised Development Envelope. Taxa in red are only known from within the Conceptual Footprint.

9.4.2. Indirect Impacts

Potential indirect impacts of the Proposal on terrestrial fauna have been identified:

- Degradation or alteration of habitat as a result of altered hydrological regimes
- Habitat degradation associated with construction and operational activities, including an increase in weeds, dust and abundance of introduced and predatory fauna species and altered fire regimes
- Disturbance from light, noise and/or vibration, resulting in the displacement of fauna associated with construction and operational activities.

9.4.2.1. Degradation or Alteration of Habitat as a Result of Altered Hydrological Regimes

The Revised Development Envelope intersects three major catchment areas, all of which are highly ephemeral. Implementing the Proposal will reduce catchment sizes which may impact the natural flow of surface water under certain conditions. This aspect of the Proposal is examined and modelled in Section 7. The hydrological assessment concludes the reductions in catchment size will not be sufficiently large enough to result in significant changes to the natural hydrological regimes (which are naturally highly variable). Consequently, negligible impacts on fauna habitats from this aspect of the Proposal are expected.

On a smaller scale, proposed mining activities within Deposit H are expected to reduce the contributing catchment of a surface water-fed ephemeral waterhole to the north of the deposit (Deposit H Waterhole - WB-WAH1, Figure 9-12). Modelling indicates that the size (capacity) of the pool is very small compared to the volume of runoff from the catchment during a typical rainfall event. Consequently, negligible changes to the hydrology of the pool is expected (discussed in Section 7).

There is the potential for local-scale degradation to fauna habitat occurring around creek floodway crossings and culverts, however potential impacts to fauna habitat are considered minimal and highly localised.

9.4.2.2. Degradation or Alteration of Habitat Features (Cave CWAN-04) as a Result of Supply Abstraction at Western Hill

The position of cave CWAN-04 is high in the landscape, having been recorded as situated midslope in a gully. Groundwater at Western Hill is deep and recorded at >50 mbgl near cave CWAN-04 (Section 7.3.4.4). Predicted drawdown from supply abstraction at Western Hill (P50 simulation) does not intersect CWAN-04, i.e. no drawdown, and worst case (P80 simulation) modelling indicates a drawdown of 0.5m at CWAN-04.

Ghost Bat caves in the Hammersley's do not typically interact with groundwater, instead, their stable microclimate and humidity is maintained via surface water permeation and the constricted shape of the cave trapping ambient humidity. In addition, Ghost Bats do not rely on humidity in their roost caves, preferring a stable microclimate, 'though the species is heavily dependent on stable ambient temperatures to maintain homeostasis, rather than humidity' (Baudinette et al., 2000). As such, there is not expected to be an impact on CWAN-04 or use by Ghost Bats from the drawdown of groundwater. Changes to groundwater levels due to dewatering can impact the suitability of caves as bat roosting habitat. CWAN-04 has been identified as a category 2 Ghost Bat roost and category 4 Pilbara Leaf-nosed Bat nocturnal refuge. The Pilbara Leaf-nosed Bat has specific temperature and humidity requirements for roosting (stable temperature of 28 – 32°C and humidity between 85 – 100%), whereas the Ghost Bat can roost in caves with more variable temperature and humidity requirements (23°C to 28°C and humidity of 50 to 100%) (TSSC 2016b) (Section 13).

9.4.2.3. Habitat Degradation Associated with Construction and Operational Activities

Weeds

Historically, weeds in the Pilbara have been introduced and spread through pastoral activities (EPA 2014). They can also be spread by other mechanisms, including wind, water, vehicles, machinery, and fauna (feral and native). As West Angelas is not part of a former pastoral lease, or pastoral activities, weeds within the West Angelas Approved Proposal area can likely be attributed to mining activities or the preceding exploration activities which are subject to less stringent environmental standards.

The increased vehicle movement and earthmoving activities associated with implementing the Proposal can potentially increase the spread of weeds within the Revised Development Envelope. The introduction or spread of weeds into an area of native vegetation can cause an increase in fuel loads and potentially alter the vegetation's natural fire regimes. Weeds can also cause the degradation of the native vegetation, as the weed species outcompete native flora and potentially adversely affect the native fauna.

As discussed in Section 7.3.4.4, eighteen weed species were recorded within the Revised Development Envelope. None of the recorded species are listed as WoNS or as Declared Pest under the BAM Act of Western Australia (Biota 2020).

Dust

The Pilbara region is naturally dusty, and the Proposal is located in and near an existing operational mine. Dust can be generated in all wind conditions but can be exacerbated during high wind conditions. Dust may be temporarily generated during clearing and operation, which may deposit on vegetation, adversely affecting fauna habitat quality. Native vegetation in the Pilbara tends to be tolerant of dust deposition; however, significant fauna habitats (supporting significant fauna species) in and around the Revised Development Envelope, including bat caves and ephemeral pools, may be sensitive to higher dust levels. Although there will be elevated dust levels resulting from the Proposal, local fauna is adapted to the dusty Pilbara climate.

Feral Animals

Six feral fauna species have been recorded in the Revised Development Envelope, including the Cat, Dingo/Dog, Dromedary Camel, European Rabbit, Cattle and House Mouse (Biologic 2021c). These species are known from the region surrounding the Revised Development Envelope. The development of new tracks and increased water points, and the production of domestic waste has the potential to attract and increase the abundance and diversity of introduced species. This may increase competition with and predation of native fauna species.

The clearing of vegetation may result in native fauna traversing cleared areas which offer a significantly reduced level of protection from introduced predators, in order to reach suitable habitats. These altered movement patterns may result in increased predation of significant fauna by feral predators, causing injury or mortality of individuals. Dingoes are known to cause a decline in smaller mammals. Where Foxes are scarce (as in the Revised Development Envelope), Cats are the main cause of population declines in smaller mammals (CALM 1996).

Altered Fire Regimes

Fire may impact fauna directly or modify habitat through altered fire frequency and intensity (Jhariya and Raj 2014). Too frequent, hot, or extensive fires during hot, dry times of the year can reduce habitat capacity to support diverse fauna assemblages by altering the vegetation structure and composition, resulting in changes in food quantity and quality and changes in cover and microhabitats (Griffiths and Brook 2014).

9.4.2.4. Disturbance from Light, Noise and/or Vibration, Resulting in Displacement of Fauna Associated with Construction and Operational Activities

Light

Light emissions can disorient flying birds, particularly during migration, and cause them to divert from efficient migratory routes or collide with infrastructure (DotEE 2020). Artificial light may interfere with activities governed by the length of the day, including reproduction, dormancy, foraging and migration. In addition, light emissions may attract invertebrates and alter the foraging activities of nocturnal species, potentially making small mammals vulnerable to predation.

Noise and Vibration

Increased noise can disturb fauna and cause interruptions in feeding and resting behaviour, reduced population densities, nest failure, abandonment of habitat area and roost sites, including caves and reduced hunting efficiency (e.g., interference in echolocation for bats) (Newport *et al.* 2014). Species sensitive to disturbance, such as the Ghost Bat and Pilbara Leaf-nosed Bat, may abandon roost sites in proximity to noise and vibration sources for the duration of active mining activities.

Noise emissions will arise from the construction and operation of the mine, particularly from blasting within the pits. These emissions generally dissipate with distance, with the habitats in close proximity to the pits the most impacted. The recognised noise threshold for Ghost Bat and Pilbara Leaf-nosed Bat roosts is 70 dBA (Bullen 2013; Bullen and Creese 2014). Noise attributable to the proposal above this level may impact these species.

Maximum mining scenarios were modelled for years 2025, 2027, 2029 and 2034 (Wood 2022). Predicted noise levels and measured data from other studies were used to assess the potential for cumulative noise impacts due to concurrent activities in areas adjacent to the Proposal. The modelled noise levels fall below the conservative noise threshold (70 dB(A)) at all identified bat cave locations during all mining years assessed (for the combined Approved Proposal and this Proposal).

Vibrations generally associated with intermittent blasting can result in loss of, or damage to, cave and rocky shelter microhabitats adjacent to mining, particularly those in Gorge/Gully and Hillcrest/Hillslope habitats.

9.4.3. Cumulative Impacts

The Proposal has the potential to cumulatively impact fauna habitats and species present within the Revised Development Envelope which has been considered as part of this assessment. The Proposal also has the potential to cumulatively impact fauna habitats and species present within the surrounding region.

All significant fauna species that occur or are likely to occur within the Revised Development Envelope may be affected by cumulative impacts from existing or foreseeable projects. Projects within a 100 km radius of the Revised Development Envelope that occur within the Hamersley subregion and have publicly accessible data were investigated to determine their impact on significant fauna and habitats. Existing and reasonably foreseeable projects within the region that may contribute to cumulative impacts along with the Proposal are described in Section 2.3.

Table 9-19 identifies the occurrence of significant species within these project areas. The cumulative impact on each significant fauna species is discussed in further detail in Section 9.6.4.

Detailed fauna habitat mapping for the Revised Development Envelope has been completed but is unavailable at the same comparable scale for the wider Pilbara region. Land System mapping at a regional level by DPIRD allows for assessing cumulative impacts on broad landscape units as a surrogate for fauna habitat. The cumulative impacts to land systems from existing and reasonably foreseeable projects in the region have been calculated based on the projects' conceptual footprint or disturbance footprint, where available, and are shown in Table 9-20.

The Boolgeeda Land System provides important habitat features such as leaf litter accumulations, woody debris, small hollows, peeling bark, and a thick upper canopy; however, these are generally common and widespread Pilbara region (Biologic 2021c). The maximum potential impact from cumulative losses is associated with the Boolgeeda Land System (62,106 ha; 10%) and Platform Land System (8,094 ha; 4%) (Table 9-20) (Shepherd et al. 2002).

The elevated rocky landforms of the Newman Land System are likely to provide the highest value for fauna as they contain features unique to the Hamersley subregion, such as rocky ridges, caves and crevices. These features are particularly important to significant fauna species as they can be used as roosts and den sites by the Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python. Rocky gorges and gullies also support the formation of water pools, which can often persist into dry periods and therefore provide an important water source within the arid landscape. Cumulative impacts to the Newman Land System are anticipated to total 50,865 ha, representing approximately 3%.

Table 9-19: Occurrence of Conservation Significant Fauna Species within Approved and Reasonably Foreseeable Projects

Significant Fauna*	This Proposal	Existing Operations	Hope Downs 1 and 4	Hope Downs 2	Rio Tinto Yandi Mine	Rio Tinto Koodaideri	BHP Mining Area C
Mammals							
Northern Quoll	✓	✓	✓	✓	✓	✓	✓
Ghost Bat	✓	✓	✓	✓	✓	✓	✓
Pilbara Leaf-nosed Bat	✓	✓	✓	✓	✓	✓	✓
Western Pebble-mound Mouse	✓	✓	✓	✓	✓	✓	✓
Short-tailed Mouse**	✓	✓	x	x	x	✓	✓
Brush-tailed Mulgara**	✓	x	x	x	✓	✓	x
Birds							
Peregrine Falcon**	✓	✓	✓	x	✓	✓	x
Grey Falcon**	✓	✓	✓	x	✓	x	✓
Reptiles							
Pilbara Olive Python	✓	✓	✓	x	✓	✓	✓
Pilbara Flat-headed Blind-snake**	✓	✓	x	x	✓	x	✓
Pilbara Barking Gecko	✓^	✓	x	x	✓	x	✓

*Significant fauna species confirmed to occur within the Revised Development Envelope of the Projects.

**Significant fauna species considered likely or possible to occur within the Revised Development Envelope

^ Same record as existing operations. Record was identified during 2014 during surveys to support the Approved Operations, within the location of this Proposal

Table 9-20: Cumulative Impacts on Land Systems within the Hamersley Subregion

Land Systems	Current Extent within Hamersley Subregion (ha)*	% of Subregion (%)	Impact within Revised Development Envelope		Impact in Existing and Reasonably Foreseeable Projects**		Cumulative Impact***	
			Total Area (ha)*	% Impact	Area (ha)*	% Current Extent	Area (ha)*	(% of Current Extent)
Boolgeeda	606,790	10	12,561	<1	48,609	8	61,170	10
Egerton	65,999	1	652	<1	440	1	1,092	2
Jamindie	79,562	1	73	<1	1,665	2	1,738	2
Eilmunna	19,222	<1	202	<1	200	1	402	2
Newman	1,853,963	30	13,007	<1	37,858	2	50,865	3
Platform	217,711	4	3,396	<1	4,081	2	7,477	3
Rocklea	711,389	11	6,032	<1	2,440	>1	8,472	1
Wannamunna	62,365	1	856	<1	981	2	1,837	3
Total	3,617,001	59	36,779	1	96,274	3	133,053	4

*Total rounded up to nearest ha. All calculations are conservatively based on the extent within the project development envelopes rather than the conceptual footprints, and so will represent an overestimation

** Land system information was not available for some projects and so could not be used in the calculations

***Cumulative impact of land systems includes the land system extent within the Revised Development Envelope of this Proposal; West Angelas C, D and G; Rio Tinto Yandi Mine; Rio Tinto Koodaideri; and BHP Mining Area C

9.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids and minimises, where practicable, impacts on significant fauna and high significance habitat types in the Revised Development Envelope.

9.5.1. Mitigation Hierarchy

Table 9-23 summarises how the EPA's mitigation hierarchy (avoid, minimise and rehabilitate) has been applied during proposal design to develop appropriate mitigation and management strategies to address the key potential impacts on terrestrial fauna, whilst the sections below provide detailed information on each in relation to significant fauna.

9.5.2. Avoidance and Minimisation

The Proponent has refined the Conceptual Footprint and Revised Development Envelope to ensure the Proposal prioritises the avoidance and/or minimisation of impacts to high significance fauna habitats and habitat features where other options exist and that connectivity across and between habitats is maintained to the greatest extent possible noting the existing avoidance and minimisation strategies approved via MS 1113 and EPBC Decision Notice 2018/8299 for the Existing Operations.

Key outcomes of these Proposal design refinements have been described in Section 2.2, including proposed MRZs and MEZs to protect significant values identified in the Revised Development Envelope.

In summary approximately 358 ha of high significance Gorge/Gully and 2,927 ha of Hillcrest/Hillslope habitat has been avoided by re-designing the Proposal and consequently reducing the Conceptual Footprint and Revised Development Envelope.

9.5.2.1. High Significance Fauna Habitat

Section 9.4.1 presents the scale of the proposed impacts on fauna habitats based on the Conceptual Footprint. The Proposal includes flexibility to alter the location of the Proposal elements within the Revised Development Envelope, however, to ensure environmental impacts are not greater than assessed, the Proponent has proposed maximum clearing extents for habitat types of high significance, as per Table 9-15. The Proponent proposes that these limits be conditioned in the Ministerial Statement. Habitat types of moderate significance are presented as approximate clearing extents and are not proposed to be conditioned.

9.5.2.2. Ghost Bat Roosts and Critical Habitat

Proposal Impacts

Of the 21 roost caves identified within the Proposal area, the Proponent proposes to impact up to four category 4 Ghost Bat and Pilbara Leaf-nosed Bat roost caves that are not considered critical habitat (night roosts and potential night roosts).

The remaining 17 caves will be protected via the implementation of MEZ and/or MRZ including:

- Three category 2 Ghost Bat caves (of which one is a primary cave within an apartment block),
- Five category 3 Ghost Bat caves (of which three are secondary caves within apartment blocks), and
- Nine category 4 Ghost Bat caves.

All category 2 and 3 Ghost Bat roost caves within the Proposal Area will be protected via MEZ and/or MRZ and will not be directly impacted as a result of the Proposal.

MEZ's are designed to protect the caves from direct disturbance, and MRZ's provides an additional buffer around the MEZ to minimise potential direct and indirect impacts to the caves by restricting

activities within this buffer zone (Table 9-22; Figure 9-13). MEZ's will not be fenced as fencing would limit access to the habitat within the MEZ by MNES species and all fauna. To further avoid impacts on category 2 and apartment block Ghost Bat roosts, the Proponent has established maximum vibration limits for caves within 300 m of proposed mining areas as per Table 9-21 and Table 9-22. The management and monitoring program in relation to noise and vibration from blasting is detailed within the EMP (Appendix A.8).

In addition to avoiding caves classified as critical habitat for Ghost Bats within the Revised Development Envelope, approximately seven caves (including one category 2) have been avoided by re-designing the Proposal and reducing the Conceptual Footprint and Revised Development Envelope (Section 2.2). These caves are now located outside the Revised Development Envelope and will not be directly impacted by the Proposal.

Approved Proposal Impacts

Twenty caves located within the Approved Development Envelope have an existing level of protection via restrictions and/or exclusions under MS 1113 (Table 9-21; Figure 9-13).

Revised Proposal

There are a total of 41 caves within the Revised Development Envelope (21 within the Proposal Area and 20 previously assessed in the Approved Development Envelope). Of these 41 caves 20 will be protected via existing protections under MS 1113 (Table 9-21; Figure 9-13), and 17 are proposed to be protected via the implementation of MEZ and MRZ (Table 9-22; Figure 9-13). Implementation of the proposed MEZ/MRZ will not result in non-compliance with previous approvals.

Table 9-21: Cave Structures Currently Restricted and Excluded in MS 1113 Areas

Cave Category	Cave ID	Proximity to Operations (m)	Ground Disturbance and PPV Limits
MS 1113 Restrictions			
Category 3	L2*	25 [^]	Minimise disturbance 50 mm/s PPV for WA-17 75 mm/s PPV for L2, L3, WA-12 and WA-20, A1
	L3	20 [^]	
	WA-17	140	
	WA-20	190	
	A1 [#]	120 [^]	
	WA-12 [#]	340	
Category 4	WA-22* [#]	800	Minimise disturbance 75 mm/s PPV for category 4 cave
	A2	130 [^]	
	I1	300 [^]	
	WA-09	100	
	WA-10	110	
	WA-11	160	
MS 1113 Exclusion Area			
Category 2	AA1	160	Ground disturbance is restricted to within 100 m of retained category 2 cave. 40 mm/s PPV for Cave AA1 25 mm/s PPV for Cave WA-21
	WA-13*	530	
	WA-21	250	
	WA-23*	610	
Category 3	CMAR-01*	1020	N/A

Cave Category	Cave ID	Proximity to Operations (m)	Ground Disturbance and PPV Limits
			PPV levels not applicable to this cave as it is located greater than 300 m from the closest pit
Category 4	CMAR-02*	1000	N/A
	CMAR-03*	1690	PPV levels not applicable to these caves as they are located greater than 300 m from the closest pit
	CMAR-04*	1690	

*PPV levels not applicable to these caves as they are located greater than 300 m from the closest pit.

#Caves A1, WA-12 and WA-22 have been downgraded from category 2 to category 3 since initial assessment based on ongoing monitoring; however, the management has not altered.

^ Distance to Proposed Conceptual Footprint (i.e. closest future operations)

Table 9-22: Proposed MEZ and MRZ and Vibration Limits for Cave Structures in Proposal Area

Cave Category	Cave ID	Proximity to Conceptual Footprint (m)	MRZ and MEZ	PPV Limit (where appropriate)
Apartment Block – Primary Roosts	CWAN-04	160	<p>MRZ: Low impact[~] activities permitted within 150-100 m of primary category 2 roost.</p> <p>MEZ: Direct disturbance is not permitted[^] within 100 m of primary category 2 roost.</p>	10 mm/s PPV during maternity months (1 October to 31 December), or 25 mm/s PPV in non-maternity months LZ ₁₀ >70 db(Z) over one hour
Apartment block – Secondary Roosts	CWAN-01 CWAN-02 CWAN-03	100 170 175	<p>MRZ: Low impact[~] activities permitted within 150-100 m of secondary category 3 roost</p> <p>MEZ: Direct disturbance is not permitted[^] within 100 m of secondary category 3 roost</p>	10 mm/s PPV during maternity months (1 October to 31 December), or 25 mm/s PPV in non-maternity months LZ ₁₀ >70 db(Z) over one hour
Isolated Category 2	CWAN-06 CWAN-07	150 150	<p>MRZ: Low impact[~] activities permitted within 150-100 m of isolated category 2 roost</p> <p>MEZ: Direct disturbance is not permitted[^] within 100 m of isolated category 2 roost</p>	10 mm/s PPV during maternity months (1 October to 31 December), or 25 mm/s PPV in non-maternity months LZ ₁₀ >70 db(Z) over one hour
Retained Category 3	CWAN-29 CWAN-31	65 100	<p>MRZ: Low impact[~] activities permitted within 65-75 m of retained category 3 roost.</p> <p>MEZ: Direct disturbance is not permitted[^] within 65 m of retained category 3 roost</p>	50 mm/s PPV
Retained Category 4 within Category 3 cave MEZ/MRZ	CWAN-27 CWAN-28 CWAN-32	7 60 155	<p>MEZ: Partial protection from overlap of nearby category 3 cave MEZ.</p> <p>MRZ: Low impact[~] activities permitted within 20 m of retained category 4 roost.</p>	NA
Retained Category 4	CWAN-08 CWAN-11	70 90	<p>MRZ: Low impact[~] activities permitted within 20 m of</p>	N/A

Cave Category	Cave ID	Proximity to Conceptual Footprint (m)	MRZ and MEZ	PPV Limit (where appropriate)
	CWAN-30	105	retained category 4 roost.	
	CWAN-34	105		
	CDHI-001	25		
	CDHI-002	25		

* Distance from the cave structure and extent.

~ Disturbance can be up to 20% of MRZ for low impact activities to support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP.

^ except for activities that support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP.

9.5.2.3. Water Habitat Features

The Proposal has been designed to avoid direct impacts to Deposit H seasonal surface water fed ephemeral pool WB-WAH1 located to the north of Deposit H. This pool is potentially of significance to terrestrial fauna, particularly the Pilbara Olive Python which was recorded within the pool (Biologic 2021c). Pools WB-WAJ1 and WB-WAJ2 are located outside of the Conceptual Footprint.

9.5.2.4. Management Strategies, Guidelines and Programs

The Proponent has also developed several management strategies, guidelines and programs to minimise the potential impact of the Proposal on the Terrestrial Fauna values within the Revised Development Envelope, which are detailed in the EMP (Appendix A.8). These include:

- **Vehicle and Fauna Interaction Guidelines** – this will describe the actions undertaken by drivers on-site that will minimise the likelihood of vehicle/fauna interactions from occurring. This includes restricting vehicles to only driving on established roads and tracks as well as adhering to the signed speed limits
- **Fence Construction Guidelines** – this will describe the situations where the utilisation of barbed wire is permitted on-site, and which measures need to be taken to minimise impact to fauna species. This includes the use of reflectors to help prevent the entanglement of bat species
- **Weed Management Strategy** – this describes actions that minimise the likelihood of weed species being introduced or spread within the Revised Development Envelope. The key actions include the periodic spraying of cleared areas, particularly higher risk areas (such as sensitive receptors), and the management of vehicle, machinery and equipment hygiene
- **Dust Suppression Strategy** – this describes the techniques to minimise dust deposition within the Revised Development Envelope. This will include the use of water carts
- **Feral Cat Control and Monitoring Program** – this describes the actions that will minimise the likelihood of the current feral Cat population from increasing as a result of the Proposal. The key

actions include the establishment of a trapping program and the establishment of a sighting log for feral animal species within the Revised Development Envelope

- **Light Management Procedures** – this will describe the most appropriate positioning of lights on-site to facilitate a safe operating environment as well as minimise the amount of light overspill
- **Blasting Management Strategy** – this outlines actions that minimise the likelihood of any blasting activity impacting the structural integrity of caves and the behaviour of local fauna species such as bats.

9.5.2.5. Other Minimisation Strategies

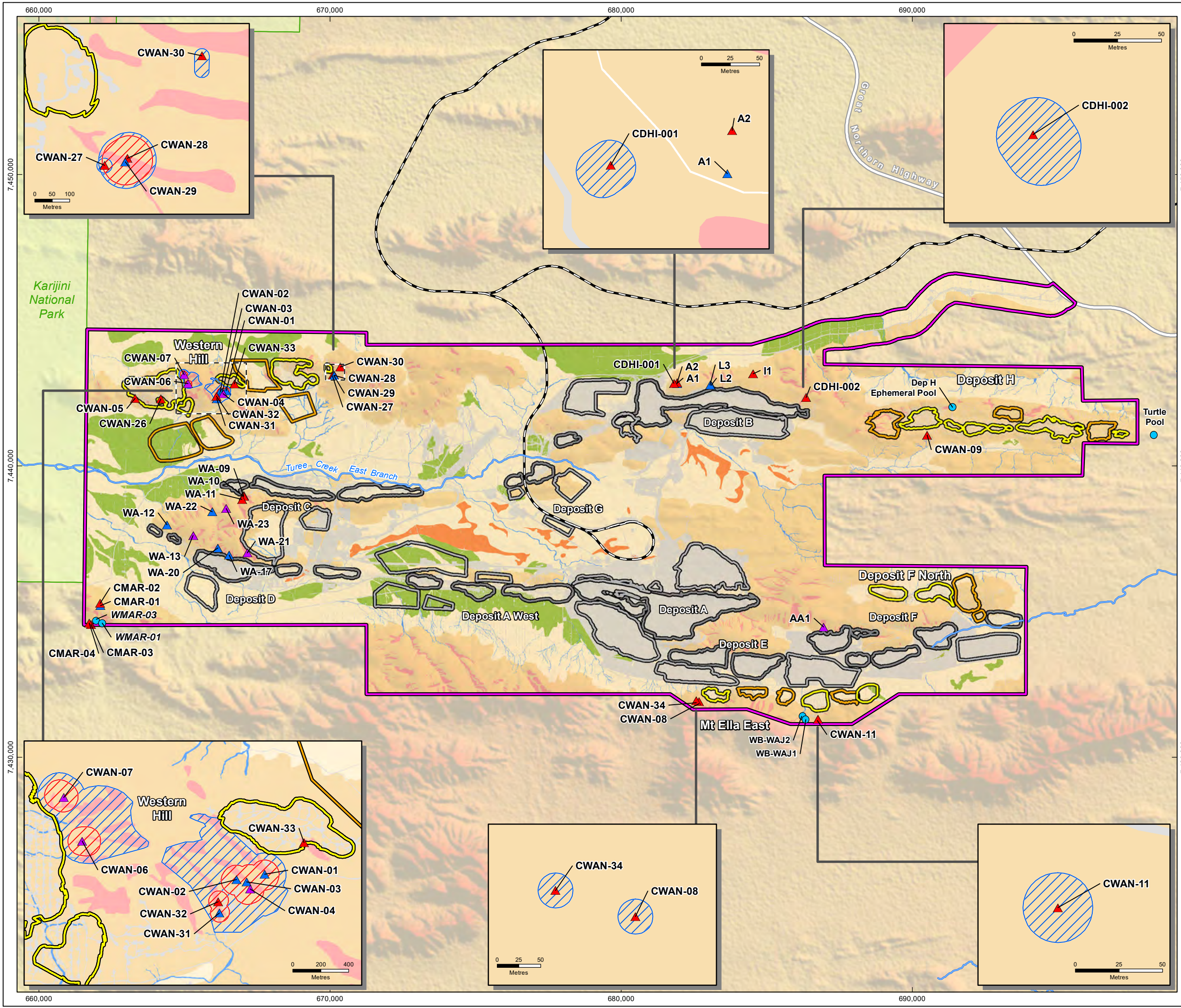
Additional strategies to minimise impacts on Terrestrial Fauna will be implemented during the Proposal and include:

- Conceptual Footprint was designed to maintain corridors of remnant vegetation within the Revised Development Envelope to facilitate the movement of fauna through the landscape
- The known location of significant fauna habitat types will be included in the Proponent's GIS system to ensure impacts to known locations of significant habitat types are minimised and authorised extents are adhered to
- Clearing will occur in approved ground disturbance areas through the continued implementation of the Proponent's Approvals Request system. The Approvals Request Coordination System is a key legislative compliance mechanism developed, implemented and utilised by Rio Tinto Iron Ore. It ensures all on ground work activities comply with regulatory requirements and internal processes
- Clearing will be undertaken progressively to allow fauna to move into undisturbed areas
- Impacts from weeds, dust, fire, noise, and vibration will be managed through standard controls, which will be described in the EMP (Appendix A.8) where suitable
- Barbed wire fencing will be avoided as far as practicable. Where the use of barbed wire cannot be avoided, the Proponent will install reflectors to deter bat interactions.

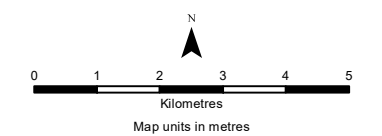
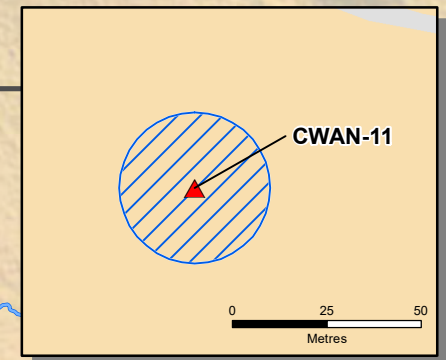
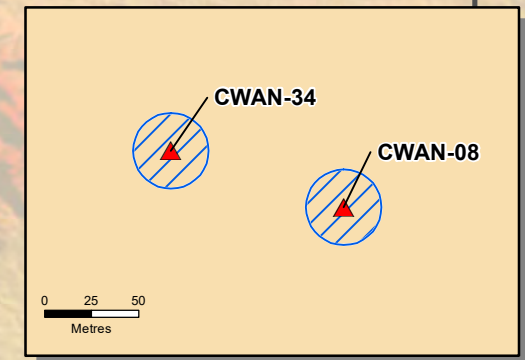
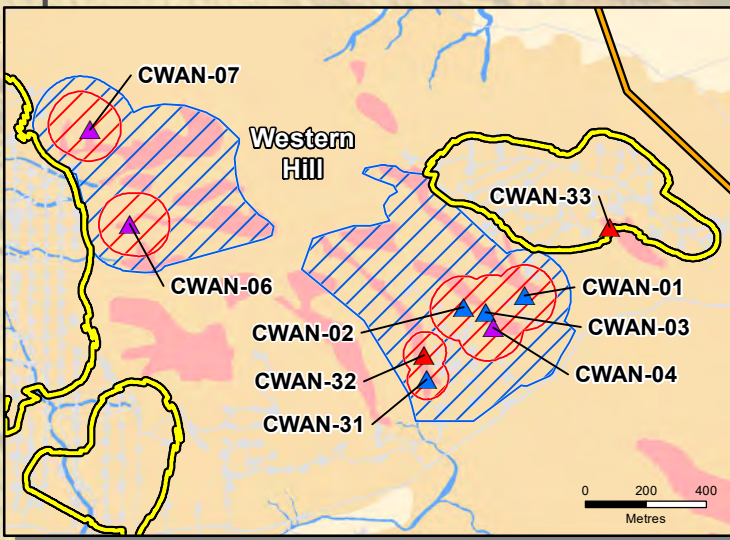
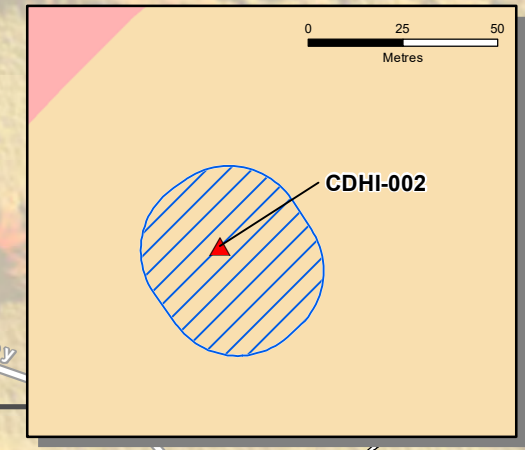
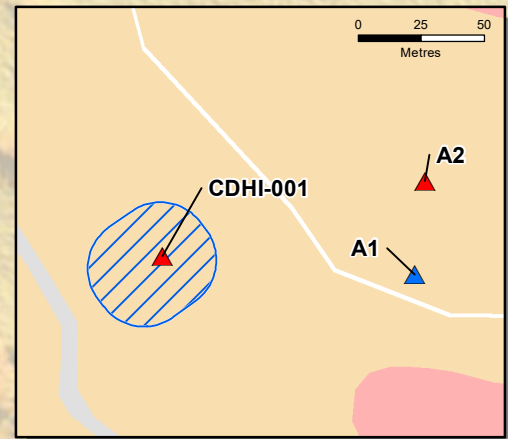
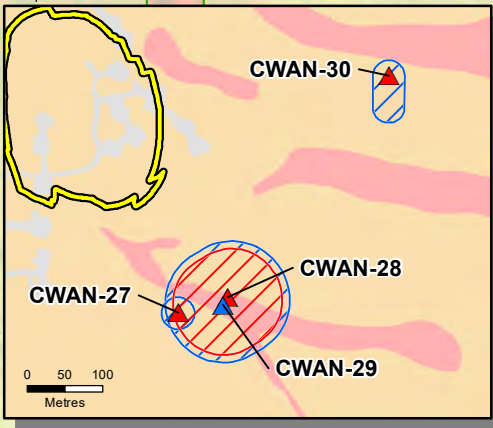
Figure 9-13
Mine Restriction and Exclusion
Zones, Roosts and Water
Features

Drawn: A.D.
Plan: RTIO-0955058v3
Date: August 2023

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



- Legend**
- Revised Development Envelope
 - Mining Exclusion Zone
 - Mining Restriction Zone
- Proposed Conceptual Layout**
- Pit
 - Waste Landform
- Approved Conceptual Layout**
- Pit
 - Waste Landform
- Water Feature**
- Water Feature
- Caves**
- ▲ Category 2
 - ▲ Category 3
 - ▲ Category 4
- Fauna Habitat**
- Drainage Line
 - Cracking Clay
 - Gorge/Gully
 - Footslopes and Plains
 - Hillcrest and Hillslope
 - Mixed Acacia Woodland
 - Disturbed
- Other Features**
- National Park
 - Rio Tinto Railway
 - Highway
 - Major Creek



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9.5.3. Mitigation of Risks at Closure

The West Angelas Revised Proposal MCP has been prepared to address closure requirements for the Proposal (Appendix A.5).

The MCP includes objectives to ensure that vegetation on rehabilitated land consists of self-sustaining native species and is compatible with the post-mining land use; that final landforms are stable and consider ecological and hydrological factors and do not represent a significant ecological risk.

Habitat elements considered part of the closure landform design includes, amongst others:

- Vegetation known to provide preferred food or shelter preference
- Rapid generation and retention of leaf litter using small-scale topography
- Introducing or leaving rocky features such as oversized waste burden or scree slopes
- Creating greater depths of friable soil (or suitable mineral wastes) for burrowing fauna
- Preserving connectivity with unmined areas and maintaining the quality of these habitats.

Rehabilitation practices generally include respreading of topsoil or another growth medium where available and spreading native seed with the aim of creating self-sustaining ecosystems. Any rehabilitation will be conducted in accordance with the *Rio Tinto Iron Ore Rehabilitation Handbook* and will include fauna and habitat monitoring.

The MCP will be updated regularly to ensure its objectives remain relevant and aligned to stakeholder expectations and that its strategies and plan are appropriate to achieve closure outcomes.

9.5.4. Summary of the Application of the Mitigation Hierarchy

As described above, the Proposal has been designed to avoid and mitigate impacts to the Terrestrial Fauna values within the Revised Development Envelope. Table 9-23 summarises the mitigation hierarchy for this Proposal.

Table 9-23: Application of the Mitigation Hierarchy for Terrestrial Fauna

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
Clearing of fauna habitat and habitat fragmentation	Measures to Avoid			
	<ul style="list-style-type: none"> The total extent of clearing required reduced from 7,200 ha (as referred) to 5,350 ha and Revised Development Envelope from 41,484 ha (as referred) to 36,779 ha (amended via s.43A) The Revised Development Envelope and Conceptual Footprint have been continually refined during the design phase to avoid direct impacts to high significance fauna habitats as much as practicable. This includes the avoidance of 17 category 2, 3 and 4 caves in the Proposal Area; Ghost Bat roosts; and water habitat features MEZs and MRZs have been established around 17 caves within the Proposal Area, with no mining disturbance permitted in MEZs and limits on disturbance within MRZs. An additional 20 caves are currently protected under MS 1113 Restriction and Exclusion Areas MRZs have been established around critical and supporting habitat linking bat roosts where appropriate MRZs and MEZs will be included in the Proponent's GIS system to ensure known locations are avoided The Proponent will ensure clearing only occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system 	Proposal Specific	Yes – approval is required under the BC Act for the disturbance of habitat for significant species	<ul style="list-style-type: none"> Project optimisation and reduction of clearing required is the most effective control to ensure impacts are ALARP. Avoidance is the first and preferred step in the mitigation hierarchy and therefore is consistent with the EPA <i>Statement of environmental principles, factors, objectives and aims of EIA</i> (EPA 2021c) The approvals request system is well-established and ensures clearing does not occur in MEZs and that limits apply to MRZs. This system also tracks clearing where limits apply to habitat types, providing confidence that clearing will not be greater than assessed Avoidance of significant habitat is a key recommendation for species conservation

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Minimise			
	<ul style="list-style-type: none"> The Revised Development Envelope and Conceptual Footprint have been designed to minimise, where practicable, disturbance of high significance fauna habitats (Gorge/Gully and Hillcrest/Hillslope), and clearing limits within these habitat types have been proposed Known locations of significant fauna habitat types will be included in the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent’s Approvals Request system Key landform corridors such as major drainage lines (i.e. Turee Creek) will remain as intact as possible to ensure habitat connectivity is maintained 	Proposal Specific and Standard Business Practice	Yes – approval is required under the BC Act for the disturbance of habitat for significant species	<ul style="list-style-type: none"> These measures are best practise and are consistent with the National Recovery Plan for Northern Quoll (Hill and Ward 2010) and conservation advice for Ghost Bat and Pilbara Leaf-nosed Bat (TSSC 2016b, a) and Pilbara Olive Python (DEWHA 2008a) The approvals request system is well-established and ensures clearing does not occur in MEZs and that limits apply to MRZs. This system also tracks clearing where limits apply to habitat types Retention of high significance fauna habitats is a key recommendation for species conservation
Measures to Rehabilitate				
<ul style="list-style-type: none"> Preparation and regular update of an MCP consistent with DMIRS <i>Guidelines for Preparing Mine Closure Plans</i> (DMIRS 2020a) The MCP includes objectives to ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use. Final landforms will be stable and consider ecological and hydrological factors. Linear infrastructure, including 	A Proposal specific MCP has been developed based on RTIO standard approach to closure planning	Yes – DMIRS for implementation of the MCP (Appendix A.5)	<ul style="list-style-type: none"> These measures follow the Statutory Guidelines for MCPs and are consistent with industry-leading practises (DMIRS 2020b) The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b) Rehabilitation will be required to provide a vegetated and stable landform with habitat 	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>crossings, will be fully decommissioned if no longer required</p> <ul style="list-style-type: none"> • Habitat elements considered for terrestrial fauna as part of rehabilitation design includes: <ul style="list-style-type: none"> ○ Vegetation is known to provide preferred food or shelter preference ○ Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore Rehabilitation Handbook and will include fauna and habitat monitoring ○ Rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement ○ 			<p>features. However, the uncertainty in relation to the re-creation of habitat values following mining is acknowledged. Therefore, clearing is treated as a long-term or permanent impact for this assessment</p>
Proposed Limits on Impact to Ensure Environmental Outcomes			Mechanism for Limit	
	<ul style="list-style-type: none"> • MEZs (no direct impacts) will be established around Ghost Bat: category 2, 3 and 4 caves (with the exception of four category 4 caves intersecting with the Conceptual Footprint). No direct disturbance is permitted in a MEZ except for activities that support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP • MRZs will be established around category 2 and apartment block caves and critical and supporting habitat linking roost clusters. MRZ permit low impact activities with disturbance up to 20% of the MRZ surface affected, which support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP (Appendix A.8) • Limits to clearing (direct impact) of high significance habitat (Gorge/Gully and Hillcrest/Hillslope) 		<ul style="list-style-type: none"> • MRZs and MEZs are anticipated to be included as a Ministerial Condition and conditions of approval under the EPBC Acts. • Clearing limits to be included as a Ministerial Condition and conditions of approval under the EPBC Act. 	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Loss of fauna individuals	Measures to Minimise			
	<ul style="list-style-type: none"> Measures to minimise the loss or injury of fauna as a result of clearing or other activities include: Implementation of the West Angelas EMP Majority of light vehicle movements outside of operating mine areas will occur during daylight hours, which will minimise interaction with nocturnal species The Proponent will undertake progressive clearing to allow fauna to migrate away from clearing activities or machinery movements Speed limits will be implemented to minimise the risk of fauna injury or mortality from vehicle strike Vehicle traffic will be confined to defined roads and tracks Roadkill will be removed from trafficable areas to reduce the risk of attracting introduced fauna an increase in feral predator numbers and of secondary vehicle strikes on scavenging fauna Avoid the use of barbed wire fencing where practicable; however, where barbed wire fencing is required for legislative compliance, reflectors will be attached to make fencing more visible and reduce the risk of fauna injury or mortality due to entanglement Site induction programs will provide information on significant fauna including their appearance and habitats. Training would also discuss standard 	Standard business practice	No	<ul style="list-style-type: none"> Where avoidance is not possible, minimisation of impacts is the next preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021c) EPA 2016d; 2016e and 2020a guidance considers minimising impacts to terrestrial fauna from potential impacts and activities (including direct and indirect) Reflectors on fences are best practice and consistent with Conservation Advice for Ghost Bat and Pilbara Leaf-nosed Bat species (TSSC 2016a and 2016b) These measures will minimise impacts to fauna species but will not avoid all injuries

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	operating procedures in the event of fauna interactions <ul style="list-style-type: none"> Artificial water sources at turkeys' nests and sediment ponds will have egress points 			
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	
	Managed through limits set relating to clearing (described above) and limits described for indirect impacts (described below) and in accordance with standard industry practices		N/A	
Clearing of habitat and loss of SRE Individuals	Measures to Avoid			
	<ul style="list-style-type: none"> The Revised Development Envelope and Conceptual Footprint have been modified during the design phase resulting in avoidance of direct impacts to high suitability SRE habitats (Gorge/gully habitat) The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system 	Standard business practise	No	<ul style="list-style-type: none"> Avoidance is the first and preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of environmental principles, factors, objectives and aims of EIA (EPA 2021c) Avoidance of high suitability habitat is a key recommendation for species conservation
	Measures to Minimise			
	<ul style="list-style-type: none"> Revised Development Envelope and Conceptual Footprint have been designed to minimise, where 	Standard business practise	No	<ul style="list-style-type: none"> The approvals request system is well-established and tracks clearing where limits apply to habitat types Retention of high suitability habitats is one of the key recommendations for species conservation

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>practicable, disturbance of high suitability SRE habitat (Gorge/Gully habitat)</p> <ul style="list-style-type: none"> • Clearing of high suitability SRE habitat will be restricted through authorised Proposal clearing extents • Clearing limits applied to MNES habitat will simultaneously result in clearing limits being applied to high suitability SRE habitat (Gorge/ Gully) • Known locations of significant SRE habitat (Gorge/Gully) will be included in the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents • The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system 			
Measures to Rehabilitate				
	<p>Preparation and regular update of a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a)</p> <p>The MCP includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with the post-mining land use. Final landforms are stable and consider ecological and hydrological factors. Habitat elements considered part of the rehabilitation design includes:</p>	<p>A Proposal specific MCP has been developed based on RTIO standard approach to closure planning.</p>	<p>Yes – DMIRS for implementation of the MCP (Appendix A.5)</p>	<ul style="list-style-type: none"> • Statutory Guidelines for MCPs are available and are consistent with industry-leading practice (DMIRS 2020a and 2020b). The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes (DMIRS 2020b) • Rehabilitation will be required to provide a vegetated and stable landform with habitat features. However, the uncertainty in relation to the re-creation of habitat values following mining is acknowledged. Therefore, clearing is treated as a long-

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<ul style="list-style-type: none"> Vegetation is known to provide preferred food or shelter preference Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore Rehabilitation Handbook and will include fauna and habitat monitoring Rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement. 			term or permanent impact for this assessment
Indirect Impact				
Degradation/alteration of habitat as a result of altered hydrological regimes	Measures to Avoid			
	<ul style="list-style-type: none"> Major infrastructure, including WRLs, have been preferentially located outside the ephemeral watercourses and their tributaries Direct impacts to ephemeral pool WB-WAH1 (Deposit H Waterhole) located north of Deposit H will be avoided, and a heritage exclusion area will be established around the pool (Section 6) Pools WB-WAJ1 and WB-WAJ2 are outside the Conceptual Footprint and will not be impacted due to proximity with the Range to the south of Mt Ella (Section 6) 	Standard Practice	No	Established and proven practice.
	Measures to Minimise			
	Pits will be isolated from significant creeklines to minimise the interception of catchment flows.	Standard practice	No	The Proponent has well-established surface water management procedures across its Pilbara mine sites.
Measures to Rehabilitate				

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<ul style="list-style-type: none"> Temporary infrastructure will be removed at closure to allow natural flow paths and catchments to be re-established in these areas The Proponent commits to the undertaking of progressive rehabilitation to restore any vegetation impacted by alterations to the hydrological regimes The MCP includes objectives to ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use. Final landforms will be stable and consider ecological and hydrological factors Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore Rehabilitation Handbook and will include fauna and habitat monitoring Rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement 	Standard practice	No	<ul style="list-style-type: none"> These measures follow the DMIRS <i>Statutory Guidelines for Mine Closure Plans</i> which are consistent with industry leading practises. Rehabilitation will be required to provide a vegetated and stable landform with habitat features. However, the uncertainty in relation to the recreation of habitat values following mining is recognised.
Habitat degradation associated with construction and operational activities, including the increase in weeds, dust and potential increased abundance of feral animals and altered fire regimes.	Measures to Avoid			
	Refer to Section 8 Flora and Vegetation for weed avoidance measures	Standard business practise	No	<ul style="list-style-type: none"> Similar measures have been implemented in the Proponent's other operations in the region and are shown to be effective and provide a high level of certainty
	Measures to Minimise			
	<ul style="list-style-type: none"> The Proponent will implement management measures such as dust suppression to minimise disturbance to fauna habitats Vehicles will be required to travel at safe operating speeds on unsealed roads and will be restricted 	Standard business practise	No	<ul style="list-style-type: none"> These measures are best practise and are consistent with the National Recovery Plan for Northern Quoll (Hill and Ward 2010) and conservation advice for Ghost Bat and

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>from accessing rehabilitated surfaces except for management purposes as per current practices</p> <ul style="list-style-type: none"> The Proponent will undertake feral animal monitoring and subsequent control in high risk areas and/or high value habitat as outlined in the EMP within the Revised Development Envelope and in cooperation with regional control programs and Traditional Owners Landfill facilities will be fenced, and putrescible wastes will be regularly covered to minimise the attraction of animals Borrow pits will be designed and constructed to minimise surface water ponding after rehabilitation Fire breaks will be maintained, and hot works procedures and fire equipment will be available in buildings and vehicles Fire response procedures and personnel training will be provided, including site induction on fire prevention and management 			<p>Pilbara Leaf-nosed Bat (TSSC 2016b, a) and Pilbara Olive Python (DEWHA 2008a)</p> <ul style="list-style-type: none"> These measures have been developed to meet the current industry standards for managing dust suppression. The management strategy will minimise the amount of dust generated within the Revised Development Envelope as a result of the Proposal The Proponent has well-established dust and waste management procedures across its Pilbara mine sites providing moderate certainty
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	
	Management via the Proponent's management procedures, the Proponent's EMP and through standard industry practices.		N/A	
	Measures to Avoid			
Disturbance from light, noise and/or vibration, and possible displacement of fauna associated with construction	<ul style="list-style-type: none"> Avoidance of 17 caves within the Proposal Area by implementing MEZ and MRZ. An additional 20 caves are currently protected under MS 1113 Restriction and Exclusion areas, as per Table 9-22 	Proposal Specific Implementation via the EMP	No	<ul style="list-style-type: none"> No industry or best practice standards are established regarding habitat protection. Avoidance is the first and preferred step in the mitigation hierarchy and therefore is consistent with the EPA Statement of

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
activity and mining operations				environmental principles, factors, objectives and aims of EIA (EPA 2021c) <ul style="list-style-type: none"> Avoidance of significant habitat is a key recommendation for species conservation
	Measures to Minimise			
	<ul style="list-style-type: none"> Vibration limits will apply to category 2 and 3 Ghost Bat caves (including within Ghost Bat apartment block caves) within the Revised Development Envelope to manage vibration impacts and maintain caves' structural integrity as per Table 9-22 Noise limits will apply to retained category 2 Ghost Bat caves in the Proposal Area to as per Table 9-22 and the EMP. MRZ/MEZ buffers (Table 9-22) will minimise noise, vibration and light pollution received by the high significance habitat and structures within the area MRZ/MEZ buffers (Table 9-22) will minimise noise, vibration and light pollution received by the high significance habitat and structures within the area Lighting will be designed and managed in accordance with the National Light Pollution 	Standard business practise	No	<ul style="list-style-type: none"> These measures have been developed to meet the current industry standards for managing light and noise pollution, including the National Light Pollution Guidelines (DotEE 2020)

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<p>Guidelines for Wildlife (DCCEEW 2023 (specifically Appendices I, J and K). These include:</p> <ul style="list-style-type: none"> • Permanent lighting will be installed only where required, mainly in-pit and operational areas • Permanent lighting and temporary lighting will be shielded and directed to active mine areas to minimise light spill • Permanent lighting will be directed away from sensitive areas (e.g. MEZs, MRZs, significant caves, critical habitat) • Temporary lighting (e.g. trailer mounted units) may be required to provide a safe working environment for short periods, where practicable, and while still providing a safe working environment; these will be positioned to minimise direct light spill into sensitive areas • Equipment design will be specified to be within Australian standard noise limits and/or fitted with noise mufflers in accordance with manufacturing specifications • The implementation of the MRZ and MEZ around caves will minimise light, noise and vibrations received by the high value habitat and structures within this area • Blasting will be restricted to daylight hours • The implementation of a Blast Management Plan to manage impacts from vibrations and maintenance of the structural integrity of significant caves 			
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	<ul style="list-style-type: none"> Vibration limits will apply to category 2 and 3 Ghost Bat caves (including within Ghost Bat apartment block caves) within the Revised Development Envelope Noise limits will apply to retained category 2 and 3 (in apartment block) Ghost Bat caves in the Proposal Area to as per Table 9-22 and the EMP. 		EMP (Appendix A.8)	

9.6. Assessment and Significance of Residual Impacts

This section addresses the impacts of the Proposal post-mitigation.

9.6.1. Assessment of Direct Impacts

9.6.1.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

The Proposal involves clearing up to 5,350 ha of native vegetation comprising 14.5% of the 36,779 ha Revised Development Envelope.

The Proposal includes flexibility to alter the location of the Proposal elements within the Revised Development Envelope; therefore, to maintain operational flexibility whilst ensuring protection of high value habitats, maximum clearing limits are proposed for high significance habitat types (Gorge/Gully (126 ha) and Hillcrest/Hillslope (3,731 ha) (Table 9-15). The remaining extents for each moderate significance fauna habitat types are shown in Table 9-16. None of the fauna habitats impacted by the Proposal are restricted to the Revised Development Envelope and are well represented in the surrounding region.

The current approval under the EPBC Act within the Revised Development Envelope for Deposits C, D and G (Decision Notice 2018/8299) specifies limits for clearing of Ghost Bat and Pilbara Leaf-nosed Bat habitat as shown in Table 9-24. As this Proposal is considered to be a Controlled Action under the EPBC Act, a separate Decision Notice will apply to the Revised Development Envelope for the Proposal (Proposed Action). The combined current clearing limit under DN 2018/8299 and the Proposal clearing are shown in Table 9-24; however, it is understood that Proposal (Proposed Action) limits will be specified in a separate Decision Notice relating to this Proposed Action. There are no clearing limits for Ghost Bat or Pilbara Leaf-nosed Bat habitat under MS 1113.

Table 9-24: Combined Proposal and Current Approved Habitat Clearing Limits

Fauna Habitat Type	Proposal Impact (Upper Limit for Flexibility) (ha)	Previous Approval Clearing Limit Within Development Envelope (ha)	Combined Proposal and Previous Authorisations Limit within Revised Development Envelope (ha)
Gorge/Gully	126	2*	128~
Hillcrest/Hillslope	3,731	484*	4,215~
Drainage Line	NS	21*	NS
Mixed Acacia Woodland	NS	NS	NS
Footslopes and Plain	NS	NS	NS
Cracking Clay	2	20^	22

* Specified in Decision Notice 2018/8299 and applies only to Deposits C, D and G. No clearing limits specified in MS 1113

^ MS 1113, no clearing limits specified in DN 2018/8299

~ Applies to Deposits C, D and G and Proposal only. Proposal and C, D, G limits specified in separate Decision Notices

NS - None specified

` Applies to all activities within Revised Development Envelope

Key fauna habitat features within the Revised Development Envelope will be protected, including 7 category 2, 13 category 3 and 17 category 4 Ghost Bat roosts (all of the caves in the Revised Development Envelope are classified as category 4 Pilbara Leaf-nosed Bat roosts). Following the implementation of mitigation measures (Section 9.5) the impact of the removal of up to four category 4 caves that are isolated and not considered critical habitat for the Ghost Bat is not considered significant (Table 9-26). Surface water fed ephemeral pools (Pools WB-WAJ1 and WB-WAJ2) will be retained and are located outside of the Conceptual Footprint. The Proposal has been designed to avoid direct impacts to Deposit H ephemeral pool WB-WAH1 located to the north of Deposit H. An MRZ will be established around this pool to avoid direct impacts from the Proposal. As such, no significant impacts to ephemeral pool fauna habitats are expected to occur as result of the Proposal.

The clearing of fauna habitat will result in reduced local availability of breeding/roosting, foraging and dispersal habitat for several vertebrate fauna species, including significant species. The significance of impacts relating to clearing of habitat to significant species with the potential to be impacted by the Proposal are described in further detail Section 9.6.4.

Fauna species will be affected by habitat fragmentation locally, especially where High significance fauna habitat (Gorge/Gully and Hillcrest/Hillslope) is cleared. However, overall habitat connectivity within the Revised Development Envelope will be maintained with due consideration given to maintaining this connectivity in the design of the Conceptual Footprint; therefore, fauna is expected to continue dispersing and foraging more broadly in the surrounding habitats.

The western edge of the Western Hill deposit in the Revised Development Envelope borders Karijini National Park. Therefore, fauna in this section of the Revised Development Envelope are expected to be able to move into similar suitable and protected habitat in the surrounding landscape. This includes the identified significant Pilbara Leaf-nosed Bat roost site (Upper Turee) within Karijini National Park, where foraging Pilbara Leaf-nosed Bat individuals within the Revised Development Envelope are likely to disperse from. Key dispersal corridors such as creek lines will be retained within the Revised Development Envelope, as will fauna habitats of High to Moderate significance that extend beyond the boundaries of the Revised Development Envelope, such as Gorge/Gully, Hillcrest/Hillslope and Mixed Acacia Woodlands. These areas will continue to provide ecological linkages for terrestrial fauna throughout the wider landscape.

An assessment of species-specific impacts from habitat loss and fragmentation is provided in Section 9.6.4 and Section 13.

9.6.1.2. Loss of Fauna Individuals

Significant fauna in the Revised Development Envelope may be vulnerable to injury or mortality from vehicle and machinery movements, mainly when foraging nocturnally or whilst warming up on roads for the Pilbara Olive Python. Vehicle movements will increase temporarily during construction, however overall vehicle movements will reduce during the operational phase. Vehicle movements at night are much lower than during the day and are generally limited to in-pit operations. In addition to vehicle strike, the Pilbara Leaf-nosed Bat and Ghost Bat are at risk of entanglement in barbed wire fencing.

The Proponent will implement management measures to mitigate the loss of fauna individuals (Table 9-23), such that vehicle and machinery movements are not expected to significantly impact significant fauna species including the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat or Pilbara Olive Python populations within the Revised Development Envelope. Following the implementation of mitigation actions such as avoiding barbed wire fencing where possible and where the use of barbed wire cannot be avoided, the Proponent will install reflectors to deter bat interactions, the potential impacts from entanglement in fencing to fauna as a result of the Proposal are expected to be low.

9.6.1.3. Clearing of SRE Habitat and Loss of SRE Individuals

Clearing, earthworks and excavation activities will unavoidably result in the loss of individual potential SRE taxa recorded within the Revised Development Envelope. Of the 38 potential SREs identified within the Revised Development Envelope, the majority are likely to be widespread or have distributions extending beyond the clearing boundaries. Eighteen taxa have been recorded only within the Revised Development Envelope and may have restricted distributions and therefore be at risk from the Proposal (Table 9-14; Table 9-25; Figure 9-14). Nine of these have been recorded only from within the Conceptual Footprint. An assessment of the potential risks to these taxa utilising habitat, distribution, and taxonomic factors is provided in Table 9-25.

Based on the assessment, five of the 18 potential SRE species recorded only in the Revised Development Envelope were identified as having a medium level risk of being impacted by the Proposal (Table 9-25). These five species were only recorded within the Conceptual Footprint. The remaining 13 species were assessed as having a low risk of being impacted from the Proposal.

The medium risk rating was typically based on species only being recorded from one site within the Conceptual Footprint and/or within restricted habitat types (Gorge/Gully and Hillcrest/Hillslope). It is considered likely that the medium risk SRE taxa are found in the restricted habitat types outside of the Conceptual Footprint (Biologic 2022i). Given that a large amount of Gorge/Gully and Hillcrest/Hillslope will remain within the Revised Development Envelope, clearing for the Proposal is not expected to significantly impact these species.

For the 13 species rated as having a low potential impact, although only recorded within the Revised Development Envelope, these species were typically recorded in widespread habitat types (Footslopes and Plain, Drainage Line and Mixed Acacia Woodland) and from multiple sites. As such, these species are considered likely to occur in these habitats outside the Conceptual Footprint and will not be significantly impacted by clearing for the Proposal.

9.6.1.4. Direct Disturbance of Country, and Sites of Social, Cultural and Heritage Significance in Regard to Fauna along with Interference with Cultural Obligations and Spiritual Beliefs tied to Fauna

An assessment of this direct impact is provided in Section 6.

Table 9-25: SRE Taxa Potentially at Risk from the Proposal

Taxon	Taxonomic Factors Affecting Risk	Distribution and Habitat Factors Affecting Risk	Recorded only in Revised Development Envelope	Recorded only in Proposal Conceptual Footprint	Potential Risk
Pseudoscorpions					
* <i>Austrochthonius</i> `sp. Biologic-PSEU101`	All three taxa could not be matched to any known sequences. Molecular work on Chthoniidae pseudoscorpions are displaying a high degree of cryptic species. Much taxonomic work is required for the family.	This taxon was recorded from within the Gorge/Gully habitat type. It was collected at the same site as specimens identified as <i>Austrochthonius</i> `pilbara` a widespread species.	x	✓	Low
* <i>Tyrannochthonius</i> `sp. Biologic-PSEU104`		Recorded from two sites in Gorge/Gully habitat.	x	✓	Medium
* <i>Tyrannochthonius</i> `sp. Biologic-PSEU107`		Recorded from a single site in Hillcrest/Hillslope habitat.	x	✓	Medium
* <i>Austrohorus</i> `sp. Biologic-PSEU103`	Olpiidae taxonomy is very limited and needs review. The molecular analysis seems to show many species with restricted ranges. It could not be matched to any other sequences.	Recorded from a single site in Gorge/Gully habitat.	x	✓	Medium
* <i>Beierolpium</i> `sp. Biologic-PSEU087`		Recorded from two sites in Gorge/Gully habitat.	x	✓	Medium
* <i>Beierolpium</i> `sp. Biologic-PSEU088`		Recorded from a single site in Gorge/Gully habitat.	x	✓	Medium
* <i>Euryolpium</i> `sp. Biologic-PSEU086`		Recorded from two sites in Gorge/Gully habitat.	✓	✓	Low
* <i>Euryolpium</i> `sp. Biologic-PSEU102`		Recorded from a single site in Gorge/Gully habitat.	✓	x	Low
*Olpiidae `sp. Biologic-PSEU084`		Recorded from a single site in widespread habitat.	✓	x	Low
*Olpiidae `sp. Biologic-PSEU085`		Recorded from a single site in widespread habitat.	x	✓	Low

Taxon	Taxonomic Factors Affecting Risk	Distribution and Habitat Factors Affecting Risk	Recorded only in Revised Development Envelope	Recorded only in Proposal Conceptual Footprint	Potential Risk
Isopods					
Armadillidae Gen. nov. `sp. nov. 1`	These are all morphologically identified taxa carried out in 2014. <i>Buddelundia</i> contains both widespread and short-ranging species. it is hard to comment on these species based on the taxonomic limitations of morphological identifications.	Unknown morphospecies collected from widespread habitat.	✓	×	Low
<i>Buddelundia</i> `sp. 10 1458A`		Collected from over 10 sites in a variety of habitats.	✓	✓	Low
<i>Buddelundia</i> `sp. 10 1458B`		Collected from four sites in a variety of habitats.	✓	✓	Low
<i>Buddelundia</i> `sp. 10 1458C`		Recorded from one site in Hillcrest/Hillslope habitat type, but morphologically resembled <i>Buddelundia</i> `sp. 10 1458A.`	×	✓	Low
<i>Buddelundia</i> `sp. 10 1458D`		Recorded from one site in Hillcrest/Hillslope habitat type, but morphologically resembled <i>Buddelundia</i> `sp. 10 1458A.`	×	✓	Low
<i>Buddelundia</i> `sp. 68WA`		Known morphospecies recorded from various habitats.	✓	×	Low
* <i>Buddelundia</i> `sp. Biologic-ISOP082`	Could not be matched to any known sequences.	Recorded from two sites in Hillcrest/Hillslope habitat.	✓	✓	Low
Snails					
Sinumeloninae nr. `Mt. Robinson`	Could not be matched to any known sequences. Genus contains widespread and restricted taxa.	Recorded from a single site in Gorge/Gully habitat.	✓	×	Low

Source: *Biologic 2022i*

Figure 9-14
Distribution of Potentially Restricted SRE Taxa within the Revised Development Envelope

Drawn: GIS Team
Plan: RTIO-0980521v1
Date: March 2023

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

Legend

- Revised Development Envelope
- Extension Area

Proposed Conceptual Layout

- Pit
- Waste Landform

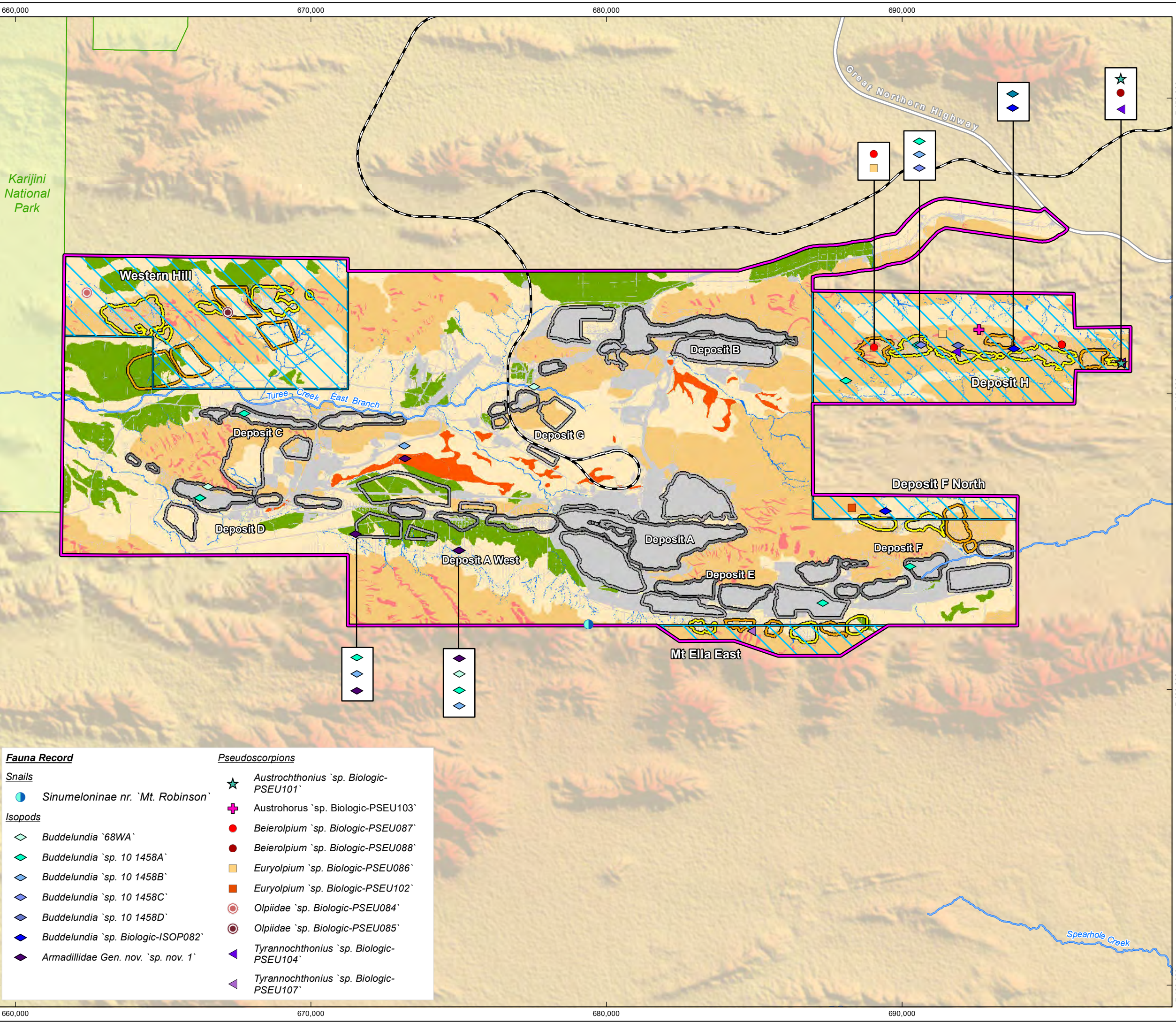
Approved Conceptual Layout

- Pit
- Waste Landform

Fauna Habitat

- Drainage Line
- Cracking Clay
- Gorge/Gully
- Footslopes and Plains
- Hillcrest and Hillslope
- Mixed Acacia Woodland
- Disturbed

- National Park
- Rio Tinto Railway
- Highway
- Major Creek

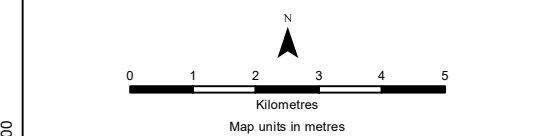


Fauna Record

- Snails**
- Sinumeloninae* nr. 'Mt. Robinson'
- Isopods**
- Buddelundia* '68WA'
 - Buddelundia* 'sp. 10 1458A'
 - Buddelundia* 'sp. 10 1458B'
 - Buddelundia* 'sp. 10 1458C'
 - Buddelundia* 'sp. 10 1458D'
 - Buddelundia* 'sp. Biologic-ISOP082'
 - Armadillidae* Gen. nov. 'sp. nov. 1'

Pseudoscorpions

- Austrochthonius* 'sp. Biologic-PSEU101'
- Austrohorus* 'sp. Biologic-PSEU103'
- Beierolpium* 'sp. Biologic-PSEU087'
- Beierolpium* 'sp. Biologic-PSEU088'
- Euryolpium* 'sp. Biologic-PSEU086'
- Euryolpium* 'sp. Biologic-PSEU102'
- Olpiidae* 'sp. Biologic-PSEU084'
- Olpiidae* 'sp. Biologic-PSEU085'
- Tyrannochthonius* 'sp. Biologic-PSEU104'
- Tyrannochthonius* 'sp. Biologic-PSEU107'



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9.6.2. Assessment of Indirect Impacts

Indirect impacts to potential SRE species are considered a low risk from degradation/alteration of fauna habitat due to hydrological changes, increased weeds, dust, feral animals and altered fire regimes, and light, noise and vibration and therefore are not discussed further.

9.6.2.1. Degradation/Alteration of Habitat as a Result of Altered Hydrological Regimes

Surface water modelling predicted that, during certain weather events, the Proposal would alter the natural hydrological regimes that predominately flow through the Drainage Line habitat. Drainage Line habitat is moderate significance (and supporting) habitat for several significant species, including Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python.

The Conceptual Footprint has been designed to reduce impacts to surface water flow regimes (Section 7). and associated potential habitat degradation. Ephemeral flow paths in named creeklines will not be diverted and major infrastructure, including WRL, have been preferentially located outside of the ephemeral watercourses and their tributaries. Proposed surface water infrastructure comprises floodway creek crossings, stormwater drainage for infrastructure and possible minor drainage diversions (Deposit F North) and minor ephemeral creek diversion (Deposit H) subject to further consultation with Traditional Owners. Diverted drainage will report back to creek flows as far as practicable.

Infrastructure will be constructed to minimise impacts on flows throughout the Revised Development Envelope and ensure sufficient water flow, particularly to Deposit H Waterhole will be maintained. This will minimise the degradation or alteration of any fauna habitat type dependent on these flows and ensure their ecological function is maintained. As such the Proposal is not expected to significantly impact remaining fauna habitat within the Revised Development Envelope. Further detail is provided in Section 7).

9.6.2.2. Degradation or Alteration of Habitat Features (Cave CWAN-04) as a Result of Supply Abstraction at Western Hill

Groundwater levels across the West Angelas Development Envelope are approximately ~50 mbgl and beyond the typical depth of vegetation root systems. As such, habitat features such as Caves, particularly cave CWAN-04 (which sits high in the landscape) is unlikely to be connected to groundwater within the regional or orebody aquifer at Western Hill and potential groundwater drawdown of the orebody or regional aquifers as discussed in Section 7 will not result in a change to the temperature and/or humidity of the caves.

9.6.2.3. Habitat Degradation Associated with Construction and Operational Activities

Weeds

The clearing of native vegetation has the inherent risk of spreading weeds to non-disturbed areas within the Revised Development Envelope. However, the Proponent has well-established weed hygiene procedures and management practices that will be implemented throughout the construction and operation of the Proposal (refer to Table 9-23). The implemented measures include but are not limited to periodic spraying of weed populations, particularly around areas identified as higher risk (e.g. to sensitive receptors) and the maintenance of equipment hygiene. Any potential impacts related to the introduction or spread or introduction of weeds on fauna species and habitat are predicted to be localised to areas of disturbance. It is, therefore, considered unlikely that the Proposal would result in the spread or introduction of new weed species to the extent that it significantly affects habitat values within the Revised Development Envelope.

Dust

Impacts from dust on fauna are typically non-lethal and generally take the form of behaviour changes, resulting in avoidance of an area. The amount of natural habitat surrounding the Proposal means that impacts are likely to be minimal and confined to the immediate area of the Proposal. Susceptible affected fauna are likely to move away from these sources. Furthermore, the dust generation and deposition are not expected to result in significant or permanent changes to fauna habitats given the Proposal timeframes and the effect of periodic rainfall. The Proponent will implement well-established dust management measures to minimise dust emissions. As such, no significant impacts on fauna individuals or habitats are expected due to dust emissions from the Proposal.

Feral Animals

All feral species recorded in the Revised Development Envelope (Section 9.3.3) are known from the region surrounding the Revised Development Envelope. However, clearing activities may create movement corridors for feral predators to access areas of retained remnant vegetation and habitat. Clearing may also force native fauna to move through cleared areas to reach suitable habitats, leaving them exposed to predation. These altered movement patterns may increase the predation of significant fauna by feral predators, causing injury and mortality. The Proponent will implement feral fauna control focussed on high risk areas and critical habitats, in co-operation with regional control programs and Traditional Owners and in accordance with the EMP (Appendix A.8).

Fencing of attractant areas (waste disposal/landfill) is currently undertaken within the Revised Development Envelope to limit the increase of pest species by decreasing access and attraction. Current measures will continue to be implemented to manage feral animals.

Species-specific impacts associated with habitat degradation due to increased human activity are discussed in further detail in Section 9.6.4 but are not expected to be significant overall.

The implementation of monitoring and management of feral animals is likely to reduce the impact of any introduced fauna species. Therefore, the Proposal is not expected to have a significant impact on the terrestrial fauna as a result of introduced / feral fauna within the Revised Development Envelope.

Altered Fire Regimes

The highest risk of bushfire ignition occurs during construction while undertaking hot work activities. Effective management of construction activities can prevent the incidence of bushfires. The increased road network and maintenance of associated firebreaks for the Proposal would also help control the size and extent of bushfires. Appropriate work procedures will be employed to reduce the risk of fires starting from activities associated with the proposal. Following implementation of mitigation and management measures (Section 9.5) means no significant increase in the risk of fire occurring is anticipated as a result of the Proposal.

9.6.2.4. Disturbance from Light, Noise and/or Vibration, and Possible Displacement of Fauna Associated with Construction Activity and Mining Operations

Due to activities associated with the Existing Operations, light, noise, and vibration impacts are present within the Revised Development Envelope. No new processing infrastructure is associated with the Proposal, and light, noise, and vibration impacts are limited to the development of mining areas.

The increased amount of ambient light can result in significant behavioural changes to various species within the Revised Development Envelope. This includes changes to invertebrate behaviours, with increased concentrations around heat sources, and thus changes to the behaviour of species that predate on them, such as the Ghost Bat and Pilbara Leaf-nosed Bat. To limit the impacts of ambient light will have on the surrounding environment, the Proponent is committed to the mitigation measures presented in Table 9-23 which align with the National Light Pollution Guidelines for

Wildlife (DotEE 2020). Through the implementation of these mitigation measures the Proposal is unlikely to have a significant residual impact.

The generation of noise and vibration are both unavoidable in the construction and operation of mine sites. Within the Revised Development Envelope, the most significant vibrations and noise will generally be associated with blasting, which has the potential to damage caves and other significant microhabitat structures present within the Revised Development Envelope. Accordingly, vibration limits have been applied to caves of significance to Ghost Bats (Table 9-22):

- A vibration upper limit of 10 mm/s PPV during breeding months (1 October to 31 December) for category 2 caves; and 25 mm/s PPV in non-breeding months
- A maximum noise limit of Lz10 70 dB(Z) over a one hour period at the entrance to category 2 caves in the Proposal Area (CWAN-04, 06 and 07) during breeding months (1 October to 31 December).

These measures, along with the buffers provided by MEZs within MRZs (refer to Table 9-22), are expected to ensure the integrity and microclimates of these roosts are maintained, and seasonal variations in vibration limits will reduce the risk of disturbance to the breeding activities of these species.

Traditional Owners have expressed concerns about the potential effect from dust, light, vibration and noise on animal habitats and suggested locations to use in any modelling and potential monitoring should include Ghost Bat cave CWAN-09 (along with Deposit H Waterhole and Turtle Pool).

Any disturbance will be localised and managed by implementing management measures (Section 9.5). As such, the impacts from light, noise and vibrations associated with the Proposal are not considered significant to any significant fauna species.

9.6.3. Assessment of Cumulative Impacts

All significant fauna species that occur or are likely to occur within the Revised Development Envelope may be affected by cumulative impacts from existing or foreseeable projects. However, these species occur widely in the Hamersley sub-region (Table 9-19) and can move through the local landscape. Retaining high significance fauna habitat where possible will minimise the impact on significant fauna species in the area.

It is not possible to quantify the cumulative extent of habitat loss that satisfies the specific habitat requirements for each species, due to the lack of detailed fauna habitat mapping for the entire subregion. Given the extent of fauna habitat which will remain within the Revised Development Envelope, cumulative impacts to fauna habitats within the Revised Development Envelope are not considered to be significant.

The estimated cumulative impacts from this Proposal and reasonably foreseeable projects on the land systems within the Hamersley subregion are anticipated to total 133,053 ha (4%). This is based on the Revised Development Envelopes of existing and foreseeable nearby projects rather than the clearing footprints, therefore overestimating the actual cumulative impact on land systems. This Proposal's contribution is 5,350 ha (<1%).

The cumulative impacts on land systems from existing or foreseeable projects are minor, with the highest loss being approximately 10% within the Boolgeeda Land System (Table 9-20).

The majority of these land systems and associated habitat will remain throughout the Hamersley subregion and the species associated with the Proposal are known to occur throughout the region, therefore the cumulative impacts to these species are not expected to be significant at a local or regional scale.

The cumulative loss of vegetation and fauna habitat due to mining in the Hamersley sub-region is recognised as potentially significant as per the EPAs cumulative environmental impacts of development

in the Pilbara region (EPA 2014) and therefore is addressed through the PEOF. This is discussed in further detail in Section 12.

9.6.4. Assessment of Significant Fauna Species-specific Impacts

9.6.4.1. Northern Quoll

The Proposal will clear up to 126 ha of habitat considered potentially critical to the species' survival for Northern Quoll, comprising Gorge/Gully habitat, which provides potential denning and foraging habitat. The Proposal will also clear approximately 187 ha of supporting habitat for the Northern Quoll, comprising Hillcrest/Hillslope and Drainage Line habitat within 1 km of confirmed critical habitat (Northern Quoll records), which provides foraging and dispersal habitat. The remaining habitats do not represent critical or supporting habitats for the Northern Quoll.

Clearing potential critical Gorge/Gully and supporting Drainage Line and Hillcrest/Hillslope habitats to the Northern Quoll is considered a significant residual impact. The residual significant impact as a result of the Proposal for the Northern Quoll will be compensated by the application of offsets in accordance with the EPBC Act Environmental Offsets Policy by contributing to the PEOF (or an alternative appropriate offset). Further information is available at the offset documentation in Section 12.

It should also be noted that Northern Quolls can disperse through various habitats. Therefore, other fauna habitat types extending beyond the Proposal's boundaries will also continue to allow the species to disperse around the landscape. Ecological corridors will remain along the ridges, hillsides, and creek lines, allowing continued movement for the species around the mining areas and throughout the landscape.

The Proposal's construction and operation can potentially result in the injury or death of Northern Quoll individuals. However, the Northern Quoll population within the Development is considered low, with one record within the Proposal Area (via secondary evidence of scats), and any interactions with this species are likely to be infrequent.

In addition, clearing will be undertaken progressively (i.e., not all areas will be cleared and mined simultaneously) to allow individuals to move away from disturbed areas. Progressive rehabilitation of areas no longer required for mine operation will occur to minimise disturbed areas. Habitat fragmentation is not expected to significantly affect Northern Quoll habitat connectivity or movement, given the remaining connected habitats and the species' mobile nature. Northern Quolls have been recorded within operational areas at other Pilbara mine sites and are capable of dispersing through these disturbed areas.

Some introduced species, such as Gamba Grass (*Andropogon gavanus*), Cane Toads and feral Cats, are recognised threats to the Northern Quoll (Hill and Ward 2010). Of these, only feral Cats have been recorded within the Revised Development Envelope and can potentially be a significant threat to the local Northern Quoll population. Following implementation of mitigation measures (Table 8-18) no significant impacts on Northern Quoll from the introduction or spread of weeds and feral predators is expected.

Impacts from the Proposal will be limited and not expected to significantly impact Northern Quoll at either a local or regional scale.

An assessment of the Proposal on Northern Quoll against the Significant Impact Guidelines is provided in Section 13 (DoE 2013).

9.6.4.2. Ghost Bat

The Proposal will clear up to 3,857 ha (30%) of habitat potentially critical to the survival of the Ghost Bat within the Revised Development Envelope, including:

- Up to 126 ha (20%) of Gorge/Gully habitat, which provides roosting and foraging habitat
- Up to 3,731 ha (31%) of Hillcrest/Hillslope habitat which provides roosting and foraging habitat
- Up to four category 4 caves that are isolated and not considered critical habitat for the Ghost Bat.

The Proposal will also result in clearing approximately 2,241 ha (14%) of supporting habitat for the Ghost Bat, comprising all other habitat types within the Revised Development Envelope (Drainage Line, Footslopes and Plain, Mixed Acacia Woodland and Cracking Clay). These habitats are considered supporting foraging and dispersal habitat for the Ghost Bat when within 12 km of critical habitat (category 2 caves and category 3 caves in apartment blocks). The Proposal will not exceed the maximum clearing of 5,350 ha of habitat.

The clearing of potential critical habitat for Ghost Bat, including Gorge/Gully and Hillcrest/Hillslope habitat, as well as supporting habitat, is considered to represent a significant residual impact. The residual significant impact as a result of the Proposal for the Ghost Bat will be compensated by the application of offsets in accordance with the EPBC Act Environmental Offsets Policy by contributing to the PEOF (or an alternative appropriate offset). Further information is available at the offset documentation in Section 12.

Given the dispersal capabilities and long flight distances this species undertakes while foraging, the Proposal is unlikely restrict the movements of individuals in the area.

The Proposal will impact four of the 21 Ghost Bat caves recorded within the Proposal Area. All four caves represent category 4 caves. Category 4 caves are not considered critical habitat for the Ghost Bat (Bat Call WA 2021a). All category 2 and 3 caves recorded within the Proposal Area will be retained and MEZs and/or MRZs will be established around all 17 caves at varying distances depending on the cave category (refer to Table 9-22).

The Proposal is unlikely to result in any further significant residual impacts, in addition to those listed above, to the Ghost Bat. Although construction and operation of the Proposal has the potential to result in the injury or death of Ghost Bat individuals, this is unlikely to be significant given that clearing will be progressive to allow fauna to disperse into adjacent habitat and clearing will mainly be undertaken during daylight hours when Ghost Bats are inactive. In addition, known category 4 Ghost Bat roosts which intersect the Clearing Footprint will be flushed, and entrances will be sheeted to prevent Ghost Bat return before ground disturbance occurs. Barbed wire fencing will be avoided wherever possible, and where unavoidable, reflectors will be installed to reduce species' entanglement.

Indirect impacts associated with habitat degradation or disturbance from light, dust, noise and vibration, weeds and feral animals are unlikely to result in significant impacts to the Ghost Bat, after implementation of mitigation measures (Table 9-22), and the amount of critical and supporting habitat remaining throughout the Revised Development Envelope. The Proponent will implement management measures within the EMP and Blast Management Plan to protect fauna values associated with caves (including the structural integrity) which will assist in protecting additional cultural values associated with these caves, including at several caves considered significant for Ghost Bats (Section 9.5).

An assessment of the Proposal on Ghost Bat against the Significant Impact Guidelines is provided in Section 13 (DoE 2013).

9.6.4.3. Pilbara Leaf-nosed Bat

No habitat that is critical to the survival of the Pilbara Leaf-nosed Bat (category 1 to 3 caves) has been recorded within the Revised Development Envelope. The nearest category 2 roost cave (Upper Turee Roost) is approximately 13.5 km west of the Revised Development Envelope in Karijini National Park.

Of the 41 potential Pilbara Leaf-nosed Bat caves within the Revised Development Envelope, all represent category 4 caves for the species and while not considered critical habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021b), can be considered supporting habitat. Four of these caves (CWAN-05,

CWAN-09, CWAN-26 and CWAN-33) will be impacted by the Proposal; however, as they are isolated, have no record of use by the species, are potential nocturnal refuges only, and 37 category 4 caves will remain available for use by the Pilbara Leaf-nosed Bat within the Revised Development Envelope, no significant impact on the Pilbara Leaf-nosed Bat is expected. Regardless, the removal of supporting habitat is considered to represent a residual impact to Pilbara Leaf-nosed Bat. The residual significant impact as a result of the Proposal for the Pilbara Leaf-nosed Bat will be compensated by the application of offsets in accordance with the EPBC Act Environmental Offsets Policy by contributing to the PEOF (or an alternative appropriate offset). Further information is available at the offset documentation in Section 12.

The Gorge/Gully, Hillcrest/Hillslope and Drainage Line habitats within the Revised Development Envelope are considered suitable habitat for the Pilbara Leaf-nosed Bat; however, given the distance from the nearest permanent roost (over 13 km) and the small number of individuals recorded within the Revised Development Envelope, indicating that the Pilbara Leaf-nosed Bat is not reliant upon the habitat within the Revised Development Envelope, this habitat is not considered supporting habitat. The Proposal will result in clearing approximately 3,936 ha (30%) of this suitable habitat, that may provide refuge, foraging and dispersal opportunities for the species. The remaining habitats within the Revised Development Envelope are of low significance to the species.

Approximately 9,271 ha (70%) of Gorge/Gully, Hillcrest/Hillslope and Drainage Line habitat will remain throughout the Revised Development Envelope. These areas will continue to provide habitat connectivity, further maintained along Drainage Lines within and surrounding the Revised Development Envelope. These linkages will facilitate the connection of night roosting and foraging habitats for the Pilbara Leaf-nosed Bat and enable dispersal and connection between individuals and populations. Habitat fragmentation is therefore not considered to represent a significant residual impact to the Pilbara Leaf-nosed Bat.

Despite the survey effort, only a small number of individuals have been recorded within the Revised Development Envelope, indicating that the Pilbara Leaf-nosed Bat in the area are not reliant upon the habitat within the Revised Development Envelope. As such, the impact on this species will be limited to occasional foraging individuals.

The disturbance of foraging habitat, including water sources, is a recognised threat to the Pilbara Leaf-nosed Bat (TSSC 2016a). The Proposal will result in the reduction of catchment size for one ephemeral surface water pool (WB-WAH1; Deposit H Waterhole). No Pilbara Leaf-nosed Bats have been recorded at this pool and given the distance of this pool to the known Pilbara Leaf-nosed Bat roost at Upper Turee Creek (i.e. over 13 km), it is unlikely that Pilbara Leaf-nosed Bat rely on this pool and rather only use it opportunistically. As such the catchment reduction of the Deposit H Waterhole is unlikely to impact the Pilbara Leaf-nosed Bat significantly. There is a significant water source near the Upper Turee Creek Roost within Karijini National Park, which is likely to be used by the Pilbara Leaf-nosed Bat the category 2 cave.

Although construction and operation of the Proposal has the potential to result in the injury or death of Pilbara Leaf-nosed Bat individuals, this is unlikely to be significant given the low number of individuals recorded within the Revised Development Envelope, and that clearing will be progressive to allow fauna dispersal to undisturbed areas, clearing being more prevalent during daylight hours. The use of barbed wire fencing will be avoided where possible. Where barbed-wire fencing is unavoidable, reflectors will be installed to deter bat individuals. In addition, any caves that intersect the clearing footprint will be flushed before ground disturbance and will be sheeted to prevent the bats return.

Indirect impacts associated with habitat degradation or disturbance from light, dust, noise and vibration are unlikely to significantly impact the Pilbara Leaf-nosed Bat due to specified mitigation measures (Table 9-23), no category 1 to 3 caves are present within the Revised Development Envelope and retention of supporting habitat remaining throughout the Revised Development Envelope.

An assessment of the Proposal on Pilbara Leaf-nosed Bat against the Significant Impact Guidelines is provided in Section 13 (DoE 2013).

9.6.4.4. Pilbara Olive Python

The Proposal will clear up to 126 ha (20%) of habitat potentially critical to the survival of the Pilbara Olive Python, comprising the Gorge/Gully habitat type, which provides breeding, shelter and foraging habitat. The Proposal will also clear approximately 355 ha of Hillcrest/Hillslope and Drainage Line habitat within 1 km of Pilbara Olive Python records, which are considered supporting habitat for the Pilbara Olive Python. These habitats provide shelter, foraging and dispersal opportunities for the species. The remaining habitats are not considered critical or supporting habitat for the species' survival.

The clearing of potential critical and supporting habitat for the Pilbara Olive Python is considered to represent a significant residual impact. The residual significant impact as a result of the Proposed Action for the Pilbara Olive Python will be compensated by the application of offsets in accordance with the EPBC Act Environmental Offsets Policy by contributing to the PEOF (or an alternative appropriate offset). Further information is available at the offset documentation in Section 12.

Remaining habitat within the Revised Development Envelope will continue to provide habitat connectivity, further maintained along Drainage Lines within and surrounding the Revised Development Envelope. These linkages will facilitate the connection of foraging and dispersal habitats for the Pilbara Olive Python and enable dispersal and connection between individuals and populations. Habitat fragmentation is therefore not considered to represent a significant residual impact to the species.

The proposed MEZ and/or MRZs around 17 of the 21 caves recorded in the Proposal Area and the current protection of the other caves within the Approved Development Envelope will protect potential denning habitat for this species within the Revised Development Envelope.

Surface water bodies, or pools, are considered critical habitats for the Pilbara Olive Python (DEWHA 2008a). The Proposal will result in the catchment reduction of one ephemeral surface water fed pool (WB-WAH1; Deposit H Waterhole). The Pilbara Olive Python would likely use this pool opportunistically, and the pool will remain available for use by the species. Therefore, the reduction in the catchment will not impact the species. The Proposal will impact the size of the catchment which feeds the pool; however, this impact will be minimised and mitigated to ensure that sufficient surface water flow continues to enter this pool to maintain ecological function. This is discussed in more detail in the Inland Waters Chapter (Section 7).

Despite the survey effort within the Revised Development Envelope, only one direct observation and one scat have been recorded, indicating a small resident population. As such, interactions with this species are likely to be infrequent.

Given the proposed management measures and the species' high mobility, no significant impacts on Pilbara Olive Python are expected to occur from increased light, dust, noise, and vibration disturbance as a result of this Proposal.

Feral Cats can potentially impact the local Pilbara Olive Python population through predation on juveniles and act as a competitor for resources. In addition, the introduction or spread of weed species can degrade Pilbara Olive Python habitat. However, indirect impacts associated with habitat degradation are not expected to be significant, given that the Proponent will undertake weed and feral fauna monitoring and control as outlined in the EMP.

An assessment of the Proposal on Pilbara Olive Python against the Significant Impact Guidelines is provided in Section 13 (DoE 2013).

9.6.4.5. Pilbara Barking Gecko

The Proposal will clear up to 3,857 ha (30%) of suitable habitat for this species which includes 126 ha (20%) of Gorge/Gully habitat and up to 3,731 ha (31%) of Hillcrest/Hillslope habitat. The remaining habitat throughout the Revised Development Envelope will continue to provide habitat connectivity.

The species has been recorded twice within the Revised Development Envelope. One record from Deposit H and one approximately 2 km southwest of Deposit H. Given the low number of records and the amount of suitable connected habitat that will remain throughout the Revised Development Envelope, the Proposal is not expected to adversely affect the regional population or the conservation status of the species.

9.6.4.6. Western Pebble-mound Mouse

The Proposal will clear approximately 5,518 ha (23%) of suitable habitat for this species which includes up to 3,731 ha (31%) of Hillcrest/Hillslope habitat and approximately 1,787 ha (15%) of Foothills and Plain habitat. The remaining habitat throughout the Revised Development Envelope will continue to provide habitat connectivity for the species.

The species has been recorded from all four deposits, inside and outside of the Conceptual Footprint, and is distributed widely throughout the Revised Development Envelope and surrounding areas. Given its widespread occurrence and the extent of suitable habitat remaining throughout the Revised Development Envelope, the Proposal is not expected to adversely affect the regional population or the conservation status of the species.

The Western Pebble-mound Mouse is of cultural significance to specifically the Yinhawangka People. A summary of management targets, actions and monitoring can be found in the relevant SCHMP.

9.6.4.7. Fork-tailed Swift

As an exclusively aerial forager within Australia, the Fork-tailed Swift is not dependent on any one habitat type within the Revised Development Envelope. As such, the Proposal is unlikely to cause substantial loss or modification to important habitat for the species. The Proposal will not result in a significant residual impact to the Fork-tailed Swift.

9.6.4.8. Significant Species to Traditional Owner Groups

In consultation to date, Traditional Owners have referred to many fauna species found within or surrounding the Revised Development Envelope, such as kangaroos, native bees, fish, freshwater turtles, and the EPBC Act listed species Ghost Bat and DBCA Priority 4, Pebble Mouse indicating these all have cultural importance.

In addition to direct impacts, the Proposal has the potential to disturb animals through blast vibrations, light and noise from operations. Caves and rock shelters have the highest potential to be indirectly disturbed by mining due to their position in the landscape and restricted size. Vibrations from blasting can impact their structural integrity. Caves and rock shelters can contain and protect significant cultural and heritage values or hold those values as cultural sites themselves, providing important habitats for significant fauna species such as Ghost Bats. Blast Management Plans will be implemented for all roost caves identified as being at risk from blasting impacts (vibration and fly rock).

9.6.4.9. Significant Species Likely to Occur

Significant species that have not been recorded within the Revised Development Envelope (and are not assessed above) but are likely to occur have been assessed (Table 9-26), with no significant residual impacts likely to occur in addition to those already identified.

Table 9-26: Assessment and Significance of Impacts to Significant Species Likely to Occur

Species	Suitable Habitat within the Revised Development Envelope	Indicative Impact to Habitat within Revised Development Envelope from the Proposal (ha, (%))	Assessment and Significance of Residual Impact
Grey Falcon	<ul style="list-style-type: none"> • Drainage Line • Foothills and Plains • Mixed Acacia Woodland 	2,240 (14)	<p>The Proposal Area and Revised Development Envelope contains suitable supporting habitat, however despite extensive survey efforts, the Grey Falcon was not recorded within the Revised Development Envelope. The nearest record of this species is 10 km north of Deposit H (Biologic 2021c)</p> <p>The species may utilise nests constructed by other birds in large trees and forage in Foothills and Plains, Drainage Line and Mixed Acacia Woodland habitat types. However, suitable supporting habitat for the species is not restricted to the Revised Development Envelope and the species would not be solely reliant on habitat within the Revised Development Envelope's.</p> <p>Given the species has not been recorded, has a transient and nomadic nature and the extent of suitable habitat that will remain throughout and beyond the Revised Development Envelope, the Proposal is not likely to adversely affect the regional population or the conservation status of the species and following implementation of the mitigation hierarchy, no significant residual impact to this species is expected.</p>
Short-tailed Mouse	<ul style="list-style-type: none"> • Drainage Line • Foothills and Plains • Mixed Acacia Woodland • Cracking Clay 	2,241 (14)	<p>There is suitable habitat for the species in the Proposal Area and Revised Development Envelope, however despite survey effort, the Short-tailed Mouse has not been recorded within the Revised Development Envelope.</p> <p>Given that the species has not been recorded despite extensive survey efforts and the extent of suitable habitat that will remain throughout and beyond the Revised Development Envelope, the Proposal is not expected to adversely affect the regional population or the conservation status of the species and following implementation of the mitigation hierarchy, no significant residual impact to this species is expected.</p>

Species	Suitable Habitat within the Revised Development Envelope	Indicative Impact to Habitat within Revised Development Envelope from the Proposal (ha, (%))	Assessment and Significance of Residual Impact
Brush-tailed Mulgara	<ul style="list-style-type: none"> • Mixed Acacia Woodland • Footslopes and Plain 	2,161 (14)	<p>Suitable habitat for the species is present within the Proposal Area and Revised Development Envelope, however despite survey effort, the Brush-tailed Mulgara has not been recorded within the Revised Development Envelope.</p> <p>Given that the species has not been recorded despite extensive survey efforts and the extent of suitable habitat that will remain throughout and beyond the Revised Development Envelope, the Proposal is not expected to adversely affect the regional population or the conservation status of the species and following implementation of the mitigation hierarchy, no significant residual impact to this species is expected.</p>
Pilbara Flat-headed Blind-snake	<ul style="list-style-type: none"> • Gorge/Gully • Drainage Line 	205 (20)	<p>The Pilbara Flat-headed Blind-snake has not been recorded within the Revised Development Envelope. However, it has been recorded approximately 2.3 km to the south of the Revised Development Envelope. Suitable habitat is present within the Proposal Area and Revised Development Envelope.</p> <p>Given the retention of suitable habitat for this species within the Revised Development Envelope, the Proposal is not expected to adversely affect the regional population or the conservation status of the species.</p>
Peregrine Falcon	<ul style="list-style-type: none"> • Hillcrest/Hillslope • Drainage Line • Mixed Acacia Woodland • Footslopes and Plain 	5,971 (21)	<p>The Peregrine Falcon has not been recorded within the Revised Development Envelope. The nearest record is 13 km northwest of Western Hill (Biologic 2021c).</p> <p>Suitable habitat for this species exists within the Proposal Area and Revised Development Envelope. However, this species is found in most habitats (from rainforests to arid zones). It prefers to nest within cliff faces and tree hollows near watercourses (Australian Museum 2022); therefore, it is unlikely to be reliant on or restricted to the Proposal Area or Revised Development Envelope for nesting and following implementation of the mitigation hierarchy, no significant residual impact to this species is expected.</p> <p>On this basis, the Proposal is not expected to adversely affect the regional population or the conservation status of the species and following implementation of the mitigation hierarchy, no significant residual impact to this species is expected.</p>

9.6.5. Significance of Residual Impacts

9.6.5.1. Non-Significant Residual Impacts

Indirect Impacts

- Degradation/alteration of habitat as a result of altered hydrological regimes (Section 9.6.2.1)
- Habitat degradation associated with construction and operational activities (Section 9.6.2.3)
- Disturbance from light, noise and/or vibration, and possible displacement of fauna associated with construction activity and mining operations (Section 9.6.2.4).

Cumulative Impacts

- Cumulative loss of vegetation and fauna habitat (Section 9.6.3).

9.6.5.2. Significant Residual Impacts

After application of mitigation measures, the following significant residual impacts are predicted for Terrestrial Fauna:

- Clearing up to 126 ha (~20%) of Gorge/Gully (High significance) habitat, which represents potential critical habitat for the following significant fauna species; Northern Quoll, Ghost Bat and Pilbara Olive Python. This clearing is proposed to be managed via upper limits of clearing as per Table 9-15 and will be offset as per Section 12
- Clearing up to 3,731 ha (~31%) of Hillcrest/Hillslope (High significance) habitats, representing potential critical habitat for Ghost Bats and supporting habitat for Northern Quoll and Pilbara Olive Python (within 1 km of records). This clearing is proposed to be managed via upper limits of clearing as per Table 9-15 and will be offset as per Section 12
- Clearing approximately 2,242 ha (~14%) of the remaining fauna habitat types, Cracking Clay, Drainage Line, Footslopes and Plain and Mixed Acacia Woodland (Moderate significance) which provides supporting habitat for the Ghost Bat (within 12 km of critical habitat). This clearing is proposed to be offset, as per Section 12.

9.6.6. Summary of Residual Impacts and Proposed Regulatory Mechanisms

Table 9-27 details the residual impact, assessment findings, and recommended conditions.

Table 9-27: Assessment Findings and Proposed Regulatory Mechanisms for Terrestrial Fauna

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
Direct Impacts		
Clearing of high significance fauna habitat	<p>The clearing associated with the Proposal will impact up to 3,857 ha (30%) of high significance fauna habitat (Gorge/Gully and Hillcrest/Hillslope) within the Revised Development Envelope.</p> <p>Clearing within these habitats will be restricted by upper clearing limits:</p>	<p>Proposed to be regulated through:</p> <ul style="list-style-type: none"> • Ministerial conditions/Decision Notice conditions limiting the extent of clearing of high significance fauna habitat • Offsets (Section 12)

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
	<ul style="list-style-type: none"> 126 ha (20%) Gorge/ Gully habitat in addition to the 2 ha currently approved under DN 2018/8299 3,731 ha (31%) Hillcrest/Hillslope in addition to the 484 ha currently approved under DN 2018/8299 <p>as outlined in Section 9.5</p>	
Impacts on fauna habitat features (caves and water features)	<p>The Proposal Area contains 21 potential bat caves and three known water features.</p> <p>The Proponent will impact four category 4 (non-critical) caves for Ghost Bat and Pilbara Leaf-nosed Bat.</p> <p>The Proponent will avoid all known category 2 and 3 Ghost Bat roosts, including one apartment block by implementing MEZs and/or MRZs around all known locations.</p> <p>The Proponent will reduce the catchment of one known surface water fed ephemeral pool (Deposit H Waterhole) but not the permanency of water within it.</p> <p>The Proponent will avoid the remaining two water features recorded in the Proposal Area but outside of the Conceptual Footprint.</p>	<p>Regulated by:</p> <ul style="list-style-type: none"> Ministerial condition and conditions of approval under the EPBC Act, limiting the extent of clearing of known bat caves within the Revised Development Envelope to four category 4 (non-critical) Ghost Bat and Pilbara Leaf-nosed Bat roosts Ministerial conditions and conditions of approval under the EPBC Act, on implementing MEZs and MRZs within the Revised Development Envelope Prepare and implement an EMP for the management of retained significant bat roosts
Impacts on significant fauna species	<p>Seven significant fauna species have been recorded within the Proposal Area with an additional five significant fauna species likely to occur within the Proposal Area.</p> <p>The Proponent has proposed mitigation measures (Table 9-23), including:</p> <ul style="list-style-type: none"> Design Proposal to avoid high significance MNES habitat Undertake progressive clearing to allow fauna to move away Vehicle traffic will be confined to defined roads and tracks Barbed wire fences will be avoided where practicable. If barbed wire fencing is required (due to legislative, safety or pastoral requirements), the top strand will be replaced with plain wire, and reflectors will be placed on the top wire to help prevent the entanglement of bats 	<p>Regulated by:</p> <ul style="list-style-type: none"> Prepare and implement an EMP for the management of significant fauna species
Impacts on potential SRE species	<p>38 potential SREs have been recorded within the Revised Development Envelope, of which 18 have only been recorded within the Revised Development Envelope and nine known only from within the Conceptual Footprint.</p>	<p>Proposed to be regulated through:</p> <ul style="list-style-type: none"> Ministerial conditions limiting the extent of disturbance to high significance fauna habitat

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
	<p>Thirteen of these species are considered at low risk to impacts of the Proposal, and five have a medium risk.</p> <p>The Proponent has proposed specific mitigation measures (Table 9-23), which are expected to ensure the EPA's objective for fauna is achieved.</p>	
Indirect Impacts		
Risk of dust deposition	The Proponent has proposed mitigation measures (Table 9-23), which are expected to ensure the EPA's objective for fauna is achieved.	Standard management. No specific regulation required
Risk of increase of feral animals	The Proponent has proposed mitigation measures (Table 9-23), which are expected to ensure the EPA's objective for fauna is achieved.	Regulated by: <ul style="list-style-type: none"> • Prepare and implement an EMP which includes the management of feral animals
Risk of habitat degradation from alterations to hydrological regimes	The Proponent has proposed mitigation measures (see Section 9), which are expected to ensure the EPA's objective for fauna is achieved.	Regulated by: <ul style="list-style-type: none"> • Prepare and implement an EMP which includes the management of hydrological regimes
Risk of increased disturbance from light, noise and vibration	The Proponent has proposed mitigation measures (Table 9-23), which are expected to ensure the EPA's objective for fauna is achieved.	Regulated by: <ul style="list-style-type: none"> • Prepare and implement an EMP which includes the management of vibration levels at significant bat roosts including maintaining the structural integrity and microclimate of Ghost Bat Caves within the MEZ's

No effect on the conservation status of significant fauna species recorded or considered likely to occur within the Revised Development Envelope.

9.7. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

9.7.1. Proposal

In consideration of the proposed avoidance and management measures and the likely residual impacts associated with the **Proposal**, the anticipated environmental outcomes that apply to Terrestrial Fauna with respect to this **Proposal** are set out below:

- Clearing from the **Proposal** will not exceed:
 - Up to four category 4 Ghost Bat and Pilbara Leaf-nosed Bat potential roosts
 - 126 ha of Gorge/Gully habitat within the Revised Development Envelope

- 3,731 ha of Hillcrest/Hillslope habitat within the Revised Development Envelope
- 2 ha of Cracking Clay habitat within the Revised Development Envelope
- No direct disturbance to Ghost Bat roosts retained within MEZs and MRZs (category 2 and 3) and MRZs only (category 4), caves CWAN-01, 02, 03, 04, 06, 07, 08, 11, 27, 28, 29, 30, 31, 32, 34 and CDHI-001 and 002 (Table 9-22)
- No direct or indirect impacts to the structural integrity and microclimate of Ghost Bat caves retained in the Proposal Area as a result of the Proposal
- No direct impacts to the three surface water fed ephemeral pools within Proposal Area (WB-WAH1, WB-WAJ1 and WB-WAJ2).

9.7.2. Revised Proposal

The anticipated environmental outcomes that apply to Terrestrial Fauna with respect to the **Revised Proposal** are set out below:

- Clearing from the **Revised Proposal** will not exceed:
 - Up to four category 4 Ghost Bat and Pilbara Leaf-nosed Bat potential roosts
 - 128 ha of Gorge/Gully habitat within the Revised Development Envelope
 - 4,215 ha of Hillcrest/Hillslope habitat within the Revised Development Envelope
 - 22 ha of Cracking Clay habitat within the Revised Development Envelope
- No direct disturbance to Ghost Bat roosts retained within MEZs and MRZs (category 2 and 3) and MRZs only (category 4), caves CWAN-01, 02, 03, 04, 06, 07, 08, 11, 27, 28, 29, 30, 31, 32, 34 and CDHI-001 and 002 (Table 9-22) and no direct or indirect impacts to the structural integrity and microclimate of these caves
- No clearing within the Ghost Bat Cave AA1, WA-13, WA-21 and WA-23 CMAR-01, CMAR-02, CMAR-03 and CMAR-04 Exclusion Zones (Table 9-22)
- Minimise disturbance due to the Revised Proposal 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 clearing of water features WB-WAH1, WB-WAJ1, WB-WAJ2, WMAR-01 and WMAR-03
- Minimise direct and indirect impacts on significant species' habitat in accordance with the EMP.

The Proponent will implement the EMP as per Appendix A.8 to achieve these outcomes.

9.7.3. Summary

Subject to the conditions recommended in Table 9-27 and the implementation of offsets (Section 12) combined with regulation through other DMA processes, the Proponent considers that the Proposal can meet the EPA's objective to protect Terrestrial Fauna so that biological diversity and ecological diversity integrity are maintained.

10. SUBTERRANEAN FAUNA

10.1. EPA Environmental Factor and Objective

The EPA’s overarching Statement of Environmental Principles, Factors and Objectives (EPA 2021c) lists the following as their objective for subterranean fauna.

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

Subterranean fauna are animals that live underground in habitats such as caves, cavities, and aquifers. They are divided into two groups:

- Troglifauna: air-breathing animals that inhabit caves, fissures, and smaller voids AWT
- Stygofauna: aquatic animals that inhabit waterbodies in caves, aquifers, and interstitial voids BWT (i.e. occur within groundwater).

Stygofauna and troglifauna can be classified into ecological categories (stygoxenes/ stygophiles/ stygobites, and troglaxenes/ trogliphiles/ troglobites) according to the degree of adaptation to subterranean environments. Stygoxenes and troglaxenes live underground periodically or for part of their lifecycles, and stygophiles and trogliphiles may inhabit both surface and subterranean habitats. Obligate subterranean fauna (stygobites and troglobites) are true subterranean fauna and have adapted to subterranean conditions such that they cannot occur on the surface. Obligate subterranean fauna are therefore restricted to, and dependent upon, subterranean habitats. Stygobites and troglobites are considered to have an increased likelihood of SRE, are sensitive to environmental change, and vulnerable to impacts from human activities that affect their habitats (EPA 2021k).

10.2. Relevant Policy and Guidance

Subterranean fauna are protected under the following State and Commonwealth legislation:

- EPBC Act (Cth)
- EP Act (WA)
- Biodiversity Conservation Act 2016 (WA).

The relevant Policy and Guidance for Subterranean Fauna are described in Table 10-1.

Table 10-1: Relevant Policy and Guidance for Subterranean Fauna

Policy or Guidance	Explain how the Policy and Guidance has been Considered
Environmental Protection Authority	
Instructions on how to prepare an Environmental Review Document (EPA 2021b)	This document forms the basis of the headings and content provided in this ERD chapter.
EPA Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The objective for Subterranean Fauna forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
EPA Environmental Factor Guideline – Subterranean Fauna (EPA 2016f)	The information required for an impact assessment has been considered in this section.
Technical Guidance – Sampling methods for subterranean fauna – updated 2021 (EPA 2016g)	Considered in the design (methods and approach) of the subterranean fauna surveys.

Policy or Guidance	Explain how the Policy and Guidance has been Considered
Technical Guidance – Subterranean fauna surveys for Environmental Impact Assessment (EPA 2021k)	

10.2.1. Conservation Status and Short-Range Endemic (SRE) Classification

Few subterranean species and assemblages from the Pilbara region are formally listed under the EPBC Act or the BC Act as threatened species, or as TEC or PEC. This is due to gaps in survey effort and low taxonomic certainty for the majority of subterranean fauna recorded. As such, many potentially SRE species do not appear on conservation lists but nevertheless should be treated as potentially having some significance following the precautionary principle.

As such, it is appropriate to give regard to the WAM categorisation for SRE invertebrates. This system is based upon the 10,000 km² range criterion proposed by Harvey (2002). It uses three broad categories to deal with varying levels of taxonomic uncertainty that may apply to any given taxon (refer to Table 9-12). However, the lack of knowledge of species distribution ranges for subterranean fauna has resulted in the majority of morphospecies invariably falling within one (or several) of the three Potential SRE sub-categories: Confirmed SRE, Potential SRE or Widespread.

10.3. Receiving Environment

The Proposal is located in the Pilbara region, a globally recognised ‘hot-spot’ for subterranean fauna biodiversity and endemism (EPA 2016f). As such, subterranean fauna has been identified as a key environmental factor to be assessed for this Proposal. For the purposes of this assessment, the Revised Development Envelope has been conceptually divided into four sections (Figure 10-1) as follows:

- Western Hill (includes Western Hill Orebody Aquifer when discussing stygofauna)
- Deposit H
- Deposit F-North
- Mt Ella East.

These sections cover the area surrounding the proposed new deposits where Proposal activities may potentially impact subterranean fauna. An additional area, the Regional Synclinal Aquifer (Figure 10-1) has also been considered during this assessment. This aquifer surrounds the Western Hill Ore Body Aquifer and is relevant for the assessment of combined impacts of the Approval Proposal and this Proposal (refer to Assessment of Combined Impacts 10.6.2.3). Deposit J reference area (Figure 10-1) represents a sampling area for the baseline survey (Biologic 2022a) which will not be subject to any direct impacts from the Proposal.

The current and proposed site layout is shown in Figure 10-1. Existing Operations comprise AWT and BWT mining as well as associated infrastructure, waste landforms, tailings, and stockpiles. Groundwater extraction supporting current operations (14GL/a) operates under Licence GWL98740 (10) under the RiWI Act and is managed via the West Angelas Groundwater Operating Strategy (GWOS) (Rio Tinto 2019).

A MAR strategy was approved under MS 1113 and Decision Notice 2018/8299 in the synclinal valley west of Deposits D and C. The MAR strategy will be implemented to maintain groundwater levels at the western boundary of the Revised Development Envelope during current mining operations, thereby supporting groundwater environmental values within Karijini National Park to the west.

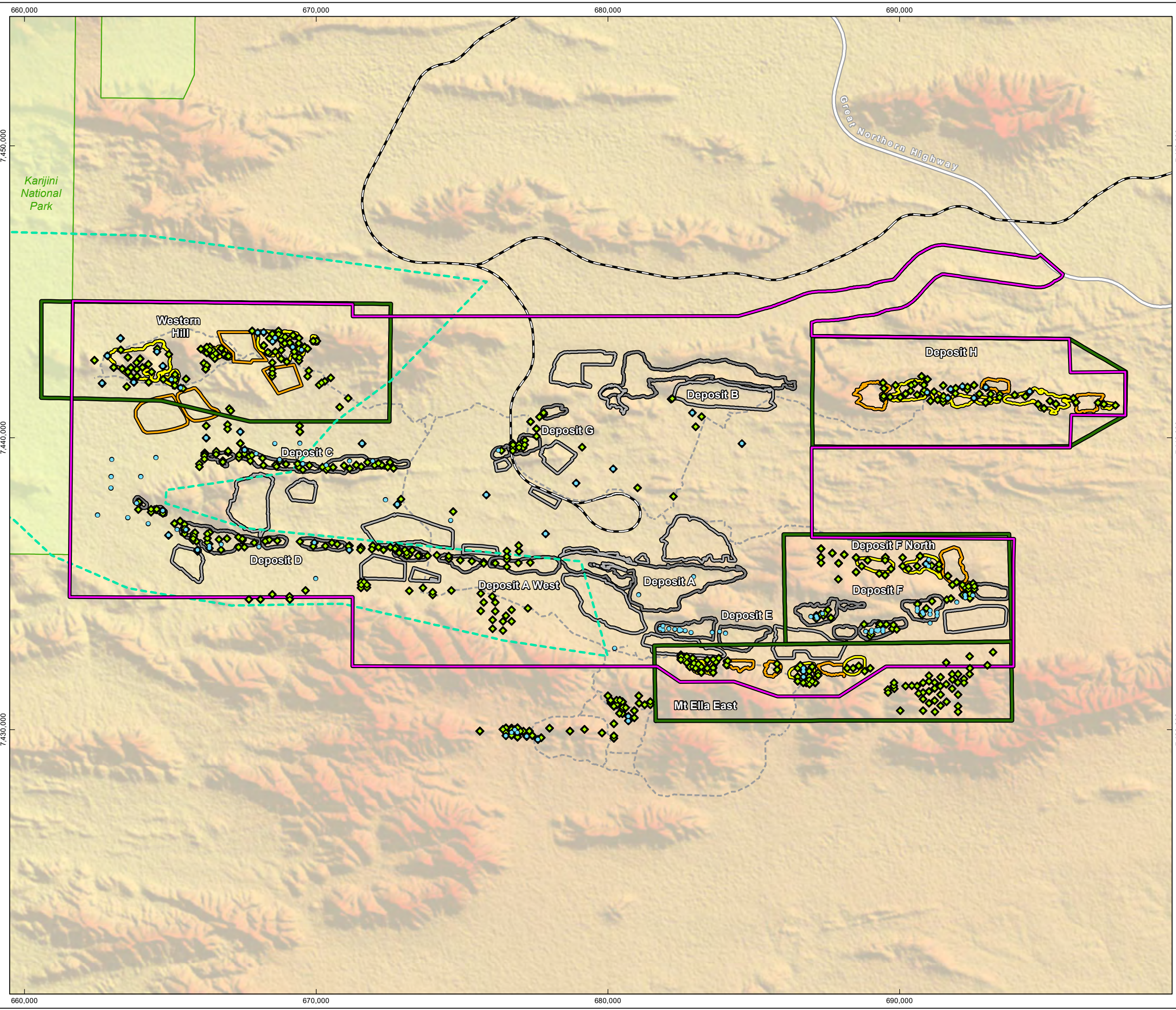
10.3.1. Studies and Survey Effort

Sixteen subterranean fauna surveys have been undertaken across the West Angelas Region from 1998 to 2020, summarised in Table 10-2. In addition, a 3D habitat assessment and modelling report for the

West Angelas Region was developed in 2021/2022. The surveys utilised standard methodologies as per contemporary EPA guidance, such as net hauling for stygofauna, litter trapping and scraping for troglofauna, as shown in Table 10-2. Historical surveys reflected historical survey practices, aligning with contemporary guidance at the time of survey (with some of the earlier surveys pre-dating EPA consideration of subterranean fauna from 2003). Accordingly, some of the historical survey data was limited in respect to sampling effort, taxonomic resolution, and the ability to compare fauna results against more recent survey data (Biologic 2022m). Nevertheless, the majority of records throughout the Revised Development Envelope and surrounds resulted from more recent surveys (2018 onwards) that met or exceeded contemporary EPA guidance (*i.e.* EPA 2016f EPA 2021k) (Biologic 2022m).

Figure 10-1
Subterranean Fauna
Sampling in the West
Angelas Region

Drawn: M.L.
Plan: RTIO-0962580v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Regional Synclinal Aquifer Habitat Modelling Boundary
- ERD Section Boundary

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

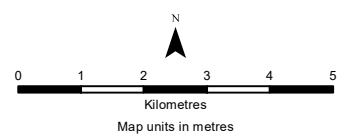
- Pit
- Waste Landform

Subterranean Fauna Sampling To

- Stygofauna
- Troglifauna

Other Features

- National Park
- Rio Tinto Railway
- Highway
- Main Access



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Table 10-2: Summary of Technical Studies for Previous Subterranean Fauna Reports within and Immediately Surrounding the Revised Development Envelope

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
Subterranean Fauna Surveys			
<p>West Angelas: 3D Subterranean Habitat Modelling and Assessment (Biologic 2022k; Appendix F.1:)</p>	<p>Study Area: West Angelas Region</p> <p>Type: Desktop assessment and integration of:</p> <ul style="list-style-type: none"> • 2D surface geology • 3D habitat modelling from drill hole information AWT and BWT. <p>Timing: 2021 to 2022</p>	<p>3D modelling throughout the Study Area showed that the West Angelas Region contains extensive and highly suitable habitats AWT and BWT.</p> <p>Modelling of proposed and combined impacts on subterranean fauna habitats within the Study Area assessed changes to habitat volume, extent, thickness, and connectivity before and after impacts.</p>	<p>This assessment has been undertaken in consideration of the following EPA guidance documents:</p> <ul style="list-style-type: none"> • Technical Guidance – Subterranean Fauna Surveys for Environmental Impact Assessment (EPA (2021k) • Environmental Factor Guideline Subterranean Fauna (EPA 2016f) • Statement of Environmental Principles, Factors, Objectives and Aims of EIA (EPA 2021c). <p>The method used provides the finest resolution of subterranean fauna habitat modelling currently known in the industry and is consistent with the EPAs objective for this factor.</p> <p>In addition, the modelling has also used the same basic methodology to subterranean fauna habitat characterisation as that utilised for the Greater Paraburdoo Iron Ore Hub Proposal (Assessment Number: 2189) which was peer reviewed by both a biological and hydrogeological expert and presented to the EPA. The 3D habitat model created for this Proposal has been further developed and refined considering the feedback from the previous peer review as well as advances in modelling technology/software capacity. The model has also been customised taking into consideration site specific geological, hydrogeological and water related conditions as would be expected and required for differing sites to ensure the model is site specific and accurately reflects the environment of the Proposal. As such, this work is consistent with the EPA’s objective for this factor.</p>

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
<p>West Angelas: Subterranean fauna survey (Biologic 2022l; Appendix F.2)</p> <p>IBSA-2023-0253</p>	<p>Study Area: Dep H, J, F North, Western Hill & Mt Ella East</p> <p>Type: Two season Level 2 Subterranean Fauna Survey: Stygofauna & Troglifauna – trapping, net hauling, scrapes – 331 bores (278 successfully sampled)</p> <p>Timing:</p> <ul style="list-style-type: none"> • 6 to 14 September 2018 • 4 to 9 November 2018 • 11 to 18 March 2019 • 29 March to 10 May 2019 • 4 to 12 March 2020 • 24 – 30 June 2020 • 30 July to 7 August 2020 • 30 September to 7 October 2020 	<p>Survey detected 59 unique troglifauna taxa (plus 18 indeterminate taxa) and 20 unique stygofauna taxa (plus six indeterminate taxa).</p> <p>Prospective troglifauna habitats sampled included Brockman and Marra Mamba Iron Formations, and detritals.</p> <p>Prospective stygofauna habitat included the orebody aquifers (Brockman and Marra Mamba Iron Formations), synclinal valley aquifers (detritals, calcrete, and Wittenoorm Formations), and central anticline aquifers (detritals above Jeerinah Formation).</p>	<p>Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • Environmental Factor Guideline: Subterranean Fauna (EPA 2016f) • Technical Guidance: Sampling methods for subterranean fauna (EPA 2021k)
<p>West Angelas Revised Proposal: Environmental Impact Assessment of Subterranean Fauna (Biologic 2022m; Appendix F.3)</p>	<p>Survey Area: Revised Development Envelope</p> <p>Type: Desktop - EIA</p> <p>Timing: December 2022</p>		<p>This assessment has been undertaken in consideration of the following EPA guidance documents:</p> <ul style="list-style-type: none"> • Technical Guidance – Subterranean Fauna Surveys for Environmental Impact Assessment (EPA (2021k) • Environmental Factor Guideline Subterranean Fauna (EPA 2016f) <p>Statement of Environmental Principles, Factors, Objectives and Aims of EIA (EPA 2021c).</p>

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
<p>West Angelas Deposit F Stygofauna Monitoring 2016 (Biologic 2016a)</p>	<p>Study Area: Dep. F Type: Stygofauna - net hauling – 28 bores (9 intercepting groundwater) Timing: 2016</p>	<p>One amphibious worm (Enchytraeidae) detected, known to inhabit both groundwater and subterranean water films above the water table.</p> <p>Deposit F aquifers assessed as low suitability for stygofauna: a series of closed systems with low permeability, potential for low nutrient and oxygen input from surface.</p> <p>Troglofauna bycatch from net hauls included arachnids (Palpigradi), centipedes (Cryptopidae), and symphylans (Scutigereidae).</p>	<p>Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • EPA Guidance Statement No. 54 (EPA 2003) • EPA Guidance Statement No. 54a (EPA 2007b)
<p>West Angelas Deposits C, D & G Subterranean Fauna Survey 2016 (Biologic 2016b)</p>	<p>Study Area: Dep. C, D, G Type: Stygofauna & Troglofauna – 92 bores sampled over two field trips; 43 troglofauna traps, 71 troglofauna scrapes, 29 stygofauna net hauls Timing: 15 to 23 March 2016 and 10 to 12 May 2016</p>	<p>Survey detected 28 morphospecies of troglofauna and stygofauna from 22 bores and holes, comprising: worms (Haplotaxida, Polychaeta, Oligochaeta, Turbellaria), crustaceans (Amphipoda, Syncarida/ Bathynellacea, Cyclopoida, Harpacticoida, Ostracoda, Isopoda), arachnids (Araneae, Pseudoscorpiones, Schizomida), hexapods (Diplura, Hemiptera, Thysanura/ Zygentoma, Collembola) and myriapods (Symphyla).</p> <p>Troglofauna habitat was primarily identified within pisolite/ calcrete, the mineralised orebody, and the Marra Mamba Formation.</p> <p>Primary stygofauna habitats included the Jeerinah Formation, orebody aquifers, and detrital aquifers in the flanking valleys.</p>	<p>Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • EPA Guidance Statement No. 54 (EPA 2003) • EPA Guidance Statement No. 54a (EPA 2007b)

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
<p>West Angelas Subterranean Fauna Assessment - Report Excerpt (Eco Logical 2015)</p>	<p>Study Area: Dep. A West, Dep. F</p> <p>Type: Desktop report prepared as an excerpt from the Greater West Angelas Subterranean Fauna Assessment (Ecologia 2013b)</p> <p>Timing: n/a</p>	<p>Desktop review concluded that no species listed under the EPBC Act, WC Act or Threatened or Priority lists were known to occur.</p> <p>One taxon identified as troglobitic Embioptera sp. indet has SRE potential and represented the first record for the Greater West Angelas area.</p> <p>Although survey was completed in accordance with relevant Guidance, there were limitations of sampling adequacy, water quality sampling, timing (seasonality), and taxonomic resolution (to species level). Some drilling and earthworks activities were inferred to potentially affect troglofauna capture rates.</p>	<p>Desktop review meets relevant EPA Act policy and guidance. Desktop review approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • EPA Guidance Statement No. 54 (EPA 2003) • EPA Guidance Statement No. 54a (EPA 2007b)
<p>West Angelas Deposit B Stygofauna Assessment (Ecologia 2015)</p>	<p>Study Area: Dep. B</p> <p>Type: Single phase stygofauna assessment– net hauling – 8 bores (7 successfully sampled in the Central Water bores area to the south of Deposit B)</p> <p>Timing: 6 to 8 October 2015</p>	<p>No stygofauna were recorded during the survey.</p> <p>Drill holes at Deposit B failed to record stygofauna - as shown in previous assessments. Assessed as potentially unsuitable geological habitat.</p> <p>A difference in groundwater depth was observed between previous assessments and current assessment, potentially suggesting an isolated aquifer at Deposit B. Further studies recommended to understand potential risks of groundwater drawdown at Deposit B to stygofauna values recorded in other areas.</p>	<p>Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • EPA Guidance Statement No. 54 (EPA 2003) • EPA Guidance Statement No. 54a (EPA 2007b)

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
<p>Rio Tinto Iron Ore Regional Troglifauna Sampling (Biota 2013)</p> <p>Rio Tinto Regional Troglobitic Fauna Study Integration Report (Biota 2014)</p>	<p>Study Area: Dep. Western Hill and, Mt Ella East</p> <p>Type: Troglifauna – trapping and scraping - 25 bores at Western Hill Deposit and 28 bores at Mt Ella East</p> <p>Timing: 28 January to 13 October 2010</p>	<p>The survey for Western Hill deposit and Mt Ella East recorded a total of seven troglifauna taxa comprising of Araneae, Pseudoscorpiones, Isopoda, Geophilida, Polyxenida, Diplura and Thysanura/ Zygentoma taxa.</p> <p>Major habitats at West Angelas were assessed as Brockman ore type, alluvium/colluvium, and calcrete.</p> <p>No stygofauna bycatch was reported.</p>	<p>Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • EPA Guidance Statement No. 54 (EPA 2003) • EPA Guidance Statement No. 54a (EPA 2007b)
<p>Greater West Angelas Subterranean Fauna Assessment (Ecologia 2013b)</p>	<p>Study Area: Dep. C, D, G, F, H</p> <p>Type: Single phase subterranean fauna survey (troglifauna and stygofauna)</p> <p>Stygofauna (4 accessible bores in Deposit F) & Troglifauna – net hauling, scraping, trapping - 91 bores (38 successfully sampled for troglifauna and 4 successfully sampled for stygofauna)</p> <p>Timing: 9 July to 5 October 2012</p>	<p>Ten troglobitic species were recorded from the following orders: Thysanura/ Zygentoma (silverfish), Psocoptera (booklice), Hemiptera (true bugs), Embioptera (web spinners), Blattodea (cockroaches), Coleoptera (beetles), Araneae (spiders), Isopoda (slaters) and Chilopoda (centipedes).</p> <p>No stygofauna was recorded; however stygofauna sampling was limited to 4 bores at Deposit F.</p>	<p>Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • EPA Guidance Statement No. 54 (EPA 2003) • EPA Guidance Statement No. 54a (EPA 2007b)

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
West Angelas Stygofauna Survey 2012 (Biota 2012)	<p>Study Area: Dep. A, TCBF</p> <p>Type: Stygofauna – net hauling – 12 bores (12 bores successfully sampled)</p> <p>Timing: 9 to 11 July 2012</p>	<p>No stygofauna were recorded from Deposit A confined aquifer nor from the Turee Creek Borefield.</p> <p>Depauperate stygofauna from Deposit A aquifer is consistent with previous surveys.</p> <p>The lack of stygofauna recorded from Turee Creek borefield during the survey is inconsistent with previous surveys that have recorded 30 stygofauna species across the borefield and Turee Creek could not be related to any plausible factors.</p>	<p>Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • MS 514 • Environmental Review and Management Programme (ERMP) for West Angelas • Groundwater Extraction Management Plan (GEMP) for West Angelas
West Angelas and Deposit A Stygofauna Survey (Biota 2008a)	<p>Study Area: Dep. A</p> <p>Type: Stygofauna – net hauling - 19 bores (13 successfully sampled)</p> <p>Timing: 4 to 6 March 2008</p>	<p>No stygofauna were recorded from any of the bores sampled during the survey</p> <p>No bycatch, including troglifauna were recorded during the survey.</p> <p>The lack of stygofauna was concluded to be due to confined and disconnected nature of the Deposit A aquifer.</p>	<p>Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • MS 514 (commitments 7, 10 and 11 in particular)
West Angelas Operations Stygofauna Requirements – Compliance Review (Biota 2008b)	<p>Study Area: West Angelas Operations</p> <p>Type: Desktop compliance review</p> <p>Timing: 2008</p>	<p>The review concluded that wording, scope, and timing of the then commitments require revision as they are in majority unachievable or lacking clarity and several existing commitments covered similar requirements. Further revision should be based on the then current regulatory standards as greater understanding of stygal systems have been achieved since start of commitments in 2000.</p>	<p>Review approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • MS 514 (commitments 7, 10 and 11 in particular)

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
West Angelas Stygofauna Monitoring Programme Report (Ecologia 2005)	<p>Study Area: Dep. A, B, CWB, TCBF</p> <p>Type: Stygofauna – net hauling – 16 bores (14 successfully sampled)</p> <p>Timing: 28 to 30 January 2005</p>	<p>Stygofauna (Amphipoda, Harpacticoida, and Cyclopoida) were recorded from six bores, five from the West Angelas Borefield and one from the Turee Creek Borefield.</p> <p>It was noted that some bores that previously yielded stygofauna may not have yielded any during this survey due to habitat patchiness or inconsistent sampling methodology.</p> <p>Bycatch included Oligochaeta, Turbellaria, Acari (terrestrial and aquatic), and Collembola (terrestrial). No troglofauna bycatch was recorded during the survey.</p>	<p>Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • GEMP for West Angelas (commitments 8, 11,12, 13 and 14)
West Angelas Expansion Deposits E and F Subterranean Fauna Survey (Biota 2004)	<p>Study area: Dep. E, F</p> <p>Type: Stygofauna – net hauling – 28 bores (20 successfully sampled)</p> <p>Timing: 5 December and 6 December 2003</p>	<p>No stygofauna were recorded from any of the bores sampled during the survey.</p> <p>No bycatch, including troglofauna, were recorded during the survey.</p> <p>Bores displayed high turbidity and geology of sampled bores/areas was not considered prospective for stygal fauna.</p>	<p>Survey meets relevant EPA Act policy and guidance. Survey approach and methodology undertaken with consideration of the following:</p> <ul style="list-style-type: none"> • EPA Guidance Statement No. 54 (EPA 2003)
West Angelas Stygofauna Survey (Biota 2003)	<p>Study area: Dep. A, B, CWB, TCBF</p> <p>Type: Stygofauna sampling – net hauling – 30 bores (24 successfully sampled)</p> <p>Timing: 28 November to 1 December 2002</p>	<p>Stygofauna (Amphipoda, Platyhelminthes, Copepoda, Oligochaeta, Thermosbaenacea) were recorded from six bores, in calcretes and fractured volcanics. The occurrence of stygofauna in fractured volcanics (mainly dolerites) was noted as relatively unusual.</p> <p>Bycatch included Oligochaeta, Platyhelminthes, no troglofauna. Identifications were limited to order/ family level, and no genetic work was undertaken.</p>	<p>Survey completion pre-dates EPA consideration of subterranean fauna.</p>

Studies/Survey/Prepared for	Study Area, Type, and Timing	Key Findings/Limitations	Consistency with Guidance
<p>West Angelas Iron Ore Project Stygofauna Assessment Survey (Ecologia 2002)</p>	<p>Study area: Existing Operations: Dep. A, B, CWB, TCBF</p> <p>Type: Stygofauna monitoring survey – net hauling – 20 bores (12 successfully sampled)</p> <p>Timing: 20 March to 22 March 2002</p>	<p>Stygofauna were recorded from five bores located in the Jeerinah Formation of the Existing Operations area (Amphipoda, Copepoda, Syncarida/ Bathynellacea, Isopoda), and from two bores in Turee Creek (Syncarida/ Bathynellacea, Acari, Amphipoda).</p> <p>It was concluded that stygofauna habitat included calcretes, unconsolidated material such as alluvium (especially coarse gravels).</p> <p>Bycatch included Turbellaria. No troglofauna bycatch was recorded during the survey.</p>	<p>Survey completion pre-dates EPA consideration of subterranean fauna.</p>
<p>West Angelas Iron Ore Project Stygofauna Assessment Survey (Ecologia 1998c)</p>	<p>Study area: Existing Operations: Dep. A, B, C, Central Water Bores (CWB), Turee Creek Borefield (TCBF)</p> <p>Type: Baseline stygofauna sampling – net hauling, baited traps – 44 bores</p> <p>Timing: October 1998</p>	<p>Stygofauna (Amphipoda, Copepoda, Syncarida/ Bathynellacea, Ostracoda) were recorded from six bores located in the Jeerinah Formation of the Existing Operations area and one pastoral bore.</p> <p>It was concluded that stygofauna were utilising fractures and weathered zones in pockets of dolerite.</p> <p>Bycatch included Oligochaeta and Turbellaria. No troglofauna bycatch was recorded during the survey.</p>	<p>Survey completion pre-dates EPA consideration of subterranean fauna.</p>

To date, 903 troglofauna samples and 141 stygofauna samples have been collected in the Revised Development Envelope and surrounds, with the four sections of the Revised Development Envelope (Western Hill and the synclinal aquifer, Deposit H, Deposit F North and Mt Ella East) contributing 712 troglofauna samples and 93 stygofauna samples to the total (Table 10-3). All other areas' as listed in Table 10-3 comprised existing operational areas outside of the sections and synclinal aquifer (Deposits A, B, E, F, G, and some of Deposit C), borefields (e.g. the central anticline area, Turee Creek Borefield) and reference areas (Deposit J reference area) (Figure 10-4).

Table 10-3: Subterranean Fauna Sampling Effort Throughout the West Angelas Region

Location Relative to Impacts	Western Hill Orebody	Western Hill Synclinal Aquifer	Deposit H	Deposit F North	Mt Ella East	All Other Areas	Total
Troglofauna							
Inside Proposed Pits	124	-	41	12	60	-	237
Inside Existing Pits	-	90	-	25	-	35	150
Outside Pits	59	95	40	69	97	156	516
Troglofauna Total	183	185	81	106	157	191	903
Stygofauna							
Inside Proposed Pits	10	-	3	3	4	-	20
Inside Existing Pits	-	12	-	18	-	19	49
Outside Pits	5	26	4	8	-	29	72
Stygofauna Total	15	38	7	29	4	48	141

Contemporary EPA (EPA 2021k) technical guidance for subterranean fauna notes the following considerations for sampling effort for detailed subterranean fauna surveys leading into EIA:

1. Scale of the impact.
2. Time since bore/ hole construction.
3. Number of phases/ repeated survey.
4. Number of sampling sites.
5. Seasonality (EPA 2021k).

Based on the above criteria, the sampling effort for troglofauna was considered adequate (Biologic 2022i). High spatial coverage across all prospective geological habitats was achieved, with a relatively even split of sampling sites located inside (387 samples) and outside (516 samples) of proposed and existing pits throughout the Revised Development Envelope. Sampled reference areas occurred within the immediate vicinity of the proposed pits, and within the same landforms and geological habitats that occurred in the local area (Figure 10-1 and Figure 10-3), and the sampling adequately covered areas inside and outside of impacts.

Table 10-2 shows that troglofauna sampling occurred over at least two to three phases at each section of the Revised Development Envelope between 2013 and 2018, with the majority of these surveys meeting the guidance requirements of the time. The most recent survey (Biologic 2022i) was the largest detailed survey undertaken throughout the Revised Development Envelope. No constraints in terms of seasonality, sampling after rainfall, or time since bore/ drill hole construction were noted from the survey effort. The overall sampling effort for troglofauna is considered to meet contemporary EPA guidance

(EPA 2021k) with respect to coverage of impact areas and prospective habitats, repeated phases, overall numbers of sites, and methodologies, noting existing limitations relating to a limited numbers of bores and drill holes intercepting groundwater at the time of survey in some of the Revised Development Envelope sections; and historical sampling had taxonomic limitations that prevented comparisons of results with more recent survey results. Overall, sampling was spread throughout each of the distinct hydrogeological settings in the Revised Development Envelope, with a higher number of sites sampled in areas where groundwater was closer to the surface and more accessible via bores and drill holes.

Low suitability BWT habitat with limited groundwater, deep beneath the surface, occurred at Mt Ella East, and Deposit F North (Biologic 2022m). As such, these Revised Development Envelope sections were not expected to support significant stygofauna values. The lower sampling effort at these areas reflected the limited numbers of bores intercepting groundwater, but nonetheless was adequate to confirm the low stygofauna habitat values and a lack of species values in these areas (Biologic 2022m). Sampling at Deposit H was similarly limited by the availability of bores and holes that intercepted groundwater at the time of the survey. Results revealed a depauperate stygofauna assemblage (comprising only oligochaete worms), despite a moderately large, porous/ weathered, 'basin-type' aquifer which would be considered potentially prospective for stygofauna. Biologic (2022m) concluded that, "while additional sampling at Deposit H may have increased confidence in the stygofauna results, even the current sampling would have been expected to reveal a richer stygofauna assemblage, if it occurred".

Western Hill and the regional synclinal aquifer had a higher sampling intensity and greater spatial coverage to appropriately cover the extensive and complex hydrogeological habitats that were present (which included weathered Wittenoom Dolomite, Turee Creek East calcrete, and extensive detrital habitats) (Figure 10-1 and Figure 10-5). Within the constraints of available drill holes, sampling sites were located throughout the extent of these aquifers within the Revised Development Envelope (Figure 10-1 and Figure 10-5). The western extent of the synclinal valley aquifer within Karijini National Park was unable to be sampled due to a lack of bores.

Overall, stygofauna sampling numbers were relatively equal inside and outside (69 and 72 samples respectively) of the existing and proposed pits, and throughout the wider extent of groundwater habitats relative to the potential drawdown impacts.

In addition to field sampling, a substantial taxonomic effort was undertaken combining morphological and genetic methods, including local and regional species comparisons. A high proportion of the taxa identified to species-level by morphology were confirmed by genetic analysis; 132 troglofauna sequences (representing approximately 62% of the total troglofauna records) and 32 stygofauna sequences (approximately 44% of the total stygofauna records) (Biologic 2022m). This work greatly expanded the understanding of local and regional species distributions from previous surveys within the Revised Development Envelope which undertook mainly morphological identifications (Biologic 2016a, 2016b, Biota 2013, 2014, and Ecologia 2013b).

10.3.2. Subterranean Fauna Habitat

10.3.2.1. 3D Habitat Modelling

To assess habitat values, Biologic (Biologic 2022k) was commissioned to undertake three-dimensional (3D) modelling of subterranean habitats, based on information from drill-hole logging data and bore logs, alongside diamond drill cores, hydrogeological information, geophysical information, and structural (i.e. faults, folds, fracture zones) information. The 3D modelling provides a step change in the density of data available to subterranean fauna habitat assessment, and increases the resulting confidence in predictions regarding:

- The extent, thickness, and connectivity of subterranean habitats
- The potential occurrence of species throughout habitats or landscapes
- Quantitative impacts assessment, across various potential impact scenarios
- The proportion and 3D extent of suitable habitat remaining intact after impacts.

Data from more than 28,350 drill holes and over 2.1 million metres of drilling was assessed throughout the Revised Development Envelope and West Angelas Region. Lithological data (combining the stratigraphic unit information and mineralisation/geomorphology characteristics) was compiled to determine unique codes denoting subterranean habitat suitability (High, Medium, Low, or Inferred). A simplified overview of the 3D habitat modelling process for subterranean fauna habitat values is provided in Figure 10-2 below.

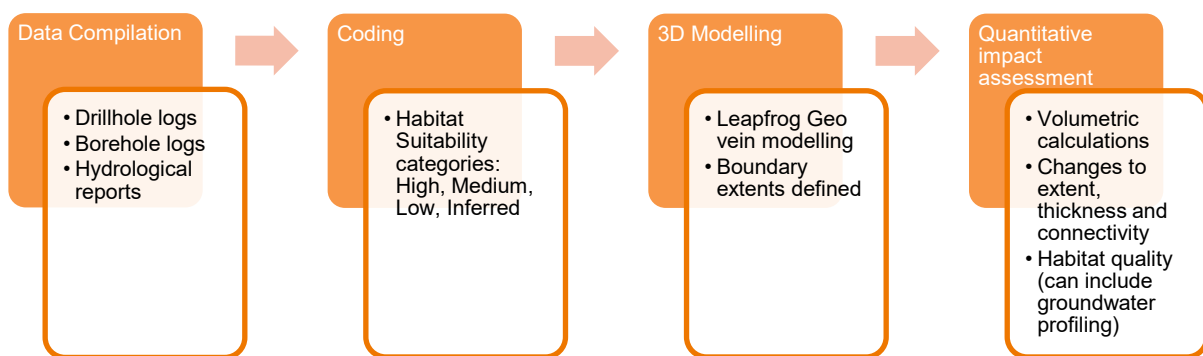


Figure 10-2: Flow Diagram of the 3D Habitat Modelling and Process

Two different types of modelling were used for subterranean fauna habitats and quantitative impact assessment, a 3D ‘vein’ model (AWT and BWT) and a stratigraphic model (BWT in the synclinal valley only). Both models were executed within specific lateral and vertical boundaries and constraints to ensure conservative estimation of habitat extent (Biologic 2022k; Appendix F.1).

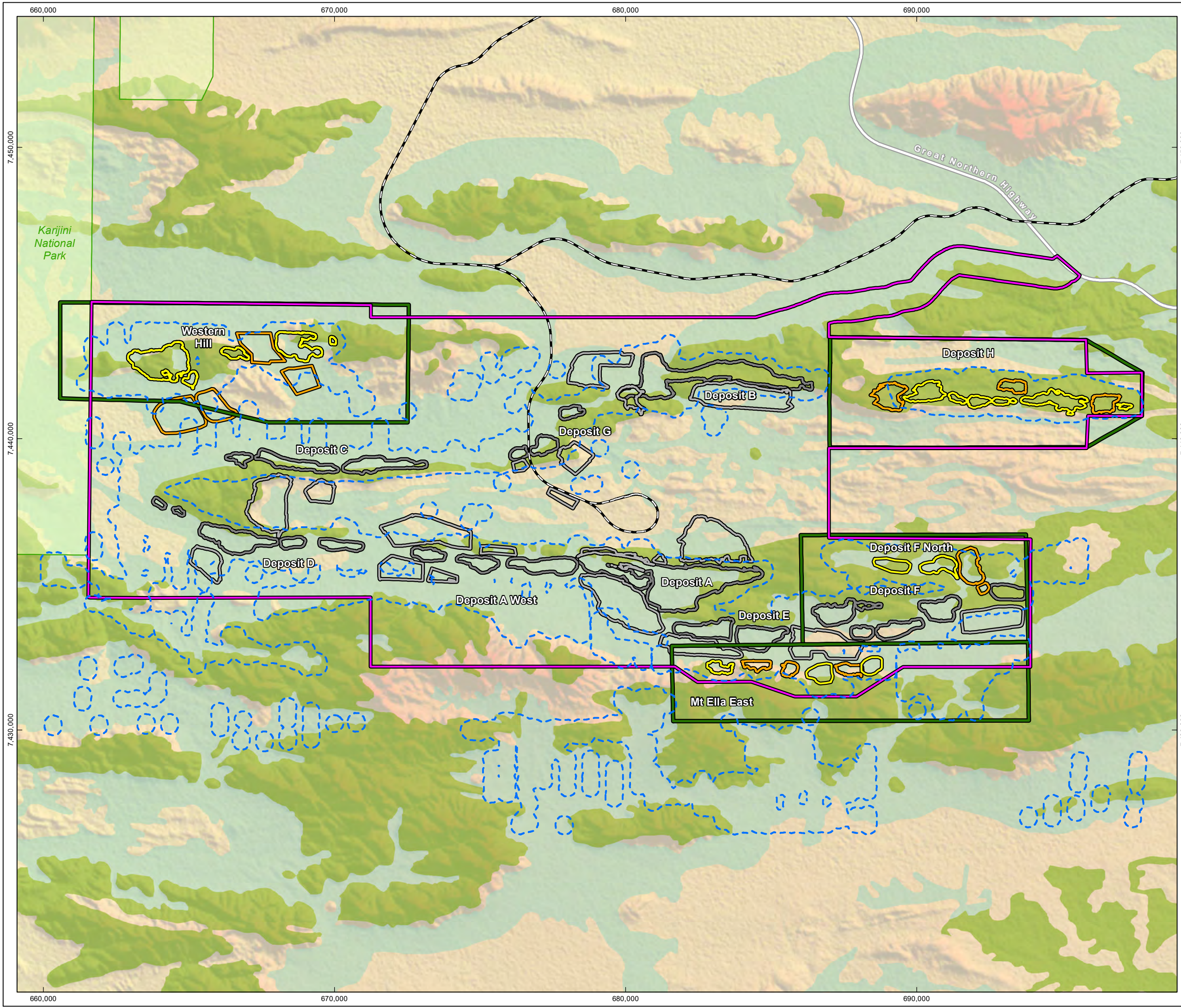
The 3D ‘vein’ modelling was undertaken throughout areas of high drilling density, by categorising the intercept data and building veins of high/medium/low subterranean fauna habitat suitability. The categorisation was based on stratigraphic information and the recorded frequency of cavities, porosity, fracturing, and weathering zones (Biologic 2022k; Figure 10-3). Water levels from hydrogeological investigations divided the AWT and BWT vein models.

Stratigraphic modelling was used BWT throughout the regional synclinal aquifer to allow the western extent of this aquifer beyond the Revised Development Envelope boundary to be modelled. Modelling of habitat veins could not be undertaken with high confidence throughout this area due to lower drilling density, therefore modelling relied upon stratigraphic trends. Stratigraphic units were categorised into two categories; “Potential habitat” or “Low potential habitat” based on geological and hydrogeological characteristics (Biologic 2022k; Figure 10-5)

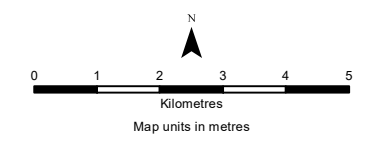
Prospective geological and hydrogeological habitats (based on GSWA mapping) are shown in Figures Figure 10.3 and Figure 10.5. The extent of the modelled suitable habitat AWT and BWT, constrained to conservative lateral modelling boundaries, is shown in Figure 10-4 and Figure 10-6).

Figure 10-3
Prospective
Geological Habitat
(Regional GSWA Mapping)

Drawn: M.L.
Plan: RTIO-0962593v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



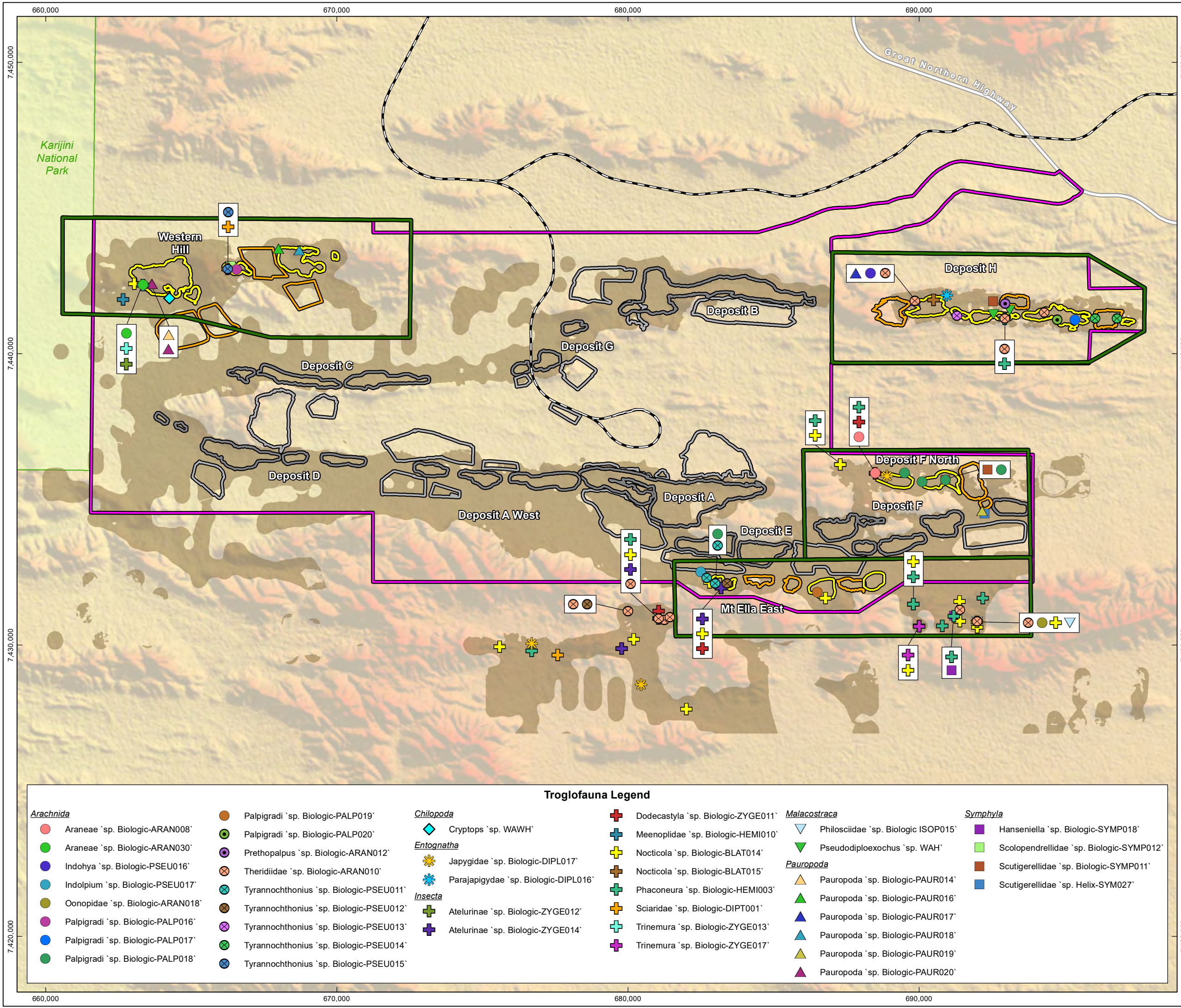
- Legend**
- Revised Development Envelope
 - ERD Section Boundary
 - Proposed Conceptual Layout*
 - Pit
 - Waste Landform
 - Approved Conceptual Layout*
 - Pit
 - Waste Landform
 - Prospective Geological Habitat (Regional GSWA Mapping)*
 - Potential Bedrock Habitats (BrIF, MMIF)
 - Potential Detrital Habitats (Colluvium/Alluvium)
 - 3D Modelling Boundary (3D Habitat Model)
 - National Park
 - Rio Tinto Railway
 - Highway



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Figure 10-4
Modelled Suitable
Troglifauna Habitat in the
West Angelas Region

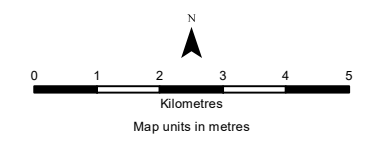
Drawn: M.L.
Plan: RTIO-0962620v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



- Legend**
- Revised Development
 - ERD Section Boundary
 - 3D Habitat Model**
 - High and Medium Suitability
 - Proposed Conceptual Layout**
 - Pit
 - Waste Landform
 - Approved Conceptual Layout**
 - Pit
 - Waste Landform
 - National Park
 - Rio Tinto Railway
 - Highway

Troglifauna Legend

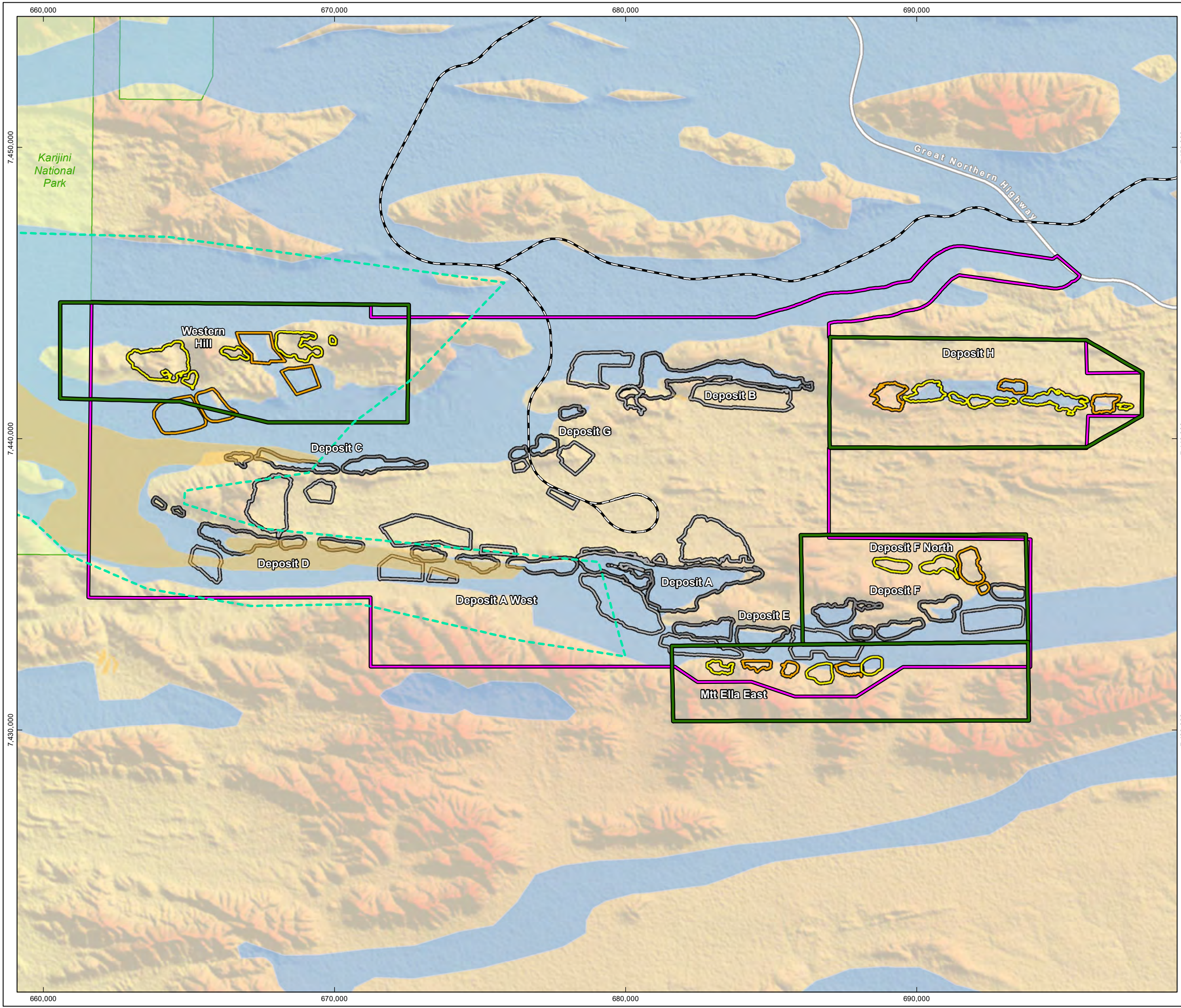
<p>Arachnida</p> <ul style="list-style-type: none"> ● Araneae `sp. Biologic-ARAN008` ● Araneae `sp. Biologic-ARAN030` ● Indohya `sp. Biologic-PSEU016` ● Indolpium `sp. Biologic-PSEU017` ● Oonopidae `sp. Biologic-ARAN018` ● Palpigradi `sp. Biologic-PALP016` ● Palpigradi `sp. Biologic-PALP017` ● Palpigradi `sp. Biologic-PALP018` 	<ul style="list-style-type: none"> ● Palpigradi `sp. Biologic-PALP019` ● Palpigradi `sp. Biologic-PALP020` ● Prethopalpus `sp. Biologic-ARAN012` ● Theridiidae `sp. Biologic-ARAN010` ● Tyrannochthonius `sp. Biologic-PSEU011` ● Tyrannochthonius `sp. Biologic-PSEU012` ● Tyrannochthonius `sp. Biologic-PSEU013` ● Tyrannochthonius `sp. Biologic-PSEU014` ● Tyrannochthonius `sp. Biologic-PSEU015` 	<p>Chilopoda</p> <ul style="list-style-type: none"> ◆ Cryptops `sp. WAWH` <p>Entognatha</p> <ul style="list-style-type: none"> ✦ Japygidae `sp. Biologic-DIPL017` ✦ Parajapygidae `sp. Biologic-DIPL016` <p>Insecta</p> <ul style="list-style-type: none"> + Atelurinae `sp. Biologic-ZYGE012` + Atelurinae `sp. Biologic-ZYGE014` 	<ul style="list-style-type: none"> + Dodecastyla `sp. Biologic-ZYGE011` + Meenoplidae `sp. Biologic-HEMI010` + Nocticola `sp. Biologic-BLAT014` + Nocticola `sp. Biologic-BLAT015` + Phaconeura `sp. Biologic-HEMI003` + Sciaridae `sp. Biologic-DIPT001` + Trinemura `sp. Biologic-ZYGE013` + Trinemura `sp. Biologic-ZYGE017` 	<p>Malacostraca</p> <ul style="list-style-type: none"> ▽ Philosciidae `sp. Biologic-ISOP015` ▽ Pseudodiploexochus `sp. WAH` <p>Paupoda</p> <ul style="list-style-type: none"> ▲ Pauropoda `sp. Biologic-PAUR014` ▲ Pauropoda `sp. Biologic-PAUR016` ▲ Pauropoda `sp. Biologic-PAUR017` ▲ Pauropoda `sp. Biologic-PAUR018` ▲ Pauropoda `sp. Biologic-PAUR019` ▲ Pauropoda `sp. Biologic-PAUR020` 	<p>Symphyla</p> <ul style="list-style-type: none"> ■ Hanseniella `sp. Biologic-SYMP018` ■ Scolopendrellidae `sp. Biologic-SYMP012` ■ Scutigereilidae `sp. Biologic-SYMP011` ■ Scutigereilidae `sp. Helix-SYM027`
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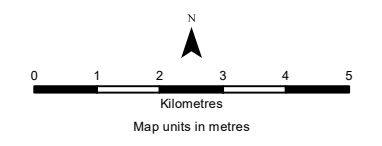
Figure 10-5
Prospective
Hydrogeological Habitat
(Regional GSWA mapping)

Drawn: M.L.
Plan: RTIO-0962583v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Turee Creek East Calcrete System
- Prospective Hydrogeological Habitat (Regional GSWA mapping)
- Regional Synclinal Aquifer Habitat Modelling Boundary
- ERD Section Boundary
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform
- National Park
- Rio Tinto Railway
- Highway

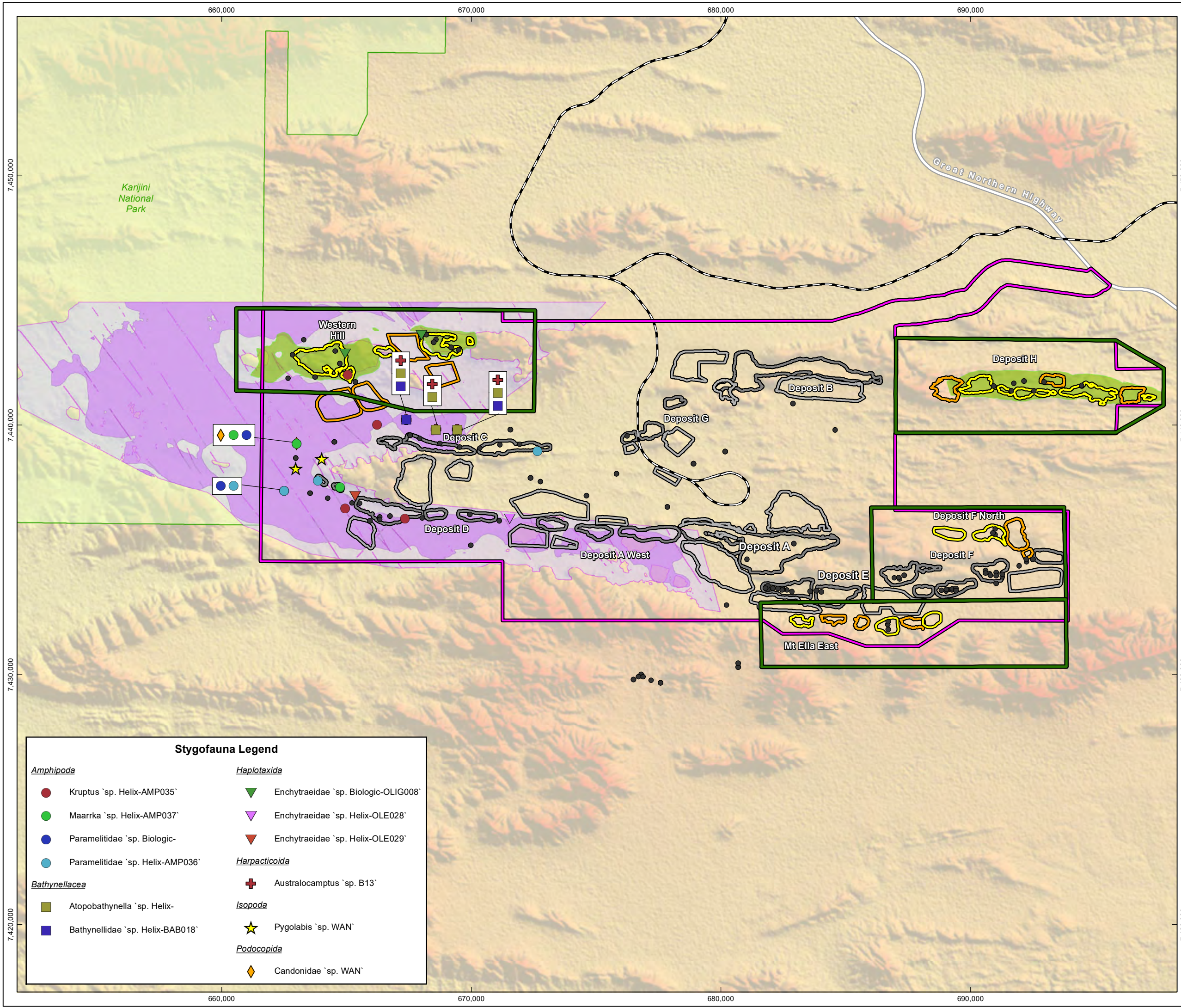


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Figure 10-6
Modelled Suitable
Stygofauna Habitat in the
West Angelas Region

Drawn: M.L.
Plan: RTIO-0962616v2
Date: March 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:140,000 @A3
GIS.Team@riotinto.com

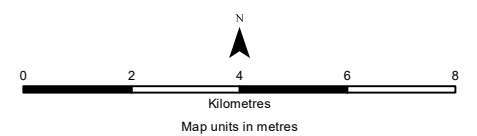


Legend

- Stygofauna Sampling Site
- ERD Section Boundary
- ▭ Revised Development Envelope
- 3D Habitat Model BWT**
- ▭ Zone A and Zone
- Stratigraphic Model BWT**
- ▭ Potential Suitable Habitat
- ▭ Inferred Habitat
- Proposed Conceptual Footprint**
- ▭ Pit
- ▭ Waste Landform
- Approved Conceptual Layout**
- ▭ Pit
- ▭ Waste Landform
- ▭ National Park
- Rio Tinto Railway
- Highway

Stygofauna Legend

- | | |
|------------------------------------|--|
| Amphipoda | Haplotaaxida |
| ● Krupus `sp. Helix-AMP035` | ▼ Enchytraeidae `sp. Biologic-OLIG008` |
| ● Maarrka `sp. Helix-AMP037` | ▼ Enchytraeidae `sp. Helix-OLE028` |
| ● Paramelitidae `sp. Biologic-` | ▼ Enchytraeidae `sp. Helix-OLE029` |
| ● Paramelitidae `sp. Helix-AMP036` | Harpacticoida |
| Bathynellacea | ⊕ Australocamptus `sp. B13` |
| ■ Atopobathynella `sp. Helix-` | Isopoda |
| ■ Bathynellidae `sp. Helix-BAB018` | ★ Pygolabis `sp. WAN` |
| | Podocopida |
| | ◆ Candonidae `sp. WAN` |



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10.3.2.2. Habitat Summary

The Revised Development Envelope encompasses the Wonmunna Anticline. This anticline-syncline structure dominates the topography of the Revised Development Envelope, comprising a low, east-west striking, rounded range extending from the west of the Revised Development Envelope to the north-eastern and south-eastern parts (i.e. splitting into a northern and a southern limb in the area of Deposits C and D). The major geological formations of the Wonmunna Anticline (predominantly the Brockman Iron Formation and Marra Mamba Formation) are broadly continuous beyond the Revised Development Envelope, occurring throughout the Hamersley subregion.

The four sections of the Revised Development Envelope (Western Hill, Mt Ella East, Deposits H, and F North) each have different combinations of geological and hydrogeological factors that have contributed to the extent, thickness, and connectivity of subterranean fauna habitats AWT and BWT as described in Table 10-4 and shown in Figure 10-3 and Figure 10-5. The main geological and hydrogeological formations which provide habitat for subterranean fauna comprise:

- Weathered/ fractured and/ or mineralized bedrock, including:
 - Dales Gorge, Whaleback Shale, and Joffre Members of the Brockman Iron Formation (occurring on hills and ridges such as Western Hill and Mt Ella East)
 - Mt Newman Member of the Marra Mamba Formation (occurring on low hills and plateaus such as Deposit H and Deposit F North)
 - Wittenoom Dolomite (typically BWT, in the synclinal valley surrounding the Wonmunna anticline and Western Hill, also extending west beyond the Revised Development Envelope)
- Detrital habitats AWT and BWT, including:
 - Poorly consolidated and porous alluvium and colluvium, occurring along the flanks of hills and ranges, throughout the valleys, and along drainage lines
 - Weathered/ fractured calcrete and pisolitic channel-iron deposits occurring as lenses within the synclinal valley surrounding the tip of the Wonmunna Anticline and extending west beyond the Revised Development Envelope (Biologic 2022k).

At Western Hill, thick AWT habitats are hosted within mineralised and weathered/fractured Brockman Iron Formation, which occurs as a series of steep hills and ridges (Figure 10-7 and Table 10-4) Pisolitic duricrust pods on the crests and flanks of the hills provides highly suitable habitat associated with hydrated mineralisation. Poorly consolidated colluvium on the lower flanks provides medium suitability habitat that is well connected between the hills and extensive AWT detrital habitats throughout the synclinal valley.

At Deposit H, high to medium suitability AWT habitats are hosted within mineralised and weathered/fractured Marra Mamba Iron Formations, occurring as low hills and plateaus (Figure 10-8 and Table 10-4). Pisolitic duricrust on the crests and flanks provides highly suitable habitat, and the Mt Newman Member is highly fractured and faulted. The surrounding Fortescue Group geologies (low suitability) constrain the wider occurrence of AWT habitat, except to the west, towards Deposit B.

At Deposit F North, high to medium suitability AWT habitats are hosted within the Marra Mamba Iron Formation, which occurs as a large, rounded range striking east-west (Figure 10-8). Poorly consolidated colluvium on the lower flanks and in the valleys provides wider connectivity of medium suitability AWT habitats. A fault (striking SSE) cross-cuts the mineralisation above the water table and results in the MacLeod Member being offset over a small portion of the mineralisation, potentially limiting AWT habitat connectivity in that area. Several dolerite dykes occur at Deposit F North, however, at present it is unclear whether they affect AWT habitat connectivity (Table 10-4).

At Mt Ella East, thick, high to medium suitability AWT habitats are hosted throughout the Brockman Iron Formation. The Mt Ella range is regionally extensive beyond the Revised Development Envelope to the south, west, and east (Figure 10-9 and Table 10-4). Poorly consolidated colluvium on the northern flank and AWT in the valley to the north provides further connectivity with Marra Mamba Iron Formation habitats at Deposit F.

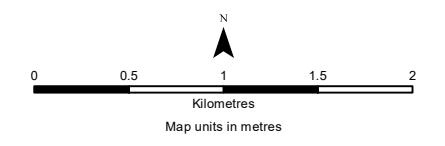
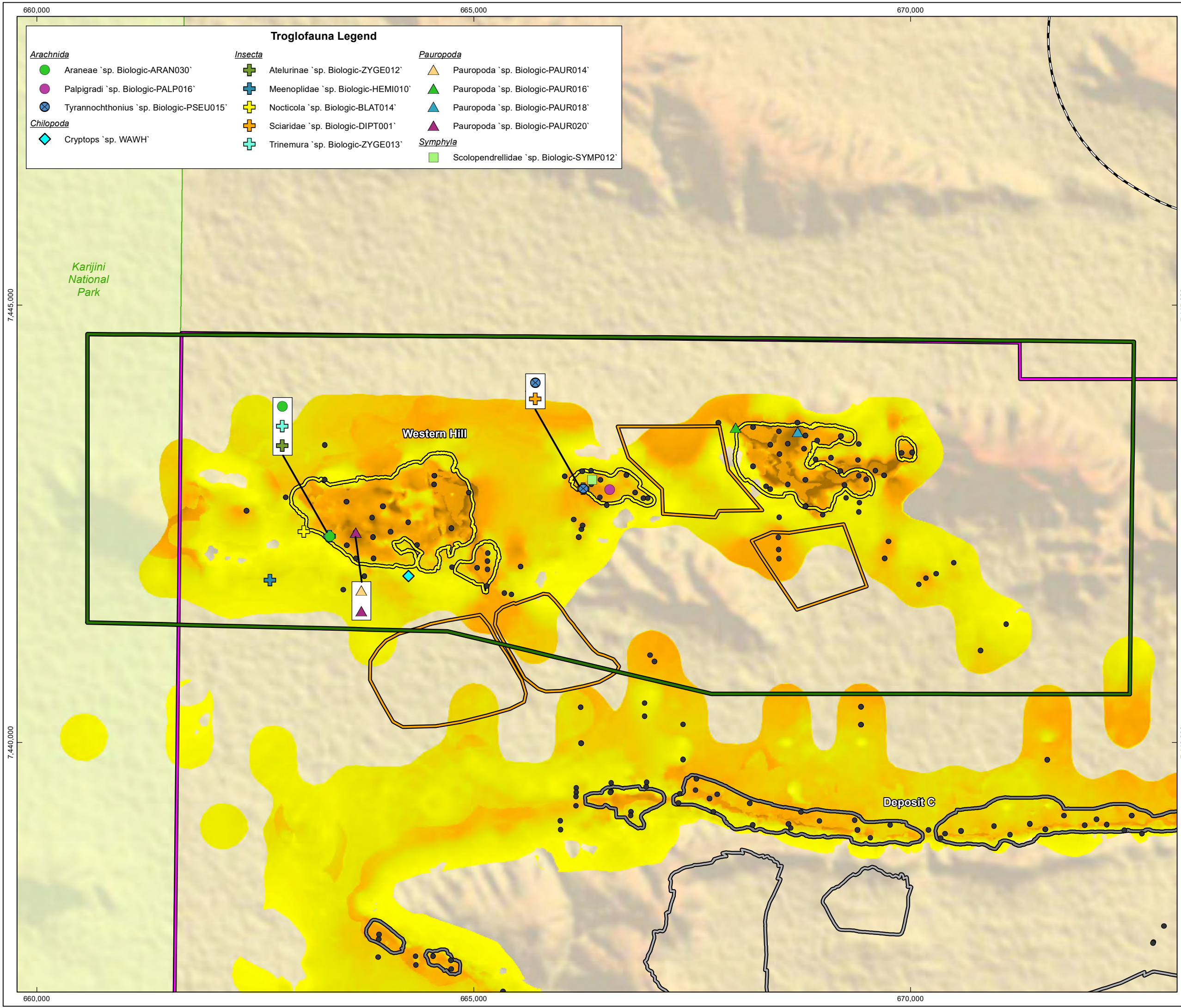
Figure 10-7
Troglifauna Records and
Pre-impact Thickness of
Suitable Habitats at Western Hill

Drawn: M.L.
Plan: RTIO-0962674v2
Date: March 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com

Troglifauna Legend		
Arachnida	Insecta	Pauropoda
● Araneae 'sp. Biologic-ARAN030'	⊕ Atelurinae 'sp. Biologic-ZYGE012'	▲ Pauropoda 'sp. Biologic-PAUR014'
● Palpigradi 'sp. Biologic-PALP016'	⊕ Meenoplidae 'sp. Biologic-HEMI010'	▲ Pauropoda 'sp. Biologic-PAUR016'
⊗ Tyrannochthonius 'sp. Biologic-PSEU015'	⊕ Nocticola 'sp. Biologic-BLAT014'	▲ Pauropoda 'sp. Biologic-PAUR018'
Chilopoda	⊕ Sciaridae 'sp. Biologic-DIPT001'	▲ Pauropoda 'sp. Biologic-PAUR020'
◆ Cryptops 'sp. WAWH'	⊕ Trinemura 'sp. Biologic-ZYGE013'	Symphyla
		■ Scolopendrellidae 'sp. Biologic-SYMP012'

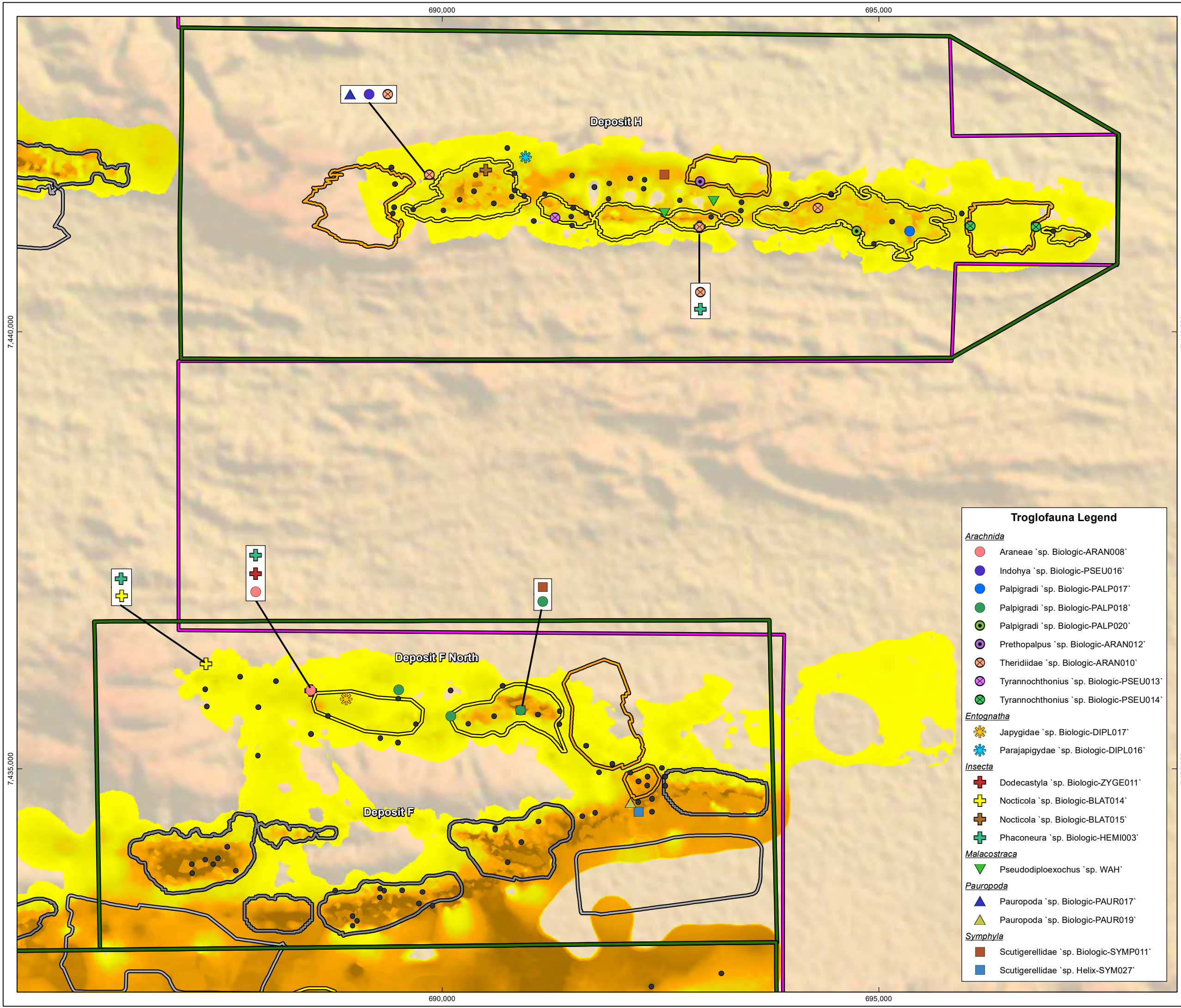
Legend	
	Revised Development
●	Troglifauna Sampling Site
	ERD Section Boundary
AWT Habitat Thickness: Pre-impact (m)	
	High : 287.215
	Low : 0
Proposed Conceptual Layout	
	Pit
	Waste Landform
Approved Conceptual Layout	
	Pit
	Waste Landform
	National Park
	Rio Tinto Railway



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Figure 10-8
Troglifauna Records and
Pre-impact Thickness of
Suitable Habitats at
Deposit H and Deposit F North

Drawn: M.L.
Plan: RTIO-0962633v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



Legend

- Troglifauna Sampling Site
 - ◻ Revised Development
 - ERD Section Boundary
- AWT Habitat Thickness:
Pre-impact (m)
- High : 150
 - Low : 1

Proposed Conceptual Layout

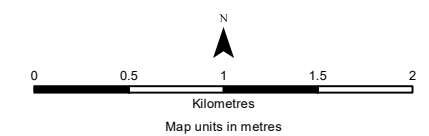
- ◻ Pit
- ◻ Waste Landform

Approved Conceptual Layout

- ◻ Pit
- ◻ Waste Landform

Troglifauna Legend

- Arachnida*
- Araneae `sp. Biologic-ARAN008`
 - Indohya `sp. Biologic-PSEU016`
 - Palpigradi `sp. Biologic-PALP017`
 - Palpigradi `sp. Biologic-PALP018`
 - Palpigradi `sp. Biologic-PALP020`
 - Prethopalpus `sp. Biologic-ARAN012`
 - Theridiidae `sp. Biologic-ARAN010`
 - Tyrannochthonius `sp. Biologic-PSEU013`
 - Tyrannochthonius `sp. Biologic-PSEU014`
- Entognatha*
- Japygidae `sp. Biologic-DIPL017`
 - Parajapygidae `sp. Biologic-DIPL016`
- Insecta*
- Dodecastyla `sp. Biologic-ZYGE011`
 - Nocticola `sp. Biologic-BLAT014`
 - Nocticola `sp. Biologic-BLAT015`
 - Phaconeura `sp. Biologic-HEMI003`
- Malacostraca*
- Pseudodiploexochus `sp. WAH`
- Paupopoda*
- Pauropoda `sp. Biologic-PAUR017`
 - Pauropoda `sp. Biologic-PAUR019`
- Symphyla*
- Scutigereillidae `sp. Biologic-SYMP011`
 - Scutigereillidae `sp. Helix-SYM027`

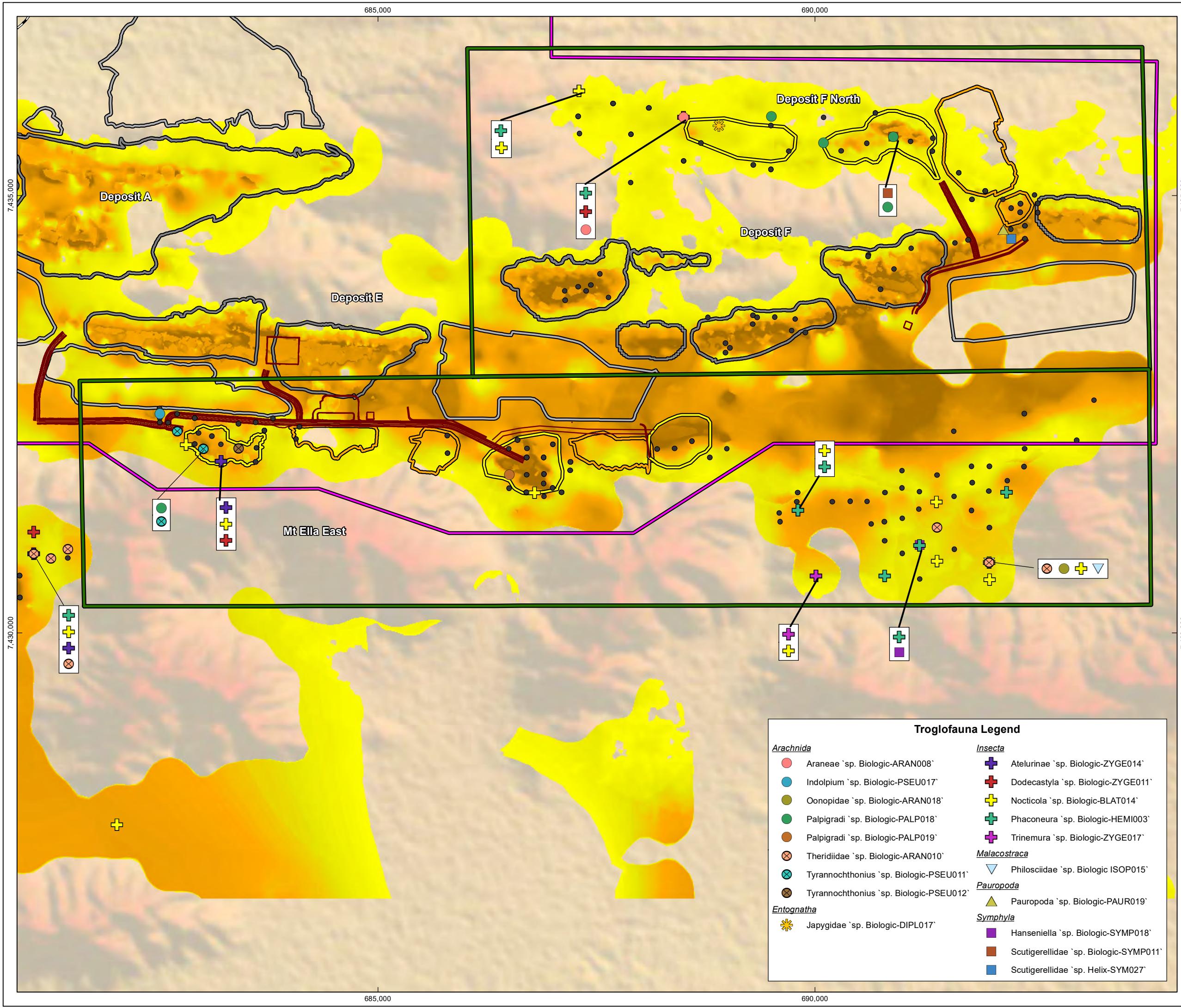


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Figure 10-9
Troglifauna Records and
Pre-impact Thickness of
Suitable Habitats at Mt Ella East

Drawn: M.L.
Plan: RTIO-0962673v2
Date: March 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com

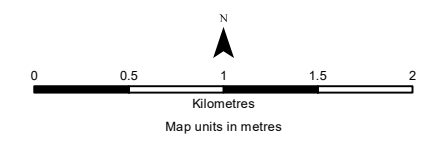


Legend

- Troglifauna Sampling Site
 - ▭ Revised Development Envelope
 - ▬ ERD Section Boundary
 - ▬ Rio Tinto Railway
- AWT Habitat Thickness:
Pre-impact (m)
- High :150
 - Low : 1
- Proposed Conceptual Layout*
- ▭ Pit
 - ▭ Waste Landform
- Approved Conceptual Layout*
- ▭ Pit
 - ▭ Waste Landform

Troglifauna Legend

Arachnida	Insecta
● Araneae `sp. Biologic-ARAN008`	⊕ Atelurinae `sp. Biologic-ZYGE014`
● Indolpium `sp. Biologic-PSEU017`	⊕ Dodecastyla `sp. Biologic-ZYGE011`
● Oonopidae `sp. Biologic-ARAN018`	⊕ Nocticola `sp. Biologic-BLAT014`
● Palpigradi `sp. Biologic-PALP018`	⊕ Phaconeura `sp. Biologic-HEMI003`
● Palpigradi `sp. Biologic-PALP019`	⊕ Trinemura `sp. Biologic-ZYGE017`
⊗ Theridiidae `sp. Biologic-ARAN010`	Malacostraca
⊗ Tyrannochthonius `sp. Biologic-PSEU011`	▽ Philosciidae `sp. Biologic ISOP015`
⊗ Tyrannochthonius `sp. Biologic-PSEU012`	Pauropoda
Entognatha	▲ Pauropoda `sp. Biologic-PAUR019`
⊗ Japygidae `sp. Biologic-DIPL017`	Symphyla
	■ Hanseniella `sp. Biologic-SYMP018`
	■ Scutigereididae `sp. Biologic-SYMP011`
	■ Scutigereididae `sp. Helix-SYM027`



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Groundwater in the West Angelas Region occurs in fractured/ weathered/ mineralised rocks (particularly the Marra Mamba Iron Formation, Wittenoom Dolomite, and Brockman Iron Formation), and in the detrital deposits that overlay them. The hydrogeological settings at each section of the Revised Development Envelope, including Western Hill, the synclinal valley, Deposit H, and the central anticline are distinct and hydrogeologically separated. Deposits F North and Mt Ella East do not host significant groundwater aquifers (Figure 10-10 and Table 10-4).

The Western Hill mineralised orebody aquifer (hosted in a deep fold of the Dales Gorge Member) and the regional synclinal aquifer (hosted in the Wittenoom Dolomite and detritals of the valley) are functionally separated by the low permeability Mt McRae Shales (Figure 10-10 and Table 10-4). Major faulting may provide limited connectivity to the south of Western Hill; however, the throughflow is minor and localised. Northwest trending dykes within the synclinal valley do not appear to impede flows or compartmentalise the regional aquifer, possibly due to faulting and the presence of saturated detritals above the dykes. The regional synclinal aquifer is extensive and well-connected beyond the Revised Development Envelope to the west, into Karijini National Park. The synclinal valley hosts high and medium suitability BWT habitats in the Wittenoom Formation and saturated detritals that feature a major calcrete deposit, namely the Turee Creek East Calcrete System (Figure 10-5).

At Deposit H, a deep, porous, mineralised bedrock aquifer is hosted within a deep fold of the Marra Mamba Iron Formation. Deposit H is surrounded by low permeability Nammuldi and Fortescue Group geologies, producing a locally constrained 'basin-type' aquifer that is functionally disconnected from other groundwater systems (Figure 10-10 and Table 10-4).

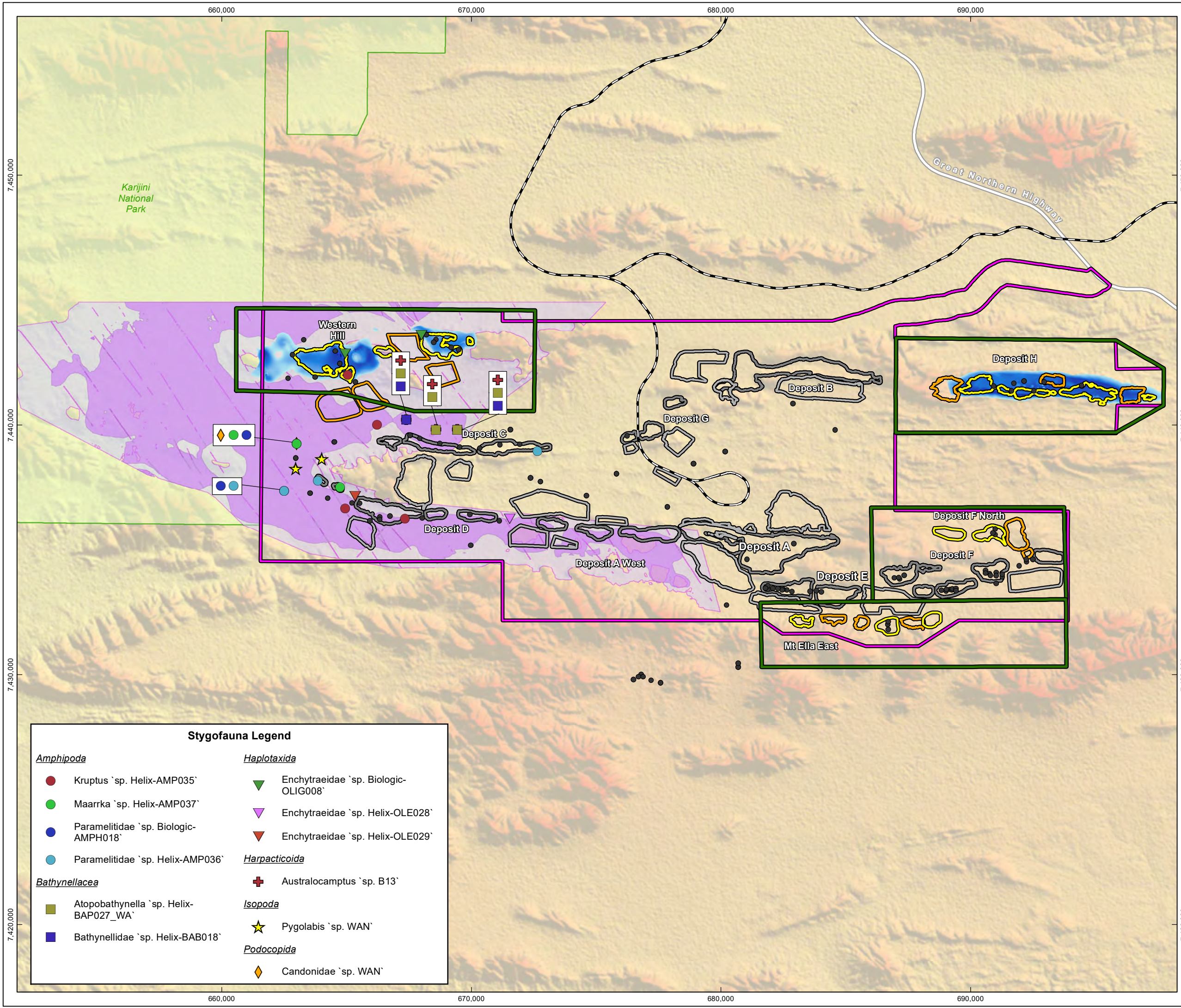
At Deposit F North, groundwater occurs as small, locally constrained area in the mineralised Mt Newman Member of the Marra Mamba Formation. Groundwater is located deep below the surface at ~716mRL (~77m below ground), interpreted from exploration hole geophysics and validated with water levels from two 2017 exploration grade holes converted into monitoring bores. The water table is approximately 46 m higher than in Deposit F to the south, which suggests a disconnect between these orebodies. The constrained area of groundwater at Deposit F North is functionally disconnected from other groundwater systems as it is surrounded by low permeability unmineralized MacLeod and Nammuldi Members of the Marra Mamba Iron Formation on all sides and does not provide suitable habitat for stygofauna (Biologic 2022m). Several dolerite dykes have been identified at Deposit F North, but it has not been established if these cause any compartmentalisation of groundwater.

No significant groundwater is known to occur at Mt Ella East, which is entirely AWT (Figure 10-10 and Table 10-4).

Figure 10-10
Stygofauna Records and
Pre-impact Thickness of
Suitable Habitats

Drawn: M.L.
Plan: RTIO-0962669v2
Date: March 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:140,000 @A3
GIS.Team@riotinto.com

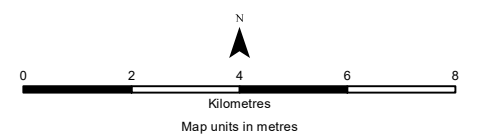


Legend

- Stygofauna Sampling Site
 - ▭ Revised Development Envelope
 - ▬ ERD Section Boundary
- BWT Habitat Thickness:
Pre-impact (m)
- High : 150
 - Low : 1
- Stratigraphic Model BWT*
- Potential Suitable Habitat
 - Inferred Habitat
- Proposed Conceptual Layout*
- Pit
 - Waste Landform
- Approved Conceptual Layout*
- Pit
 - Waste Landform
- National Park
 - Rio Tinto Railway
 - Highway

Stygofauna Legend

- | | |
|---|--|
| Amphipoda | Haplotaxida |
| ● Kruptus `sp. Helix-AMP035` | ▼ Enchytraeidae `sp. Biologic-OLIG008` |
| ● Maarrika `sp. Helix-AMP037` | ▼ Enchytraeidae `sp. Helix-OLE028` |
| ● Paramelitidae `sp. Biologic-AMPH018` | ▼ Enchytraeidae `sp. Helix-OLE029` |
| ● Paramelitidae `sp. Helix-AMP036` | Harpacticoida |
| Bathynellacea | ⊕ Australocamptus `sp. B13` |
| ■ Atopobathynella `sp. Helix-BAP027_WA` | Isopoda |
| ■ Bathynellidae `sp. Helix-BAB018` | ★ Pygolabis `sp. WAN` |
| | Podocopida |
| | ◆ Candonidae `sp. WAN` |



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Table 10-4: Subterranean Fauna Habitat Values at each Revised Development Envelope Section

Section of the Revised Development Envelope	Geological Setting	Key Habitat Values for Troglifauna (AWT)	Value Extent- Pre-impact Suitable Habitat AWT (million m ³)*	Key Habitat Values for Stygofauna (BWT)	Value Extent - Pre-impact Suitable Habitat BWT (million m ³) *
Western Hill and regional synclinal aquifer	<p>Brockman Iron Formation (hills and ranges).</p> <p>Detritals, calcrete/ CID, and Wittenoom Dolomite in the valley.</p>	<p>Extensive, thick habitats AWT (fractured/ weathered/ mineralised Dales Gorge & Whaleback Shale).</p> <p>Thick detritals (poorly consolidated colluvium) AWT in the valley and hill slopes.</p> <p>Broad habitat connectivity between hills and throughout valley.</p>	845,580	<p>Western Hill mineralised orebody aquifer, Dales Gorge Member. Mt McRae Shales layer separates orebody aquifer from regional synclinal aquifer.</p> <p>Regional synclinal valley aquifer hosting Wittenoom Dolomite, detritals, calcrete. Extensive surrounding central anticline, Western Hill, and beyond Revised Development Envelope to the west.</p> <p>Dykes do not impede connectivity due to faulting, detritals BWT.</p>	<p>Western Hill orebody aquifer:</p> <ul style="list-style-type: none"> • 409,281 (3D 'vein' modelling) <p>Synclinal aquifer:</p> <ul style="list-style-type: none"> • 15,025,691 (Stratigraphic habitat modelling)
Deposit H	<p>Marra Mamba Iron Formation (hills and plateau).</p> <p>Thin detritals atop plateau.</p>	<p>Thick suitable habitats AWT (weathered/ mineralised Mt Newman Member). Major faulting/ fracturing.</p> <p>Thin detritals, no known dykes. Fortescue Group geologies (low suitability) surround the Deposit.</p> <p>Potential connectivity to the west.</p>	189,173	<p>Deep mineralised orebody aquifer in Mt Newman Member.</p> <p>Surrounding Fortescue Group geologies constrain the aquifer (closed, 'basin-type' system).</p> <p>No wider BWT habitat connectivity beyond Deposit H/ MMIF.</p>	598,930

Section of the Revised Development Envelope	Geological Setting	Key Habitat Values for Troglifauna (AWT)	Value Extent- Pre-impact Suitable Habitat AWT (million m ³)*	Key Habitat Values for Stygofauna (BWT)	Value Extent - Pre-impact Suitable Habitat BWT (million m ³) *
Deposit F North	Marra Mamba Iron Formation (hill tops and upper flanks). Detritals (lower flanks and valley).	Thick suitable habitats AWT (weathered/ mineralised Mt Newman Member). Fault potentially affecting AWT connectivity. Dolerite dykes known to occur but their effects on habitat connectivity unknown. Thick detrital habitats extending north/ west/ south.	727,330	No significant aquifer or BWT habitat within MMIF (Figure 10-6) Small, constrained groundwater patch, deep below surface (~78m). Low suitability for stygofauna.	Negligible
Mt Ella East	Brockman Iron Formation (hills and ranges). Deep detritals in the valley to the north.	Regionally extensive, thick habitats AWT (fractured/ weathered/ mineralised Dales Gorge & Whaleback Shale). Thick detritals AWT in the valley to the north - broad connectivity between and beyond deposits.	1,163,720	No significant aquifer or BWT habitat within Brockman Iron Formation (Figure 10-6). Adjacent northern valley groundwater very deep (>100 m), low suitability. Mt Ella East pits entirely AWT, Proposal will not impact groundwater.	Negligible

*AWT habitat volumes comprise high and medium suitability habitat, and BWT habitat volumes comprise high, medium, and inferred suitability habitat (refer to Appendix F.1). Volumes are shown for habitats within each of the four Revised Development Envelope section boundaries. Habitat modelled outside of the modelling boundaries is not included in the volumetric calculations of the DE sections

10.3.3. Subterranean Fauna Species Values

Consolidation of the results from all the subterranean fauna surveys undertaken within and surrounding the Revised Development Envelope (refer to Table 10-2) identified 165 troglofauna individuals representing 77 troglofauna taxa, and 490 stygofauna individuals representing 23 stygofauna taxa (Figure 10-11 and Figure 10-12).

Indeterminate subterranean fauna records (i.e. those that could not be identified to a species-equivalent level) were not included in the above. For the most part, these records represented residual specimens that were left over from sub-sampling for molecular analysis, poor-quality damaged specimens, juveniles, and legacy records from historical surveys (pre-2012) that were unfit for further taxonomic work.

Of the total 77 troglofauna taxa and 23 stygofauna taxa recorded in the West Angelas Region, 42 troglofauna taxa and 12 stygofauna taxa were considered relevant to the assessment (Biologic 2022m). These taxa are described as troglofauna and stygofauna species values in sections 10.3.3.1 and 10.3.3.3 below.

The remaining 35 troglofauna taxa and 11 stygofauna taxa were excluded from further consideration in this assessment based on their:

- Records occurring exclusively outside of direct/ indirect/ combined impact areas (unlikely to be impacted)
- Regionally widespread occurrence (linear ranges >100 km; therefore impacts expected to be negligible)
- Widely occurring regional genetic matches (linear ranges >50 km beyond the Revised Development Envelope; therefore, impacts expected to be negligible)
- Records occurring exclusively within approved impact areas (i.e. already assessed).

10.3.3.1. Troglofauna Values

The 42 troglofauna taxa relevant to the assessment represented 12 orders comprising Araneae (5 taxa), Blattodea (2 taxa), Symphyla (4 taxa), Diplura (2 taxa), Diptera (1 taxon), Hemiptera (2 taxa), Isopoda (2 taxa), Palpigradi (5 taxa), Pauropoda (6 taxa), Pseudoscorpiones (7 taxa), Scolopendrida (1 taxon) and Zygentoma (5 taxa) (Table 10-5 and Table 10-6). Western Hill and Mt Ella East recorded 14 troglofauna taxa, 13 at Deposit H and 9 at Deposit F North (Table 10-5 and Table 10-6). Important details for troglofauna are shown in Table 10-6 and locations in Figure 10-7, Figure 10-8, and Figure 10-9.

Table 10-5: Summary of Troglofauna Species Values Relevant to the Proposal

Revised Development Envelope Section	Taxonomic Orders Represented [^]	Number of Taxa [^]	Number of Singletons	Number of Troglobitic (and Potentially Troglobitic) Potential SREs
Western Hill	10	14	10	4
Deposit H	9	13	8	7
Deposit F North	8	8	3	2
Mt Ella East	8	14	4	6
All other areas				
Total	12	62 [^]	25	18 [^]

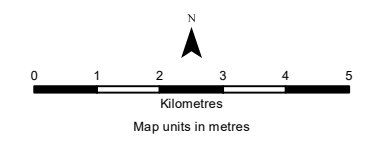
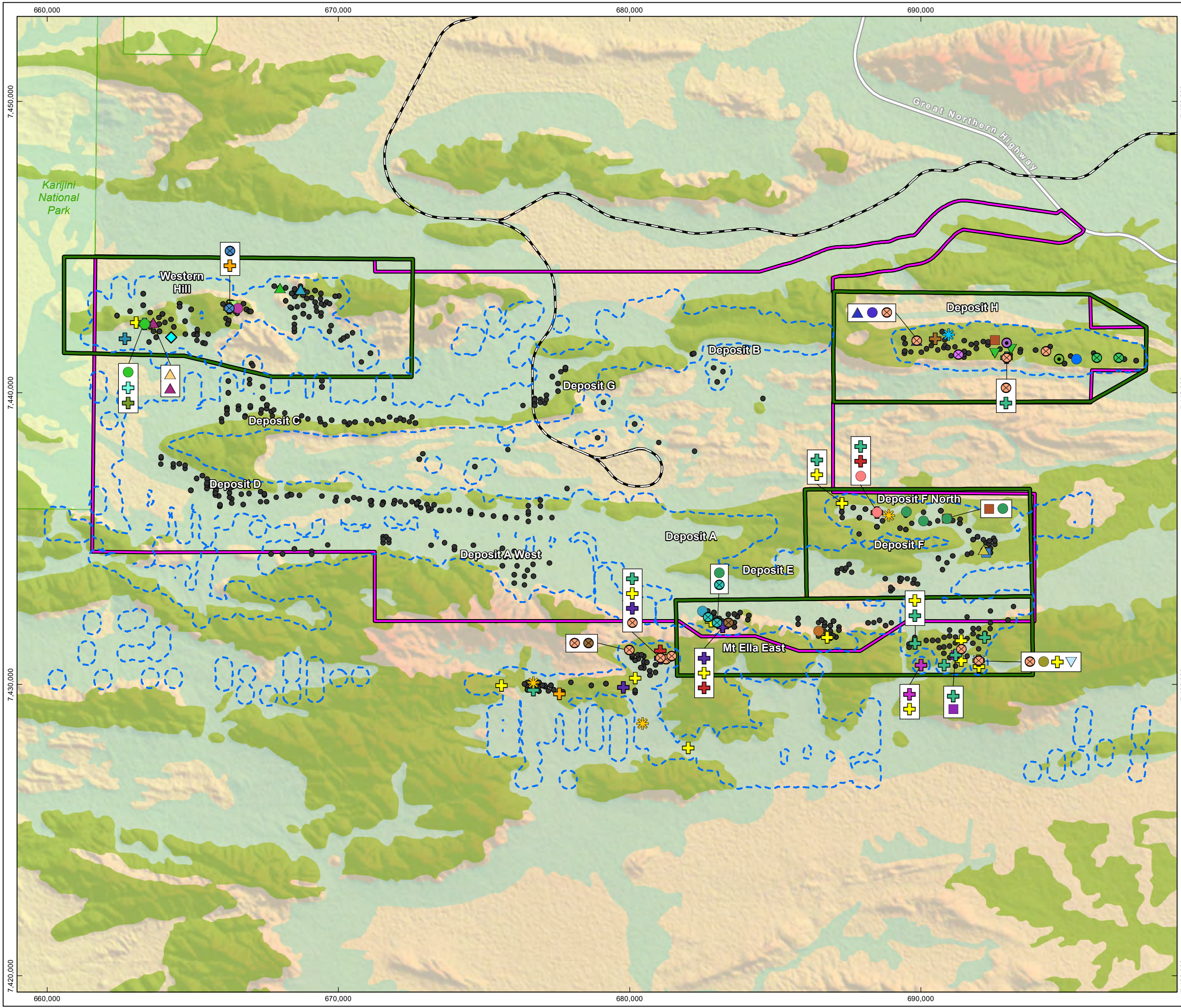
[^] Several taxa were recorded in more than one Revised Development Envelope section; in such cases the totals do not equal the sum of each section.

Figure 10-11
Potential Geological Habitat
and All Troglifauna Taxa
Recorded to Date

Drawn: M.L.
Plan: RTIO-0962618v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Troglifauna Sampling Site
- ▭ Revised Development
- Potential Detrital Habitats (Colluvium/Alluvium)
- Potential Bedrock Habitats (BrIF, MMIF)
- ERD Section Boundary
- - - 3D Modelling Boundary (3D Habitat Model)
- National Park
- Rio Tinto Railway
- Highway



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Legend - Troglodfauna

Arachnida

- Araneae `sp. Biologic-ARAN008`
- Araneae `sp. Biologic-ARAN030`
- Indohya `sp. Biologic-PSEU016`
- Indolpium `sp. Biologic-PSEU017`
- Oonopidae `sp. Biologic-ARAN018`
- Palpigradi `sp. Biologic-PALP016`
- Palpigradi `sp. Biologic-PALP017`
- Palpigradi `sp. Biologic-PALP018`
- Palpigradi `sp. Biologic-PALP019`
- Palpigradi `sp. Biologic-PALP020`
- Prethopalpus `sp. Biologic-ARAN012`
- Theridiidae `sp. Biologic-ARAN010`
- Tyrannochthonius `sp. Biologic-PSEU011`
- Tyrannochthonius `sp. Biologic-PSEU012`
- Tyrannochthonius `sp. Biologic-PSEU013`
- Tyrannochthonius `sp. Biologic-PSEU014`
- Tyrannochthonius `sp. Biologic-PSEU015`

Chilopoda

- ◆ Cryptops `sp. WAWH`

Entognatha

- ✱ Japygidae `sp. Biologic-DIPL017`
- ✱ Parajapygidae `sp. Biologic-DIPL016`

Insecta

- ✚ Atelurinae `sp. Biologic-ZYGE012`
- ✚ Atelurinae `sp. Biologic-ZYGE014`
- ✚ Dodecastyla `sp. Biologic-ZYGE011`
- ✚ Meenoplidae `sp. Biologic-HEMI010`
- ✚ Nocticola `sp. Biologic-BLAT014`
- ✚ Nocticola `sp. Biologic-BLAT015`
- ✚ Phaconeura `sp. Biologic-HEMI003`
- ✚ Sciaridae `sp. Biologic-DIPT001`
- ✚ Trinemura `sp. Biologic-ZYGE013`
- ✚ Trinemura `sp. Biologic-ZYGE017`

Malacostraca

- ▽ Philosciidae `sp. Biologic ISOP015`
- ▽ Pseudodiploexochus `sp. WAH`

Pauropoda

- ▲ Pauropoda `sp. Biologic-PAUR014`
- ▲ Pauropoda `sp. Biologic-PAUR016`
- ▲ Pauropoda `sp. Biologic-PAUR017`
- ▲ Pauropoda `sp. Biologic-PAUR018`
- ▲ Pauropoda `sp. Biologic-PAUR019`
- ▲ Pauropoda `sp. Biologic-PAUR020`

Symphyla

- Hanseniella `sp. Biologic-SYMP018`
- Scolopendrellidae `sp. Biologic-SYMP012`
- Scutigereillidae `sp. Biologic-SYMP011`
- Scutigereillidae `sp. Helix-SYM027`

Figure 10-12
Potential Hydrogeological
Habitat and All Stygofauna
Taxa Recorded to Date

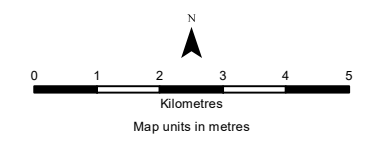
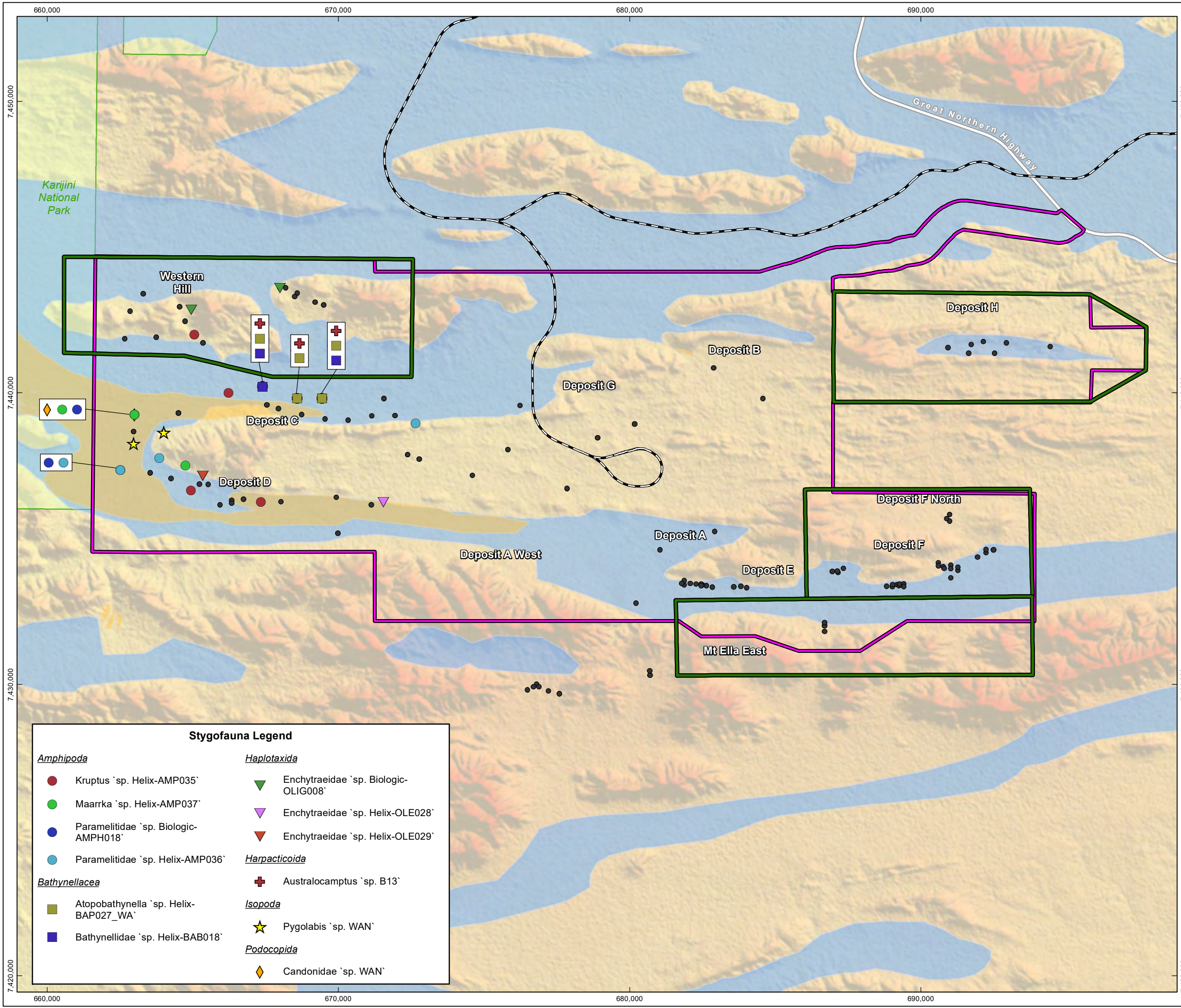
Drawn: M.L.
Plan: RTIO-0962622v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Stygofauna Sampling Site
- ▭ Revised Development Envelope
- ▭ ERD Section Boundary
- ▭ Turee Creek East Calcrete System
- ▭ Prospective Hydrogeological Habitat (Regional GSWA mapping)
- ▭ National Park
- ▬ Rio Tinto Railway
- ▬ Highway

Stygofauna Legend

- | | |
|---|--|
| Amphipoda | Haplotaxida |
| ● Kruptus `sp. Helix-AMP035` | ▼ Enchytraeidae `sp. Biologic-OLIG008` |
| ● Maarka `sp. Helix-AMP037` | ▼ Enchytraeidae `sp. Helix-OLE028` |
| ● Paramelitidae `sp. Biologic-AMPH018` | ▼ Enchytraeidae `sp. Helix-OLE029` |
| ● Paramelitidae `sp. Helix-AMP036` | Harpacticoida |
| Bathynellacea | ⊕ Australocamptus `sp. B13` |
| ■ Atopobathynella `sp. Helix-BAP027_WA` | Isopoda |
| ■ Bathynellidae `sp. Helix-BAB018` | ★ Pygolabis `sp. WAN` |
| | Podocopida |
| | ◆ Candonidae `sp. WAN` |



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The overall richness and capture rates for troglofauna throughout the West Angelas Region (total 77 taxa from 903 samples, 0.085 species per sample) is considered to be moderate and relatively consistent with other surveys (Biologic 2021). The troglofauna species richness is considered associated with the spatial distances between different sections of the Revised Development Envelope, the variety of different geological habitats, and the overall survey effort, taxonomic effort, and genetic analyses undertaken (Biologic 2021).

10.3.3.2. Conservation Significance of Troglofauna

No TECs or PECs relevant to troglofauna have been recorded from the Revised Development Envelope or wider West Angelas Region. None of the troglofauna taxa recorded within the West Angelas Region are listed as threatened or priority species. None of the troglofauna species are recognised as confirmed SRE species, which may be influenced by a lack of taxonomic certainty and formal description at the species level.

Following the WAM categorisation (refer to Section 10.2.1), 18 troglofauna taxa have been identified as being troglobitic (or potentially troglobitic), potential SRE species (Table 10-5 and Table 10-6). These taxa were identified as new species recorded only from the Revised Development Envelope, which are likely to occur in locally restricted geological habitats. These 18 troglobitic (and potentially troglobitic) taxa have therefore conservatively been treated as putative SREs for the purpose of the impact assessment.

Table 10-6: Troglifauna Species Values Relevant to the Proposal, and Ecological/Distribution Attributes

Shaded rows indicate species known only from the proposed mining pits.

Taxonomy	Occurrence in Revised Development Envelope	Identification / Match	Subterranean Status	Local/ Regional Linear Range	Distribution*
Araneae					
Araneae `sp. Biologic-ARAN008`	Deposit F North	Genetics, unique	Troglobite, Potential SRE	-	Single site, outside impacts
Araneae `sp. Biologic-ARAN030`	Western Hill	Genetics, unique	Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Oonopidae `sp. Biologic-ARAN018`	Mt Ella East	Genetic match, regional sequence	Potential Troglobite, Potential SRE	7.6 km	Locally widespread, external genetic match, outside impacts
<i>Prethopalpus</i> `sp. Biologic-ARAN012`	Deposit H	Genetics, unique	Troglobite, Potential SRE	-	Single site, indirect impacts. Habitat extends beyond impacts.
Theridiidae `sp. Biologic-ARAN010`	Deposit H, Mt Ella East	Genetic match, regional sequence	Troglophile/ xene, Uncertain SRE	13.8 km/ 17.6 km	Locally widespread, external match, outside impacts.
Palpigradi					
Palpigradi `sp. Biologic-PALP016`	Western Hill	Genetics, unique	Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Palpigradi `sp. Biologic-PALP017`	Deposit H	Genetics, unique	Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Palpigradi `sp. Biologic-PALP018`	Deposit F North, Mt Ella East	Genetics, unique	Potential Troglobite, Potential SRE	8.7 km	Locally widespread, inside & outside impacts.

Taxonomy	Occurrence in Revised Development Envelope	Identification / Match	Subterranean Status	Local/ Regional Linear Range	Distribution*
Palpigradi `sp. Biologic-PALP019`	Mt Ella East	Genetics, unique	Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Palpigradi `sp. Biologic-PALP020`	Deposit H	Genetics, unique	Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Pseudoscorpiones					
<i>Indohya</i> `sp. Biologic-PSEU016`	Deposit H	Genetics, unique	Troglobite, Potential SRE	-	Single site, indirect impacts only.
<i>Indolpium</i> `sp. Biologic-PSEU017`	Mt Ella East	Genetic match, regional sequence	Troglophile/ xene, Uncertain SRE	23.2 km	Locally widespread, external match, outside impacts.
<i>Tyrannochthonius</i> `sp. Biologic-PSEU011`	Mt Ella East	Genetics, unique	Troglobite, Potential SRE	0.3 km	Localised range, inside & outside impacts.
<i>Tyrannochthonius</i> `sp. Biologic-PSEU012`	Mt Ella East	Genetics, unique	Troglobite, Potential SRE	3.5 km	Localised range, inside & outside impacts.
<i>Tyrannochthonius</i> `sp. Biologic-PSEU013`	Deposit H	Genetics, unique	Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
<i>Tyrannochthonius</i> `sp. Biologic-PSEU014`	Deposit H	Genetics, unique	Troglobite, Potential SRE	0.7 km	Localised range, indirect & outside impacts.
<i>Tyrannochthonius</i> `sp. Biologic-PSEU015`	Western Hill	Genetics, unique	Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Scolopendrida					

Taxonomy	Occurrence in Revised Development Envelope	Identification / Match	Subterranean Status	Local/ Regional Linear Range	Distribution*
<i>Cryptops</i> `sp. WAWH`	Western Hill	Morphological, putatively unique	Uncertain troglobite/trogloxene. Potential SRE	-	Single site, outside impacts
Pauropoda					
Pauropoda `sp. Biologic-PAUR014`	Western Hill	Genetics, unique	Uncertain troglobite/trogloxene. Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Pauropoda `sp. Biologic-PAUR016`	Western Hill	Genetic match, regional sequence	Uncertain troglobite/trogloxene. Potential SRE	37.2 km	Locally widespread, regional match, outside impacts.
Pauropoda `sp. Biologic-PAUR017`	Deposit H	Genetics, unique	Uncertain troglobite/trogloxene. Potential SRE	-	Single site, indirect impacts
Pauropoda `sp. Biologic-PAUR018`	Western Hill	Genetics, unique	Uncertain troglobite/trogloxene. Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Pauropoda `sp. Biologic-PAUR019`	Deposit F North	Genetics, unique	Uncertain troglobite/trogloxene. Potential SRE	-	Single site, outside impacts. Habitat extends beyond impacts.
Pauropoda `sp. Biologic-PAUR020`	Western Hill	Genetics, unique	Uncertain troglobite/trogloxene. Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Symphyla					
<i>Hanseniella</i> `sp. Biologic-SYMP018`	Mt Ella East	Genetics, unique	Uncertain troglobite/trogloxene. Potential SRE	-	Single site, outside impacts
Scutigereillidae `sp. Biologic-SYMP011`	Deposit H, Deposit F North, synclinal valley	Genetic match, local sequence	Uncertain troglobite/trogloxene. Potential SRE	24.1 km	Locally widespread, inside & outside impacts.

Taxonomy	Occurrence in Revised Development Envelope	Identification / Match	Subterranean Status	Local/ Regional Linear Range	Distribution*
Scolopendrellidae `sp. Biologic-SYMP012`	Western Hill	Genetics, unique	Uncertain troglobite/ troglaxene. Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
ScutigereUidae sp. `Helix-SYM027`	Deposit F North	Genetics, unique	Uncertain troglobite/ troglaxene. Potential SRE	-	Single site, indirect and outside impacts
Diplura					
Parajapygidae `sp. Biologic-DIPL016`	Deposit H	Genetics, unique	Uncertain troglobite/ troglaxene. Potential SRE	-	Single site, outside impacts
Japygidae `sp. Biologic-DIPL017`	Deposit F North	Genetic match, regional sequence	Troglophile/ troglaxene. Potential SRE	29.4 km	Locally widespread, regional match, inside & outside impacts.
Blattodea					
<i>Nocticola</i> `sp. Biologic-BLAT014`	Western Hill, Deposit F North, Mt Ella East	Genetic match, regional sequence	Potential troglophile/ troglaxene. Unlikely SRE	50.9 km	Locally widespread, regional match, inside & outside impacts.
<i>Nocticola</i> `sp. Biologic-BLAT015`	Deposit H	Genetics, unique	Uncertain troglobite/ troglaxene. Unlikely SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
Diptera					
Sciaridae `sp. Biologic-DIPT001`	Western Hill	Genetic match, regional sequence	Potential troglophile/ troglaxene Unlikely SRE	38.4 km	Locally widespread, regional match, inside & outside impacts.
Hemiptera					
Meenoplidae `sp. Biologic-HEMI010`	Western Hill	Genetics, unique	Troglophile/ troglaxene. Unlikely SRE	28.4 km	Locally widespread, outside impacts.

Taxonomy	Occurrence in Revised Development Envelope	Identification / Match	Subterranean Status	Local/ Regional Linear Range	Distribution*
<i>Phaconeura</i> `sp. Biologic-HEMI003`	Deposit H, Deposit F North	Genetic match, regional sequence	Troglophile/ troglaxene. Unlikely SRE	67 km	Locally widespread, external match. Inside and outside impacts
Zygentoma					
<i>Dodecastyla</i> `sp. Biologic-ZYGE011`	Deposit F North, Mt Ella East	Genetic match, regional sequence	Troglophile/ troglaxene. Unlikely SRE	9.1 km/ 20.9 km	Locally widespread, regional match, inside & outside impacts.
<i>Atelurinae</i> `sp. Biologic-ZYGE012`	Western Hill	Genetics, unique	Troglophile/ troglaxene. Unlikely SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
<i>Atelurinae</i> `sp. Biologic-ZYGE014`	Mt Ella East	Genetics, unique	Troglophile/ troglaxene. Unlikely SRE	4.0 km	Locally widespread, inside & outside impacts.
<i>Trinemura</i> `sp. Biologic-ZYGE013`	Western Hill	Genetics, unique	Potential Troglobite, Potential SRE	-	Single site, inside impacts. Habitat extends beyond impacts.
<i>Trinemura</i> `sp. Biologic-ZYGE017`	Mt Ella East	Genetics, unique	Potential Troglobite, Potential SRE	-	Single site, outside impacts
Isopoda					
Philosciidae `sp. Biologic ISOP015`	Mt Ella East	Genetics, unique	Potential troglophile/ troglaxene. Potential SRE	-	Single site, outside impacts
<i>Pseudodiploexochus</i> `sp. WAH`	Deposit H	Morphological, putatively unique	Potential Troglobite. Potential SRE	0.8 km	Localised range, outside impacts.
Total species/ taxa	42				

*Distribution is discussed relative to direct (pit locations) and indirect (waste/infrastructure locations) impact areas.

10.3.3.3. Stygofauna Values

The 12 stygofauna taxa relevant to the assessment represented six (6) taxonomic Orders: Amphipoda (4 taxa), Bathynellacea (2 taxa), Harpacticoida (1 taxon), Podocopida (1 taxon), Tubificida (3 taxa), and Isopoda (1 taxon).

Most of the stygofauna taxa were recorded from the regional synclinal aquifer, two taxa were recorded from Western Hill orebody aquifer, and no stygofauna taxa relevant to the assessment were recorded from Deposits H, F North and Mt Ella East. Details for each stygofauna species, SRE status, distribution and known area of occurrence are shown in Table 10-7, Table 10-8 and locations in Figure 10-10.

The overall richness and capture rates for stygofauna throughout the West Angelas Region (total 23 taxa from 141 samples, 0.16 species per sample) was considered to be relatively low in comparison with other regional surveys (Biologic 2022l). The availability of bores and drill holes intercepting groundwater in some areas, and legacy taxonomic issues limited the ability to compare historically collected specimens. Nevertheless, the overall sampling and taxonomic effort was considered to have met the minimum requirements throughout the West Angelas Region (Biologic 2022m).

Table 10-7: Summary of Stygofauna Species Values Relevant to the Proposal

Revised Development Envelope Section	Taxonomic Orders Represented	Number of Taxa [^]	Number of Singletons	Number of Stygobitic Potential SREs
Western Hill orebody aquifer	2	2	0	1
Regional synclinal aquifer	6	11	3	7
Deposit H	-	-	-	-
Deposit F North	-	-	-	-
Mt Ella East	-	-	-	-
All other areas	n/a	n/a	n/a	
Total	6	12	3	7[^]

[^] Several taxa were recorded in more than one Revised Development Envelope section; in such cases the totals do not equal the sum of each section.

10.3.3.4. Conservation Significance of Stygofauna

No TECs or PECs relevant to stygofauna have been recorded from the Revised Development Envelope or wider West Angelas Region. None of the recorded stygofauna taxa are listed as threatened or priority species. None of the stygofauna species are recognised as confirmed SREs, which may be influenced by a lack of taxonomic certainty and formal description.

Following the WAM categorisation system (Section 10.2.1), seven stygofauna taxa were identified as stygobitic, potential SRE species (Table 10-7 and Table 10-8). These taxa were identified as new species recorded only from distinct hydrogeological habitats within the Revised Development Envelope (Biologic 2022m). These seven stygobitic taxa have therefore conservatively been treated as putative SREs for the purpose of the impact assessment.

Table 10-8: Stygofauna Species Values Relevant to the Proposal, and Ecological/Distribution Attributes

Taxonomy	Occurrence in Revised Development Envelope	Identification	Subterranean Status	Linear Range (km)	Distribution*
Tubificida					
Enchytraeidae `sp. Biologic-OLIG008`	Western Hill OB	Genetic match, regional sequence	Amphibious, unlikely SRE	21	Locally widespread, regional match, outside predicted direct impacts
Enchytraeidae `sp. Helix-OLE028`	Synclinal aquifer	Genetics, unique	Amphibious, unlikely SRE	-	Singleton within synclinal aquifer. Habitat extends beyond predicted direct impacts
Enchytraeidae `sp. Helix-OLE029`	Synclinal aquifer	Genetics, unique	Amphibious, unlikely SRE	-	Singleton within synclinal aquifer. Habitat extends beyond predicted direct impacts
Podocopida					
Candonidae `sp. WAN`	Synclinal aquifer	Morphological	Stygobite. Uncertain SRE	-	Single site within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Harpacticoida					
<i>Australocamptus`sp. B13`</i>	Synclinal aquifer	Morphological	Stygobite, Potential SRE	2.1	Localised range within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Syncarida					
<i>Atopobathynella`sp. Helix-BAP027_WA`</i>	Synclinal aquifer	Genetics, unique	Stygobite, Potential SRE	2.1	Localised range within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Bathynellidae `sp. Helix-BAB018`	Synclinal aquifer	Genetics, unique	Stygobite, Potential SRE	2.1	Localised range within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Amphipoda					
<i>Kruptus`sp. Helix-AMP035`</i>	Western Hill OB, Synclinal aquifer	Genetics, unique	Stygobite, Potential SRE	6.2	Localised range within synclinal aquifer. Habitat extends beyond predicted direct impacts.

Taxonomy	Occurrence in Revised Development Envelope	Identification	Subterranean Status	Linear Range (km)	Distribution*
<i>Maarrka</i> `sp. Helix-AMP037`	Synclinal aquifer	Genetics, unique	Stygobite, Potential SRE	2.4	Localised range within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Paramelitidae `sp. Biologic-AMPH018`	Synclinal aquifer	Genetics, unique	Stygobite, Potential SRE	1.1	Localised range within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Paramelitidae `sp. Helix-AMP036`	Synclinal aquifer	Genetics, unique	Stygobite, Potential SRE	8.9	Occurs widely within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Isopoda					
<i>Pygolabis</i> `sp. WAN`	Synclinal aquifer	Morphological	Stygobite, Uncertain SRE	1.1	Localised range within synclinal aquifer. Habitat extends beyond predicted direct impacts.
Total species/ taxa	12				

* Distribution is discussed relative to predicted direct impacts - pit locations and predicted drawdown extents.

10.3.4. Key Subterranean Values

The key environmental values associated with subterranean fauna in the Revised Development Envelope and which are the subject of assessment (including cumulative impact assessment) include:

- High and medium suitability above water table troglofauna habitat
- Suitable below water table stygofauna habitat
- Moderate species richness of troglofauna (42 troglobitic taxa)
- Low species richness of stygofauna (12 stygobitic taxa)

10.4. Potential Environmental Impacts

10.4.1. Direct Impacts

Potential direct impacts from the Proposal to subterranean fauna include:

- Loss of individuals or permanent reduction of troglofauna habitat as a result of mining (i.e. pit excavation)
- Loss of individuals or permanent reduction of stygofauna habitat values through mining and associated groundwater drawdown (i.e. pit dewatering and water supply).

10.4.2. Indirect Impacts

Indirect impacts may occur when proposed actions reduce the quality of subterranean fauna habitat or degrade the habitat that remains intact following direct impacts. Indirect impacts are typically more subtle or gradational and may be expressed at varying distances from the source of impact or activity. The following are potential indirect impacts from the Proposal that may affect the known subterranean fauna values:

- Changes to surface inputs of flow/volume of water, nutrients and oxygen from:
 - Construction of waste landforms, stockpiles
 - Vegetation clearing
 - Changed hydrological regime
- Changes to the structure and presence of underground voids from:
 - Sedimentation and fill (beneath waste landforms, stockpiles)
 - Compaction, blasting/shock and vibration
- Desiccation of subterranean habitat from:
 - Groundwater drawdown
 - Changes to surface infiltration
- Fragmentation of previously connected/contiguous habitat by excavation
- Contamination from spills, leaching and environmental incidents.

Indirect impacts to subterranean fauna habitats are difficult to quantify and assess, particularly where evidence of the environmental tolerances of subterranean species is limited. Indirect impacts from hydrological changes were quantified using a two-dimensional assessment of the area occupied by proposed WRL's and stockpiles against the area of suitable habitat remaining under the worst-case (combined impacts) scenario as modelled (Biologic 2022m). Potential habitat fragmentation was also assessed based on the connectivity and thickness of modelled suitable habitat remaining after direct impacts. Whilst the other indirect impacts listed above could not be quantified based on current

knowledge, these impacts were considered likely to be negligible, given the extent of suitable habitat unlikely to be indirectly impacted.

10.4.3. Combined Impacts

Combined impacts represent the combination of direct impacts from existing approved operations and predicted direct impacts resulting from the Proposal. Biologic (2022m) modelled subterranean fauna habitats throughout the West Angelas Region, facilitating quantitative assessment of combined impacts to subterranean fauna habitats and species values within each section of the Revised Development Envelope where combined impacts occurred. The work focused on direct impacts for the combined assessment, as indirect impacts are more subtle and gradational, less well supported by evidence and data, and are unable to be quantified as confidently as direct impacts.

10.4.4. Cumulative Impacts (Third party Operations)

Combined impacts represent the combination of direct impacts from existing approved operations and predicted direct impacts resulting from the Proposal. Biologic (2022m) modelled subterranean fauna habitats throughout the West Angelas Region, facilitating quantitative assessment of combined impacts to subterranean fauna habitats and species values within each section of the Revised Development Envelope where combined impacts occurred. The work focused on direct impacts for the combined assessment, as indirect impacts are more subtle and gradational, less well supported by evidence and data, and are unable to be quantified as confidently as direct impacts.

10.5. Mitigation

The Proponent is committed to ensuring that the Proposal avoids, minimises, and manages impacts to subterranean fauna species, assemblages and habitats as far as practicable, following application of the mitigation hierarchy.

10.5.1. Mitigation Hierarchy

Table 10-9 demonstrates the application of the mitigation hierarchy regarding subterranean fauna impacts, and the measures employed to avoid, minimise, rehabilitate, and limit potential impacts. Biologic's (2022m) EIA concluded that significant impacts to subterranean fauna values are unlikely to occur following implementation of the Proposal and that potential impacts will be manageable. Therefore, environmental offsets are not required for subterranean fauna.

10.5.2. Avoidance Minimisation

The Proponent has refined the Conceptual Footprint and Revised Development Envelope to ensure that the Proposal prioritises the avoidance and/or minimisation of impacts to troglofauna and stygofauna values to the greatest extent possible, including impacts to habitat connectivity (across and between habitats), where other options exist. Key outcomes of these refinements have been described in Table 10-9.

10.5.3. Mitigation of Risk at Closure

The West Angelas Revised Proposal MCP has been prepared to address closure requirements for the Proposal (Appendix A.5).

The MCP includes objectives to ensure that vegetation on rehabilitated land consists of self-sustaining native species and is compatible with the post-mining land use; that final landforms are stable and consider ecological and hydrological factors and do not represent a significant ecological risk. Specifically in relation to subterranean fauna, the MCP discusses partial backfill of pits and recovery of groundwater for habitat recovery post closure. The MCP will be updated regularly to ensure its objectives

remain relevant and aligned to stakeholder expectations and that its strategies and plan are appropriate to achieve closure outcomes.

10.5.4. Summary of the Application of the Mitigation Hierarchy

As described above, the Proposal has been designed to avoid and mitigate impacts to subterranean fauna values within the Revised Development Envelope. Table 10-9 summarises the mitigation hierarchy for this Proposal.

Table 10-9: Mitigation Measures for the Subterranean Fauna Environmental Factor

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Direct Impacts				
<ul style="list-style-type: none"> Loss of individuals or reduction in troglofauna habitat Loss of individuals or reduction in stygofauna habitat 	<p>Measures to Minimise</p> <ul style="list-style-type: none"> Pit dewatering will be minimised to that required to safely access below water table resources Clearing will be minimised to only that required for implementation of the Proposal Water from mine dewatering will be used on site in the first instance to minimise the requirement for additional groundwater abstraction for operational water supply The water management strategy includes the option of temporary surplus water storage in disused mine pits when they are available. This approach may result in passive recharge and recovery of groundwater at those locations Abstraction of groundwater will be within licence limits and groundwater levels will be monitored to ensure impact remains within the predicted range of drawdown. Abstraction of groundwater managed under Groundwater Licence GWL98740 Abstraction licence The MAR will be monitored to ensure it is working as intended under MS 1113 in accordance with the Groundwater Environmental Management Plan 	<p>Proposal Specific</p>	<p>Yes – Groundwater Licence limiting the total abstraction volume per annum and associated Groundwater Licence Operating Strategy</p>	<ul style="list-style-type: none"> There are no industry or best practice standards established in relation to the protection of subterranean fauna and/or habitat protection. Minimisation of impacts to species and/or habitats is considered the most effective control. Approximately 98% of existing connected high and medium suitability troglofauna habitat, and 86% of suitable stygofauna habitat will be retained following direct impacts from the Proposal, providing sustainable habitat for subterranean fauna assemblages. No troglofauna or stygofauna taxa lost at a species level, local impacts from the Proposal were all considered low to medium. MAR will be operated to ensure natural groundwater levels west of the Revised Development Envelope boundary. Operation of the MAR will be managed via Groundwater Environmental Management Plan and to the conditions of MS 1113.

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Rehabilitate			
	<ul style="list-style-type: none"> • Backfill of pits to enable potential groundwater recovery over time and avoid ongoing evaporative losses • The Closure Plans include a closure objective to ensure that the final landform is stable and considers hydrogeological factors, including backfilling pits in accordance with the West Angelas MCP and Condition 7 of MS 1113 (Rehabilitation) • Progressive rehabilitation will be undertaken which will assist with re-establishing nutrient, oxygen, and water flows into the subterranean environment 	Proposal Specific	Yes – DMIRS for implementation of the MCP	<ul style="list-style-type: none"> • Backfilling of pits to reduce potential drawdown extent post closure is considered an effective control in preventing long term drawdown • Progressive rehabilitation will follow industry best practices.
Proposed Limits on Impact to Ensure Environmental Outcomes			Mechanism for Limit	
<ul style="list-style-type: none"> • As per extent that was approved under MS 1113 (Condition 6 and 7) and future attachments to this statement or new Ministerial Statements • Impacts are limited to the proposed mining pits and groundwater drawdown areas within the Revised Development Envelope 			<ul style="list-style-type: none"> • Ministerial condition with annual limit on groundwater abstraction • Implementation of conditions in accordance with the Ministerial Approval Statement (Part IV EP Act) • Operating Licence, L7774/2000 (issued by DWER under Part V of the EP Act) • Abstraction of groundwater managed under Groundwater Licence GWL98740 (DWER) • Approved footprint under new MS (Part IV EP Act). 	

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
Indirect Impacts				
<ul style="list-style-type: none"> • Changes to surface inputs of flow/volume of water, nutrients and oxygen • Changes to the structure and presence of underground voids • Desiccation of subterranean habitat • Fragmentation of previously connected/contiguous habitat 	<p>Measures to Minimise</p> <ul style="list-style-type: none"> • Clearing and/or disturbance to remain within the Approved Development Envelope • Appropriate design of waste landforms specifically encapsulation of PAF waste rock and minimisation of oxidation to prevent changes to groundwater quality • Appropriate design of hazardous material storages in accordance with relevant guidelines and Australian Standards • Construction and maintenance of surface water drainage systems to control and contain runoff from mining areas and divert clean stormwater away from pits and other mining disturbance areas • Monitoring of groundwater quality during operations. • Provision of spill kits and implementation of spill management procedures • Progressive rehabilitation will be undertaken. • Major disruption to surface hydrology patterns will be managed via drainage management procedures 	Standard business practise	No	These measures are standard business practise and are considered effective controls in minimising indirect impacts on subterranean fauna

Potential Impact	Mitigation	Standard Business Practise or Proposal Specific?	Other Decision-making Process Relevant?	Effectiveness of the Controls
	Measures to Rehabilitate			
	<ul style="list-style-type: none"> • Backfill of pits to prevent formation of pit lakes post closure • Opportunistic investigation into backfilling of pits to surface if possible • The Closure Plans include a closure objective to ensure that the final landform is stable and considers hydrogeological factors, including backfilling pits in accordance with the West Angelas MCP and Condition 7 of MS 1113 (Rehabilitation) 	Proposal Specific	Yes – DMIRS for implementation of the MCP	<ul style="list-style-type: none"> • Backfilling of pits with moderate or high risk of forming acidic pit lakes is considered an effective control in preventing contamination of local aquifers • The MCP must detail all legal obligations for rehabilitation and closure that affect post-mining land use and closure outcomes, including backfill of pits (DMIRS 2020a)
	Proposed Limits on Impact to Ensure Environmental Outcomes		Mechanism for Limit	
No limits proposed – managed through standard industry practices		N/A		

10.6. Assessment and Significance of Residual Impacts

Impact Ratings - Habitat Values

Through giving due regard to the best available information on subterranean fauna habitats (3D modelling) and species (survey information), the impact ratings to subterranean fauna habitat values are based on the following thresholds (Biologic 2022m):

- **High impact** – Loss of pre-mining habitat volume > 50% (*i.e.* retention of habitat < 50%). Overall changes to habitat extent, thickness, and connectivity are significant. Long-term viability and persistence are at risk; the capacity of the habitat to support subterranean fauna species may be at risk
- **Medium impact** – Loss of pre-mining habitat volume 25 – 50% (*i.e.* retention of habitat 50-75%). Overall changes to habitat extent, thickness, and connectivity are moderate. Long-term viability and persistence are not at risk; the habitat values may be subject to change, but the capacity to support subterranean fauna species is not at risk
- **Low impact** – Loss of pre-mining habitat volume < 25% (*i.e.* retention of habitat >75%). Overall change to habitat extent, thickness, and connectivity is minimal. The long-term viability or persistence of the habitat values is unlikely to change.

Impact Ratings - Species Values

Through giving due regard to the best available information on subterranean fauna species (survey records, distributions, ecological information) and habitat (modelled extent and connectivity of habitat remaining), Impact ratings to subterranean fauna species values based on the following thresholds (Biologic 2022m):

- **High impact** – Impacts are significant and unlikely to be confidently managed/ mitigated. Residual impacts may affect the long-term viability or persistence of the values; the species (or assemblage) is at risk of being lost
- **Medium impact** – Impacts are moderate and/or may be confidently managed/ mitigated. Residual impacts are unlikely to affect the long-term viability or persistence of the values; the level of risk to the species (or assemblage) is moderate and/or manageable
- **Low impact** – Impacts are likely to be minimal and are not expected to change the long-term viability or persistence of the species (or assemblage).

10.6.1. Assessment of Impacts to Troglifauna Values

10.6.1.1. Assessment of Direct Impacts

Permanent Reduction of Troglifauna Habitat as a Result of Mining

Creation of pits will result in the direct removal of suitable troglifauna habitat within the Revised Development Envelope. Modelling indicated well-connected suitable habitat in the Brockman Iron Formation and colluvial detritals (Western Hill and Mt Ella East) and Marra-Mamba Formations (Deposit H and Deposit F North) within the Revised Development Envelope, with no major barriers to fauna movement or dispersal (Figure 10-7, Figure 10-8, and Figure 10-9).

The potential loss of habitat as a result of direct impacts was quantified using changes in volume of modelled high and medium suitable habitat (Biologic 2022m). Overall, only 2% of suitable troglifauna habitat within the Revised Development Envelope and West Angelas Region will be directly impacted by the Proposal, with no more than 17% (at Western Hill) of habitat impacted in any section of the Revised Development Envelope (Table 10-10, Biologic 2022b). Based on the modelled extent, thickness, and connectiveness of the habitats remaining following direct impacts from the Proposal

Figure 10-13 to Figure 10-15, and Figure 10-17 to Figure 10-19), It is expected that these habitats continue to support troglofauna in all sections of the Revised Development Envelope following implementation of the Proposal.

The overall reduction in habitat across the Revised Development Envelope as a result of the Proposal is considered to be Low (based on the criteria outlined in Section 10.6), with approximately 98% of the suitable troglofauna habitat expected to be retained post mining (Table 10-6). Local habitat loss ranged from 2 – 17% which is considered a low impact in all sections of the Revised Development Envelope (Biologic 2022m).

Table 10-10: Overall Summary of the Proportions of Troglofauna Habitat Values Proposed to be Directly Impacted at Each Section of the Revised Development Envelope

Revised Development Envelope Section	Pre-Impact 3D Habitat Volume (m ³ , '000)	Proposed Scenario 3D Habitat Loss		Change to AWT Habitat Extent, Thickness, Connectivity	Overall Impact to Troglofauna Habitat Values
		m ³ ('000)	%		
Western Hill	845,580	144,310	17%	Minor	Low
Deposit H	189,173	24,801	13%	Minor	Low
Deposit F North	727,330	19,760	3%	Negligible	Low
Mt Ella East	1,163,720	27,390	2%	Negligible	Low
Remaining West Angelas	6,258,877	0	0%	None	None
Total Revised Development Envelope	9,184,680	216,261	2%	Minor	Low

Loss of Troglofaunal Individuals as a Result of Mining

An assessment of the troglofauna species considered relevant to the direct impact assessment has been undertaken. Based on this assessment, 42 troglofauna species were restricted to the direct impact areas within the Revised Development Envelope (Figure 10-4). Troglofauna species recorded within the Revised Development Envelope were assessed on their known distribution, ecological and habitat requirements and assigned a risk category of High, Medium or Low according to the potential impact of the Proposal on each species (Section 10.6). Of the 42 troglofauna species recorded within the Revised Development Envelope, the direct impacts of the Proposal were considered Medium for seven troglofauna species known only from direct impact areas at Western Hill and Deposit H (Table 10-11, Figure 10-7, and Figure 10-8). Proposal were considered Low for the remaining 35 troglofauna species values recorded from Revised Development Envelope as they are known to be locally widespread beyond impact areas, and as a result are not discussed further (Table 10-11 and Table 10-12).

Table 10-11: Numbers of Troglifauna Taxa within Each Impact Rank Under the Proposed Direct Impact Scenario

Revised Development Envelope Section	High Ranked Taxa	Medium Ranked Taxa	Low Ranked Taxa
Western Hill	-	6	8
Deposit H	-	1	12
Deposit F North	-	-	9
Mt Ella East	-	-	14
Total Revised Development Envelope	0	7	35[^]

[^] Some low-risk taxa were recorded in multiple Revised Development Envelope sections

Table 10-12: Key Impact Assessment Details for Troglifauna Species Values for Proposal by Section of the Revised Development Envelope

Revised Development Envelope Section	Troglifauna Taxa (Medium Impact)	Impact Assessment Details (Biologic 2022m)	Troglifauna Taxa (Low Impact)	Impact Assessment Details (Biologic 2022m)
Western Hill	<p>Arachnida</p> <p>Araneae sp. `Biologic ARAN030`</p> <p>Palpigradi `sp. Biologic-PALP016`</p> <p>Insecta</p> <p><i>Trinemura</i> `sp. Biologic-ZYGE013`</p> <p>Myriapoda</p> <p>Pauropoda `sp. Biologic-PAUR014`</p> <p>Pauropoda `sp. Biologic-PAUR020`</p> <p>Scolopendrellidae `sp. Biologic-SYMP012`</p>	<p>Taxa currently known only from single sites within proposed pits.</p> <p>Suitable and moderately to very thick (35 m to >70 m) habitat remains intact AWT within pit boundaries and beyond. Habitat remains well-connected within and beyond pit boundaries, and likely extends beyond modelling.</p> <p>Overall loss of habitat is low (17%). Direct impacts not expected to result in loss of troglifauna species values.</p>	<p>Arachnida</p> <p><i>Tyrannochthonius</i> `sp. Biologic-PSEU015`</p> <p>Entognatha</p> <p>Atelurinae `sp. Biologic-ZYGE012`</p> <p>Insecta</p> <p>Meenoplidae `sp. Biologic-HEMI010`</p> <p><i>Nocticola</i> `sp. Biologic-BLAT014`</p> <p>Sciaridae `sp. Biologic-DIPT001`</p> <p>Myriapoda</p> <p><i>Cryptops</i> `sp. WAWH`</p> <p>Pauropoda `sp. Biologic-PAUR016`</p> <p>Pauropoda `sp. Biologic-PAUR018`</p>	<p>Taxa have also been recorded outside of direct impact areas.</p> <p>Suitable habitat remains intact and well-connected throughout Western Hill section.</p> <p>Overall loss of habitat is low (17%). Direct impacts not expected to result in loss of troglifauna species values.</p>
Deposit H	<p>Arachnida</p> <p>Palpigradi `sp. Biologic-PALP017`</p>	<p>Recorded only from a single site within proposed pit.</p> <p>Suitable and moderately thick (>25 m) habitat remains intact AWT within pit boundaries and beyond. Habitat remains well-connected within and beyond pit boundaries.</p> <p>Overall loss of habitat is low (13%). Direct impacts not expected to result in loss of troglifauna species values.</p>	<p>Arachnida</p> <p><i>Indohya</i> `sp. Biologic-PSEU016`</p> <p>Palpigradi `sp. Biologic-PALP020`</p> <p><i>Prethopalpus</i> `sp. Biologic-ARAN012`</p> <p>Theridiidae `sp. Biologic-ARAN010`</p> <p><i>Tyrannochthonius</i> `sp. Biologic-PSEU013`</p> <p><i>Tyrannochthonius</i> `sp. Biologic-PSEU014`</p> <p>Crustacea</p> <p><i>Pseudodiploexochus</i> `sp. WAH`</p>	<p>Taxa have also been recorded outside of direct impact areas.</p> <p>Suitable habitat remains intact and well-connected throughout Deposit H section.</p> <p>Overall loss of habitat is low (13%). Direct impacts not expected to result in loss of troglifauna species values.</p>

Revised Development Envelope Section	Troglofauna Taxa (Medium Impact)	Impact Assessment Details (Biologic 2022m)	Troglofauna Taxa (Low Impact)	Impact Assessment Details (Biologic 2022m)
			<p>Entognatha Parajapigydae `sp. Biologic-DIPL016`</p> <p>Insecta <i>Nocticola</i> `sp. Biologic-BLAT015` <i>Phaconeura</i> `sp. Biologic-HEMI003`</p> <p>Myriapoda Pauropoda `sp. Biologic-PAUR017` Scutigereillidae `sp. Biologic-SYMP011`</p>	
Deposit F North	No taxa at Medium level of impact	N/A	<p>Arachnida Araneae `sp. Biologic-ARAN008` Palpigradi `sp. Biologic-PALP018`</p> <p>Insecta <i>Dodecastyla</i> `sp. Biologic-ZYGE011` <i>Nocticola</i> `sp. Biologic-BLAT014` <i>Phaconeura</i> `sp. Biologic-HEMI003`</p> <p>Entognatha Japygidae `sp. Biologic-DIPL017`</p> <p>Myriapoda Pauropoda `sp. Biologic-PAUR019` Scutigereillidae `sp. Biologic-SYMP011` Scutigereillidae `sp. Helix-SYM027`</p>	<p>Taxa have also been recorded outside of direct impact areas.</p> <p>Suitable habitat remains intact and well-connected throughout Deposit F North section.</p> <p>Overall loss of habitat is low (3%). Direct impacts not expected to result in loss of troglofauna species values.</p>

Revised Development Envelope Section	Troglofauna Taxa (Medium Impact)	Impact Assessment Details (Biologic 2022m)	Troglofauna Taxa (Low Impact)	Impact Assessment Details (Biologic 2022m)
Mt Ella East	No taxa at Medium level of impact	N/A	<p>Arachnida <i>Indolpium</i> `sp. Biologic-PSEU017` Oonopidae `sp. Biologic-ARAN018` Palpigradi `sp. Biologic-PALP018` Palpigradi `sp. Biologic-PALP019` Theridiidae `sp. Biologic-ARAN010` <i>Tyrannochthonius</i> `sp. Biologic-PSEU011` <i>Tyrannochthonius</i> `sp. Biologic-PSEU012`</p> <p>Crustacea Philosciidae `sp. Biologic ISOP015`</p> <p>Entognatha Atelurinae `sp. Biologic-ZYGE014` <i>Trinemura</i> `sp. Biologic-ZYGE017`</p> <p>Insecta Coleoptera `sp. Biologic-COLE007` <i>Dodecastyla</i> `sp. Biologic-ZYGE011` <i>Nocticola</i> `sp. Biologic-BLAT014`</p> <p>Myriapoda <i>Hanseniella</i> `sp. Biologic-SYMP018`</p>	<p>Taxa have also been recorded outside of direct impact areas.</p> <p>Suitable habitat remains intact and well-connected throughout Mt Ella East section.</p> <p>Overall loss of habitat is low (2%). Direct impacts not expected to result in loss of troglofauna species values.</p>

10.6.1.2. Assessment of Indirect Impacts

Indirect Impacts to Areas Beneath Proposed Waste Landforms/Stockpiles

Overall indirect impacts to troglofauna values are considered Low, with only a minor proportion (approximately 3%) of the suitable habitat remaining under the worst-case (combined) scenario potentially to be impacted (Table 10-13). Together with the conservative modelling boundaries and the subtle and gradational nature of indirect impacts, indirect impacts from the Proposal are considered unlikely to be significant, and indirect impacts from WRL's and stockpiles are not expected to significantly increase the impact to troglofauna habitat or species value within the Revised Development Envelope.

A total of six troglofauna taxa were recorded within indirect impact areas (WRL's/ stockpiles) comprising five taxa at Deposit H (Prethopalpus `sp. Biologic-ARAN012`, Theridiidae `sp. Biologic-ARAN010`, Indohya `sp. Biologic-PSEU016`, Tyrannochthonius `sp. Biologic-PSEU014`, and Pauropoda `sp. Biologic-PAUR017`), and one taxon at Deposit F North (Scutigereleididae sp. `Helix-SYM027`). For the reasons detailed above, the indirect impacts to these taxa were assessed as Low (Biologic 2022m).

Table 10-13: Overall Summary of the Proportions of Troglofauna Habitat Remaining Under the Combined Scenario Indirectly Impacted by the Proposal, Based on 2D Area Assessment

Revised Development Envelope Section	Minimum Area of 2D Habitat Remaining Intact (Combined Scenario) (ha)	Area of Habitat within Proposed Indirect Impacts (Waste, Stockpiles)		Overall Indirect Impact to Troglofauna Habitat
		ha	% *	
Western Hill	2,030	248	12%	Low
Deposit H	899	131	15%	Low
Deposit F North	1,627	79	5%	Low
Mt Ella East	1,860	93	5%	Low
Remaining West Angelas	13,679	37	<1%	Negligible
Total Revised Development Envelope	20,095	588	3%	Low

*Percentage of the 2D habitat area remaining in the worst-case (combined) scenario that is covered by proposed WRL's and stockpiles

10.6.1.3. Assessment of Combined Impacts

Combined impacts on troglofauna habitat and species values within the Revised Development Envelope are considered Low, with approximately 88% of the suitable modelled troglofauna habitat expected to be retained post mining (Table 10-14 and Biologic 2022m). Combined impacts are only present near existing pits within the Deposit F North section and, to a negligible degree, at Mt Ella East (Biologic 2022m) (Figure 10-16 and Figure 10-18). There are no combined impacts at Western Hill and Deposit H. Overall, only 12% of suitable troglofauna habitat within the Revised Development Envelope and West Angelas Region will be impacted by combined impacts, and local habitat loss ranged from 3 – 22% (Table 10-14) which is considered to be a Low impact rating in all sections (Biologic 2022m).

Based on the modelled extent, thickness, and connectiveness of the habitats remaining following combined direct impacts, these habitats are expected to continue to support troglofauna in all sections of the Revised Development Envelope following implementation of the Proposal. In addition, large areas of potentially suitable, well-connected, contiguous geological habitats have been shown to occur beyond the conservative 3D modelling boundaries (Biologic 2022m).

Table 10-14: Overall Summary of the Proportions of Troglifauna Habitat Impacted by Combined Direct Impacts (Current and Proposed) within the Revised Development Envelope

Revised Development Envelope Section	Pre-impact 3D Habitat Volume (m ³ '000)	Combined Scenario		Change to AWT Habitat extent, Thickness, Connectivity	Overall Impact to Troglifauna Habitat Values
		3D Habitat Loss m ³ ('000)	%		
Western Hill	845,580	144,310	17%	Minor	Low
Deposit H	189,173	24,801	13%	Minor	Low
Deposit F North	727,330	156,283	22%	Minor	Low
Mt Ella East	1,163,720	38,660	3%	Negligible	Low
Remaining West Angelas	6,258,877	712,586	11%	Not assessed	Not assessed
Total Revised Development Envelope	9,184,680	1,076,640	12%	Minor	Low

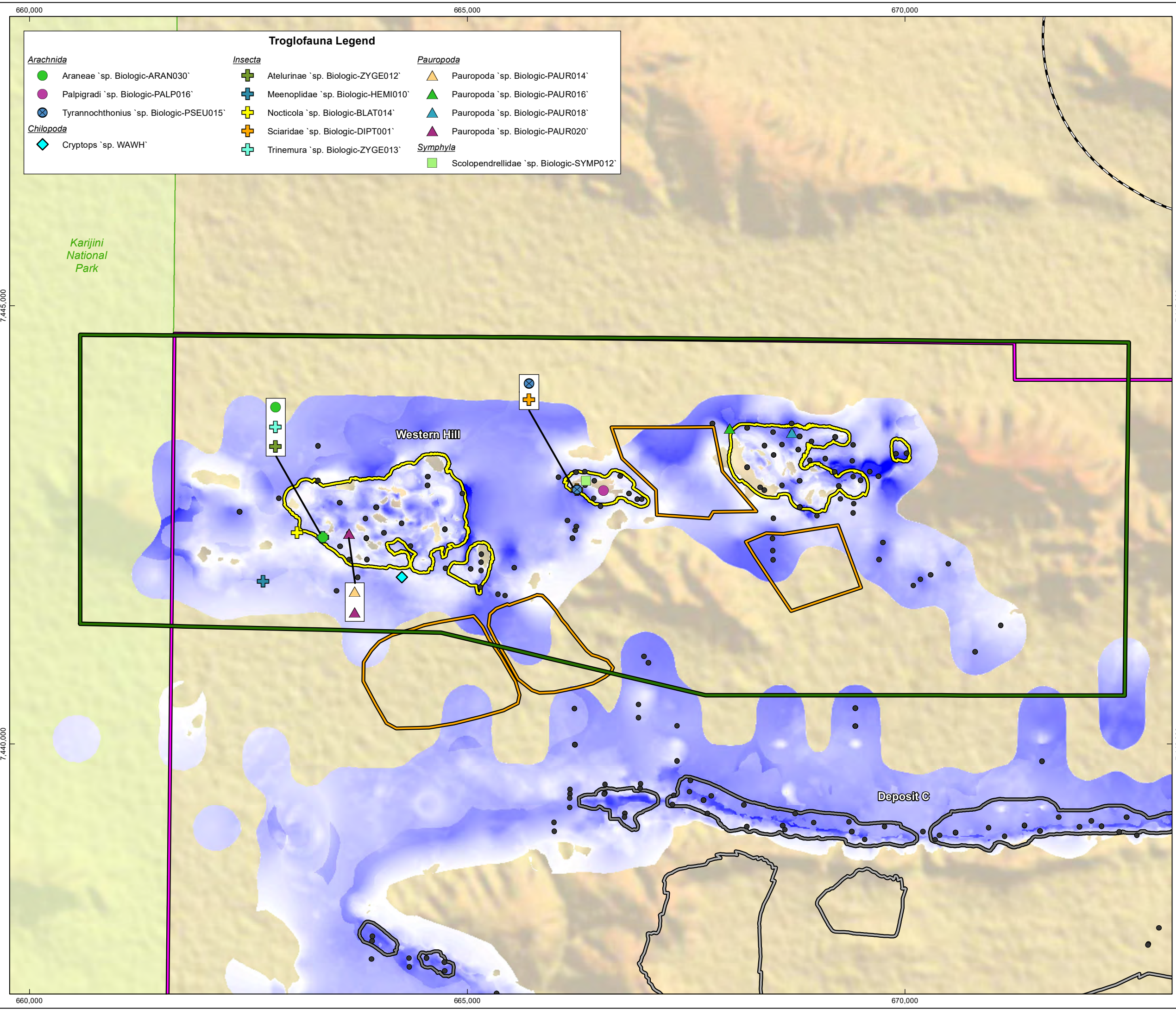
The combined direct impacts of the Proposal are not anticipated to change the impact ranking for any of the 42 troglifauna species assessed as part of this Proposal (Table 10-11 and Table 10-12). Therefore, the combined direct impacts of the Proposal are classified as Medium for seven troglifauna species known from Western Hill and Deposit H and Low for the remaining 35 species (Table 10-11).

10.6.1.4. Assessment of Cumulative Impacts

Given that there are no third-party mining projects within the immediate vicinity of the Revised Development Envelope or West Angelas Region (refer Section 10.4.4), the likelihood of the Proposal causing or contributing to cumulative impacts to troglifauna values is considered very low.

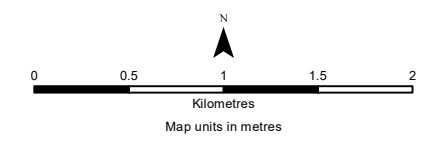
Figure 10-13
Troglifauna Records and Suitable Habitats Remaining Intact After Proposed Impacts at Western Hill

Drawn: M.L.
Plan: RTIO-0962663v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



Troglifauna Legend		
Arachnida	Insecta	Pauropoda
● Araneae 'sp. Biologic-ARAN030'	⊕ Atelurinae 'sp. Biologic-ZYGE012'	▲ Pauropoda 'sp. Biologic-PAUR014'
● Palpigradi 'sp. Biologic-PALP016'	⊕ Meenoplidae 'sp. Biologic-HEMI010'	▲ Pauropoda 'sp. Biologic-PAUR016'
● Tyrannochthonius 'sp. Biologic-PSEU015'	⊕ Nocticola 'sp. Biologic-BLAT014'	▲ Pauropoda 'sp. Biologic-PAUR018'
Chilopoda	⊕ Sciaridae 'sp. Biologic-DIPT001'	▲ Pauropoda 'sp. Biologic-PAUR020'
◆ Cryptops 'sp. WAWH'	⊕ Trinemura 'sp. Biologic-ZYGE013'	Symphyla
		■ Scolopendrellidae 'sp. Biologic-SYMP012'

Legend	
●	Troglifauna Sampling Site
□	Revised Development
—	ERD Section Boundary
AWT Habitat Thickness: Proposed Scenario (m)	
■	High: 150
■	Low: 1
Proposed Conceptual Layout	
□	Pit
□	Waste Landform
Approved Conceptual Layout	
□	Pit
□	Waste Landform
■	National Park
—	Rio Tinto Railway



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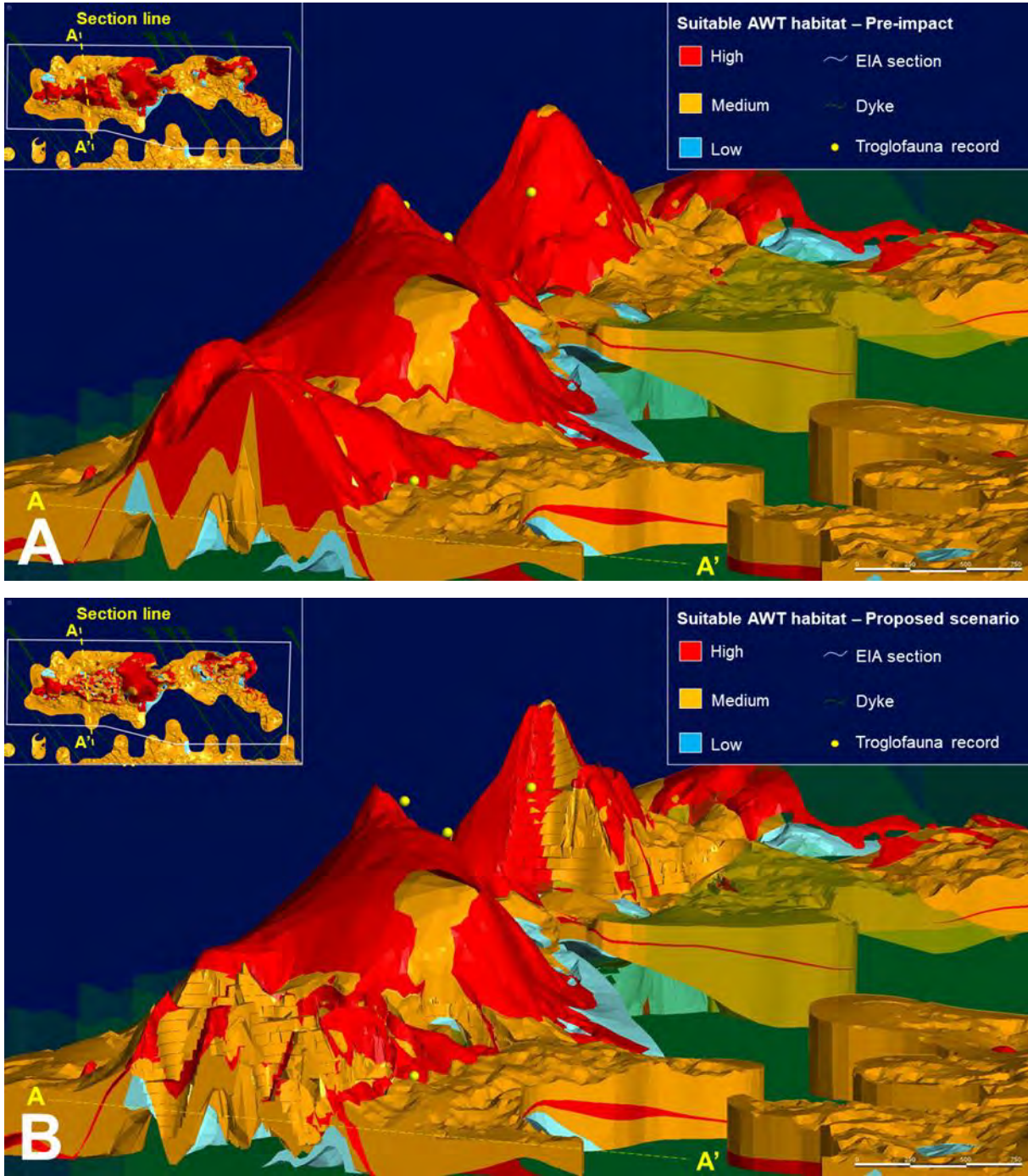
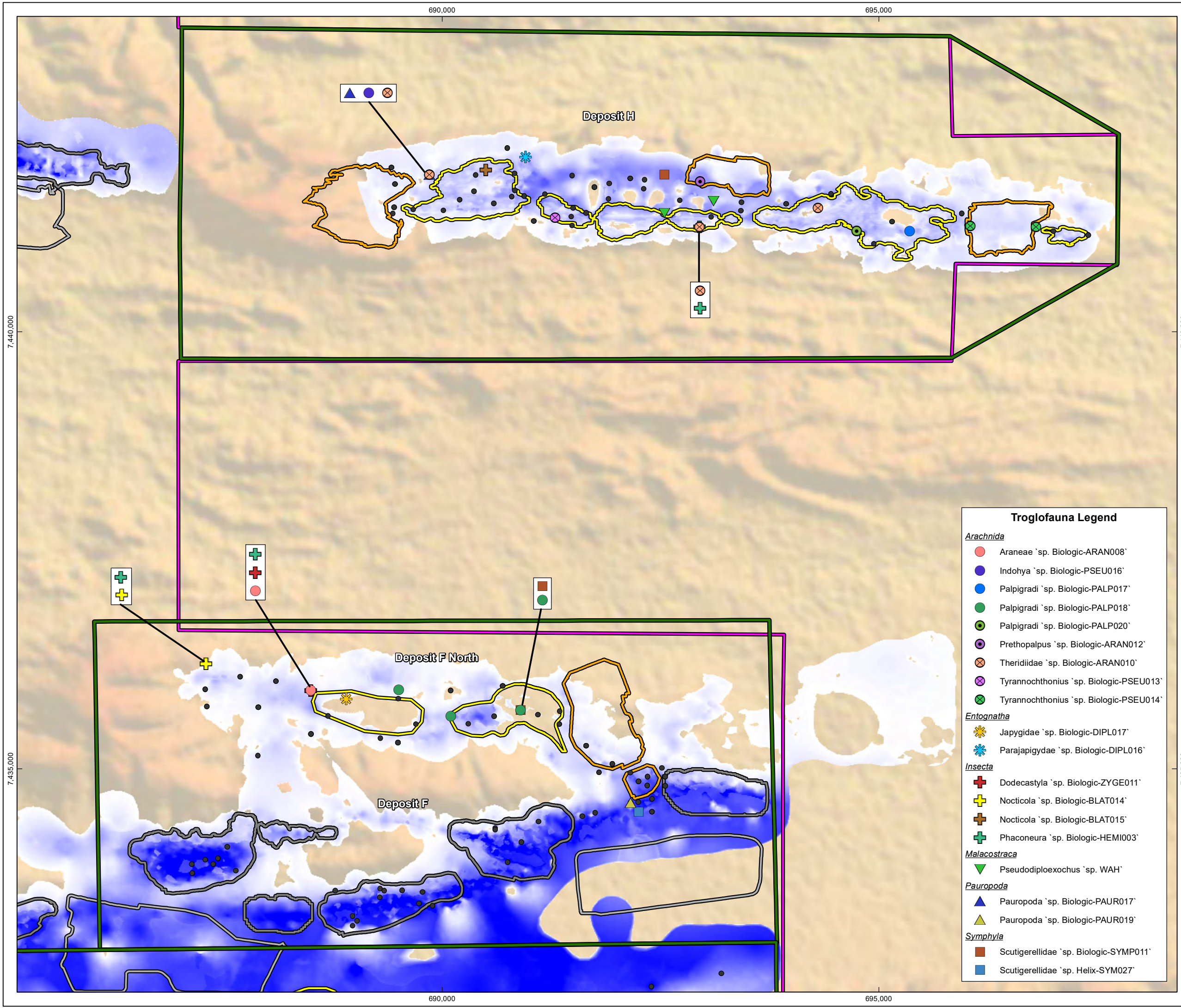


Figure 10-14: Cross-section of the 3D Subterranean Habitat Model Showing AWT Habitats (A) Pre-impact and (B) Post-impact (Proposed) at Western Hill. Vertical Scale Exaggerated x5

Figure 10-15
Troglafauna Records and
Suitable Habitats Remaining Intact
After Proposed Impacts at
Deposit H and Deposit F North

Drawn: M.L.
Plan: RTIO-0962666v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



Legend

- Troglafauna Sampling Site
- Revised Development
- ERD Section Boundary

AWT Habitat Thickness:
Proposed Scenario (m)

High : 287.215
Low : 0

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

- Pit
- Waste Landform

Troglafauna Legend

Arachnida

- Araneae `sp. Biologic-ARAN008`
- Indohya `sp. Biologic-PSEU016`
- Palpigradi `sp. Biologic-PALP017`
- Palpigradi `sp. Biologic-PALP018`
- Palpigradi `sp. Biologic-PALP020`
- Prethopalpus `sp. Biologic-ARAN012`
- Theridiidae `sp. Biologic-ARAN010`
- Tyrannochthonius `sp. Biologic-PSEU013`
- Tyrannochthonius `sp. Biologic-PSEU014`

Entognatha

- Japygidae `sp. Biologic-DIPL017`
- Parajapygidae `sp. Biologic-DIPL016`

Insecta

- Dodecastyla `sp. Biologic-ZYGE011`
- Nocticola `sp. Biologic-BLAT014`
- Nocticola `sp. Biologic-BLAT015`
- Phaconeura `sp. Biologic-HEMI003`

Malacostraca

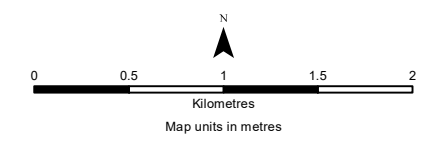
- Pseudodiploexochus `sp. WAH`

Paupopoda

- Pauropoda `sp. Biologic-PAUR017`
- Pauropoda `sp. Biologic-PAUR019`

Symphyla

- Scutigereidae `sp. Biologic-SYMP011`
- Scutigereidae `sp. Helix-SYM027`

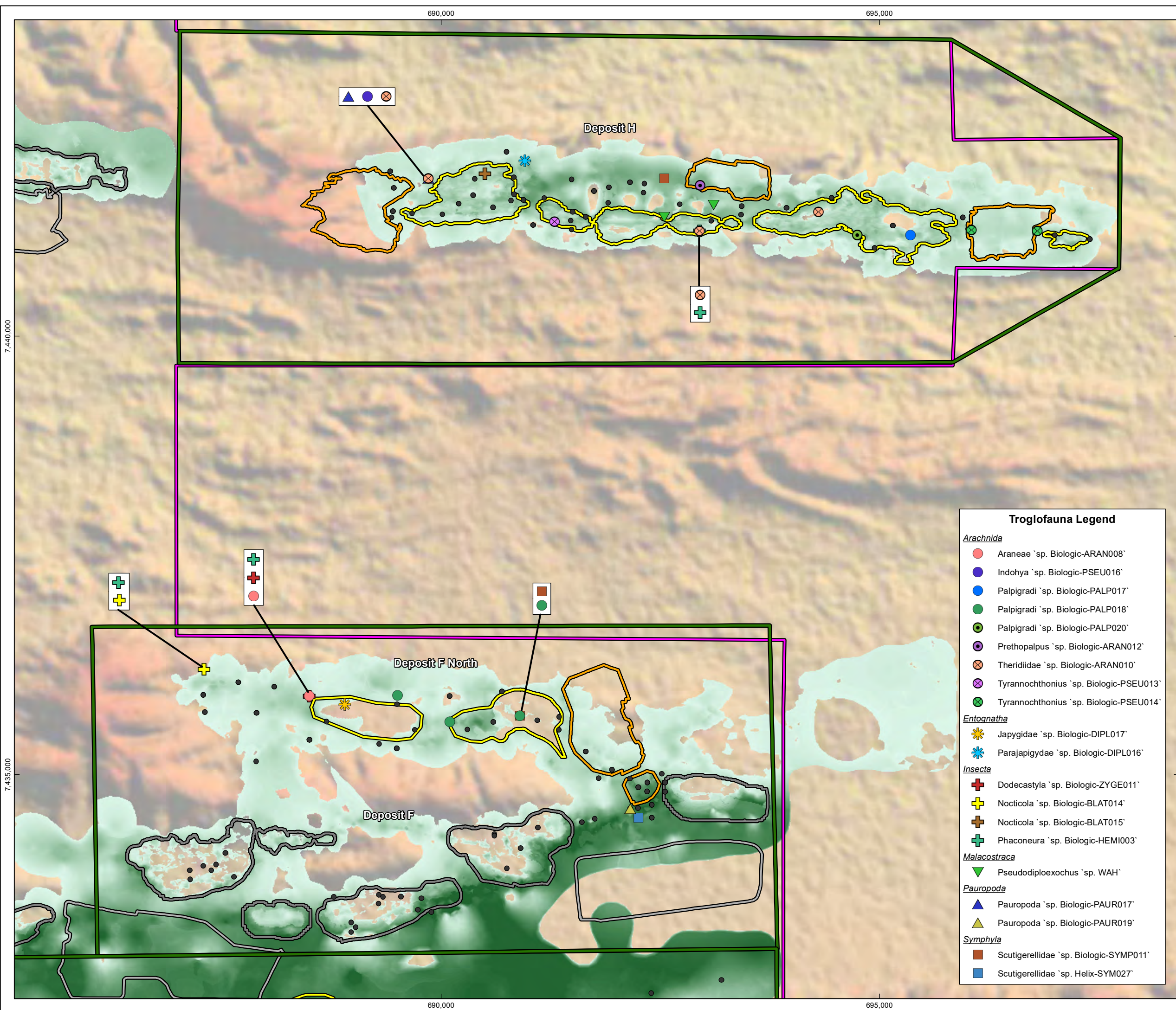


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Figure 10-16
Troglifauna Records and
Suitable Habitats Remaining Intact
After Combined Impacts at
Deposit H and Deposit F North

Drawn: M.L.
Plan: RTIO-0962667v2
Date: March 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



Legend

- Troglifauna Sampling Site
 - ▭ Revised Development Envelope
 - ▭ ERD Section Boundary
- AWT Habitat Thickness:
Combined Scenario (m)
- High : 216.009
 - Low : 0

Proposed Conceptual Layout

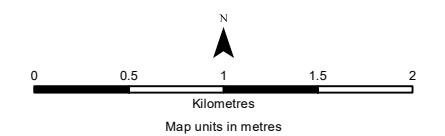
- ▭ Pit
- ▭ Waste Landform

Approved Conceptual Layout

- ▭ Pit
- ▭ Waste Landform

Troglifauna Legend

- Arachnida*
- Araneae `sp. Biologic-ARAN008`
 - Indohya `sp. Biologic-PSEU016`
 - Palpigradi `sp. Biologic-PALP017`
 - Palpigradi `sp. Biologic-PALP018`
 - Palpigradi `sp. Biologic-PALP020`
 - Prethopalpus `sp. Biologic-ARAN012`
 - Theridiidae `sp. Biologic-ARAN010`
 - Tyrannochthonius `sp. Biologic-PSEU013`
 - Tyrannochthonius `sp. Biologic-PSEU014`
- Entognatha*
- Japygidae `sp. Biologic-DIPL017`
 - Parajapygidae `sp. Biologic-DIPL016`
- Insecta*
- Dodecastyla `sp. Biologic-ZYGE011`
 - Nocticola `sp. Biologic-BLAT014`
 - Nocticola `sp. Biologic-BLAT015`
 - Phaconeura `sp. Biologic-HEMI003`
- Malacostraca*
- Pseudodiploexochus `sp. WAH`
- Pauropoda*
- Pauropoda `sp. Biologic-PAUR017`
 - Pauropoda `sp. Biologic-PAUR019`
- Symphyla*
- Scutigereillidae `sp. Biologic-SYMP011`
 - Scutigereillidae `sp. Helix-SYM027`



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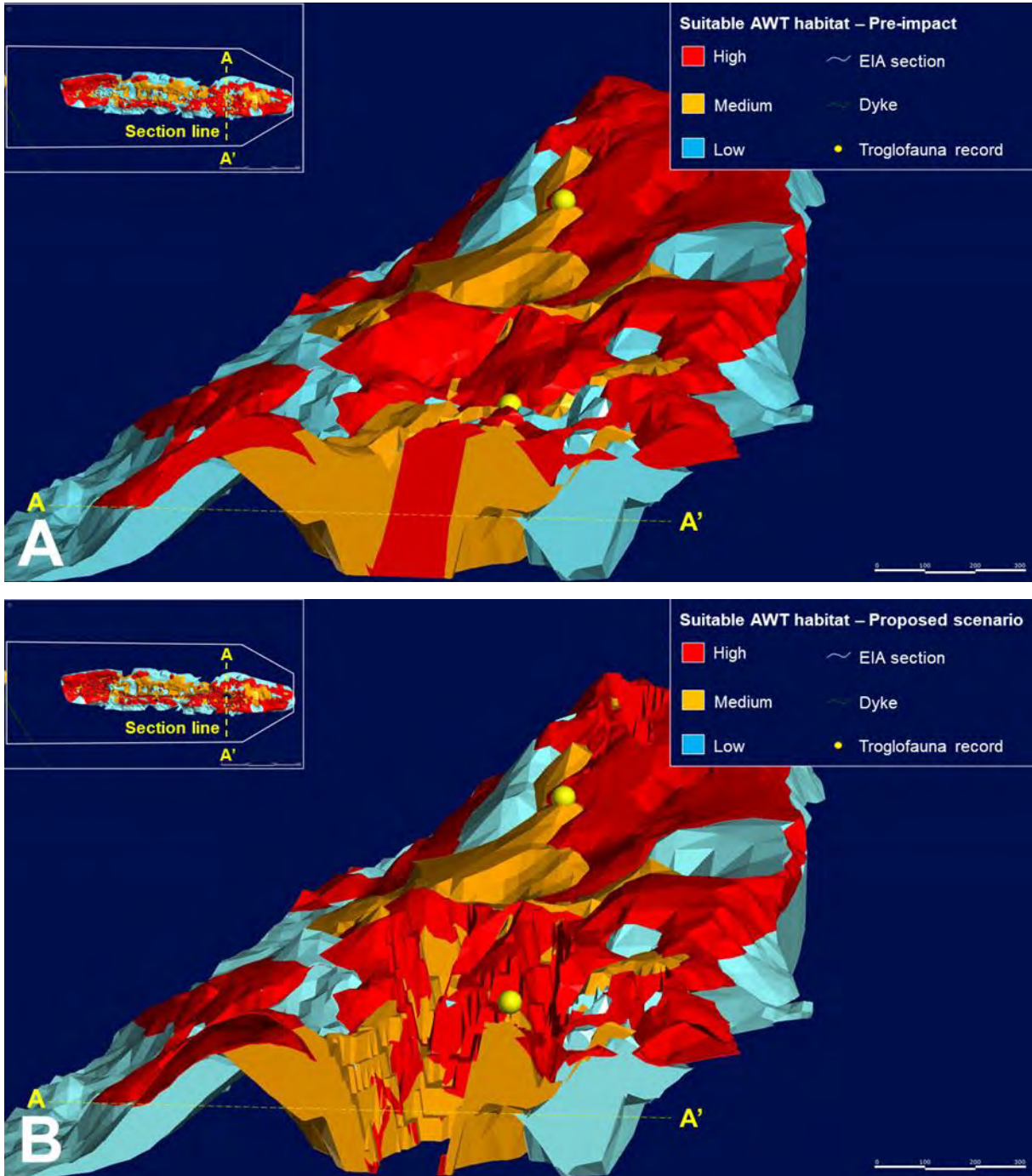


Figure 10-17: Cross-section of the 3D Subterranean Habitat Model Showing AWT Habitats (A) Pre-impact and (B) Post-impact (Proposed) at Deposit H. Vertical Scale Exaggerated x5

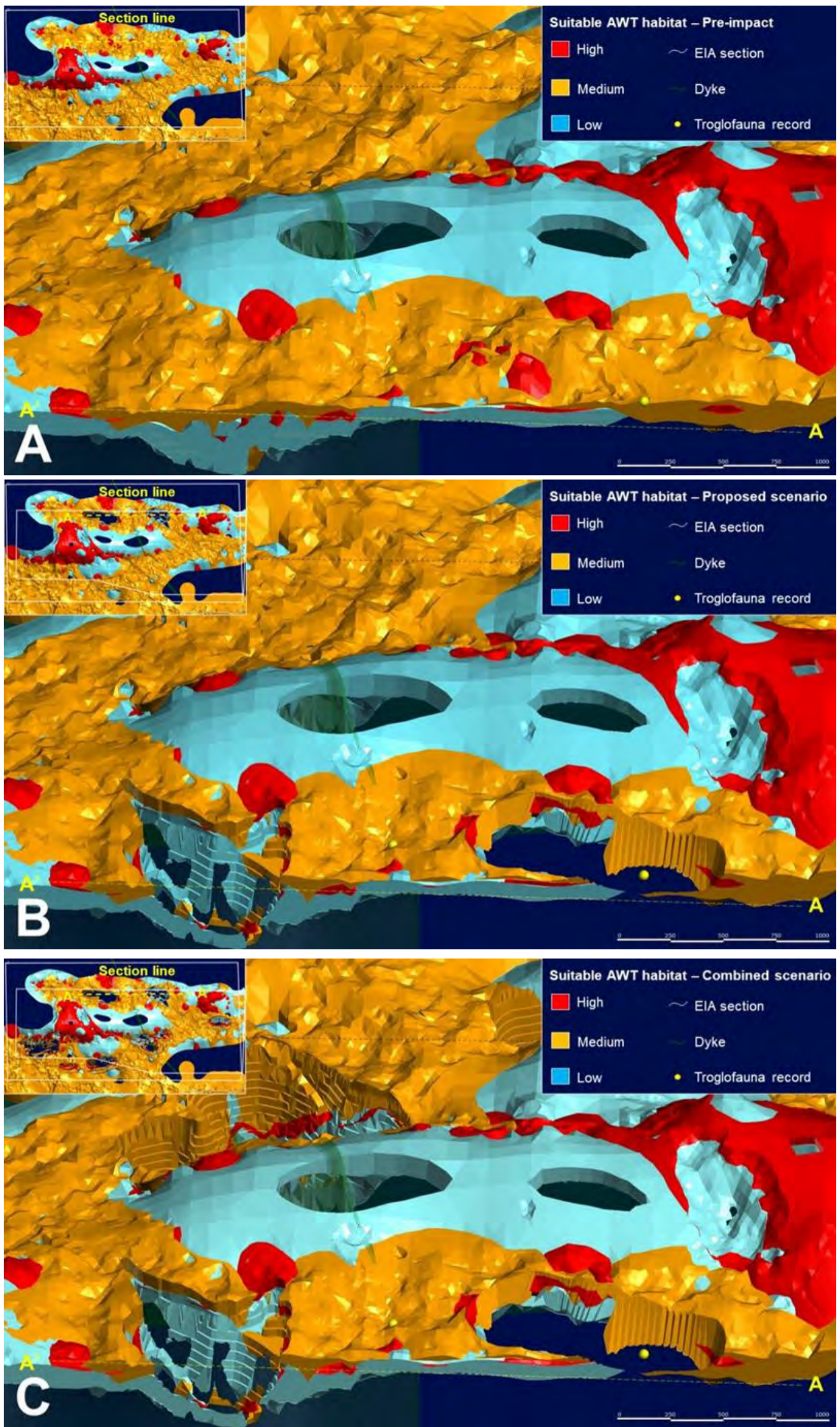
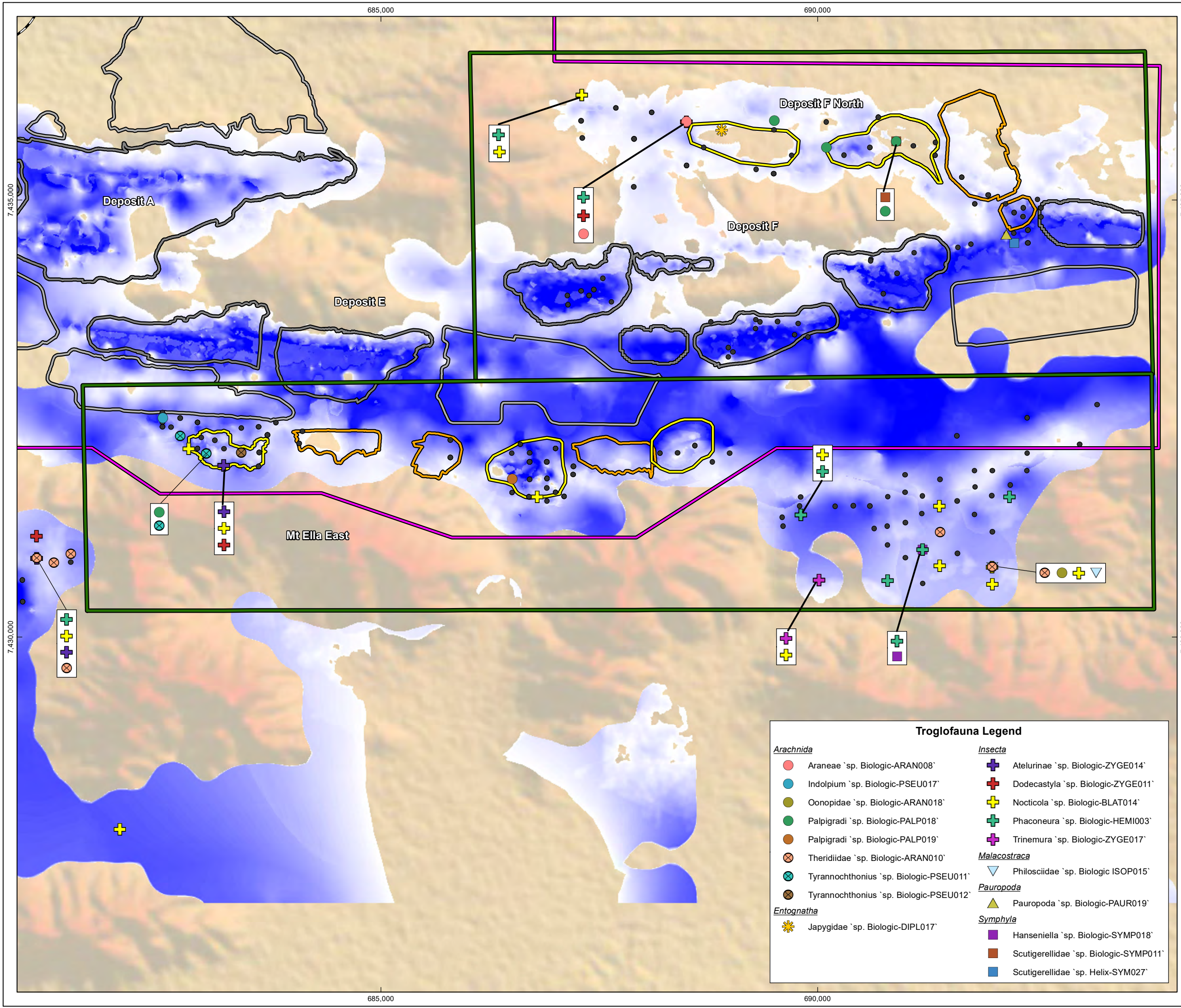


Figure 10-18: Long-section of the 3DSubterranean Habitat Model Showing AWT Habitats (A) Pre-impact (B) Post-impact (Proposed) and (C) Post-impact (Combined) at Deposit F North. Vertical Scale Exaggerated x5

Figure 10-19
Troglifauna Records and Suitable Habitats Remaining Intact After Proposed Impacts at Mt Ella East

Drawn: M.L.
Plan: RTIO-0962659v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com

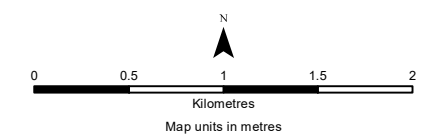


Legend

- Troglifauna Sampling Site
 - ▭ Revised Development Envelope
 - ▬ ERD Section Boundary
 - Rio Tinto Railway
- AWT Habitat Thickness:
Proposed Scenario (m)
- High: 150
 - Low: 1
- Proposed Conceptual Layout*
- ▭ Pit
 - ▭ Waste Landform
- Approved Conceptual Layout*
- ▭ Pit
 - ▭ Waste Landform

Troglifauna Legend

- | | | | |
|---|---|-------------------------------------|---|
| Arachnida | | Insecta | |
| ● Araneae `sp. Biologic-ARAN008` | ● Indolpium `sp. Biologic-PSEU017` | ⊕ Atelurinae `sp. Biologic-ZYGE014` | ⊕ Dodecastyla `sp. Biologic-ZYGE011` |
| ● Oonopidae `sp. Biologic-ARAN018` | ● Palpigradi `sp. Biologic-PALP018` | ⊕ Nocticola `sp. Biologic-BLAT014` | ⊕ Phaconeura `sp. Biologic-HEMI003` |
| ● Palpigradi `sp. Biologic-PALP019` | ⊗ Theridiidae `sp. Biologic-ARAN010` | ⊕ Trinemura `sp. Biologic-ZYGE017` | |
| ⊗ Tyrannochthonius `sp. Biologic-PSEU011` | ⊗ Tyrannochthonius `sp. Biologic-PSEU012` | Malacostraca | ▽ Philosciidae `sp. Biologic-ISOP015` |
| Entognatha | ⊗ Japygidae `sp. Biologic-DIPL017` | Paupoda | ▲ Paupoda `sp. Biologic-PAUR019` |
| | | Symphyla | ■ Hanseniella `sp. Biologic-SYMP018` |
| | | | ■ Scutigereillidae `sp. Biologic-SYMP011` |
| | | | ■ Scutigereillidae `sp. Helix-SYM027` |



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10.6.2. Assessment of Impacts to Stygofauna Values

10.6.2.1. Assessment of Direct Impacts

Permanent Reduction of Stygofauna Habitat Values through Mining and Associated Groundwater Drawdown

Creation of pits and extraction of groundwater will result in the direct removal of suitable stygofauna habitat within the Revised Development Envelope. Direct impacts from the Proposal are only anticipated to occur at Western Hill orebody aquifer and Deposit H. Deposit F North, Mt Ella East, and the regional synclinal aquifer will not be subject to direct impacts as they either lack significant habitat and species values (Deposit F North and Mt Ella East) or lack impacts to groundwater levels beyond the natural variability of groundwater table fluctuations (regional synclinal aquifer, Mt Ella East) (Biologic 2022m).

The overall reduction in stygofauna habitat across the Revised Development Envelope as a result of the Proposal is considered to be Low (based on the criteria outlined in Section 10.6), with approximately 86% of the suitable stygofauna habitat expected to be retained post mining (Table 10-15 and Figure 10-20). Local habitat reduction ranged from 1% (at Western Hill orebody aquifer) to 23% (at Deposit H) which met the Low impact rating assessment criteria (refer to section 10.6) in both areas. Based on the modelled extent, thickness, and connectiveness of the habitats remaining following direct impacts from the Proposal (Figure 10-20), it is expected that these habitats will continue to support stygofauna in all sections of the Revised Development Envelope following implementation of the Proposal (Biologic 2022m). The regional synclinal aquifer within the Revised Development Envelope was excluded from direct impact assessment of the Proposal as groundwater drawdown modelling showed that the propagation of groundwater drawdown from the orebody aquifer to the synclinal aquifer will be negligible (less than 0.5 m), which is considered within the natural variability of groundwater table fluctuations and is consequently considered to have a negligible impact to stygofauna values (Biologic 2022m).

Table 10-15: Overall Summary of the Proportions of Suitable Stygofauna Habitat Impacted Throughout the Revised Development Envelope by Direct Impacts at Each Deposit

Revised Development Envelope Section	Pre-mining 3D Habitat volume (m ³ , '000)	Proposed Scenario 3D Habitat loss		Change to BWT Habitat Extent, Thickness, Connectivity	Overall Impact to Stygofauna Habitat Values
		m ³ ('000)	%		
Western Hill (orebody aquifer)*	409,281	5,707	1%	Negligible	Low
Deposit H*	598,930	135,828	23%	Minor	Low
Deposit F North^	NA	NA	NA	NA	Negligible
Mt Ella East^	NA	NA	NA	NA	Negligible
Total Habitat in Revised Development Envelope	1,008,211	141,535	14%	Minor	Low

*Groundwater drawdown propagation into Western Hill synclinal valley is negligible (<0.5 m GWDD) and within natural variability of groundwater table fluctuations and therefore, the synclinal valley was excluded from the direct impact assessment.

^no significant stygofauna habitat values occur at Deposit F North and Mt Ella East. Mt Ella East is not proposed for BWT mining and proposed groundwater drawdown at Deposit F North is not expected to affect stygofauna habitat values as it is unsuitable for stygofauna and disconnected from other groundwater systems (Biologic 2022m).

Table 10-16: Numbers of Stygofauna Taxa within Each Impact Rank Under the Direct Impacts of Mine Pit Dewatering

Revised Development Envelope Section	Number of Taxa Recorded	High Ranked Taxa	Medium Ranked Taxa	Low Ranked Taxa
Western Hill orebody aquifer	2	-	-	2
Regional synclinal aquifer*	11*	-	-	-
Deposit H	0	-	-	-
Deposit F North	0	-	-	-
Mt Ella East	0	-	-	-
Total	12^	0	0	2

*Stygofauna taxa exclusively recorded from the regional synclinal aquifer are not considered in the direct impact assessment due to negligible direct impacts to BWT habitats in the regional synclinal aquifer

Table 10-17: Key Impact Assessment Details for Stygofauna Species Values for Proposal Potentially Impacted at Each Section of the Revised Development Envelope

Revised Development Envelope Section	Stygofauna Taxa (Low Impact)	Impact Assessment Details (Biologic 2022m)
Western Hill * (orebody aquifer)	<p>Oligochaeta Enchytraeidae `sp. Biologic-OLIG008` (amphibious, stygoxene/ stygophile)</p> <p>Amphipoda <i>Kruptus</i> `sp. Helix-AMP035`</p>	<p>Identified taxa are recorded from Western Hill orebody aquifer.</p> <p>One taxon (Enchytraeidae) amphibious, not limited to groundwater habitats.</p> <p>One taxon (<i>Kruptus</i>) also occurs throughout synclinal aquifer south of Western Hill orebody aquifer.</p> <p>Overall loss of habitat is negligible (1%).</p> <p>Groundwater drawdown impacts a minor proportion of overall Western Hill BWT habitat.</p> <p>Suitable habitat remains intact, connected, extensive, and thick throughout Western Hill orebody aquifer.</p> <p>Direct impacts of Proposal not expected to result in loss of species values or stygofauna habitat.</p>
Deposit H	No stygofauna taxa likely to be impacted	N/A
Deposit F North	No stygofauna species values present	<p>No significant habitat present for stygofauna - groundwater occurs within a small, locally-restricted patch deep below the surface, disconnected from other local aquifers. Local groundwater has been evaluated as low suitability for stygofauna (Biologic 2022m).</p> <p>Groundwater drawdown will be confined within this small, localised area due to the surrounding low permeability geologies.</p> <p>Direct impacts of Proposal not expected to result in loss of stygofauna species values or habitat.</p>
Mt Ella East	No stygofauna species values present	No groundwater drawdown impacts from Proposal

*Ten stygofauna taxa exclusively recorded from the regional synclinal aquifer within the Revised Development Envelope are not considered in the direct impact assessment due to negligible direct impacts to BWT habitats in this area (Biologic 2022m)

10.6.2.2. Assessment of Indirect Impacts

The potential indirect impacts of changes to surface hydrology associated with the placement of WRL’s and stockpiles which could result in changes to surface inputs of water, nutrients, and oxygen to the subterranean habitat have been quantified. Based on the modelling within the Revised Development Envelope, it was estimated that the Proposal will have a Low (approximately 7%) overall indirect impact (through proposed WRL’s and stockpiles) on the surface area of suitable stygofauna habitat remaining after direct impacts (Table 10-18) (Biologic 2022m). Extensive areas of suitable, well-connected stygofauna habitats will be maintained following the establishment of WRL’s and stockpiles (Biologic 2022m).

No stygofauna were recorded within indicative indirect impact areas (WRL’s/stockpile); therefore, indirect impacts are not expected to significantly increase the impact ranking of stygofauna species within the Revised Development Envelope.

No stygofauna were recorded within indicative indirect impact areas (WRL’s/stockpile); therefore, indirect impacts are not expected to significantly increase the impact ranking of stygofauna species within the Revised Development Envelope.

Table 10-18: Overall Summary of the Proportions of Stygofauna Habitat (Post Mining) Indirectly Impacted by the Proposal, Based on 2D Area Assessment

Revised Development Envelope Section	Minimum Area of 2D Habitat Remaining Intact (Proposed Scenario) (ha)	Area of Habitat within Proposed Indirect Impacts (Waste, Stockpiles)		Overall Indirect Impact to Stygofauna Habitat
		ha	% *	
Western Hill (orebody aquifer)	851	0	0%	Negligible
Deposit H	755	120	16%	Low
Deposit F North^	NA	NA	NA	Negligible
Mt Ella East^	NA	NA	NA	Negligible
Total Revised Development Envelope	1,605	120	7%	Low

*Percentage of the 2D BWT habitat area remaining in the worst-case scenario that is occupied by proposed WRL’s and stockpiles.

^No significant stygofauna habitat values occur at Deposit F North and Mt Ella East. Mt Ella East is not proposed for BWT mining and proposed groundwater drawdown at Deposit F North is not expected to affect stygofauna habitat values as it is unsuitable for stygofauna and disconnected from other groundwater systems (Biologic 2022m).

10.6.2.3. Assessment of Combined Impacts

The combination of direct impacts (creation of pits and groundwater extraction) from existing/approved operations and proposed operations in the West Angelas Region was quantified and assessed by Biologic (2022m). Based on this assessment, combined impacts are only anticipated to occur at Western Hill orebody aquifer and the surrounding regional synclinal aquifer (Figure 10-21) Deposits H, F North, and Mt Ella East will not be subject to combined impacts as they either have no current or approved mining operations (Deposit H), lack significant stygofauna species or habitat values (Deposit F North and Mt Ella East), or lack impacts to groundwater (Mt Ella East).

The combined direct reduction of suitable habitat throughout the West Angelas Region was considered Low (17% habitat reduction) (Table 10-19 and Biologic 2022b). Modelling indicates that the remaining suitable habitat is extensive (approximately 83%), with only minor reduction in thickness and extent, and no significant reduction of habitat connectivity (Figure 10-21). This extent of combined direct habitat loss

(17%) is only slightly greater than that predicted for direct loss as part of the Proposal (14%) (Table 10-19).

The implementation of the MAR strategy as approved (Condition 6-1(1) of MS1113) is expected to maintain pre-impact groundwater levels within the regional synclinal aquifer (including Turee Creek East Calcrete) west of the Revised Development Envelope boundary and within Karijini National Park (Biologic 2022m). Accordingly, 3D modelling by predicted that the implementation of the MAR effectively prevents groundwater drawdown impacts from propagating beyond the Revised Development Envelope, subsequently maintaining 98% of the suitable habitat for stygofauna within the synclinal aquifer (Biologic 2022m, Table 10-19, Figure 10-22, and Figure 10-23).

Following implementation of the MAR, the overall combined impacts on stygofauna habitat and species values within the Revised Development Envelope and West Angelas Region were assessed as Low (Table 10-19). Overall, only 3% of suitable stygofauna habitat within the Revised Development Envelope and West Angelas Region was predicted to be impacted by combined impacts (with MAR), and local habitat reduction ranged from 2 – 23% (Table 10-19, Figure 10-22 and Figure 10-23) which met the Low impact rating in all sections of the Revised Development Envelope.

Although a hypothetical impact scenario without MAR was modelled, showing a 17% reduction in suitable BWT habitat (Biologic 2022m), (Table 10-19), this scenario is not expected to occur given the approved MAR strategy, and would nonetheless represent a Low overall impact to the known stygofauna habitat and species values.

Table 10-19: Overall Summary of the Proportions of Stygofauna Habitat Impacted by Combined Direct Impacts (Current and Proposed) within the West Angelas Region with and without MAR

Revised Development Envelope Section	Pre-Impact 3D Habitat Volume (m ³ , '000)	Combined Scenario 3D Habitat Reduction		Change to BWT Habitat Extent, Thickness, Connectivity	Overall Impact to Stygofauna Habitat Values
		m ³ ('000)	%		
Western Hill (orebody aquifer)*	409,281	7,796	1%	Negligible	Low
Regional synclinal aquifer	13,996,583	2,396,269	17%	Minor	Minor
Regional synclinal aquifer with MAR	13,996,583	265,201	2%	Negligible	Low
Deposit H*	598,930	135,828	23%	Minor	Low
Total West Angelas Region without MAR^	15,004,794	2,539,893	17%	Minor	Low
Total West Angelas Region with MAR	15,004,794	408,825	3%	Minor	Low

*Direct impacts from the Proposal only, no impacts from current/ existing operations in this area

^ Hypothetical scenario

No significant stygofauna habitat values occur at Deposit F North and Mt Ella East. Mt Ella East is not proposed for BWT mining and proposed groundwater drawdown at Deposit F North is not expected to affect stygofauna habitat values as it is unsuitable for stygofauna and disconnected from other groundwater systems (Biologic 2022m). Therefore, these two sections of the Revised Development Envelope were omitted from the table.

The combined impacts on the 12 stygofauna species values recorded within the West Angelas Region (Table 10-20 and Figure 10-21) are considered Low, with or without the implementation of MAR for reasons detailed in Table 10-21.

Table 10-20: Numbers of Stygofauna Taxa within Each Impact Rank under the Combined Direct Impacts of Mine Pit Dewatering, with or without MAR

Revised Development Envelope Section	Number of Taxa Recorded	High Ranked Taxa	Medium Ranked Taxa	Low Ranked Taxa
Western Hill orebody aquifer*	2	-	-	2
Regional synclinal aquifer	11	-	-	11
Deposit H*	0	-	-	-
Deposit F North	0	-	-	-
Mt Ella East*	0	-	-	-
Total	12^	0	0	12^

*Direct impacts from the Proposal only, no impacts from current/ existing operations in this area

^ One low-risk taxon was recorded in multiple Revised Development Envelope sections.

Table 10-21: Key Impact Assessment Details for Stygofauna Species Values Potentially Impacted by Combined Direct Impacts

Location	Stygofauna Taxa (Low Impact)	Impact Assessment Details (Biologic 2022m)
Western Hill (orebody aquifer)	<p>Oligochaeta Enchytraeidae `sp. Biologic-OLIG008` (amphibious, stygoxene/ stygophile)</p> <p>Amphipoda <i>Kruptus</i> `sp. Helix-AMP035`</p>	<p>Identified taxa are recorded from Western Hill orebody aquifer</p> <p>One taxon (Enchytraeidae) amphibious, not limited to groundwater habitats.</p> <p>One taxon (<i>Kruptus</i>) also occurs throughout synclinal aquifer south of Western Hill orebody aquifer</p> <p>Overall habitat reduction is negligible (1%).</p> <p>Groundwater drawdown impacts a minor proportion of overall Western Hill BWT habitat.</p> <p>Suitable habitat remains intact, connected, extensive, and thick throughout Western Hill orebody aquifer.</p> <p>Combined impacts not expected to result in loss of stygofauna species values or habitat.</p>
Regional synclinal aquifer)	<p>Oligochaeta Enchytraeidae `sp. Helix-OLE028` (amphibious, stygoxene/ stygophile) Enchytraeidae `sp. Helix-OLE029` (amphibious, stygoxene/ stygophile)</p> <p>Ostracoda Candonidae `sp. WAN` Harpacticoida (Copepoda) <i>Australocamptus</i> `sp. B13` Bathynellacea (Syncarida) <i>Atopobathynella</i> `sp. Helix-BAP027` Bathynellidae `sp. Helix-BAB018`</p> <p>Amphipoda <i>Kruptus</i> `sp. Helix-AMP035` <i>Maarrka</i> `sp. Helix-AMP037` Paramelitidae `sp. Biologic-AMPH018` Paramelitidae `sp. Helix-AMP036`</p> <p>Isopoda <i>Pygolabis</i> `sp. WAN`</p>	<p>Identified taxa are recorded only from Regional synclinal aquifer.</p> <p>Two taxa (Enchytraeidae) amphibious, not limited to groundwater habitats.</p> <p>Overall habitat reduction is minor (3% with MAR).</p> <p>Groundwater drawdown impacts a minor proportion of overall habitat within the synclinal valley.</p> <p>Suitable habitat remains intact, connected, extensive, and thick throughout the Western Hill synclinal valley.</p> <p>Combined impacts of existing/ approved and proposed mining activities are not expected to result in loss of stygofauna species values or habitat.</p>
Deposit H	No stygofauna taxa likely to be impacted	N/A
Deposit F North	No stygofauna species values present	No significant stygofauna habitat values present. Groundwater drawdown will be restricted to the localised area of groundwater deep below the surface which has been evaluated as unsuitable for stygofauna (Biologic 2022b) and is disconnected from other groundwater systems.

Location	Stygofauna Taxa (Low Impact)	Impact Assessment Details (Biologic 2022m)
Mt Ella East	No stygofauna species values present	No combined groundwater drawdown impacts

10.6.2.4. Assessment of Cumulative Impacts:

Given that there are no third-party mining projects within the immediate vicinity of the Revised Development Envelope (refer to Section 10.4.4) the likelihood of cumulative impacts to stygofauna habitat values or species values as a result of the implementation of the Proposal is considered to be very low.

10.6.3. Summary of Residual Impacts and Proposed Regulatory Mechanisms

Table 10-22 details the residual impact, assessment findings, and recommended conditions.

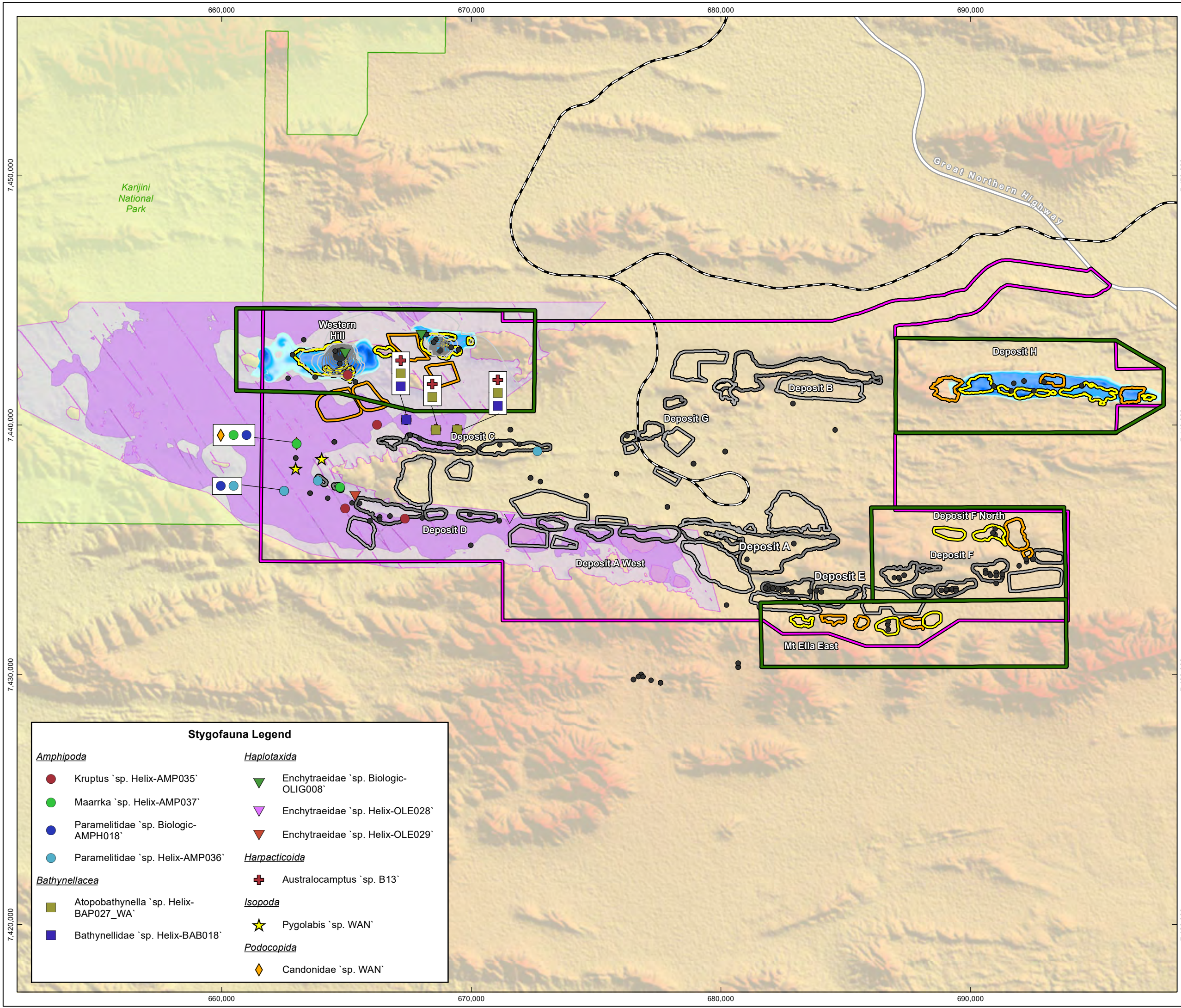
Table 10-22: Assessment Findings and Proposed Regulatory Mechanisms for Subterranean Fauna

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
Direct Impacts		
Troglofauna Habitat: Reduction of up to 216,261,000 m ³ (2%) (combined 12%) of suitable AWT (troglofauna) habitat.	The impact is considered minor and overall impact to troglofauna habitat values are Low. The combined impact to suitable AWT habitat throughout the West Angelas Region was considered Low.	Standard management, no additional regulation proposed.
Troglofauna Individuals: potential to impact seven Medium ranked (loss of pre-mining habitat volume 25 – 50%) and 35 Low ranked (loss of pre-mining habitat volume < 25%) troglofauna taxa (impacts do not change under cumulative scenario).	Overall impacts to troglofauna taxa are considered Low.	Standard management, no additional regulation proposed.

Residual Impact or Risk to Environmental Value	Assessment Finding	Recommended Conditions and DMA Regulation
<p>Stygofauna Habitat: Reduction of up to 141,535,000 m³ (14%) (combined without MAR 17%) of suitable BWT (stygofauna) habitat.</p>	<p>The change to BWT habitat extent, thickness and connectivity is considered minor and overall impact to stygofauna habitat values are Low. The combined impact to suitable habitat throughout the West Angelas Region was considered Low. Impacts do not consider the current MAR which, when considered, results in a total combined impact of 3% of suitable BWT habitat.</p>	<p>Proposed to be regulated through implementation conditions: Annual dewatering limit.</p> <p>Condition 6 of MS 1113 currently mandates no drawdown at the boundary of, or within, Karijini National Park. This condition (which is met by the West Angelas MAR project) is proposed to be retained. No additional regulation is proposed.</p> <p>Other DMA processes: RiWI Act - Groundwater abstraction will be regulated through a groundwater licence and operating strategy.</p>
<p>Stygofauna Individuals: potential to impact two Low ranked stygofauna taxa (cumulative 12 Low ranked taxa).</p>	<p>Overall impacts to stygofauna taxa are considered Low.</p>	<p>See for stygofauna habitat</p>
<p>Indirect Impacts</p>		
<p>Troglofauna Habitat: Approximately 588 ha (3%) of the 20,095 ha of mapped 2D troglofauna habitat remaining in the worst-case (combined scenario) will be impacted by waste landforms and stockpiles</p>	<p>Overall indirect impacts to troglofauna values are considered Low.</p>	<p>Standard management. No specific regulation considered required</p>
<p>Stygofauna Habitat: Approximately 120 ha (7%) of the 1,605 ha of mapped 2D stygofauna habitat remaining in the worst-case scenario will be impacted by waste landforms and stockpiles</p>	<p>Overall indirect impacts to stygofauna values are considered Low.</p>	<p>Standard management. No specific regulation considered required.</p>

Figure 10-20
Stygofauna Records and
Suitable Habitat Remaining
After Proposed Impacts

Drawn: M.L.
Plan: RTIO-0962671v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:140,000 @A3
GIS.Team@riotinto.com

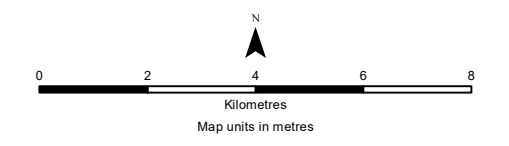


Legend

- Stygofauna Sampling Site
 - ▭ Revised Development Envelope
 - ERD Section Boundary
- BWT Habitat Thickness:
Proposed Scenario (m)**
- High : 150
Low : 1
- Proposed Groundwater Drawdown**
- Metres Below Pre-impact Water Level
- 0 - 2
 - 2 - 5
 - 5 - 8
- Stratigraphic Model BWT**
- ▭ Potential Suitable Habitat
 - ▭ Inferred Habitat
- Proposed Conceptual Layout**
- ▭ Pit
 - ▭ Waste Landform
- Approved Conceptual Layout**
- ▭ Pit
 - ▭ Waste Landform
- ▭ National Park
 - Rio Tinto Railway
 - Highway

Stygofauna Legend

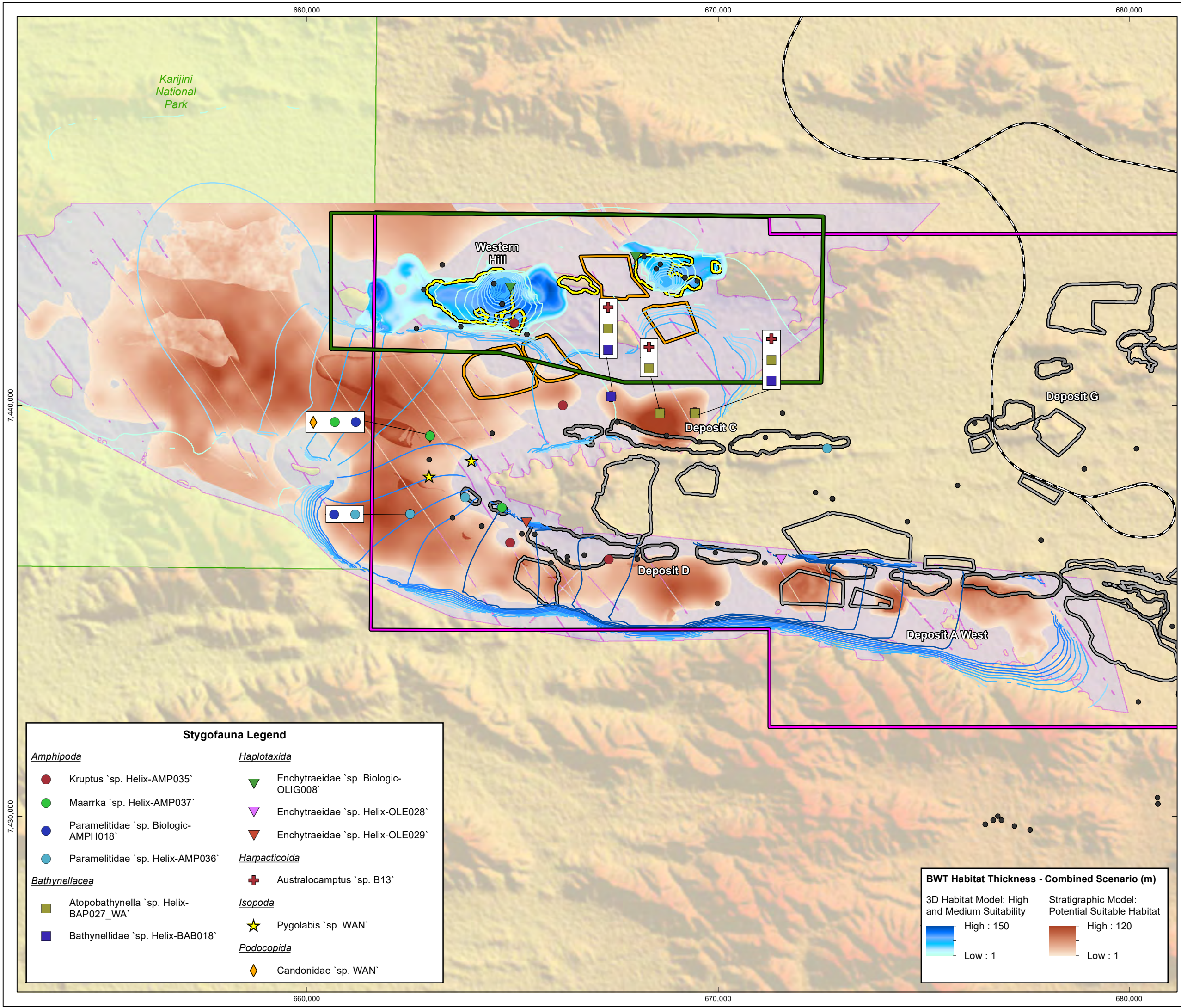
- | | |
|---|--|
| Amphipoda | Haplotaxida |
| ● Kruptus `sp. Helix-AMP035` | ▼ Enchytraeidae `sp. Biologic-OLIG008` |
| ● Maarrka `sp. Helix-AMP037` | ▼ Enchytraeidae `sp. Helix-OLE028` |
| ● Paramelitidae `sp. Biologic-AMPH018` | ▼ Enchytraeidae `sp. Helix-OLE029` |
| ● Paramelitidae `sp. Helix-AMP036` | Harpacticoida |
| Bathynellacea | ✚ Australocamptus `sp. B13` |
| ■ Atopobathynella `sp. Helix-BAP027_WA` | Isopoda |
| ■ Bathynellidae `sp. Helix-BAB018` | ★ Pygolabis `sp. WAN` |
| | Podocopida |
| | ◆ Candonidae `sp. WAN` |



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Figure 10-21
Stygofauna Records and Suitable Habitat Remaining After Combined Impacts

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Plan: RTIO-0962672v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:85,000 @A3
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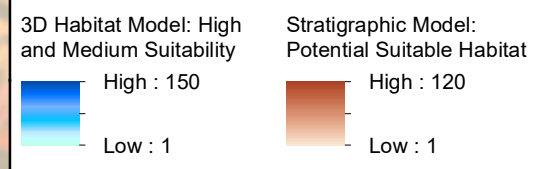
Legend

- Stygofauna Sampling Site
- ▭ Revised Proposal Development Envelope
- ERD Section Boundary
- Combined Groundwater Drawdown Without MAR*
- Metres Below Pre-impact Water Level
- 0 - 2
- 2 - 5
- 5 - 8
- 8 - 12
- 12 - 16
- Stratigraphic Model BWT*
- ▭ Inferred Habitat
- Proposed Conceptual Layout*
- ▭ Pit
- ▭ Waste Landform
- Approved Conceptual Layout*
- ▭ Pit
- ▭ Waste Landform
- ▭ National Park
- Rio Tinto Railway

Stygofauna Legend

- | | |
|---|--|
| Amphipoda | Haplotaxida |
| ● Kruptus `sp. Helix-AMP035` | ▼ Enchytraeidae `sp. Biologic-OLIG008` |
| ● Maaraka `sp. Helix-AMP037` | ▼ Enchytraeidae `sp. Helix-OLE028` |
| ● Paramelitidae `sp. Biologic-AMPH018` | ▼ Enchytraeidae `sp. Helix-OLE029` |
| ● Paramelitidae `sp. Helix-AMP036` | Harpacticoida |
| Bathynellacea | ✚ Australocamptus `sp. B13` |
| ■ Atopobathynella `sp. Helix-BAP027_WA` | Isopoda |
| ■ Bathynellidae `sp. Helix-BAB018` | ★ Pygolabis `sp. WAN` |
| | Podocopida |
| | ◆ Candonidae `sp. WAN` |

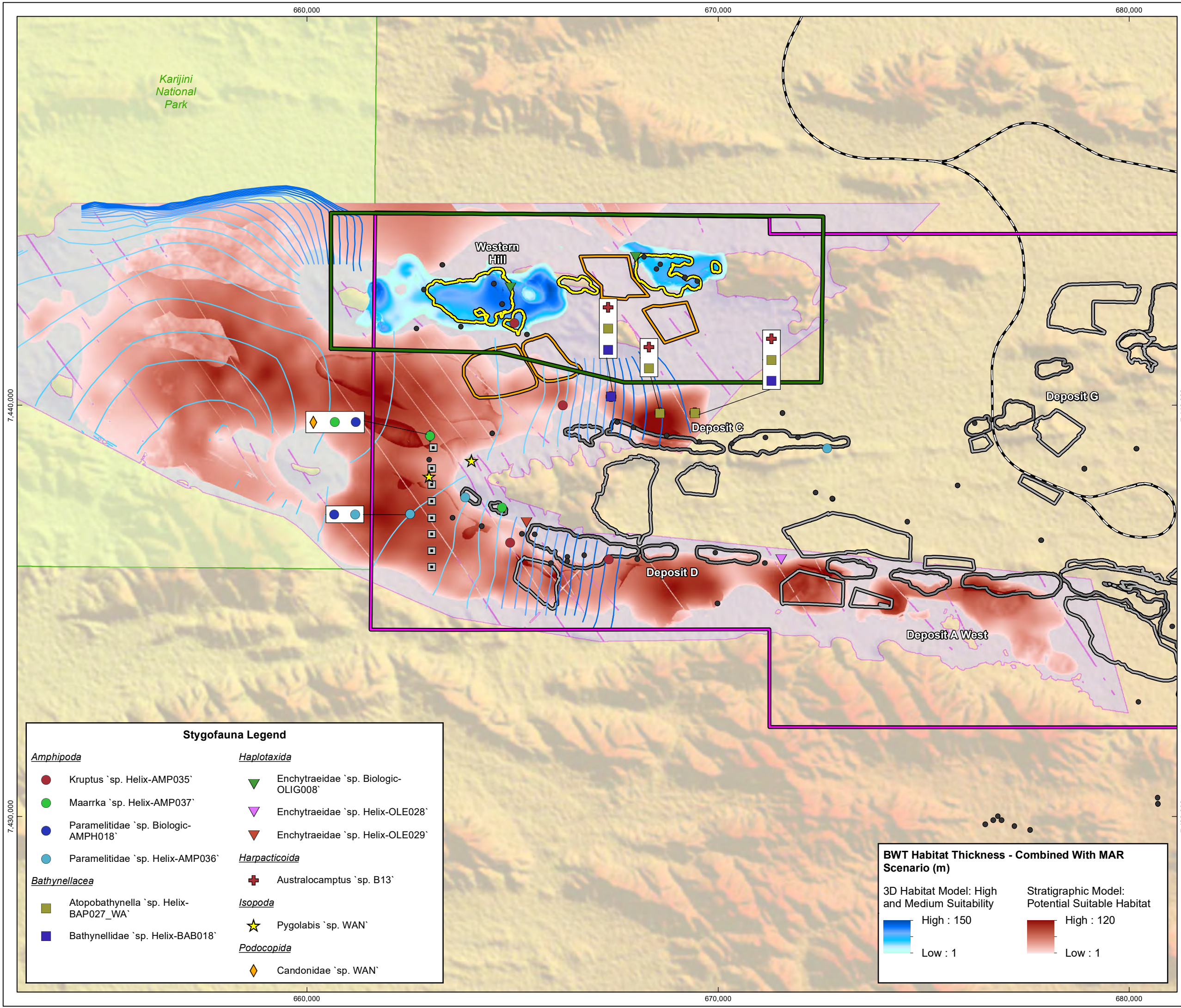
BWT Habitat Thickness - Combined Scenario (m)



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Figure 10-22
Stygofauna Records and
Suitable Habitat Remaining
After Combined Impacts with MAR

Drawn: M.L.
Plan: RTIO-0962632v2
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:85,000 @A3
GIS.Team@riotinto.com

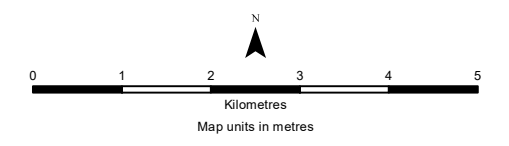
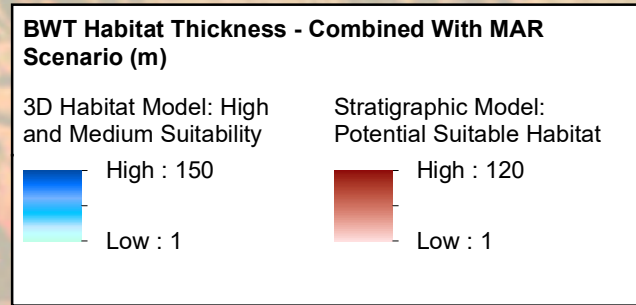


Legend

- Stygofauna Sampling Site
 - Indicative MAR Bores
 - ▭ Revised Development Envelope
 - ERD Section Boundary
- Modelled Groundwater Levels Under MAR Scenario*
- mAH
- 623 - 623.5
 - 623.5 - 624
 - 624 - 624.5
 - 624.5 - 625
- Stratigraphic Model BWT*
- ▭ Inferred Habitat
- Proposed Conceptual Layout*
- ▭ Pit
 - ▭ Waste Landform
- Approved Conceptual Layout*
- ▭ Pit
 - ▭ Waste Landform
- ▭ National Park
 - Rio Tinto Railway

Stygofauna Legend

- | | |
|---|--|
| Amphipoda | Haplotaxida |
| ● Kruptus `sp. Helix-AMP035` | ▼ Enchytraeidae `sp. Biologic-OLIG008` |
| ● Maarra `sp. Helix-AMP037` | ▼ Enchytraeidae `sp. Helix-OLE028` |
| ● Paramelitidae `sp. Biologic-AMPH018` | ▼ Enchytraeidae `sp. Helix-OLE029` |
| ● Paramelitidae `sp. Helix-AMP036` | Harpacticoida |
| ● Paramelitidae `sp. Helix-AMP036` | ✚ Australocamptus `sp. B13` |
| Bathynellacea | Isopoda |
| ■ Atopobathynella `sp. Helix-BAP027_WA` | ★ Pygolabis `sp. WAN` |
| ■ Bathynellidae `sp. Helix-BAB018` | Podocopida |
| | ◆ Candonidae `sp. WAN` |



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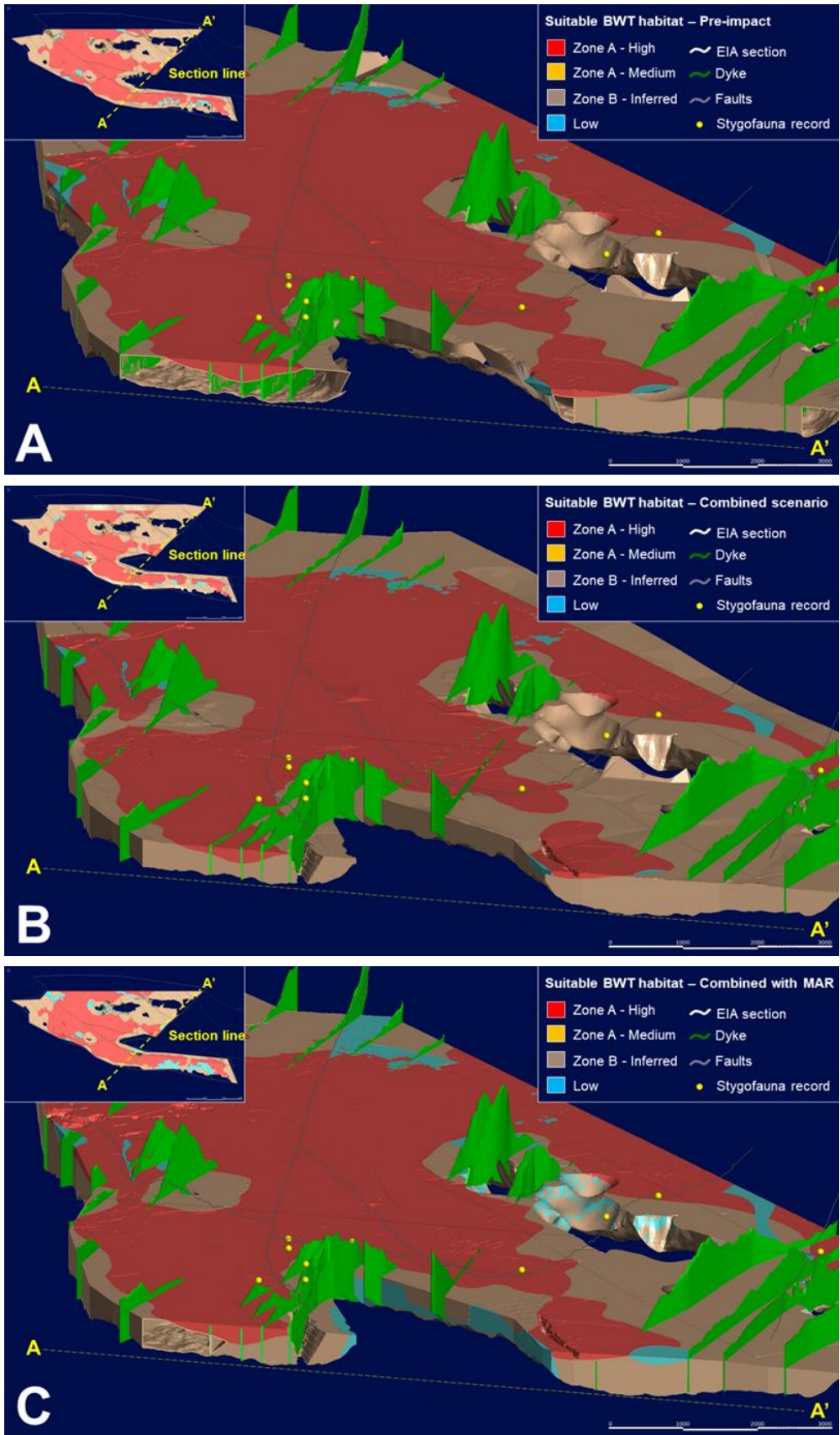


Figure 10-23: Long-section of the Stratigraphic 3D Subterranean Habitat Model Showing BWT Habitats (A) Pre-impact, (B) Post-impact (Combined), and (C) Post-impact (Combined with MAR) at Western Hill Synclinal Valley. Vertical Scale Exaggerated x5

10.7. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

10.7.1. Proposal

After application of avoidance and management measures, no significant residual impacts to troglofauna and stygofauna as a result of the **Proposal** remain.

Environmental outcomes in relation to the **Proposal** for troglofauna include:

- Direct impact to up to 216,261,000 cubic metres (2%) of suitable AWT (troglofauna) habitat (12% for Revised Proposal)
- Medium predicted impacts to seven troglofauna taxa (taxa currently known only from single sites within proposed pits), and Low predicted impacts to 35 troglofauna taxa following implementation of the Proposal
- Potential indirect impact to approximately 588 ha (3%) of the 20,095 ha of mapped 2D troglofauna habitat by the placement of waste landforms and stockpiles

Environmental outcomes in relation to the **Proposal** for stygofauna include:

- Direct impact to up to 141,535,000 cubic metres (14%) of suitable BWT (stygofauna) habitat (17% for Revised Proposal)
- Low predicted impacts to two stygofauna taxa following implementation
- Potential indirect impacts to approximately 120 ha (7%) of the 1,605 ha of mapped 2D stygofauna habitat by the placement of waste landforms and stockpiles.

10.7.2. Revised Proposal

Environmental outcomes in relation to the **Revised Proposal** for troglofauna include:

- Direct impact to up to 1,076,640,000 cubic metres (12%) of suitable AWT (troglofauna) habitat
- Medium predicted impacts to seven troglofauna taxa (taxa currently known only from single sites within proposed pits), and Low predicted impacts to 35 troglofauna taxa.

Environmental outcomes in relation to the **Revised Proposal** for stygofauna include:

- Direct impact to up to 2,539,893,000 cubic metres (17%) of suitable BWT (stygofauna) habitat
- Low predicted impacts to two stygofauna taxa.

10.7.3. Summary

Through the implementation of the mitigation hierarchy, the residual impacts of the Proposal to troglofauna and stygofauna are as low as reasonably practicable. Proposed impacts are not considered significant at a local or regional level.

The Proponent considers that the EPA's objective for subterranean fauna can continue to be managed for the Revised Proposal in relation to the known troglofauna and stygofauna values such that no offsets for impacts to subterranean fauna are required.

11. GREENHOUSE GAS EMISSIONS

11.1. EPA Environmental Factor and Objective

The EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2023c) lists the following as its objective for Greenhouse Gas Emissions.

To reduce net greenhouse gas emissions in order to minimise the risk of environmental harm associated with climate change.

Greenhouse Gas (GHG) Emissions are a key contributor to climate change, which has already had a significant effect on Western Australia's environment (EPA 2020b).

Annual Scope 1 GHG emissions associated with the Proposal will be above the EPA assessment threshold of 100 kilotonnes (kt) of carbon dioxide equivalent (CO₂-e) in any year. Therefore, the GHG emissions associated with the Proposal are a key environmental factor and are included in the environmental impact assessment for the Proposal, consistent with the EPA Chair's determination (EPA 2019b).

11.2. Relevant Policy and Guidance

11.2.1. Commonwealth Policy and Guidelines

In 2015 the Paris Agreement was ratified by parties to the United Nations Framework Convention on Climate Change. The Paris Agreement establishes a series of targets, including:

- Keeping "global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit temperature increase to 1.5°C"
- Reach global peaking of GHG emissions as soon as possible to achieve a balance between anthropogenic emissions by sources and removals by sinks in the second half of this century.

The Paris Agreement acknowledged that the Nationally Determined Contributions (NDCs) made by countries as commitments were insufficient to meet the goals of the Paris Agreement. To manage this, the Paris Agreement includes a process to update or 'ramp-up' NDCs every five years.

Australia is a signatory to the agreement; and to assist in meeting the agreement's aims, on 16 June 2022, Australia communicated its updated NDC to the United Nations which included confirmation of Australia's commitment to achieve net zero emissions by 2050, and a new, increased, 2030 target of 43% below 2005 levels by 2030. To achieve this target, the government set targets in legislation via the *Climate Change Bill 2022*.

The primary policy mechanisms to implement national targets, and therefore Australia's current commitments under the Paris Agreement, are the *National Greenhouse and Energy Reporting (Safeguard Mechanism) Rule 2015* (Cth) made under the *National Greenhouse and Energy Reporting Act 2007* (Cth) (NGER Act) and are administered by the Clean Energy Regulator (CER). The Safeguard Mechanism applies to facilities with Scope 1 emissions (covered emissions) of more than 100,000 t CO₂-e per year (CER 2023). The recently reformed (passed Parliament) Safeguard Mechanism applies baselines (including a year on year decline rate commencing July 1st 2023) to large GHG-emitting facilities to ensure that net emissions are kept below a defined baseline. If the baseline is exceeded, or is likely to, emitters can manage excess emissions by:

- Pursuing activities that reduce emissions of the facility
- Purchase and surrender carbon units (Australian Carbon Credit Units (ACCUs) are the sole currently prescribed units)
- Apply for a multi-year monitoring period
- Apply for an exemption due to exceptional circumstances (CER 2023).

11.2.2. Western Australian Policy and Guidelines

On 28 August 2019, the WA Government released its State Government’s (GoWA 2019b) *Greenhouse Gas Emissions Policy for Major Projects* (State GHG Policy) for major projects assessed by the EPA. The EPA published the original Environmental Factor Guideline – Greenhouse Gas Emissions (GHG Guideline) in April 2020 and in April 2023 published its revised GHG Guideline (EPA 2023c).

The GHG Guideline outlines how and when the Greenhouse Gas Emissions factor is considered by the EPA in the environmental impact assessment (EIA) process. It aims to facilitate flexible approaches to GHG reduction that promote innovation, emerging best practice technologies and potential new industries and opportunities for WA. It supports the development of Greenhouse Gas Management plans for proponents which should detail:

- Interim and long-term emissions reductions targets the proposal aims to achieve throughout the project
- Best practice design, technology, management and reasonable practicable alternatives and measures appropriate to avoid, reduce or offset Scope 1 and 2 emissions from the proposal
- Partnerships and arrangements with third parties considered to reduce Scope 3 emissions
- How the proposal is consistent with achieving corporate emissions reduction targets
- Other legal and policy instruments that require GHG emissions reductions from the proposal to meet the EPA’s objectives.

Table 11-1 presents the relevant policy and guidance for GHG and demonstrates how they have been considered in the Proposal.

Table 11-1: Relevant Policy and Guidance for Greenhouse Gas Emissions

Policy or Guidance	Explain how the Policy and Guidance has been considered
Environmental Protection Authority	
Statement of Environmental Principles, Factors and Objectives (EPA 2021c)	The EPA objective for Greenhouse Gas Emissions forms the basis of this assessment. This assessment has regard to the aims of EIA, consideration of significance and the application of the mitigation hierarchy.
Environmental Factor Guideline: Greenhouse Gas Emissions (EPA 2023c)	Considerations for EIA as outlined in the guideline has been considered in this chapter, including: <ul style="list-style-type: none"> • The application of the mitigation hierarchy to avoid, reduce and offset emissions • The interim and long-term emissions reduction targets the Proponent proposes to achieve net zero emissions by 2050 • The best practice design, technology and management measures to mitigate GHG emissions and relevant benchmarking are described in

Policy or Guidance	Explain how the Policy and Guidance has been considered
	<p>Greenhouse Gas Management Plan (GHG EMP; Appendix A.7)</p> <ul style="list-style-type: none"> • The Rio Tinto corporate emissions reduction targets and how the proposal is consistent with achieving those targets • Other legal and policy instruments that require reductions in GHG emissions from the proposal that also meet the EPA's objectives (e.g. Safeguard Mechanism).
<p>Instructions on how to prepare an Environmental Review Document (EPA 2021b)</p>	<p>This document forms the basis of the headings and content provided in this ERD.</p>
<p>Instructions on how to prepare EP Act Part IV Environmental Management Plans (EPA 2021f)</p>	<p>Considered during the development of this document and the EMP.</p>
<p>Other State or Commonwealth</p>	
<p>Greenhouse Gas Emissions Policy for Major Projects (GoWA 2019b)</p>	<p>The Proponent is committed to contributing towards the State's aspiration of net zero by 2050.</p> <p>In line with this policy, a GHG EMP has been prepared with the following commitments associated with emissions reduction targets:</p> <ul style="list-style-type: none"> • Management based five-yearly interim reduction targets from 2025 to 2040 • If the target is not met, commitment to offset via purchase of eligible offset units • Five yearly progress reporting • Five yearly formal re-submission or if significant change is triggered.
<p>Western Australian Climate Policy (GoWA 2020)</p>	<p>The Proposal includes interim and long-term emission reduction targets consistent with the State's net zero aspiration.</p>
<p>National Greenhouse and Energy Reporting Act 2007 (NGER Act) (DISER 2007)</p>	<p>Emissions from the Proposal operations will be reported annually through the NGER scheme, in accordance with the NGER Act.</p>
<p>National Greenhouse and Energy Reporting (Measurement) Determination 2008 (Measurement Determination) (DISER 2008)</p>	<p>The GHG emissions inventory for the Proposal have been estimated using the methods and criteria from the Measurement Determination.</p>
<p>Safeguard Mechanism (Crediting) Amendment Act 2023</p>	<p>Emissions from the Proposal are attributed to the West Angelas facility under the Safeguard Mechanism. The West Angelas facility will endeavour to keep its emissions at or below its baseline by:</p> <ul style="list-style-type: none"> • Avoiding emissions through the electrification of fleet (as this technology becomes available) • Reducing emissions in the interim (for example through energy efficiency initiatives) • Managing remaining excess emissions through the purchase and surrendering of Australia Carbon Credit Units (ACCU's).

Policy or Guidance	Explain how the Policy and Guidance has been considered
Renewable Energy (Electricity) Act 2000	As a liable entity under the Renewable Energy Target (RET) the Proponent annually purchases and surrenders the appropriate amount of large-scale generation certificates (LGCs) and small-scale technology certificates (STCs).

11.3. Receiving Environment

11.3.1. Assessment Context

There has been a steady increase in GHG emissions from WA since the 1990s, and emissions growth is generally expected to continue in the short and medium term (EPA 2020b).

In 2021, WA emitted an estimated 80.2 million tonnes of CO₂-e and offset approximately 8.6 million tonnes of CO₂-e (DISER 2023). Approximately 42% of WA's emissions are associated with the mining sector (DCCEE 2023).

Consistent with the EPA Guideline (EPA 2023c), the geographic scope for the assessment of GHG emissions associated with the Proposal is the state of Western Australia.

11.4. Potential Environmental Impacts

Over its estimated 22-year life, the Proposal will result in:

- Direct emissions from the burning of fossil fuels for mobile and stationary energy demands and changes in land use (clearing of vegetation) (Scope 1 emissions)
- Indirect emissions from the consumption of electricity. The Proponent draws its power from the integrated Rio Tinto power network (Pilbara Power Generation Network) (Scope 2 emissions)
- Indirect emissions (other than Scope 2 emissions) as a consequence of the activities of the Proponent's customers, from sources not owned or controlled by the Proponent's business (Scope 3 emissions). In this case, largely in the manufacturing of steel¹⁹.

In recognition of the impact of greenhouse gases on the climate, particularly associated with our operating footprint in Western Australia, Rio Tinto is committed to being an integral part of the solution to climate change. The Proponent is part of the Rio Tinto integrated power network which has an established Climate Action Plan that seeks to reduce emissions impact on the physical climate. The Proponent is exploring a range of options to achieve emissions reductions, via abatement projects at the Pilbara system level and through specific site-based energy efficiency improvements.

11.4.1. Greenhouse Gas Emissions Estimates

A GHG emissions inventory has been calculated for the Proposal using the methods and criteria from the *National Greenhouse and Energy Reporting (Measurement) Determination 2008* (DISER 2008) (NGER Determination).

¹⁹ Scope 3 emissions site outside of the geographic scope for assessment and are included for context purposes only

The major emission types of GHG emissions from the Proposal are carbon dioxide (CO₂), nitrogen oxide (N₂O) and methane (CH₄). The principal sources of GHG emissions include:

- Stationary, mobile and transport diesel combustion (Scope 1)
- Land clearing (Scope 1)
- Consumption of electricity from the Pilbara Power Generation Network (Scope 2).

It should be noted that no fugitive emissions are expected for the Proposal.

The Proponent sells an iron ore blend and calculates its Scope 3 emissions based on a portfolio of sales. Estimated Proposal Scope 3 emissions are 8.9 Mt CO₂-e (annual average) and 35.2 Mt CO₂-e through the 22-year life of the Proposal.

A summary of estimated annual average and total GHG emissions over the operational life of the Proposal by source and scope is presented in Table 11-2 with unabated greenhouse gas emissions in yearly intervals shown in Figure 11-1.

Table 11-2: Estimated GHG Emissions from the Proposal²⁰

Activity	Average Annual Emission (t CO ₂ -e/yr)	Total Emission over Life of Proposal (~22 years) (t CO ₂ -e)
Scope 1 Emissions Emissions generated as a direct result of an activity or a series of activities at a facility level		
Land clearing	861	18,937
Diesel fuel	53,689	1,181,162
Scope 2 Emissions Emissions generated from the consumption of an energy product		
Electricity generation from natural gas	8,985	197,680
Scope 3 Emissions		
Based on a sales portfolio of the Proponent's Iron Ore Blend	8,872,090	35,151,487

The Proposal is expected to contribute 63,535 t CO₂-e total Scope 1 and Scope 2 emissions per annum (average) through 2025 to 2046 period, as follows:

- Scope 1 emissions: ~54,550 t CO₂-e per year (Average)
- Scope 2 emissions: ~8,985 t CO₂-e per year (Average).

Through the ~22 year LoM, the Proposal is expected to emit a combined total of 1,397,779 t CO₂-e Scope 1 and Scope 2 emissions.

A summary of estimated peak²¹, annual average and total GHG emissions over an estimated 22-year life for the Proposal and Existing Operations (MS 1113 Deposit C, D & G only) by source and scope are presented in Table 11-3. Estimated GHG emissions for the entire West Angelas Hub (all deposits) have

²⁰ Emissions relate to the operational phase only, noting closure studies are currently in progress with an emissions estimate being developed. The GHG EMP will be updated to reflect closure emissions once data is available

²¹ Peak annual emissions is the year in which total Scope 1 & 2 emissions peak, this is not the same year when individually different source emissions peak (e.g. land clearing peak annual emissions occur in 2026)

also been included for information; however, deposits approved prior to MS 1113 do not currently require mitigation.

Table 11-3: Proposal, Existing Operations (CDG) and West Angelas Hub Operational Peak, Annual Average and Total GHG Emissions by Source and Scope

Source	Proposal		Existing Operations MS 1113 Deposit C,D and G		West Angelas Hub	
	Scope 1 Emissions	Scope 2 Emissions	Scope 1 Emissions	Scope 2 Emissions	Scope 1 Emissions	Scope 2 Emissions
	(t CO2-e pa)	(t CO2-e pa)	(t CO2-e pa)	(t CO2-e pa)	(t CO2-e pa)	(t CO2-e pa)
Diesel – Peak Annual	157,498 (2029)	-	159,851 (2026)	-	354,231 (2026)	-
Land Clearing – Peak Annual	0 (2029) ²²	-	0 (2026) ²³	-	6,367 (2026) ²⁴	-
Electricity – Peak Annual	-	28,442 (2029) ²⁵	-	34,441 (2026) ²⁶	-	42,338 (2026) ²⁷
Total (Scope 1 + Scope 2) – Peak Annual	185,940		194,291		402,936	
Diesel – Annual Average Life of Proposal	54,550	-	48,806	-	149,702	-
Land clearing – Annual Average Life of Proposal	861	-	240	-	763	-
Electricity – Annual Average Life of Proposal	-	8,985	-	9,373	-	24,515
Total (Scope 1 + Scope 2) – Annual Average LoM	63,535		58,419		257,386	
Diesel – Total Life of Proposal	1,181,162	-	1,268,966	-	4,940,175	-

²² GHG emissions from Proposal land clearing in the peak year of total Scope 1 and 2 emissions, not peak year of land clearing.

²³ GHG emissions from Deposit CDG land clearing in the peak year of total Scope 1 and 2 emissions, not peak year of land clearing.

²⁴ GHG emissions from Greater West Angelas Hub land clearing in the peak year of total Scope 1 and 2 emissions, not peak year of land clearing.

²⁵ GHG emissions from Proposal electricity in the peak year of total Scope 1 and 2 emissions, not peak year of electricity use.

²⁶ GHG emissions from Deposit CDG electricity in the peak year of total Scope 1 and 2 emissions, not peak year of electricity use.

²⁷ GHG emissions from Greater West Angelas electricity in the peak year of total Scope 1 and 2 emissions, not peak year of electricity use.

Land clearing – Total Life of Proposal	18,937	-	6,240	-	25,177	
Electricity – Total Life of Proposal	-	197,680	-	243,693		809,002
Total (Scope 1 + Scope 2) – LoM	1,397,779		1,518,899		5,774,354	

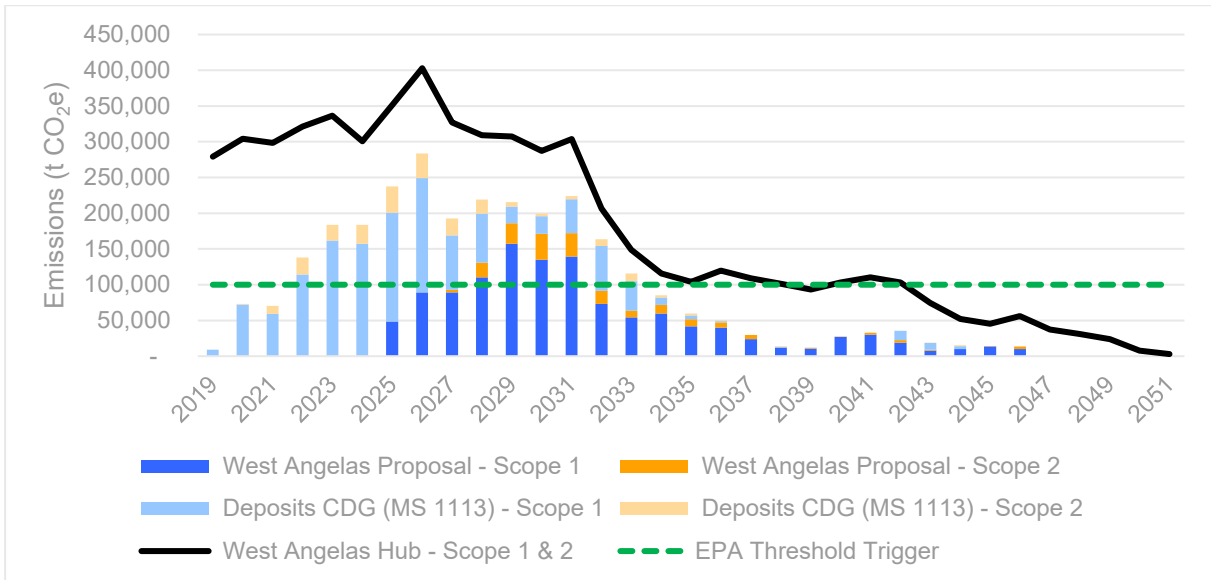


Figure 11-1: Estimated Annual Scope 1 & 2 Emissions (without Abatement)

11.4.2. Cumulative Impacts

Mine production included in the Proposal will sustain rather than increase annual throughput associated with the existing operations within the Revised Development Envelope. The Proposal will increase the total mine life as the existing approved mines reach the end of their productive life. Therefore, the Proposal represents a continuation of iron ore mining. As a result, the Revised Proposal (Deposits C, D and G subject to MS 1113 and deposits associated with this Proposal) is expected to contribute approximately 104,167 t CO₂-e per annum (average), as follows:

- Scope 1 emissions: 88,404 t CO₂-e per annum (average)
- Scope 2 emissions: 15,763 t CO₂-e per annum (average).

Through the LoM, the Revised Proposal is expected to contribute ~2,916,678 t CO₂-e Scope 1 and 2 emissions.

11.4.3. GHG Benchmarking Assessment

A GHG benchmarking assessment was undertaken to compare the GHG emissions performance of the Proposal against comparable open cut iron ore mining projects located in Western Australia’s Pilbara region, based on publicly available information (Table 11-4).

The operations considered for benchmarking are similar iron mines, but also include above and below-water table mining using conventional open pit methods.

Comparable benchmarking of emissions from individual mining operations is challenging, as it does not consider the site-specific circumstances which impact on GHG intensity. Waste to ore ratios, grade characteristics and topography have a significant influence on GHG intensity. Given this, the benchmarking results indicate that the performance of the Proposal is comparable to other recent iron ore developments in the Pilbara. Noting this intensity is prior to any abatement initiatives being applied.

Table 11-4: Benchmarking Against Comparable Open Cut Iron Ore Mines in the Pilbara

Facility	Peak annual Scope 1 covered emissions (t CO ₂ -e)	Emissions intensity (t CO ₂ -e/t iron ore)
The Proposal	157,498	0.0081
West Angelas Deposit C, D and G (MS 1113)	159,851	0.0079
West Angelas Deposit C, D and G and this Proposal	242,762	0.0080
Default Emission Intensity Iron Ore Mining Safeguard Mechanism	-	0.0048
FMG – Eliwana ²⁸	272,315	0.0070
BHP – Western Ridge	138,926	0.0073
Roy Hill – Roy Hill Revised Proposal	430,981	0.0076

11.5. Mitigation

The Proponent is committed to achieving net-zero GHG emissions by 2050, consistent with the State GHG Policy and Guidelines. The Proponent is exploring a range of options to achieve emissions reductions via abatement projects at the Pilbara system level and through specific site-based energy efficiency improvements.

11.5.1. Mitigation Hierarchy

In recognition of the State GHG Policy (GoWA 2020), the Proposal has implemented the EPA's mitigation hierarchy (avoid, reduce, offset), and internal processes are in place to integrate GHG considerations into the design and planning of the Proposal. Strategic decisions are made throughout the development of the Proposal to ensure energy-efficient lower-emission solutions are prioritised where practicable and are discussed below and summarised in Table 11-5.

11.5.2. Measures to Avoid and Reduce GHG Emissions

Options being explored to achieve emissions reductions include leveraging abatement projects at both a Pilbara system level and through site-based energy efficiency improvements. The Proposal is connected to the RTIO integrated Pilbara-wide power generation network, and the Proponent is exploring leveraging abatement projects such as solar and wind renewable energy. RTIO's climate action plan includes connecting renewable generation facilities such as these to the power network at any location, providing 'green' power to the system, reducing reliance on gas across all operating mines and port operations.

Internal guidelines are in place to integrate GHG considerations into the design and planning of development projects.

Strategic decisions have been made throughout the development of the Proposal to ensure energy-efficient lower-emission solutions are prioritised where practicable. The Proposal, in conjunction with

²⁸ FMG Fortescue Metals Group (2018), Eliwana Iron Ore Mine Project, Environmental Review Document, EW-RP-EN-0003-0. Table 57

the internal Rio Tinto Study Definition Guidelines and aligned with the State GHG Policy and Guideline, considers energy efficiency throughout design, construction and operational phases:

- Application of a mitigation hierarchy to avoid, reduce and offset emissions
- Contribution to emissions reduction targets
- Adoption of best practice design, technology and management appropriate to the mitigation measures implemented
- Continuous improvement to reduce emissions over the life of the Proposal in a measured and consistent manner.

Specific measures implemented to avoid or reduce GHG emissions from the Proposal are identified in the Proponent's GHG EMP (Appendix A.7) and summarised in Table 11-5.

11.5.3. Offsets

If and where abatement is insufficient, the Proponent will offset emissions against the interim and long-term targets by retiring credible offset units in 2025, 2030, 2035, 2040, 2045 and 2050. Diversity in credible offset units is an important means of managing risks to source sufficient volumes, but it is also important to ensure the quality and credibility of offset units used.

Where offsets are required, the Proponent proposes to use Australian Carbon Credit Units (ACCUs), that may have also been retired to meet any Safeguard Mechanism obligations, to meet any EPA commitments. Integrity standards, as set out in the Commonwealth *Carbon Credits (Carbon Farming Initiative) Act 2011*, will be adhered to for any ACCUs that may be retired for the purpose of meeting any Safeguard Mechanism obligations as well as interim targets for the Proposal.

Table 11-5: Application of the Mitigation Hierarchy for Greenhouse Gas Emissions

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Predicted Outcome
Generation of greenhouse gases through combustion of fossil fuels and land clearing (Scope 1 emissions) and generation of power (Scope 2)	Measures to Avoid			
	<p>The Proposal incorporates the following best practice designs to avoid GHG emissions:</p> <ul style="list-style-type: none"> The Proponent has study and development processes that identify, assess and where practicable develop existing, innovative and new technology developments Emission abatement projects may be implemented as part of the Proposal or at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld, as part of the RTIO climate action plan Investigation into the use of biofuels for Heavy Mining Equipment 	Proposal Specific	No	<ul style="list-style-type: none"> Residual impacts and risks associated with contribution of the Proposal to global GHG emissions are considered as low as reasonably possible (ALARP) and acceptable A GHG EMP has been prepared which outlines the Proponents commitments to avoid where possible and minimise GHG emissions as far as reasonably practicable (Appendix A.7) in line with WA and Commonwealth's Legislation and Guidance Performance against the Proposal target will be reported in the MS Annual Compliance Assessment Report every five years Emissions from the Greater West Angelas hub (including the Proposal) will also be reported annually through NGER, in accordance with the NGER Act The Proponent considers the Proposal can be managed to meet the EPA's objective for GHG emissions
	Measures to Reduce			
	<p>The Proposal incorporates the following best practices to reduce GHG emissions:</p>	Proposal specific	No	As per avoidance.

Potential Impact	Mitigation	Standard Business Practice or Proposal Specific?	Other Decision-making Process Relevant?	Predicted Outcome
	<ul style="list-style-type: none"> • Reducing ancillary vehicle movements, e.g. Using buses to transport personnel between site and accommodation • Investigating progressive backfilling of the pits as far as practicable to reduce the amount of total material moved (TMM) and truck operating hours • Investigate opportunities to continuously improve productivity and minimise emissions during the construction and operation of the Proposal include: <ul style="list-style-type: none"> ○ Increasing effective utilisation through reducing idle time/ queue time and parking up equipment wherever possible ○ Increasing the efficiency of operations (including waste and ore haulage) through mine planning, design and scheduling ○ Regular maintenance and servicing of equipment 			
Measures to Offset				
	<p>The Proponent will offset emissions where abatement is insufficient against the interim and long-term targets outlined in Section 3.2.1 of the GHG EMP. Offsets will be delivered by retiring credible offsets units in 2025, 2030, 2035 and 2040, as follows:</p> <ul style="list-style-type: none"> • Calculate Safeguard Mechanism obligations purchased within the relevant five-year cumulative period to determine if any offsets purchased met the EPA requirements in these time periods 	Proposal specific	No	<p>Where required, ACCUs will be sourced and retired to meet any annual (financial year) Safeguard Mechanism obligations which will also meet interim emissions reduction targets for the Proposal.</p> <p>This strategy will allow the Proponent to be confident in meeting the interim and long-term targets effectively.</p> <p>Therefore, this is consistent with the State’s aspiration of net zero by 2050 stated in the <i>Western Australian Climate Policy</i> (GoWA 2020) and <i>Greenhouse Gas Emissions Policy for Major Projects</i> (GoWA 2019)</p>

11.5.4. RTIO Climate Action Plan

In Western Australia, the RTIO climate action plan forms a part of the Rio Tinto corporate decarbonisation strategy. It includes a suite of renewable energy and electrification of diesel fleet projects. This is due to RTIO's fossil fuel use which is derived from ~30% gas consumption for power generation, the electricity used in plant, port and office facilities, with the remaining ~70% diesel, predominantly powering mobile equipment, for example haul and rail. The solutions to transition mobile fleet from diesel to low emission energy are not yet commercially and technically viable at scale. Therefore, the short to medium term low-carbon transition strategy initiatives are focussed on displacement of gas in electricity generation with renewable energy sources. In some cases, developments may be sought, with emissions abatement projects implemented at alternative locations to the Proposals. Managing the technical constraints of the network in a system wide fashion, ensures security, reliability and stability is upheld. Emissions abatement projects are treated holistically in their application across Rio Tinto's integrated Pilbara operations providing net emissions reduction regardless of their physical location.

While extensive work across executed projects is being undertaken to meet RTIO's 2030 targets, RTIO is also setting up the foundations for the next phase of abatements required to achieve net zero emission across all operations by 2050.

Existing open cycle gas turbines provide firming of intermittent renewable energy and RTIO's existing Pilbara Power Generation network provides pathways for future fleet electrification. A number of alternative power solutions are being investigated and delivered as part of the planning for future potential opportunities to lower our carbon emissions in the Pilbara. The opportunities in delivery and under assessment include:

- A Battery Energy Storage System (BESS), that has the potential to provide back-up power capacity, known as spinning reserve
- A solar PV (34MW) facility. Solar PV reduces emissions through the displacement of gas in electricity generation with renewable energy sources
- Renewable energy studies focused on solar PV and wind energy are assessing deep renewable energy penetration (1GW) to support the transition of mobile fleet away from diesel
- Rio Tinto has successfully completed the full transition of its heavy machinery from fossil diesel to renewable diesel at its Boron, California operation and continues to investigate biofuels as an interim step
- Rio Tinto is investigating the development of a viable trolley assist option for existing haul fleet to enable substantial reduction in diesel use while on trolley
- Rio Tinto has partnered an industry wide partnership initiative collaborating to identify and develop innovative mobile fleet charging solutions
- Additional partnerships have been established to develop and implement battery electric haul solutions including haul trucks

For further detail on these opportunities, please refer to the GHG EMP (Appendix A.7).

11.5.5. Emission Reduction Targets

11.5.5.1. Group Level

The RTIO decarbonisation strategy is based upon the Rio Tinto Group announcement regarding its ambition to reach net zero emissions by 2050 across all operations. To support this ambition, interim global targets have been introduced for Scope 1 and 2 emissions, effective from 2021, to:

- Reduce absolute emissions by 15% by 2025 (approximately 4.9 Mt CO₂-e equity basis)
- Reduce absolute emissions by 50% by 2030 (approximately 16.3 Mt CO₂-e equity basis)

The target is measured against a 2018 global equity baseline, currently 32.6M t CO₂e, which will be adjusted for divestments and acquisitions.

11.5.5.2. Proponent Interim and Long-Term Emissions Reduction Targets

The Proponent is committed to contributing to the State's aspiration of net zero by 2050 by achieving interim and long-term emissions reduction targets. The emitting assets subject to this Proposal will and are included in the long-term emissions reduction pathways currently under investigation and will naturally see significant reductions over the longer timeframe as technologies develop and alternatives to firm power generation and mobile diesel become available.

To support the State's ambition, the Proponents interim and long-term emissions reduction targets for the Proposal are to:

- Reduce or abate emissions by 15% by 2025 (approximately 7,244 t CO₂-e)
- Reduce or abate emissions by 50% by 2030 (approximately 335,114 t CO₂-e)
- Reduce or abate emissions by 44% by 2035 (approximately 199,058 t CO₂-e)
- Reduce or abate emissions by 0% by 2040
- Reduce or abate emissions by 4% by 2045 (approximately 3,928 t CO₂-e)
- Reduce or abate emissions by 100% by 2050 (approximately 13,618 t CO₂-e).

Where reduction or abatement is insufficient, the retirement of Credible Offset Units in relation to the Proposal for 2025, 2030, 2035, 2040, 2045 and 2050 will occur to meet Scope 1 & 2 interim and long-term emissions reduction targets.

Through the mitigation hierarchy, the Proponent is committed to delivering emissions reductions in a linear trajectory (based on 5 yearly targets) to net zero GHG emissions by 2050.

11.5.6. Greenhouse Gas Environmental Management Plan

The Proponent in consultation with WA EPA and EPA Services has developed a GHG EMP (Appendix A.7) in accordance with the Environmental Factor Guideline: Greenhouse Gas Emissions (EPA 2023c) and in line with the State GHG Policy. The GHG EMP has been prepared with the following commitments associated with emissions reduction targets:

- Management based on five yearly interim reduction targets from 2025 to 2040 as outlined in Section 3.2.1 of the GHG EMP
- Reasonable and practicable initiatives that either avoid, reduce or offset Scope 1 & 2 emissions (Table 5-1 and Table 5-2 of the GHG EMP)
- If the target is not met, commitment to offset via the purchase of eligible offset units (Section 3.2.1 and 3.8 of the GHG EMP)
- Annual (summary) and five yearly (consolidated report against Proposal targets) progress reporting as described in Section 5 of the GHG EMP
- Five yearly formal re-submission or if a significant change is triggered as outlined in Section 4 of the GHG EMP.

11.6. Assessment of Significance of Residual Impacts

After the avoidance and reduction measures, the Proposal is expected to contribute net GHG emissions (Scope 1 and 2 emissions) of approximately 838,816 t CO₂-e through the ~22-year life of the project (Figure 11-2).

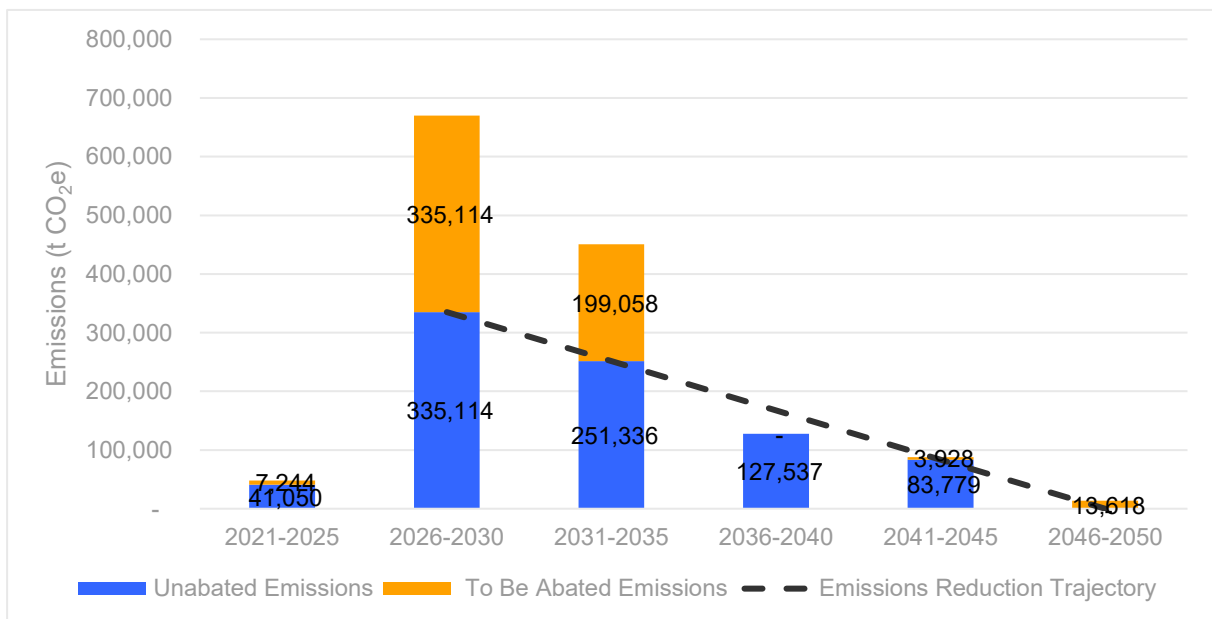


Figure 11-2: Net emissions of the Proposal after avoidance and reduction Measures

11.7. Environmental Outcomes

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a proposal has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent, or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

In consideration of the proposed management measures and likely residual impacts associated with the Proposal, the anticipated environmental outcomes that apply to Greenhouse Gases are:

- The Proponent shall take measures to reduce emissions 15% by 2025 and 50% by 2030 and then deliver emissions reductions in a linear trajectory (based on five-yearly targets) to net zero GHG emissions by 2050
- The Proponent shall take measures to ensure that net GHG emissions associated with the Proposal do not exceed:
 - 41,050 t CO₂-e for the period between 1 January 2024 and 31 December 2025
 - 335,114 t CO₂-e for the period between 1 January 2026 and 31 December 2030
 - 251,336 t CO₂-e for the period between 1 January 2031 and 31 December 2035
 - 167,557 t CO₂-e for the period between 1 January 2036 and 31 December 2040
 - 83,779 t CO₂-e for the period between 1 January 2041 and 31 December 2045
 - 0 t CO₂-e for the period between 1 January 2046 and 31 December 2050

The proponent will implement the GHG EMP (Appendix A.7) to meet these outcomes which is consistent with the EPA factor objective for GHG.

The proponent has prepared a GHG EMP (Appendix A.7) to meet these outcomes which is consistent with the EPA factor objective for GHG.

The Proposal design, combined with the Proponents' Pilbara wide emissions reductions and abatement mitigation measures, will support the Proponent's commitment to achieving net zero GHG emissions by 2050. Accordingly, the Proponent considers that the Proposal can be managed to meet the EPA's objective to minimise the risk of environmental harm associated with climate change by reducing greenhouse gas emissions as practicable.

12. OFFSETS

This section summarises the Proposal's predicted significant residual environmental impacts in the Hamersley IBRA subregion and proposed offsets.

The process of identifying significant residual impacts and determining appropriate offsets follows the framework provided by the *WA Environmental Offsets Policy* (GoWA 2011) and the *WA Environmental Offsets Guidelines* (GoWA 2014) while ensuring that the type and scale of the offsets proposed for MNES are appropriate and consistent with the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a) in addition to the State's requirements.

12.1. Objective

Environmental offsets are actions that provide environmental benefits which counterbalance the significant residual environmental impacts or risks of a proposal or activity. Unlike mitigation actions, which occur on-site as part of the Proposal and reduce the direct impact of that proposal, offsets are generally undertaken outside of the Development Envelope and counterbalance significant residual impacts.

Environmental offsets need only be applied where the residual impacts of a proposal are determined to be significant after avoidance, minimisation, and rehabilitation have been pursued. To ensure consistency and transparency on whether offsets should be applied to a proposal, the significance of residual impacts has been determined by applying the residual impact significance model (RISM) provided in the Environmental Offsets guidelines. This model outlines how significance is determined and when an offset is likely to be required, or may be required, in relation to relevant EPA environmental factors and the relevant clearing principles in Schedule 5 of the EP Act (GoWA 2014), whilst ensuring that the type and scale of the offsets proposed for MNES are appropriate and consistent with the EPBC Act (DSEWPaC 2012a).

The mitigation hierarchy of 'avoid, minimise, rehabilitate and offset' has been considered in assessing the biodiversity factors for this Proposal. This will continue to be applied during the implementation phase, as far as reasonably practicable, such that impacts are first avoided, then minimised, rehabilitated and finally offset if significant residual impacts are unavoidable. This approach is consistent with both State and Federal policy and guidance.

The GHG factor has different mitigation, which has been considered in assessing the GHG factor for this Proposal, namely:

- Avoid – Avoid emissions through best practice design
- Reduce – Reduce emissions over the Project life
- Offset – Offset some or all residual emissions where abatement is not feasible.

12.2. Policy and Guidance

12.2.1. West Australian Environmental Offsets Policy

The Government of Western Australia's Environmental Offsets Policy (2011) (the Policy) seeks to protect and conserve environmental and biodiversity values for present and future generations. The Policy ensures that economic and social development may occur while supporting long-term environmental and conservation values. The Policy seeks to ensure that environmental offsets are applied in specified circumstances transparently to create certainty and predictability while acknowledging that some environmental values are not readily replaceable. It serves as an overarching framework to underpin environmental offset assessment and decision-making in Western Australia.

12.2.2. West Australian Environmental Offset Guidelines

The Government of Western Australia's Environmental Offset Guidelines (2014) (the Guidelines) complements the Policy by clarifying the determination and application of environmental offsets in Western Australia. The application of the Guidelines is designed to ensure that decisions made on environmental offsets are consistent and accountable under the EP Act.

The Guidelines expand on the Policy to:

- Ensure that the basis for decision-making on environmental offsets is understood by decision-makers, government officers, industry and the community and consistently applied by decision-makers
- Ensure transparency in the determination and application of offsets
- Provide a basis for auditing, compliance and enforcement.

Notably, the Guidelines establish that environmental offsets are designed to address significant residual environmental impacts that remain after on-site avoidance and mitigation measures have been undertaken.

The policy and guidance relevant to the consideration and application of environmental offsets is summarised in Table 12-1.

12.2.3. EP Act

12.2.3.1. Biodiversity Factors

The rate, scale and nature of current and future developments in the Pilbara, combined with the impacts of other land uses and threatening processes, have been identified as a concern by the EPA (EPA 2014). In relation to the potential for significant residual impacts, the EPA (2014) identified a concern regarding the regulation and management of cumulative impacts on native vegetation due to impacts from clearing, pastoralism, feral animals, weeds and climate change in the Pilbara, and the lack of reliable information on the extent and condition of native vegetation at a regional scale.

The EPA has determined that a proactive approach to compensating for clearing native vegetation in the Pilbara is required. DWER has therefore established a strategic regional conservation initiative to consolidate and manage offset funds to support delivery of coordinated offset projects for the Pilbara bioregion, namely the PEOF. The WA Government has established the PEOF in response to recommendations from the EPA for a strategic, coordinated approach to applying environmental offsets to achieve broad-scale biodiversity conservation outcomes.

According to the policy and associated guidelines, the PEOF consolidates financial contributions for environmental offsets for Pilbara resource and infrastructure projects approved under the EP Act. Financial contributions to the PEOF will be used to implement conservation projects that counterbalance any significant residual impacts of those developments at a landscape level in the Pilbara.

The EPA notes that in establishing and implementing the PEOF, the WA Government has committed to ensuring that the offsets implemented via the PEOF are underpinned by the principles set out in the Policy (GoWA 2011). The six principles are:

1. Environmental offsets will only be considered after avoidance and mitigation options have been pursued
2. Environmental offsets are not appropriate for all projects
3. Environmental offsets will be cost cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted
4. Environmental offsets will be based on sound environmental information and knowledge

5. Environmental offsets will be applied within a framework of adaptive management
6. Environmental offsets will be focused on longer term strategic outcomes.

Specifically, the offsets of this Proposal align with Principles 1, 3, 4, 5 and 6.

Strategic approaches, such as using a fund, can provide a coordinating mechanism to implement offsets across a range of land tenure (GoWA 2014). Funds should be used for landscape-scale on-ground actions in the Pilbara IBRA region and indirect actions (such as research) that will directly counterbalance the significant residual impacts and contribute to biodiversity conservation outcomes in the region (DWER 2019, 2021).

Contributions to the PEOF to offset the significant residual impact from clearing native vegetation considered in good to excellent condition have been used as the standard offset approach by the EPA and proponents in the Pilbara since 2012. Where there are other environmental values with elevated significance, a higher offset rate (i.e. dollars per hectare cleared) is applied to account for this greater value.

12.2.3.2. Greenhouse Gas emissions

In its assessment of the Proposal, the EPA may request information on any considered and proposed mitigations that demonstrate that all reasonable and practicable measures have been applied at each step of the mitigation hierarchy, including offsetting emissions (carbon offsets) through the implementation of GHG emissions offset package to offset some or all residual emissions (EPA 2020b).

The EPA has advised that where carbon offsets are to be implemented, they should meet offset integrity principles and be based on clear, enforceable and accountable methods (EPA 2020b). For example, the EPA recognises Australian Carbon Credit Units issued under the *Carbon Credits (Carbon Farming Initiative) Act 2011* as meeting these standards. Compliance offsets under the Safeguard Mechanism and voluntary offsets purchased to reduce residual emissions may contribute to a proponent's Greenhouse Gas Management Plan and will be recognised by the EPA.

The State's *Greenhouse Gas Emissions Policy for Major Projects* (GoWA 2019b) declares that local innovation and local benefits are encouraged, particularly in the development of carbon offsets, and indicates a willingness to consider credible international offsets to limit abatement costs (GoWA 2019b).

12.2.4. EPBC Act

The *EPBC Act Environmental Offsets Policy* (DSEWPac 2012a) outlines the Australian Government's approach to using environmental offsets under the EPBC Act.

This policy is intended to provide a transparent framework to provide greater certainty for businesses considering actions that may be subject to an offset requirement while promoting consistency and providing robust, positive environmental outcomes.

The policy is accompanied by the *Offsets Assessment Guide* (DSEWPac 2012b), developed to give effect to the policy requirements, utilising a balance sheet approach to estimate impacts and offsets for threatened species and ecological communities.

The policy and guide provide a decision support framework to normalise the judgements associated with determining proposed offsets for a given impact. The overarching test of both the policy and the guide is that suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the environment aspect protected by national environment law and affected by the proposed action.

12.2.5. Memorandum of Understanding Concerning the Pilbara Environmental Offset Fund

On 19 November 2020, the State and Commonwealth governments established a memorandum of understanding to enable achievement of landscape-scale biodiversity outcomes for MNES in the Pilbara Bioregion via the PEOF. The agreement means that the PEOF now collects and deploys the environmental offset monies paid by industry operating in the Pilbara Bioregion under State and Commonwealth (as a condition under Part 9 or 10 of the EPBC Act (DAWE 2020a)) environmental legislation.

Table 12-1: Relevant Environmental Offset Policy and Guidance

Agency	Title	Relevance
State		
Government of Western Australia	WA Environmental Offset Policy (2011)	The WA Environmental Offsets Policy (GoWA 2011) and WA Environmental Offsets Guideline (GoWA 2014) guide proponents on the approach needed to determine offset requirements for proposals
	WA Environmental Offset Guidelines (2014)	
Environmental Protection Authority	Environmental Protection Authority 2021, Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual, EPA, Western Australia	Guidance on how the EPA will consider offsets through the EIA process. This guidance establishes the EPA's position on environmental offsets and the information required in an ERD
	Cumulative Environmental Impacts of Development in the Pilbara Region (2014)	The EPA's strategic advice to the Minister for Environment under Section 16(e) of the EP Act was provided to avoid adverse cumulative environmental impacts in the Pilbara region. It also provides the context for the EPA's advice on the environmental acceptability of significant developments. The advice also establishes the rationale behind the EPA's recommendation for the establishment of a strategic conservation initiative to coordinate the delivery of offsets in the Pilbara.
Commonwealth		
Commonwealth of Australia	EPBC Act Environmental Offsets Policy (2012a)	The EPBC Act Environmental Offsets Policy outlines the Commonwealth government's approach to the use of offsets under the EPBC Act. The Policy defines offsets as 'measures that compensate the residual adverse impacts of an action on the environment'. The policy states that avoidance and mitigation measures must be the primary strategy to manage significant impacts and that offsets do not reduce likely impacts but rather compensate for residual significant impacts.

12.3. Assessment and Significance of Residual Impact – EP Act

12.3.1. Biodiversity Impacts

Environmental offsets will only be applied where the residual impacts of the Proposal are determined to be significant after avoidance, minimisation, and rehabilitation have been pursued (GoWA 2014). These measures have been detailed in the relevant impact assessment chapters (Section 6.9, 7.6, 8.6, 9.6, 10.6 and 11.6) and are summarised in Table 12-2.

The significance of residual impacts to biodiversity values has been determined according to the RISM provided in the WA Environmental Offsets Guidelines (GoWA 2014) as summarised in Table 12-2.

The Proposal will result in clearing up to 5,350 ha of native vegetation within the Hamersley IBRA subregion. Following the application of the mitigation hierarchy, the following residual impacts are considered significant and require an offset:

- Clearing approximately 4,922 ha of native vegetation in good to excellent condition, including:
 - Up to an additional 35 ha of riparian vegetation (total combined clearing of 60 ha of riparian vegetation for the Revised Proposal (this Proposal and the Approved Proposal))
 - Up to an additional 2 ha of 'other representations' of cracking clay PEC (no clearing within PEC-2015-5) (total combined clearing of 22 ha of cracking clay for the Revised Proposal (this Proposal and the Approved Proposal))
 - Up to 126 ha of potential critical Gorge/Gully habitat for Northern Quoll, Ghost Bat and Pilbara Olive Python
 - Up to 3,731 ha of potential critical Hillcrest/Hillslope habitat for Ghost Bat
 - Approximately 78 ha of supporting Drainage Line habitat for Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python as per the following ranges for each species:
 - Northern Quoll and Pilbara Olive Python: 1 km from records
 - Ghost Bat: 12 km from category 2 caves and category 3 caves in apartment blocks
 - Approximately 2,162 ha of supporting Foothills and Plain, Mixed Acacia Woodland and Cracking Clay habitat for Ghost Bat within the range of this species (12 km from critical habitat).

The clearing of native vegetation will impact terrestrial fauna habitats. The assessment of residual impacts on MNES fauna habitats are further discussed in Section 12.4.

12.3.2. Greenhouse Gas Emissions

After the avoidance and reduction measures, the Proposal is expected to contribute net GHG emissions (Scope 1 and 2 emissions) of approximately 838,816 t CO₂-e over the life of the Proposal, with five-year targets set to progress to net zero by 2050. If the Proponent cannot meet the proposed targets by implementing emissions reduction initiatives, the Proponent will offset the excess emissions by retiring credible carbon units, which are further discussed in Section 12.5.2.

Table 12-2: Quantification of Residual Impact to be Offset

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
Environmental Factor: Social Surroundings				
<p>Context/Key Survey Findings:</p> <p>Recognising each Traditional Owner group is different and has different values, concerns, and issues (and individual members have a range of views) regarding the Proposal, the following list is considered by the Proponent to encapsulate the common key broad themes and issues raised during Social Surroundings consultation:</p> <p>Ngarlawangga:</p> <ul style="list-style-type: none"> • Cultural Heritage • Water • Pollution (dust, chemical, noise, waste) • Destruction of physical environment and rehabilitation • Access • Flora and Fauna <p>Yinhawangka:</p> <ul style="list-style-type: none"> • Protection of Country • Connection to Country • Caring for country • Sustainable future • Partnership and agreement <p>The key themes frequently overlap due to the holistic view of Country that Traditional Owners hold and inform the discussion of Traditional Owner Social Surroundings values</p> <p>The Revised Development Envelope comprises the following Social Surroundings values:</p> <ul style="list-style-type: none"> • Aboriginal heritage cultural values and traditional usage and access of the land to the Ngarlawangga and Yinhawangka People • Pastoral activity at nearby Turee Creek Pastoral Station in particular water related usage • Karijini National Park and related amenity <p>Predicted Impacts:</p> <ul style="list-style-type: none"> • Impact to cultural heritage, including interference with cultural obligations 	<p>The Proposal has been designed to manage and minimise the following potential impacts to Social Surroundings.</p> <p>Overarching Avoidance Principles:</p> <ul style="list-style-type: none"> • The Proponent will collaborate with the Ngarlawangga and Yinhawangka People to prioritise avoidance of impacts to those areas and values identified as significant. This will be guided by the existing studies and consultation and will continue to be guided by the SCHMPs • The Proponent has amended the mine design to avoid places of cultural significance including removal of Deposit J along with amendment of pit design of Mt Ella East and Western Hill in consultation with Yinhawangka and Ngarlawangga People <p>Overarching Minimisation Principles:</p> <ul style="list-style-type: none"> • The Proponent will collaborate with the Ngarlawangga and Yinhawangka People to prioritise the minimisation of impacts to those areas and values identified as significant. This will be guided by the SCHMPs • The proponent will continue to consult with Turee Creek Pastoral Station in regard to water management • Consideration of amenity to KNP via visual impact assessment and water management (Refer to Inland Waters) <p>Specific Avoidance Measures:</p> <ul style="list-style-type: none"> • Mining of ore reserves at Western Hill will be limited to AWT to avoid mine pit dewatering for this Proposal, owing to the proximity of Karijini National Park • Groundwater Environmental Management Plan will be implemented to ensure no change to groundwater levels at the boundary of, or within Karijini National Park that are attributable to the Proposal • Water levels within the waterhole at Deposit H Waterhole and Turtle Pool are modelled to continue to fill in accordance with pre mining level and frequency taking into account natural variation • No additional surplus water discharge to Turee Creek East as a result of the Proposal. Continue to avoid discharge footprint (wetting front) within 2 km of KNP in accordance with requirements of MS 1113 • Groundwater is abstracted according to programs that have been modelled to ensure 	<p>The Proponent will:</p> <ul style="list-style-type: none"> • Work in collaboration with the Ngarlawangga and Yinhawangka People during the rehabilitation of the site • Consult with the Ngarlawangga and Yinhawangka People regarding the proposed closure outcomes and landform designs, including the proposed visual impact from key vantage points of cultural heritage importance • Assess rehabilitation seed mixes and seek to incorporate identified culturally significant species (bush tucker/medicine) where practical • Utilise Land Access Protocols with Traditional Owners to assist with safe accessibility to specified areas of cultural significance as identified during consultation with Traditional Owners • Progressive backfilling opportunities will be undertaken during the life of the operation, where practicable 	<p>Not applicable.</p>	<p>Extent</p> <p>Clearing up to 5,350 ha on Ngarlawangga and Yinhawangka Land within their Native Title Determination Areas.</p> <p>Quality</p> <p>4,922 ha of native vegetation is in good to excellent condition, including up to 35 ha of riparian vegetation, 2 ha of cracking clay (excluding PEC-2015-5).</p> <p>Land Tenure</p> <p>Not applicable.</p> <p>Time Scale</p> <p>Clearing will be undertaken progressively.</p>

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
<p>and spiritual beliefs tied to water, as a result of altered hydro-logical regimes</p> <ul style="list-style-type: none"> Alteration to groundwater and surface water regimes impacting Traditional Owner sense of place Restriction of access to Country Direct disturbance of Country and cultural heritage Indirect disturbance of cultural sites and places as a result of active mining Disturbance, or reduced presence, of plants and animals due to dust, light, noise and vibration Changes to local landforms, installation of infrastructure which may result in altered visual landscapes Alteration of the sense of place and amenity due to dust Alteration of the sense of place and amenity due to noise and vibration Changes to local landforms, installation of infrastructure which may result in altered visual landscapes Alteration of the sense of place and amenity due to dust 	<p>dewatering volumes are minimised while ensuring safe access to BWT mine pits. Ongoing groundwater level monitoring is used to verify the models and adjust dewatering programs as required</p> <ul style="list-style-type: none"> Operational water demand will be supplied from mine dewatering in the first instance (where feasible), reducing the requirement for water supply volumes The Proponent has implemented changes to avoid direct disturbance of the Deposit H Waterhole Infrastructure interactions with upper catchment of Turtle Pool will have culvert/floodway designed and installed to ensure existing flows to the pool are maintained. Major infrastructure, including WRL, have been preferentially located outside of the ephemeral watercourses and their tributaries The Proposal will avoid interactions with significant water features, where it is practicable to do so The Deposit H Waterhole site complex, and Turtle Pool will be avoided through implementation of heritage site boundaries Turtle Pool is outside the Revised Development Envelope and will not be impacted directly by the Proposal. WRL will be preferentially placed outside of the floodplain of local creek lines and watercourses Where possible, surface water diversion drains will be constructed to avoid natural flows from entering disturbed areas, including mining voids. The flow diversions will be designed, constructed and maintained so as to minimise mobilisation and transport of sediment laden runoff to sensitive environmental receptors Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements and industry guidelines, including within secondary containment The Proponent will avoid as far as practicable restricting access to culturally important areas (and on which cultural activities are conducted and within which resources are collected) The Proponent has refined the Proposal scope and Revised Development Envelope via a Section 43A application under the EP Act and Section 156A application under the EPBC Act which significantly reduced potential impacts at Mt Ella East <p>Yinhawangka</p>			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> • Deposit J has been removed from the Proposal altogether, with the Revised Development Envelope and Conceptual Footprint changed to reflect this via a Section 43A application under the EP Act and Section 156A application under the EPBC Act • The Conceptual Footprint has been amended to avoid direct impacts to the Western Hill site complex, the Mt Ella East site complex, (now outside the Revised Development Envelope), and the unnamed range to the south of the existing West Angelas operations <p>Ngarlawangga</p> <ul style="list-style-type: none"> • The Conceptual Footprint has been amended to avoid direct impacts to the Deposit H Waterhole site complex and the Mt Ella Range (now outside the Revised Development Envelope) • Heritage site boundaries, the Proponents CHMS, and commitment to no direct impacts as a result of this Proposal be implemented in some sections of the Revised Development Envelope, which will avoid direct impacts to important cultural sites and places within these areas • Disturbance will be managed using the Proponent's IHMP, CHMS, and the Rio Tinto Approvals Request database to avoid unauthorised disturbance of sites of cultural significance. Information derived from surveys and consultations is used in the Proponent's GIS to spatially manage heritage and other important places, such as through the creation of exclusion boundaries, so that personnel designing a project can seek to avoid significant places where possible • Prior to all disturbance heritage clearance surveys will be conducted to ensure all heritage sites are identified, with Proposal activities designed to avoid heritage sites if possible • Avoidance of 17 caves within the Proposal Area by implementing MEZ and MRZ. An additional 20 caves are currently protected under MS 1113 Restriction and Exclusion areas, as per Table 9-21 <p>Measures to Minimise:</p> <ul style="list-style-type: none"> • The Conceptual Footprint has been designed to minimise impacts to watercourses within the Revised Development Envelope. The Proposal largely relies on existing infrastructure, including crossings • Alternative water sources external to Deposit H aquifer be considered as part of mine designs. This mine design alternative is currently subject to further technical investigation and will be consulted with both Traditional Owner groups, understanding that water for production would 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<p>need to be sourced from other aquifers at West Angelas operations</p> <ul style="list-style-type: none"> • Water use will be continually reviewed and updated against dust suppression effectiveness and technological advancement, with resulting options considered in consultation with Traditional Owners over the life of the operation. Such reviews will include the implementation of trials on alternative techniques and strategies • Reuse of Deposit H surplus water from mine pit dewatering will preferentially occur at Deposit H in accordance with Traditional Owner wishes • Refer to Inland waters minimisation for AMD and contamination risk mitigation measures • Refer to Inland waters section for minimisation of impacts to surface flows from altered hydrologic regime • Prioritise dust suppression and monitoring, particularly around Deposit H Waterhole and Turtle Pool as a recommendation from social surroundings consultation with Ngarlawangga Traditional Owners • Deposit H pit design will be agreed with Ngarlawangga Traditional Owners prior to implementation (see SCHMP, Appendix B.2.d) • The Proponent will continue to consult with Traditional Owners to confirm all areas required to remain accessible (within health and safety limitations) and investigate Mine Design and access design options to further minimise restrictions, ensure no worse off access and non-prevention of access on these areas and access generally • Traditional Owner access to sites that may be identified through ongoing surveys and consultation, will be facilitated throughout the life of the Proposal. Access track options are being investigated to provide Traditional Owners unrestricted access to the Deposit H Waterhole site complex • Land Access Protocols will be updated or developed with Traditional Owners to facilitate and support access • The Proponent will maintain ongoing communication with Ngarlawangga and Yinhawangka to ensure that access to the places specified in the LAP is properly managed throughout the life of the Proposal. This will involve regular joint review of the LAP. Additional places, such as those identified in future surveys, will be included in the LAPs as required • The Proponent will prepare SCHMPs with each Traditional Owner group that will address processes and/or arrangements to facilitate access within the Revised Development 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<p>Envelope. [SCHMP –co-designed with Traditional Owners to ensure each plan’s aims, objectives and actions are agreed with each group prior to implementation</p> <ul style="list-style-type: none"> • The Proponent will consult with Traditional Owners regarding post-closure access in relation to final landform design • Pre-disturbance heritage surveys will inform decision to relocate activities to minimise potential impacts to heritage sites where possible • Mine design optionality and potential impacts to important cultural sites and heritage sites will be assessed with Traditional Owners through appropriate consultation forums • Salvage of artefacts will occur for sites unavoidably impacted, where salvage is not possible these values will be recorded • The Proponent will engage with Traditional Owners to provide Proposal workforce with cultural awareness training including importance of avoiding areas outside approved disturbance, other heritage requirements and recognition of artefacts • Proponent workforce will not be permitted to access areas outside direct disturbance and operational areas without authorisation (e.g. in order to undertake monitoring, surveys and required activities). Access to some areas and conduct of some activities is expected to require Proponent personnel to be accompanied by Traditional Owners with appropriate cultural authority • Use of heritage site boundaries, Rio Tinto’s CHMS; dust, noise and blast vibration and flyrock modelling, geotechnical assessment, blast management plans within 350 m of rock shelter (or vibration sensitive) sites to inform additional potential mitigation measures in consultation with Traditional Owners • Dust, noise and vibration monitoring will be undertaken in the vicinity of key caves, and where agreed under SCHMPs • Heritage and other specific survey activities for confirmation of values and site locations in regard to proposal designs as directed by Traditional Owners • Implementation of Traditional Owner LAPs to facilitate access to important cultural sites and places, and heritage sites • Implementation of mine design controls such as waterhole/waterway sedimentation and pollution management and monitoring, in consultation with Traditional Owners 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> Refer to minimisation measures for Flora and Vegetation Refer to minimisation measures for Terrestrial Fauna The Proponent has refined its mine plan, with the Revised Development Envelope significantly reduced at Western Hill, Mt Ella East, and Deposit H to avoid impacts to culturally important sites and places, which will minimise potential impacts to plants and animals occurring within these areas The Proponent has refined its mine plan to minimise visual impact on landforms by removing Deposit J and significantly amending Mt Ella East sections of the Revised Development Envelope Options to minimise dust accumulating in culturally important areas – minimisation / management options to be discussed further – e.g. increase dust suppression/ water carts near creeks/ creek crossings paving road sections Management of all waste and litter is subject to standard site operating procedures, which require all waste and litter to be contained and disposed of appropriately The Proponent commits to ensuring waste management and site housekeeping actions are undertaken to minimise the visual impact of litter and waste SCHMP to include involvement of Traditional Owners in site observations to allow feedback on (among other things) waste/litter The Proponent will implement dust management measures, such as dust suppression and sediment traps to minimise indirect impacts to Karijini National Park and other nearby viewpoints 			
Environmental Factor: Inland Waters				
<p>Context/Key Survey Findings:</p> <p>The Revised Development Envelope comprises the following Inland Water values:</p> <ul style="list-style-type: none"> Turee Creek East, (which flows westwards into and through Karijini National Park) The regional groundwater aquifer (Wittenoom Formation) that underlies the Proposal and Karijini National Park Potential Groundwater Dependent Ecosystems (features 1a, 12, 14 and 22) 	<p>Avoidance</p> <p>The Proposal has been designed to avoid the following impacts to Inland Waters:</p> <ul style="list-style-type: none"> Groundwater drawdown: <ul style="list-style-type: none"> Mining of ore reserves at Western Hill will be limited to AWT to avoid mine pit dewatering for this Proposal, owing to the proximity to Karijini National Park Groundwater Environmental Management Plan will be implemented to ensure no change to groundwater levels at the boundary of, or within Karijini National Park that are attributable to the Proposal 	<ul style="list-style-type: none"> Groundwater levels are expected to recover naturally once dewatering within the aquifer is concluded. Recovery timeframes have not yet been modelled however will be addressed in future MCP updates – refer to MCP (Appendix A.5) All dewatering and production bores will be decommissioned in accordance with relevant guidelines or retained and transferred to third party/stakeholder or Traditional Land Owner once they are no longer required Once satisfactorily decommissioned and rehabilitated, surface drainage systems from previously disturbed areas (other than pits, which will be appropriately banded) will be reconnected with the natural systems 	<p>Can the environmental values be rehabilitated? Evidence?</p> <ul style="list-style-type: none"> Removal of linear structures is a standard practice for reinstating uninterrupted flows Long term diversion drains are an effective means of maintaining smaller flows back into major creek systems and is expected to be effective at Deposit H) Backfilling of pits to avoid formation of pit lakes is an effective means of avoiding the long-term potential impacts from the creation of pit lakes Stabilisation of landforms is a standard closure objective with well-established techniques to ensure that runoff from closure landforms does not create erosion and sedimentation 	<p>The Proponent considers that potential impacts can be managed in accordance with EPA objectives for this factor and that residual impacts will not be significant.</p> <p>Therefore, no offset for inland waters is proposed</p>

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
<ul style="list-style-type: none"> Surface water fed ephemeral pools (Deposit H Waterhole, Turtle Pool, Mt Ella East Pool(s)) <p>Predicted Impacts/Outcomes:</p> <ul style="list-style-type: none"> No drawdown of groundwater associated with the Proposal at the boundary of, or within, Karijini National Park No environmentally significant impacts to groundwater or surface water quality related to AMD from mine pits, WRL and other Proposal elements and activities No determinable change to the volume, rate and quality of controlled surface water discharge (from dewatering) as a result of the Proposal No environmentally significant change in catchment flows as a result of mining operations intercepting creek tributaries Water levels within the waterhole at Deposit H and Turtle Pool are modelled to continue to fill in accordance with pre mining frequency and level 	<ul style="list-style-type: none"> Water levels within the waterhole at Deposit H and Turtle Pool are modelled to continue to fill in accordance with pre mining level and frequency taking into account natural variation (refer to EMP; Appendix A.8) Groundwater mounding from surplus storage in disused pits: <ul style="list-style-type: none"> To avoid impacts to environmental values, surplus water storage in pits will only occur where pit lakes would not be expected to cause mounding in areas of shallow water table (i.e., <20 m bgl) Changes to Surface Water Catchments: <ul style="list-style-type: none"> Major infrastructure, including WRL, have been preferentially located outside of the ephemeral watercourses and their tributaries Changes to surface hydrological regime of Turee Creek: <ul style="list-style-type: none"> No additional surplus water discharge to Turee Creek East as a result of the Proposal. Continue to avoid discharge footprint (wetting front) extending within 2 km of KNP in accordance with requirements of MS 1113 Existing approved operations discharge will remain otherwise unchanged and will be managed in accordance with the requirements of MS 1113 and the West Angelas EMP (Rio Tinto 2020d) Impacts to Water Quality - Potential AMD from pits and WRL: <ul style="list-style-type: none"> BWT mine pits will be backfilled to a level where the formation of pit lakes will be avoided Impacts to Water Quality - Sediments and other contaminants in stormwater runoff / accidental spills: <ul style="list-style-type: none"> Where possible, surface water diversion drains will be constructed to avoid natural flows from entering disturbed areas, including mining voids. The flow diversions will be designed, constructed and maintained so as to minimise mobilisation and transport of sediment laden runoff to sensitive environmental receptors Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will be stored in accordance with legislative requirements and industry guidelines, including within secondary containment 	<ul style="list-style-type: none"> Operational diversions at Deposit H will be retained and upgraded to meet closure specifications All contamination will be appropriately managed at closure, as per the <i>Contaminated Sites Act 2003</i> Modelling will be used to ensure the integrity of legacy structures, such as WRL, is retained over the long term All solid and liquid wastes and other contaminated material will be appropriately managed during and post-closure Once satisfactorily decommissioned and rehabilitated, drainage diversions (other than pits, which will be appropriately banded) will be removed and surface water systems reconnected unless specified to be retained in the MCP The stabilisation and revegetation of landforms at closure is anticipated to minimise sediment runoff 	<p>Operator experience in undertaking rehabilitation?</p> <p>Rio Tinto conducts rehabilitation activities progressively at all its operations in the Pilbara. All rehabilitation is undertaken according to the Rio Tinto Iron Ore Rehabilitation Handbook, which is reviewed and updated periodically to reflect changes in industry standards, reflect new knowledge obtained through research and development, and adopt learnings from ongoing rehabilitation projects. The Handbook addresses:</p> <ul style="list-style-type: none"> Soil resource management Rehabilitation techniques Local provenance species seeding practices Records and data management Ongoing monitoring <p>What is the type of vegetation being rehabilitated?</p> <p>The Proponent purchases appropriate local provenance seeds from commercial seed suppliers for rehabilitation. Stringent controls on seed quality, provenance, and storage are in place, and seed pre-treatments are researched and incorporated for some species to maximise the potential of applied seed to germinate successfully and persist.</p> <p>Time scale</p> <p>Once internal stakeholders have signed off areas as no longer required for current or future operations, they are added to the progressive rehabilitation implementation schedule. However, mine plans are dynamic and subject to continuous revision.</p> <p>Progressive rehabilitation will continue to be undertaken throughout the life of the Proposal where practicable; however, most of the rehabilitation will be undertaken at closure.</p> <p>Credibility of the rehabilitation proposed (evidence of demonstrated success).</p> <p>Rehabilitation success across the existing Pilbara operations has been variable to date. Some areas indicate positive performance and very good rehabilitation, and poor rehabilitation outcomes are observed in some other historical areas.</p> <p>In response and in consultation with DMIRS, the Proponent has recently undertaken extensive revisions of mine closure planning (for all its Pilbara operations) to ensure, among other things, improved detail is provided on how closure objectives, such as those related to progressive rehabilitation, will be achieved successfully.</p>	

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<p>Minimisation</p> <p>The Proposal has been designed to minimise the following impacts to Inland Waters:</p> <ul style="list-style-type: none"> • Lowering of Groundwater Levels <ul style="list-style-type: none"> ○ Groundwater is abstracted according to programs that have been modelled to ensure dewatering volumes are minimised while ensuring safe access to BWT mine pits. Ongoing groundwater level monitoring is used to verify the models and adjust dewatering programs as required ○ Operational water demand will be supplied from mine dewatering in the first instance (where feasible), reducing the requirement for water supply volumes • Changes to Surface Water Catchments: <ul style="list-style-type: none"> ○ Pits will be isolated from significant creeklines and their floodplains to minimise interception of surface water catchment flows ○ Minimise clearing within and preferentially locate non critical infrastructure outside or Turee Creek East catchments directly adjacent to Karijini National Park at Western Hill ○ Water levels within the waterhole at Deposit H and Turtle Pool are modelled to continue to fill in accordance with pre mining level and frequency taking into account natural variation (refer to EMP; Appendix A.8) ○ Linear infrastructure will be designed to convey high frequency flood events (up to 1 in 10 AEP) through culverts or similar structures to avoid impediment of flows ○ Infrastructure may be designed to allow overtopping in lower frequency events to minimise upstream flooding and scouring downstream of culvert outlets ○ Surface water fed ephemeral pools WB-WAJ1 and WB-WAJ2 will be protected via Heritage site exclusion areas (refer Section 6). Flow to these pools will not be impacted by the Proposed Action as they are fed from catchments to the south of the pools, and the Proposed Action is located to the north • Changes to surface hydrological regime of Turee Creek: <ul style="list-style-type: none"> ○ Surplus water storage in disused mine pits will potentially reduce both discharge Turee Creek and abstraction for supply 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> • Temporary in-pit storage of surplus mine dewater: <ul style="list-style-type: none"> ○ Surplus water storage in mine pits that do not have exposed PAF is the proposed surplus water strategy once mine pits are available and criteria for storage are met • Impacts to Water Quality - Potential AMD from pits and WRL: <ul style="list-style-type: none"> ○ Implement established procedures for the early identification of PAF materials to ensure adequate blending with NAF/high ANC materials, or encapsulation if required ○ Implement the Mineral Waste Management Plan ○ If PAF waste material is encountered at Western Hill the SCARD plan will be implemented ○ PAF material will be encapsulated within NAF material within waste landforms to minimise potential for contaminated leachate ○ Pits will be backfilled to cover any exposed PAF material at closure to prevent further exposure and potential for generation of AMD ○ Update Groundwater Environmental Management Plan (Rio Tinto 2022d) prior to commencement of mining at Western Hill and implement • Impacts to Water Quality - Sediments and other contaminants in stormwater runoff / accidental spills: <ul style="list-style-type: none"> ○ All structures within creeklines and floodplains will be appropriately armoured or otherwise protected to ensure erosion risks are minimised ○ Potentially contaminating substances, such as solid and liquid wastes, bulk hydrocarbons, etc, will not be stored within or near creeklines, or within floodplains ○ All personnel involved in the storage and handling of potentially contaminating materials will be appropriately trained and supported by adequate resources including signage, spill kits and PPE ○ Prioritise dust suppression and monitoring, particularly around Deposit H Waterhole and Turtle Pool as a recommendation from social surroundings consultation with Ngarlawangga Traditional Owners 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
Environmental Factor: Flora and Vegetation				
<p>Context/Key Survey Findings:</p> <p>The Revised Development Envelope comprises the following Flora and Vegetation values:</p> <ul style="list-style-type: none"> • 28,907 ha of native vegetation in good to excellent condition • 433 ha of Priority 1 PEC – ‘West Angelas Cracking Clays’ PEC • Three vegetation types of high local significance value • 28 Priority flora species (seven P2, 17 P3 and four P4) • 392 ha of riparian vegetation • One potential GDE within the Revised Development Envelope, and three other potential GDEs outside the Revised Development Envelope <p>Predicted Impacts:</p> <ul style="list-style-type: none"> • Clearing up to 5,350 ha of native vegetation, of which approximately 4,922 ha is in very good to excellent condition, including: <ul style="list-style-type: none"> ○ Up to 35 ha of riparian vegetation ○ Clearing of up to 2 ha of vegetation type (P15) which is considered to represent the Priority 1 PEC - West Angelas Cracking-Clays (P1) ○ Direct disturbance to 28 Priority P2, P3 and P4 flora species (seven Priority 2, 17 Priority 3 and four Priority 4 flora species) 	<p>Avoidance</p> <ul style="list-style-type: none"> • Clearing of Native Vegetation: <ul style="list-style-type: none"> ○ Cannot be avoided • Clearing of Priority Flora Species: <ul style="list-style-type: none"> ○ No priority 1 flora species within the Revised Development Envelope ○ Clearing of Priority 2, 3 and 4 species cannot be avoided • Degradation of Vegetation Condition due to Increased Abundance and Diversity of Weeds: <ul style="list-style-type: none"> ○ The Proponent will avoid introducing new weed species listed as WoNS entering the Revised Development Envelope through implementation of the West Angelas EMP (Appendix A.8) which may include: <ul style="list-style-type: none"> - Equipment hygiene and inspection certificate required for all earth moving vehicles, heavy machinery and drill rig equipment entering and leaving the Revised Development Envelope or moving between identified weed infestation areas to areas that are not infested - No transfer or relocation of material potentially harbouring weeds/weed seeds is permitted from identified weed infested areas to areas with no/low weed infestation (e.g., transfer of topsoil from identified weed infested areas to areas with no/low weed infestation) - Infested or potentially infested material will be quarantined to areas with existing infestations • Degradation or Alteration of Vegetation as a Result of Altered Hydrological Regimes: <ul style="list-style-type: none"> ○ Deposits F North and H will avoid direct impacts on to the natural flows of large creek systems and the vegetation communities supported by them by placing landforms and infrastructure outside the 1:100yr ARI floodplain extent ○ Riparian vegetation along the major creeklines is not proposed to be subject to additional surplus water discharge as a result of the Proposal • Degradation of Vegetation from Dust Deposition and Potential Increase in Fire Risk: 	<p>The Proponent will:</p> <ul style="list-style-type: none"> • Prepare an MCP following DMIR’s Guidelines for Preparing MCPs (Appendix A.5) • The Proponent commits to undertaking progressive rehabilitation to minimise the extent of cleared areas as well as restore vegetation using recovered topsoil and seed of local provenance where possible • Consult with Yinhawangka on Backfilling pits at Mt Ella East, and adhere to any management actions agreed to in the SCHMP • Ensure that vegetation on rehabilitated land is self-sustaining and compatible with the final land use – including: <ul style="list-style-type: none"> ○ Topsoil to be re-spread over rehabilitated areas to act as a seed source ○ Local provenance seed and propagated material will be used (if required) to rehabilitate disturbed areas ○ Undertake weed spraying during rehabilitation, especially during the LoM ○ Include indicative closure completion criteria to ensure that the only weed species recorded within rehabilitation areas are also present within the local uncleared area ○ If suitable species are identified through the ethnobotanical heritage surveys or other sources, the seed mixes will be detailed within the MCP with processes for consultation and involvement of Traditional Owners regarding MCPs to be included in the co-designed SCHMPs 	<p>Can the environmental values be rehabilitated? Evidence?</p> <ul style="list-style-type: none"> • All rehabilitation is undertaken in accordance with the Proponent’s Rehabilitation Procedures • A total disturbance area of 214 ha at West Angelas has been rehabilitated to date (Q1 2022), ranging from low disturbance areas to highly disturbed waste landforms • Rehabilitation that is monitored is overall performing well. East WRL at Deposit A is progressing particularly well, with all native perennial cover and other vegetation density parameters within the reference site range or similar to at least one reference site. Multiple vegetation layers were present on the rehabilitation, with spinifex mostly dominant and spinifex cover exceeding the reference sites <p>Operator experience in undertaking rehabilitation?</p> <p>Rio Tinto conducts rehabilitation activities progressively at all its operations in the Pilbara. All rehabilitation is undertaken according to the Rio Tinto Iron Ore Rehabilitation Handbook, which is reviewed and updated periodically to reflect changes in industry standards, reflect new knowledge obtained through research and development, and adopt learnings from ongoing rehabilitation projects. The handbook addresses:</p> <ul style="list-style-type: none"> • Soil resource management • Rehabilitation techniques • Local provenance species seeding practices • Records and data management • Ongoing monitoring <p>What is the type of vegetation being rehabilitated?</p> <p>The Proponent purchases appropriate local provenance seeds from commercial seed suppliers for rehabilitation. Stringent controls on seed quality, provenance and seed storage are in place. Seed pre-treatments are researched and incorporated for some species to maximise the potential of applied seed to germinate successfully and persist.</p> <p>Time scale</p> <p>Once internal stakeholders have signed off areas as no longer required for current or future operations, they are added to the progressive rehabilitation implementation schedule. However, mine plans are dynamic and subject to continuous revision.</p> <p>Progressive rehabilitation will continue to be undertaken throughout the life of the Proposal where</p>	<p>Extent</p> <p>Clearing up to 5,350 ha of native vegetation, approximately 4,922 ha is in good to excellent condition.</p> <p>Quality</p> <p>4,922 ha of native vegetation is in good to excellent condition, including:</p> <ul style="list-style-type: none"> • up to 35 ha of riparian vegetation • 2 ha of cracking clay (excluding PEC-2015-5) <p>Land tenure</p> <p>Not applicable.</p> <p>Time scale</p> <p>Clearing will be undertaken progressively.</p> <p>The direct disturbance of Vegetation in Good to Excellent condition in the Pilbara is recognised by the EPA as a significant residual impact and will be offset.</p>

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> ○ Cannot be avoided but will be minimized as far as practicable ● Extend protection to non-listed species that are otherwise culturally important to Traditional Owner Groups: <ul style="list-style-type: none"> ○ Impact to ethnobotanical species will be minimised as far as practicable <p>Minimisation</p> <ul style="list-style-type: none"> ● Clearing of native vegetation: <ul style="list-style-type: none"> ○ Total extent of clearing required reduced from 7,200 ha (as referred) to 5,350 ha (amended via s.43A) ○ Implement upper clearing limit of 2 ha for the Proposal for the regionally significant vegetation; West Angelas Cracking Clays Priority 1 PEC, as detailed in the West Angelas EMP (Appendix A.8) ○ Implement upper clearing limit for riparian vegetation of 35 ha for the Proposal, as detailed in the West Angelas EMP (Appendix A.8) ○ Ensure clearing occurs only in approved areas through continued implementation of the Proponent's Approvals Request System ○ Utilise existing disturbed areas wherever practicable ○ Conduct a site induction program to provide information on vegetation protection and ground disturbance authorisation procedures ● Clearing of Priority Flora Species: <ul style="list-style-type: none"> ○ The Proponent will minimise impacts to Priority flora species within the Revised Development Envelope, as far as practical Proposed clearing based on the conceptual footprint is detailed in Table 8-15 ○ Ensure clearing occurs only in approved areas through continued implementation of the Proponent's Approvals Request System ● Degradation of Vegetation Condition due to Increased Abundance and Diversity of Weeds: <ul style="list-style-type: none"> ○ A baseline weed and introduced species survey will be commissioned to inform the survey and control program ○ The survey and control program will include a review to identify and target high risk areas (e.g., environmental value, existing weed presence, status of weeds that are present, and potential for 		<p>practicable; however, the majority of the rehabilitation will be undertaken at closure.</p> <p><u>Credibility of the rehabilitation proposed (evidence of demonstrated success)</u></p> <p>In response and in consultation with DMIRS, the Proponent has recently undertaken extensive revisions of mine closure planning (for all its Pilbara operations) to ensure, among other things, improved detail is provided on how closure objectives, such as those related to progressive rehabilitation, will be achieved successfully.</p> <p>The Proponent's Approval Request System is a well established mechanism for prioritising the avoidance of higher value areas and is considered an effective control</p>	

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<p>further transfer/dispersal e.g., waterways and high trafficable areas)</p> <ul style="list-style-type: none"> ○ Implement the targeted survey and control program at target high risk areas ○ Use the results of the survey and control program to inform targeted management ○ The results of the survey and outcomes of weed management will be reported annually in the Annual Compliance Assessment Report (including to DoCCEEW) <ul style="list-style-type: none"> ● Degradation or Alteration of Vegetation as a Result of Altered Hydrological Regimes: <ul style="list-style-type: none"> ○ The impact on the surface water catchment supporting the Deposit H surface water fed ephemeral pool will be minimised through ensuring sufficient flows as modelled (Section 6) to ensure filling of the pool are maintained throughout the life of the mine ○ Flows to Deposit H Waterhole will be monitored, managed and reported as specified in the West Angelas EMP (Appendix A.8) ● Degradation of Vegetation from Dust Deposition and Potential Increase in Fire Risk: <ul style="list-style-type: none"> ○ Implementation of dust suppression techniques such as sprayers on crushers and water trucks is expected to help minimise dust generation during construction and operation ○ Limiting the amount of disturbed land to as small as reasonable reducing the amount of dust producing surfaces ○ Continuation of fire management measures such as hot works permit system, vehicle movement (not leaving cleared tracks) and disposal of potential fire-starting waste [e.g. cigarette butts] is expected to minimise the risk of bushfires as a result of the Proposal ○ Firefighting equipment will be located around the site and in vehicles. Fire response procedures and personnel training will also be provided, including site inductions on fire prevention and management ● Extend protection to non-listed species that are otherwise culturally important to Traditional Owner Groups: <ul style="list-style-type: none"> ○ Ethnobotanical / Traditional Ecological Knowledge surveys are being conducted and more planned with Traditional Owners to provide more information on 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<p>native honeybees, honey trees and myriad other species of cultural importance</p> <ul style="list-style-type: none"> The Proponent will also work with Traditional Owners to ensure culturally important plants are considered for use in rehabilitation Further work will occur to understand the potential use of these species in rehabilitation 			
Environmental Factor: Terrestrial Fauna				
<p>Context/Key Survey Findings:</p> <p>The Revised Development Envelope comprises the following Terrestrial Fauna values:</p> <ul style="list-style-type: none"> Seven significant fauna species known to occur, including: <ul style="list-style-type: none"> Northern Quoll (EPBC Act, E) Ghost Bat (EPBC Act, V) Pilbara Leaf-nosed Bat (EPBC Act, V) Pilbara Olive Python (EPBC Act, V) Fork-tailed Swift (EPBC Act, M) Western Pebble-mound Mouse (P4) Pilbara Barking Gecko (P2) Five significant fauna species likely to occur, including: <ul style="list-style-type: none"> Grey Falcon (EPBC Act, V) Peregrine Falcon (EPBC Act, OS) Short-tailed Mouse (P4) Brush-tailed Mulgara (P4) Pilbara Flat-headed Blink Snake (P1) Two high significance fauna habitats: <ul style="list-style-type: none"> Gorge/Gully Hillcrest/Hillslope 	<p>Avoidance</p> <p>The Proposal has been designed to avoid the following potential impacts to Terrestrial Fauna:</p> <ul style="list-style-type: none"> Clearing of fauna habitat and habitat fragmentation: <ul style="list-style-type: none"> The Revised Development Envelope and Conceptual Footprint have been continually refined during the design phase to avoid direct impacts to high significance fauna habitats as much as practicable. This includes the avoidance of 17 category 2, 3 and 4 caves in the Proposal Area; Ghost Bat roosts; and water habitat features MEZs and MRZs have been established around 17 caves within the Proposal Area, with no mining disturbance permitted in MEZs³⁰ and limits on disturbance within MRZs. An additional 20 caves are currently protected under MS 1113 Restriction and Exclusion Areas MRZs have been established around critical and supporting habitat linking bat roosts where appropriate MRZs and MEZs will be included in the Proponent's GIS system to ensure known locations are avoided The Proponent will ensure clearing only occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system Clearing of habitat and loss of SRE Individuals: <ul style="list-style-type: none"> The Revised Development Envelope and Conceptual Footprint have been modified during the design phase to avoid direct 	<p>The Proponent will:</p> <ul style="list-style-type: none"> Prepare and regularly update an MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020a) The MCP includes objectives to ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use Final landforms will be stable and consider ecological and hydrological factors. Linear infrastructure, including crossings, will be fully decommissioned if no longer required Habitat elements considered for terrestrial fauna as part of rehabilitation design includes: Vegetation is known to provide preferred food or shelter preference Rehabilitation will be conducted in accordance with the Rio Tinto Iron Ore Rehabilitation Handbook and will include fauna and habitat monitoring Rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement Temporary infrastructure will be removed at closure to allow natural flow paths and catchments to be re-established in these areas The Proponent commits to the undertaking of progressive rehabilitation to restore any vegetation impacted by alterations to the hydrological regimes The MCP includes objectives to ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use. Final landforms will be stable and consider ecological and hydrological factors 	<p>Can the environmental values be rehabilitated? Evidence?</p> <ul style="list-style-type: none"> All rehabilitation is undertaken in accordance with the Proponent's Rehabilitation Procedures A total disturbance area of 214 ha at West Angelas has been rehabilitated to date (Q1 2022), ranging from low disturbance areas to highly disturbed waste landforms Rehabilitation that is monitored is overall performing well. East WRL at Deposit A is progressing particularly well, with all native perennial cover and other vegetation density parameters within the reference site range or similar to at least one reference site. Multiple vegetation layers were present on the rehabilitation, with spinifex mostly dominant and spinifex cover exceeding the reference sites <p>Operator experience in undertaking rehabilitation?</p> <p>Rio Tinto conducts rehabilitation activities progressively at all its operations in the Pilbara. All rehabilitation is undertaken according to the Rio Tinto Iron Ore Rehabilitation Handbook, which is reviewed and updated periodically to reflect changes in industry standards, reflect new knowledge obtained through research and development, and adopt learnings from ongoing rehabilitation projects. The handbook addresses:</p> <ul style="list-style-type: none"> Soil resource management Rehabilitation techniques Local provenance species seeding practices Records and data management Ongoing monitoring <p>What is the type of vegetation being rehabilitated?</p>	<p>Extent</p> <ul style="list-style-type: none"> Clearing up to 5,350 ha of which 4,922 ha is high or moderate significance fauna habitat. This includes clearing up to 3,857 ha of high significance fauna (126 ha Gorge/gully and 3,731 ha of Hillcrest/Hillslope) habitat and approximately 2,242 ha of moderate significance fauna habitat (~79 ha Drainage Line, ~1,787 ha Footholds and Plain, ~374 ha Mixed Acacia Woodland and 2 ha Cracking Clay) Loss of up to four category 4 Ghost Bat and Pilbara Leaf-nosed Bat roosts <p>Quality</p> <p>High significance habitats include Gorge/Gully and Hillcrest/Hillslope.</p> <p>Moderate significance habitats include Drainage Line, Mixed Acacia Woodland, Footholds and Plain and Cracking Clay.</p> <p>Land tenure</p> <p>Not applicable.</p> <p>Time scale</p> <p>Clearing will be undertaken progressively.</p>

³⁰ except activities associated with environmental management and monitoring as per the EMP

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
<ul style="list-style-type: none"> Nineteen (19) potential SRE species recorded from the Revised Development Envelope A total of 41 caves within the Revised Development Envelope of which 21 are located within the Proposal Area Three surface water fed ephemeral pools within the Proposal Area: <ul style="list-style-type: none"> WB-WAJ1 WB-WAJ2 WB-WAH1 (Deposit H Waterhole) <p>Predicted Impacts:</p> <p>Clearing of up to 5,350 ha of fauna habitat, comprising:</p> <ul style="list-style-type: none"> Up to 3,857 ha of high significance (Gorge/Gully and Hillcrest/Hillslope)²⁹ Approximately 2,242 ha of moderate significance (Drainage Line, Footslopes and Plain, Cracking Clay and Mixed Acacia Woodland) Loss of up to four category 4 (Ghost Bat and Pilbara Leaf-nosed Bat) roosts <p>Note clearing will be limited to 5,350 ha</p>	<ul style="list-style-type: none"> impacts to high suitability SRE habitats (Gorge/gully habitat), where practicable <ul style="list-style-type: none"> The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system Revised Development Envelope and Conceptual Footprint have been designed to minimise, where practicable, disturbance of high suitability SRE habitat (Gorge/Gully habitat) Clearing of high suitability SRE habitat will be restricted through authorised Proposal clearing extents Clearing limits applied to MNES habitat will simultaneously result in clearing limits being applied to high suitability SRE habitat (Gorge/ Gully) Known locations of significant SRE habitat (Gorge/Gully) will be included in the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents Degradation/alteration of habitat as a result of altered surface catchments: <ul style="list-style-type: none"> Major infrastructure, including WRLs, have been preferentially located outside the ephemeral watercourses and their tributaries Direct impacts to surface water fed ephemeral pool WB-WAH1 (Deposit H Waterhole) located north of Deposit H will be avoided, and a heritage exclusion area will be established around the pool (Section 6) Pools WB-WAJ1 and WB-WAJ2 are outside the Conceptual Footprint and will not be impacted due to proximity with the Range to the south of Mt Ella (Section 6) Habitat degradation associated with construction and operational activities, including the increase in weeds, dust and potential increased abundance of feral animals and altered fire regimes: <ul style="list-style-type: none"> Refer to Section 8 Flora and Vegetation, for weed avoidance measures 		<p>The Proponent purchases appropriate local provenance seeds from commercial seed suppliers for rehabilitation. Stringent controls on seed quality, provenance and seed storage are in place. Seed pre-treatments are researched and incorporated for some species to maximise the potential of applied seed to germinate successfully and persist.</p> <p>Time scale</p> <p>Once internal stakeholders have signed off areas as no longer required for current or future operations, they are added to the progressive rehabilitation implementation schedule. However, mine plans are dynamic and subject to continuous revision.</p> <p>Progressive rehabilitation will continue to be undertaken throughout the life of the Proposal where practicable; however, the majority of the rehabilitation will be undertaken at closure.</p> <p>Credibility of the rehabilitation proposed (evidence of demonstrated success)</p> <p>In response and in consultation with DMIRS, the Proponent has recently undertaken extensive revisions of mine closure planning (for all its Pilbara operations) to ensure, among other things, improved detail is provided on how closure objectives, such as those related to progressive rehabilitation, will be achieved successfully.</p>	

²⁹ Includes upper clearing limits, clearing will be limited to 5,350 ha in total.

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> • Disturbance from light, noise and/or vibration, and possible displacement of fauna associated with construction activity and mining operations: <ul style="list-style-type: none"> ○ Avoidance of 17 caves within the Proposal Area by implementing MEZ and MRZ ○ Vibration limits will apply to category 2 and 3 Ghost Bat caves (including within Ghost Bat apartment block caves) within the Revised Development Envelope to manage vibration impacts and maintain caves' structural integrity as per Table 9-22 and the EMP ○ Noise limits will apply to retained category 2 and 3 (apartment block) Ghost Bat caves in the Proposal Area to as per Table 9-22 and the EMP <p>Minimisation</p> <p>The Proposal has been designed to minimise the following impacts to Terrestrial Fauna:</p> <ul style="list-style-type: none"> • Clearing of fauna habitat and habitat fragmentation: <ul style="list-style-type: none"> ○ The Revised Development Envelope and Conceptual Footprint have been designed to minimise, where practicable, disturbance of high significance fauna habitats (Gorge/Gully and Hillcrest/Hillslope), and clearing limits within these habitat types have been proposed ○ Known locations of significant fauna habitat types will be included in the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents ○ The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system ○ Key landform corridors such as major drainage lines (i.e. Turee Creek) will remain as intact as possible to ensure habitat connectivity is maintained • Loss of fauna individuals: <ul style="list-style-type: none"> ○ Implementation of the West Angelas EMP ○ Most light vehicle movements outside of operating mine areas will occur during daylight hours, which will minimise interaction with nocturnal species ○ The Proponent will undertake progressive clearing to allow fauna to 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> migrate away from clearing activities or machinery movements ○ Speed limits will be implemented to minimise the risk of fauna injury or mortality from vehicle strike ○ Vehicle traffic will be confined to defined roads and tracks ○ Roadkill will be removed from trafficable areas to reduce the risk of attracting introduced fauna an increase in feral predator numbers ○ Removal of barbed wire fences within the Revised Development Envelope except where required by legislation. Reflectors will be placed on any barbed wire fences to help prevent the entanglement of bat species ○ Site induction programs will provide information on significant fauna including their appearance and habitats. Training would also discuss standard operating procedures in the event of fauna interactions ○ Artificial water sources at turkeys' nests and sediment ponds will have egress points ● Clearing of habitat and loss of SRE Individuals: <ul style="list-style-type: none"> ○ Revised Development Envelope and Conceptual Footprint have been designed to minimise, where practicable, disturbance of high suitability SRE habitat (Gorge/Gully habitat) ○ Clearing of high suitability SRE habitat will be restricted through authorised Proposal clearing extents ○ Clearing limits applied to MNES habitat will simultaneously result in clearing limits being applied to high suitability SRE habitat (Gorge/ Gully) ○ Known locations of significant SRE habitat (Gorge/Gully) will be included in the Proponents GIS system to ensure impacts to known locations of significant habitat types are minimised and adhere to authorised extents ○ The Proponent will ensure clearing occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system ● Degradation/alteration of habitat as a result of altered surface catchments: <ul style="list-style-type: none"> ○ Refer to Section 7, Inland Waters for minimisation additional measures. 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> ○ Pits will be isolated from significant creeklines to minimise the interception of catchment flows • Habitat degradation associated with construction and operational activities, including the increase in weeds, dust and potential increased abundance of feral animals and altered fire regimes: <ul style="list-style-type: none"> ○ The Proponent will implement management measures such as dust suppression to minimise disturbance to fauna habitats ○ Vehicles will be required to travel at safe operating speeds on unsealed roads and will be restricted from accessing rehabilitated surfaces except for management purposes as per current practices ○ The Proponent will undertake feral animal monitoring and subsequent control in high risk areas and/or high value habitat as outlined in the EMP within the Revised Development Envelope and in cooperation with regional control programs and Traditional Owners as per current practices ○ Landfill facilities will be fenced, and putrescible wastes will be regularly covered to minimise the attraction of animals ○ Borrow pits will be designed and constructed to minimise surface water ponding after rehabilitation ○ The Proponent will implement measures such as maintaining fire breaks and hot works procedures and fire equipment will be available in buildings and vehicles ○ Fire response procedures and personnel training will be provided, including site induction on fire prevention and management ○ Weed management will be as specified in Section 7 Flora and Vegetation and documented in the EMP (Appendix A.8) • Disturbance from light, noise and/or vibration, and possible displacement of fauna associated with construction activity and mining operations: <ul style="list-style-type: none"> ○ Lighting will be designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020). These include: <ul style="list-style-type: none"> - Permanent lighting will be installed only where required, mainly in-pit and operational areas 			

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> - Permanent lighting and temporary lighting will be shielded and directed to active mine areas to minimise light spill - Permanent lighting will be directed away from sensitive areas (e.g. MEZs, MRZs, significant caves, critical habitat) - Temporary lighting (e.g. trailer mounted units) may be required to provide a safe working environment for short periods, where practicable, and while still providing a safe working environment; these will be positioned to minimise direct light spill into sensitive areas o Equipment design will be specified to be within Australian standard noise limits and/or fitted with noise mufflers in accordance with manufacturing specifications o The implementation of the MRZ and MEZ around caves will minimise light, noise and vibrations received by the high value habitat and structures within this area o The implementation of a Blast Management Plan to manage impacts from vibrations and maintenance of the structural integrity of significant caves o Maintaining fire breaks and hot works procedures, and fire equipment will be available in buildings and vehicles o Providing fire response procedures and personnel training, including site induction on fire prevention and management 			
Environmental Factor: Subterranean Fauna				
<p>Context/Key Survey Findings:</p> <ul style="list-style-type: none"> • Modelled 9,184,680 million m³ of high and medium suitability above water table subterranean fauna (troglofauna) habitats • Modelled and inferred 1,008,211 million m³ suitable below water table subterranean fauna habitats (excluding the synclinal valley) • 42 troglofauna taxa representing 11 orders • 12 stygofauna taxa representing 6 orders 	<p>Minimisation</p> <p>The Proposal has been designed to minimise the following impacts to Subterranean Fauna:</p> <p>Minimising clearing of fauna habitat by reducing the total extent of clearing required from 7,200 ha (as referred) to 5,350 ha (amended via s.43A).</p> <ul style="list-style-type: none"> • Loss of individuals or reduction in troglofauna habitat and loss of individuals or reduction in stygofauna habitat: <ul style="list-style-type: none"> o Pit dewatering will be minimised to that required to safely access below water table resources 	<p>The Proponent will:</p> <ul style="list-style-type: none"> • Prepare and regularly update a MCP consistent with DMIRS Guidelines for Preparing Mine Closure Plans (DMIRS 2020b) • The Closure Plans include a closure objective to ensure that the final landform is stable and considers hydrogeological factors, including backfilling pits in accordance with the West Angelas MCP and Condition 7 of MS 1113 (Rehabilitation) • Undertake progressive rehabilitation which will assist with re-establishing nutrient, oxygen, and water flows into the subterranean environment 	<p>The Proponent's approach to rehabilitation (as outlined in the Flora and Vegetation and Inland Waters section in this table) are expected to provide additional benefits for subterranean fauna habitats (eg. Re-vegetation supporting re-establishing nutrient, oxygen, and water flows into the subterranean environment).</p>	<p>The Proponent considers that the potential impacts can be managed and that the residual impacts are not considered to be significant. Therefore no offset is proposed.</p>

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	<ul style="list-style-type: none"> ○ Clearing will be minimised to only that required for implementation of the Proposal ○ Water from mine dewatering will be used on site in the first instance to minimise the requirement for additional groundwater abstraction for operational water supply ○ The water management strategy includes the option of temporary surplus water storage in disused mine pits when they are available. This approach may result in passive recharge and recovery of groundwater at those locations ○ Abstraction of groundwater will be within licence limits and groundwater levels will be monitored to ensure impact remains within the predicted range of drawdown. Abstraction of groundwater managed under Groundwater Licence GWL98740 ○ The MAR will be monitored to ensure it is working as intended under MS 1113 in accordance with the Groundwater Environmental Management Plan ○ Clearing and/or disturbance to remain within the approved Development Envelope ○ Appropriate design of waste landforms specifically encapsulation of PAF waste rock and minimisation of oxidation to prevent changes to groundwater quality ○ Appropriate design of hazardous material storages in accordance with relevant guidelines and Australian Standards ○ Construction and maintenance of surface water drainage systems to control and contain runoff from mining areas and divert clean stormwater away from pits and other mining disturbance areas ○ Monitoring of groundwater quality during operations in accordance with the West Angelas Groundwater Environmental Management Plan ○ Provision of spill kits and implementation of spill management procedures ○ Major disruption to surface hydrology patterns will be managed via drainage management procedures 	<ul style="list-style-type: none"> ● Backfill of pits to prevent formation of pit lakes post closure ● Undertaken opportunistic investigation into backfilling of pits to surface if possible ● The Closure Plans include a closure objective 		
Environmental Factor: Greenhouse Gas Emissions				
<p>Potential Impacts:</p> <ul style="list-style-type: none"> ● Scope 1 and 2 emissions of approximately 63,565 t CO₂-e per annum through the life of the Proposal 	<p>Avoidance</p> <ul style="list-style-type: none"> ● Generation of greenhouse gases through combustion of fossil fuels and land clearing 	<p>Net emissions from the Proposal are expected to decrease over the coming years as a result of:</p> <ul style="list-style-type: none"> ● The closure of existing operational areas within the overall project 	Not Applicable	The Proponent considers that potential impacts can be managed and that residual impacts will not be significant. If the expected reductions are not achieved, then offsets

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
<ul style="list-style-type: none"> Scope 1 emissions approximately 1,200,099 t CO₂-e through the life of the Proposal Scope 2 emissions approximately 197,680 t CO₂-e through the life of the Proposal Scope 3 emissions associated with the Proposal will be approximately 195,185,975 t CO₂-e through the life of the Proposal 	<p>(scope 1 emissions) and generation of power (scope 2 emissions):</p> <ul style="list-style-type: none"> The Proposal incorporates the following best practice designs to avoid GHG emissions: <ul style="list-style-type: none"> The Proponent has study and development processes that identify, assess and where practicable develop existing, innovative and new technology developments Emission abatement projects may be implemented as part of the Proposal or at alternative locations, depending on the technical constraints of the network to ensure security, reliability and stability is upheld, as part of the Proponent's decarbonisation strategy <p>Minimisation:</p> <p>The Proposal incorporates the following best practices to reduce GHG emissions:</p> <ul style="list-style-type: none"> Reducing ancillary vehicle movements, e.g. Using buses to transport personnel between site and accommodation Investigating progressive backfilling of the pits as far as practicable to reduce the amount of TMM and truck operating hours Investigate opportunities to continuously improve productivity and minimise Scope 1 emissions during the construction and operation of the Proposal include: <ul style="list-style-type: none"> Increasing effective utilisation through reducing idle time/ queue time and parking up equipment wherever possible Increasing the efficiency of operations (including waste and ore haulage) through mine planning, design and scheduling Regular maintenance and servicing of equipment <p>Offsetting:</p> <p>The Proponent will offset emissions where abatement is insufficient against the interim and long-term targets outlined in Section 11.5.3.2 and Section 3.2.1 of the GHG EMP. Offsets will be delivered by retiring credible offsets units in 2025, 2030, 2035, 2040, 2045 and 2050, as follows:</p> <ul style="list-style-type: none"> Integrate principles of the ICROA in relation to the sourcing and use of credible offsets units for carbon offsetting Credible offset units sourced will be based on the principles outlined in ICROA's Technical 	<ul style="list-style-type: none"> The implementation of emissions reduction measures and subsequent decrease in emissions intensity Retirement of credible offset units where abatement is insufficient against the interim and long-term targets. Rehabilitation will include establishing vegetation on rehabilitated landforms; therefore, there will be some carbon capture at closure. This has not been taken into account in the emissions calculations. 		would be provided to ensure net emissions are no greater than expected.

Existing Environment/ Impact	Mitigation			Significant Residual Impact
	Avoid and Minimise	Rehabilitation Type	Likely Rehabilitation Success	
	Specification: real, measurable, permanent, and additional. Independently verified and unique <ul style="list-style-type: none"> • Only credible offset units sourced from projects that are, or will be validated, verified and registered 			

Table 12-3: Residual Impact Significance Model (RISM)

Part IV Environmental Factors	Flora and Vegetation						
				Terrestrial Fauna			
				Subterranean Fauna			
Part V Clearing Principles	Threatened flora	Threatened ecological communities	Remnant vegetation	Wetlands and waterways	Conservation Areas	High Biological Diversity	Habitat for fauna
The residual impact that is environmentally unacceptable and cannot be offset	None identified	None identified	None identified	None identified	None identified	None identified	None identified
Significant residual impacts that will require an offset	None identified	None identified	<ul style="list-style-type: none"> Clearing up to 5,350 ha of native vegetation of which 4,922 ha is in good to excellent condition within the Revised Development Envelope, including <ul style="list-style-type: none"> Up to 2 ha of the West Angelas Cracking Clay PEC will be cleared Up to 35 ha of riparian vegetation clearing The Proposal is located within the Hamersley IBRA subregion. Contribution to the PEOF will be made at a dollar rate per ha of cleared vegetation in good to excellent condition (Refer to Section 12.5) 	None identified	Karijini National Park is located adjacent to the Western boundary of the Revised Development Envelope. No clearing will be undertaken within Karijini National Park and proposed clearing within the Revised Development Envelope will be managed to minimise impacts to Karijini National Park and will be managed through the West Angelas EMP (Appendix A.8).	None identified	<p>Clearing up to 126 ha of potential critical and supporting denning, roosting, breeding, shelter and foraging (Gorge/Gully) habitat for the following which includes clearing of up to 4 category 4 Ghost Bat and Pilbara Leaf-nosed Bat roosts:</p> <ul style="list-style-type: none"> Northern Quoll Ghost Bat Pilbara Leaf-nosed Bat Pilbara Olive Python <p>Clearing up to 3,731 ha of potential critical roosting and foraging (Hillcrest/Hillslope) habitat for the Ghost Bat and supporting foraging and dispersal habitat for Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python</p> <p>Clearing approximately 78 ha of supporting shelter, foraging and dispersal (Drainage Line) habitat for:</p> <ul style="list-style-type: none"> Northern Quoll Ghost Bat Pilbara Leaf-nosed Bat Pilbara Olive Python <p>Clearing approximately 2,241 ha of supporting foraging and dispersal (Mixed Acacia Woodlands, Footslopes and Plain and Cracking Clay) habitat for the Ghost Bat</p>
Significant residual impacts that may require an offset	None identified	None identified	None identified	None identified	None identified	None identified	None identified
Residual impacts that are not significant	No Threatened flora species listed under the EP Act or EPBC Act have been recorded within the Revised Development Envelope	No TECs listed under the EPBC Act or BC Act have been recorded within the Revised Development Envelope	None identified	Hydrological regimes will be maintained across the Revised Development Envelope as far as practicable. Flows to Deposit H Waterhole will be maintained to ensure the pre mining filling frequency and level is consistent with the pre-mining scenario. As such the Proposal is not expected to impact ephemeral waterways, surface water fed ephemeral pools, groundwater dependent ecosystems (namely feature 22) or potential aquatic fauna significantly.	No conservation areas (i.e. conservation reserve or ESA) are present within the Revised Development Envelope. Karijini National Park is adjacent to the Western boundary of the Revised Development Envelope. Potential downstream impacts to Karijini National Park from the Proposal can be managed via the West Angelas EMP and Groundwater Environmental Management Plan and are not considered to be significant.	No biodiversity hotspots or habitat supporting migratory species have been identified within the Revised Development Envelope	The Proposal is not expected to significantly impact Grey Falcon, Fork-tailed Swift or Night Parrot (MNES species) as the species are not dependent on the habitat present within the Revised Development Envelope and suitable habitat is widespread throughout the Pilbara region

12.4. Assessment of Significant Residual Impact – EPBC Act

Significant residual impacts for environmental values recognised under Commonwealth policy have been determined in accordance with the EPBC Act Environmental Offsets Policy (DSEWPaC 2012a) and the *Matters of National Environmental Significance: Significant Impact Guidelines 1.1* (DoE 2013).

Six species listed as Threatened under the EPBC Act have been recorded (Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Fork-tailed Swift) or are considered likely to occur (Grey Falcon) within the Revised Development Envelope. The Proposed Action has been designed to avoid and minimise potential impacts to these species as far as practicable.

Following the application of the mitigation hierarchy, the Proposed Action is predicted to result in significant residual impacts to the Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat, and Pilbara Olive Python due to the clearing of:

- Up to 126 ha of critical Gorge/Gully habitat for Northern Quoll, Ghost Bat and Pilbara Olive Python
- Up to 3,731 ha of critical Hillcrest/Hillslope habitat for Ghost Bat. This habitat is also considered supporting habitat when within the range of the Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python
- Approximately 2,241 ha of the remaining habitat types, which provide supporting habitat for the Ghost Bat.

No significant residual impacts are predicted for the Grey Falcon and Fork-tailed Swift as the Proposed Action is unlikely to result in a substantial loss or modification of important habitats for these species (discussed in further detail in Section 13).

It is noted that the EPBC Act referral guidelines provide broad definitions of critical habitat at the national level; however, this should not preclude the use of extensive Pilbara datasets for MNES species to inform a more detailed understanding and assessment of the significance of habitats and impacts at a local and regional level. Where sufficient scientific information exists, the detailed understanding of local species occurrence and habitat use in the Revised Development Envelope has been used to support a local definition of core habitat critical to the survival of the local population. Below is a summary of the significance assessment of each MNES species.

Supporting habitat has been calculated on the individual fauna species' home range (Figure 12-1). Recovery plans, research and VHF bat tracking programs at West Angelas and other locations across the Pilbara have informed suitable distances for defining the individual fauna species' home range, the MNES fauna species range is defined as:

- Northern Quoll and Pilbara Olive Python – 1 km from critical habitat (known records)
- Ghost Bat – 12 km from critical habitat (category 2 caves and category 3 caves in apartment blocks)
- Pilbara Leaf-nosed Bat – 10 km from critical habitat (permanent diurnal roosts)

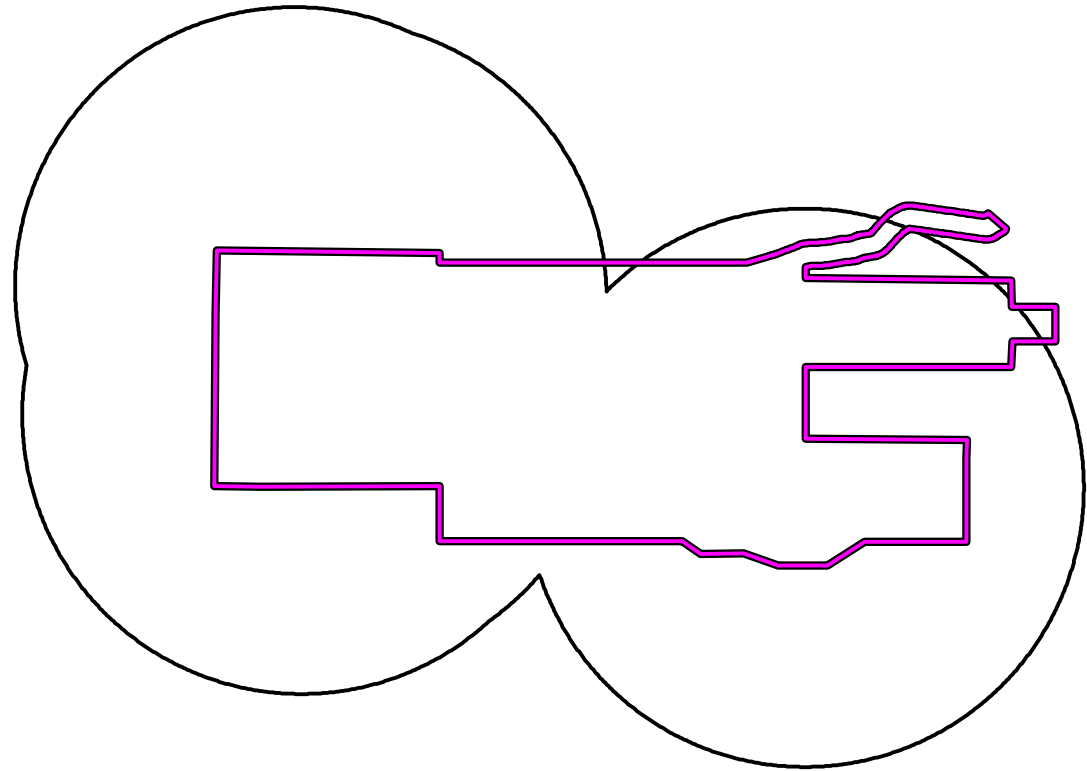
A detailed assessment of residual impacts for each MNES species are discussed in Section 13.

Figure 12-1
Significant Species Offset Buffers
Utilised to Determine Total Offset
Area for Supporting Habitat

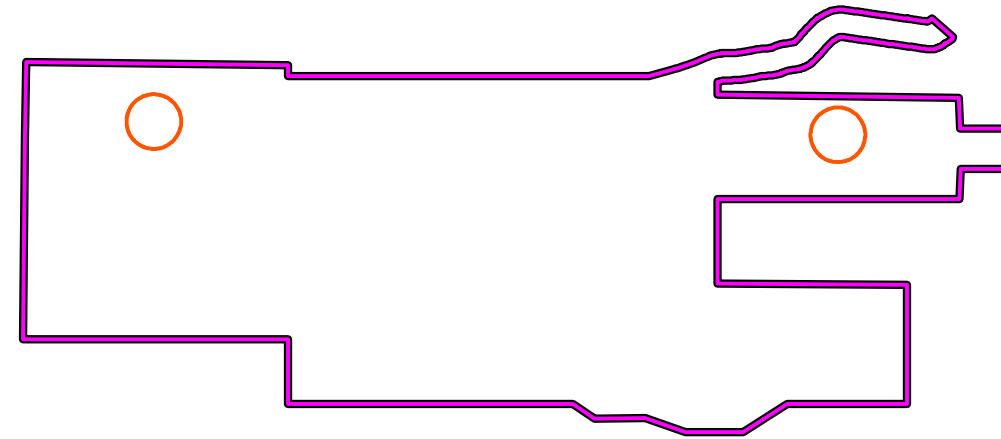
Drawn: A.D.
Plan: RTIO-1030051v1
Date: November 2023

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

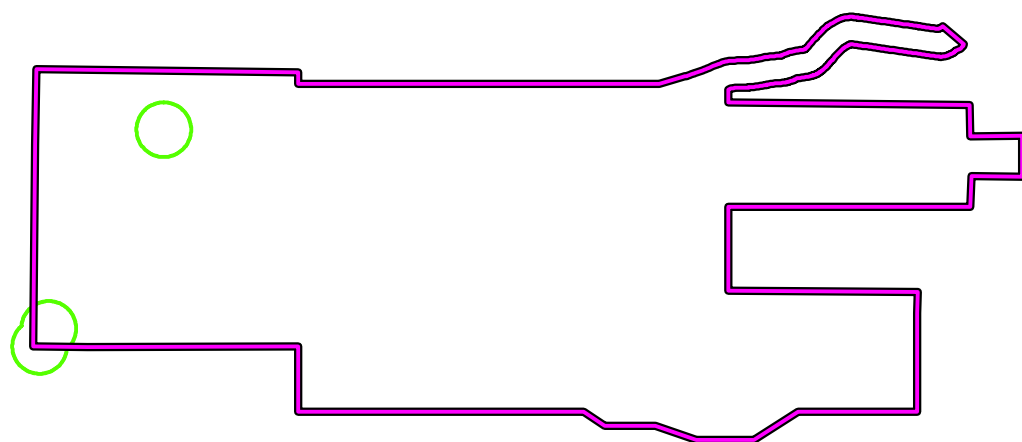
Total Offset Area



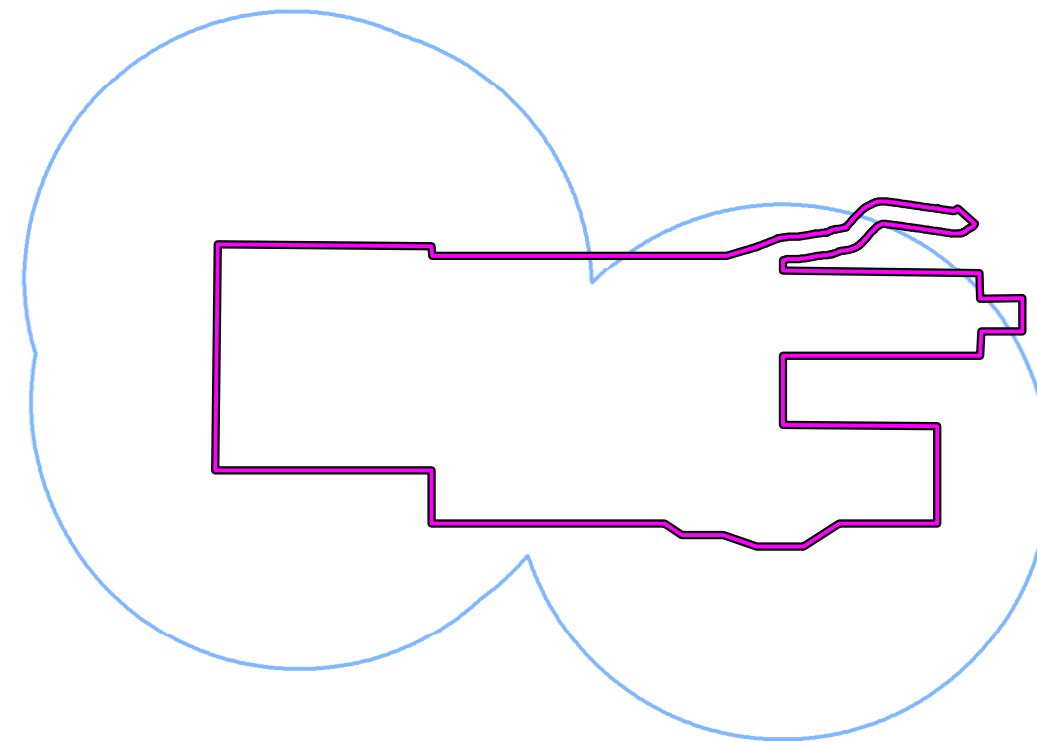
Pilbara Olive Python



Northern Quoll



Ghost Bat



12.4.1. Northern Quoll

The Northern Quoll has been recorded once within the Revised Development Envelope via secondary evidence (approximately 200 scats) (Biologic 2021c; Biologic 2021e). Under the EPBC Act Referral Guideline for Northern Quoll (DoE 2016b), this would be deemed a 'low density' population if present (i.e., where trapping has captured no individuals, but there is latrine evidence).

Potential critical denning and shelter habitat for the Northern Quoll occurs in the Revised Development Envelope within the Gorge/Gully habitat. It may be critical to the survival of the species as defined by the *National Recovery Plan* (Hill and Ward 2010) due to the presence of shelter, potential denning and foraging habitat (Biologic 2021e).

The Hillcrest/Hillslope and Drainage Line habitat types is considered supporting habitat for the Northern Quoll within 1 km of confirmed critical habitat (Northern Quoll records). These habitat types provide dispersal and foraging habitat, which support populations or provide connectivity between populations and are important to the species' long-term survival (DoE 2016b).

After application of the mitigation hierarchy, the following residual impacts to the Northern Quoll from the Proposal (Proposed Action) are considered significant:

- Clearing up to up to 126 ha (20%) of habitat recorded within the Revised Development Envelope considered potentially critical to the species' survival, comprising Gorge/Gully habitat, which provides potential denning, shelter and foraging habitat
- Clearing approximately 187 ha of supporting habitat within the Revised Development Envelope for the Northern Quoll, comprising Hillcrest/Hillslope and Drainage Line habitat within 1 km of Northern Quoll records.

These are considered to be significant residual impacts from the Proposed Action after the mitigation hierarchy has been applied, and offsets are proposed.

12.4.2. Ghost Bat

The presence of seven category 2 caves (2 confirmed maternity, 5 potential maternity) within the Revised Development Envelope suggests that the species resides permanently within the Revised Development Envelope. The population of Ghost Bats within the Revised Development Envelope forms part of a key source population for breeding and dispersal and is, therefore, an 'important population' as defined by DoE (2013). Due to the prevalence of caves, Gorge/Gully and Hillcrest/Hillslope habitats within the Revised Development Envelope are considered critical roosting and foraging habitat for the Ghost Bat.

Ghost Bats are known to forage across a range of habitats; as such, foraging and dispersal habitat occurs within all six fauna habitat types present within the Revised Development Envelope (i.e. Gorge/Gully, Hillcrest/Hillslope, Drainage Line, Foothills and Plain, Mixed Acacia Woodland and Cracking Clay). Drainage Line, Foothills and Plain, Mixed Acacia Woodland and Cracking Clay habitat is considered supporting habitat for the Ghost Bat when within 12 km of critical habitat (category 2 caves and category 3 caves in apartment blocks).

A total of 41 caves within the Revised Development Envelope were identified as suitable roosting sites for the Ghost Bat (of which 21 are located within the vicinity of the Proposed Action). This includes seven category 2, 13 category 3 and 21 category 4 caves. Four category 4 caves will be impacted due to the Proposed Action. Category 4 caves are not considered critical habitat for the Ghost Bat (Bat Call WA 2021a). No category 2 or 3 caves, including apartment block caves, will be impacted by the Proposed Action. MEZs and/or MRZs will be established to protect 37 of the 41 recorded caves within the Revised Development Envelope.

After application of the mitigation hierarchy, the following residual impacts to the Ghost Bat from the Proposal (Proposed Action) are considered significant:

- Clearing up to 126 ha (20%) of Gorge/Gully and 3,731 ha (31%) of Hillcrest/Hillslope habitat types recorded within the Revised Development Envelope including four category 4 caves which provide potential critical roosting and foraging habitat
- Clearing approximately 2,241 ha (14%) of Drainage Line, Footslopes and Plain, Mixed Acacia Woodland and Cracking Clay habitat types recorded within the Revised Development Envelope which provide supporting habitat (foraging and dispersal) within 12 km of critical habitat.

These are considered to be significant residual impacts from the Proposed Action after the mitigation hierarchy has been applied, and offsets are proposed.

12.4.3. Pilbara Leaf-nosed Bat

No habitat within the Revised Development Envelope is considered critical to the survival of the Pilbara Leaf-nosed Bat, as there are no category 1, 2 or 3 caves present. Forty-one (41) caves recorded within the Revised Development Envelope are classified as nocturnal refuges (category 4 – non-critical) for the Pilbara Leaf-nosed Bat and are considered supporting habitat. The nearest category 2 cave (Upper Turee Roost) is approximately 13.5 km from the Revised Development Envelope in Karijini National Park. The species is considered an infrequent forager within the Revised Development Envelope.

Nineteen caves occur within the Gorge/Gully habitat type across the Revised Development Envelope, with the remaining 22 caves in the Hillcrest/Hillslope habitat type. Four of these caves will be impacted by the Proposed Action; however, as they are isolated, have no record of use by the species, are potential nocturnal refuges only, and 37 category 4 caves will remain available for use by the Pilbara Leaf-nosed Bat within the Revised Development Envelope, no significant impact on the Pilbara Leaf-nosed Bat is expected. Regardless, the removal of supporting habitat is considered to represent a residual impact to Pilbara Leaf-nosed Bat.

In addition, MRZs and/or MEZs will be implemented around all retained caves within the Revised Development Envelope to avoid direct and indirect impacts.

The Gorge/Gully, Drainage Line, and Hillcrest/Hillslope habitat types are considered suitable habitat for the Pilbara Leaf-nosed Bat as they provide foraging and dispersal opportunities for the species (Biologic 2021c) however, given the distance from the nearest permanent roost (over 13 km) and the small number of individuals recorded within the Revised Development Envelope, indicating that the Pilbara Leaf-nosed Bat in the area are not reliant upon the habitat within the Revised Development Envelope, this habitat is not considered supporting habitat.

After application of the mitigation hierarchy, the following residual impacts to the Pilbara Leaf-nosed Bat from the Proposal (Proposed Action) are considered significant:

- Removal of four category 4 caves considered supporting habitat for the Pilbara Leaf-nosed Bat.

These are considered to be significant residual impacts from the Proposed Action after the mitigation hierarchy has been applied, and offsets are proposed.

12.4.4. Pilbara Olive Python

Gorge/Gully habitat within the Revised Development Envelope is potential critical habitat for the Pilbara Olive Python as it can provide important denning, shelter, foraging and dispersal habitat for the species and includes the presence of water features, caves and crevices (Biologic 2021c; e).

Drainage Line habitat within the Revised Development Envelope lacks the permanent water features required by the species to meet the criteria of critical habitat for the Pilbara Olive Python. Both Drainage

Line and Hillcrest/Hillslope habitat types are considered supporting habitat when within 1 km of Pilbara Olive Python records, as they provide shelter, foraging and dispersal opportunities for the species.

After application of the mitigation hierarchy, the following residual impact for Pilbara Olive Pythons from the Proposal (Proposed Action) are considered significant:

- Clearing up to 126 ha (20%) of Gorge/Gully habitat which, provides potentially critical breeding, shelter and foraging habitat
- Clearing of approximately 355 ha of supporting Hillcrest/Hillslope and Drainage Line habitat within 1 km of Pilbara Olive Python records, which provides shelter, foraging and dispersal habitat.

These are considered to be significant residual impacts from the Proposed Action after the mitigation hierarchy has been applied, and offsets are proposed.

12.4.5. Summary of Residual Impacts to MNES Species

The impacts discussed in the above sections are not additive. A higher offset rate (i.e. dollars per hectare cleared) is applied to avoid duplication of offsets with an overlap between State and Commonwealth environmental interests (offsets for residual impacts under EP Act and EPBC Act) and other environmental values with elevated significance. This accounts for impacts on habitats with a higher level of significance. These values are summarised in Table 12-4. Differing offset rates apply, with higher rates applicable to the most significant values impacted (discussed in Section 12.5).

Table 12-4: Summary of Significant Residual Impact on MNES Species Habitat

Habitat Type	Value for Species	Species	Habitat Use	Offset Area (ha)	Offsets Required
Gorge/Gully	Critical	Northern Quoll	Potential denning and foraging	126	Yes
		Ghost Bat	Roosting and foraging		Yes
		Pilbara Olive Python	Breeding and shelter		Yes
	Supporting	Pilbara Leaf-nosed Bat	Roosting and foraging		Yes
Hillcrest/Hillslope	Critical	Ghost Bat	Roosting and foraging	3,731	Yes
	Supporting	Northern Quoll	Foraging and dispersal		Yes
		Pilbara Leaf-nosed Bat	Foraging and dispersal		Yes
		Pilbara Olive Python	Foraging and dispersal		Yes
Drainage Line	Supporting	Northern Quoll	Foraging and dispersal	78	Yes
		Ghost Bat	Foraging and dispersal		Yes
		Pilbara Leaf-nosed Bat	Foraging and dispersal		Yes
		Pilbara Olive Python	Foraging and dispersal		Yes
Mixed Acacia Woodland	Supporting	Ghost Bat	Foraging and dispersal	374	Yes
	Limited	Northern Quoll	Foraging and dispersal		No
		Pilbara Leaf-nosed Bat	Foraging and dispersal		No
		Pilbara Olive Python	Foraging and dispersal		No
Footslopes and Plain	Supporting	Ghost Bat	Foraging and dispersal	1,787	Yes
	Limited	North Quoll	Foraging and dispersal		No
		Pilbara Leaf-nosed Bat	Foraging and dispersal		No
		Pilbara Olive Python	Foraging and dispersal		No
Cracking Clay	Supporting	Ghost Bat	Foraging and dispersal	2	Yes
	Limited	Northern Quoll	Foraging and dispersal		No
		Pilbara Leaf-nosed Bat	Foraging and dispersal		No
		Pilbara Olive Python	Foraging and dispersal		No

12.5. Proposed Offsets

12.5.1. Biodiversity Factors

The Proponent proposes environmental offsets for biodiversity factors in the form of financial contributions to the PEOF at the specified rates outlined in Table 12-5 to clear native vegetation in good to excellent condition and critical and supporting MNES habitats. The offset rate per hectare for the Hamersley IBRA subregion was sourced from the PEOF webpage on the WA.gov.au website and will be subject to adjustment in accordance with the Consumer Price Index (CPI) for Perth, as recorded by the Australian Bureau of Statistics (GoWA 2022).

In addition, rates pertaining to EPBC Act offsets for residual impacts of clearing of critical breeding, denning and roosting habitat and supporting habitat for MNES species (Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python) are also included in Table 12-5.

Areas requiring offsets outlined below and throughout this ERD are conservative estimates based upon the most current mine planning information at the time of writing this ERD. An Impact Reconciliation Procedure (IRP; Appendix G.1) will determine the required quantum of impact and offsets.

The proposed offset rates for contributions to the PEOF and the estimated areas are provided in Table 12-5.

The total offset value is estimated to be approximately \$16,489,433 (which is related to MNES and regionally significant vegetation) (Table 12-5). Figure 12-2 illustrates the environmental values to be offset. All the good to excellent native vegetation mapped within the revised Development Envelope overlaps the MNES fauna habitat, which is to be offset at a higher rate, however riparian vegetation and the West Angelas Cracking Clays PEC are offset at a higher rate under the EP Act where they overlap supporting habitat. The contributions to the PEOF are inclusive, and offsets at the higher rates also include benefits to the other listed environmental values. The higher amount shall apply when offsets are required for an environmental value subject to offsets under one or more environmental values. Table 12-5 presents the proposed environmental offsets for the Proposal under the EP Act based on the information provided in Section 12.3.

The actual offset amounts will be based on the extent of actual clearing, which will be reported biennially in an Impact Reconciliation Report in accordance with the IRP provided in Appendix G.1. The PCD specifies that the total clearing extent will not exceed 5,350 ha.

Table 12-5: Environmental Values from the Proposal that Require Offsets

Environmental Value	IBRA Subregion	Potential Extent of Significant Residual Impact	Proposed Offset Rate
Clearing of potential critical Gorge/Gully habitat for Northern Quoll, Ghost Bat, and Pilbara Olive Python and clearing of potential critical Hillcrest/Hillslope habitat for Ghost Bat (this includes Pilbara Leaf-nosed Bat supporting habitat – category 4 caves)	Hamersley	Up to 3,857ha	\$3,306/ha
Clearing of riparian vegetation		Up to 35 ha	\$1,780*/ha
Clearing of supporting Drainage Line habitat within: <ul style="list-style-type: none"> • 1 km of Northern Quoll and Pilbara Olive Python records • 12 km from critical habitat (category 2 caves and category 3 caves in apartment blocks) for Ghost Bat 		Approximately 78 ha	\$1,653*/ha
Clearing of West Angelas Cracking Clay Priority Ecological Community habitat of regional significance and provides supporting habitat for Ghost Bat within 12 km of critical habitat		Up to 2 ha	\$1,780/ha
Clearing of supporting habitat (Mixed Acacia Woodland and Foothills and Plain habitat types) within 12 km of critical Ghost Bat habitat		Approximately 2,181 ha	\$1,653*/ha
Clearing of good to excellent condition vegetation		Approximately 4,922 ha	\$890/ha

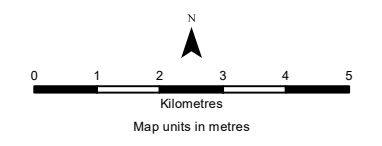
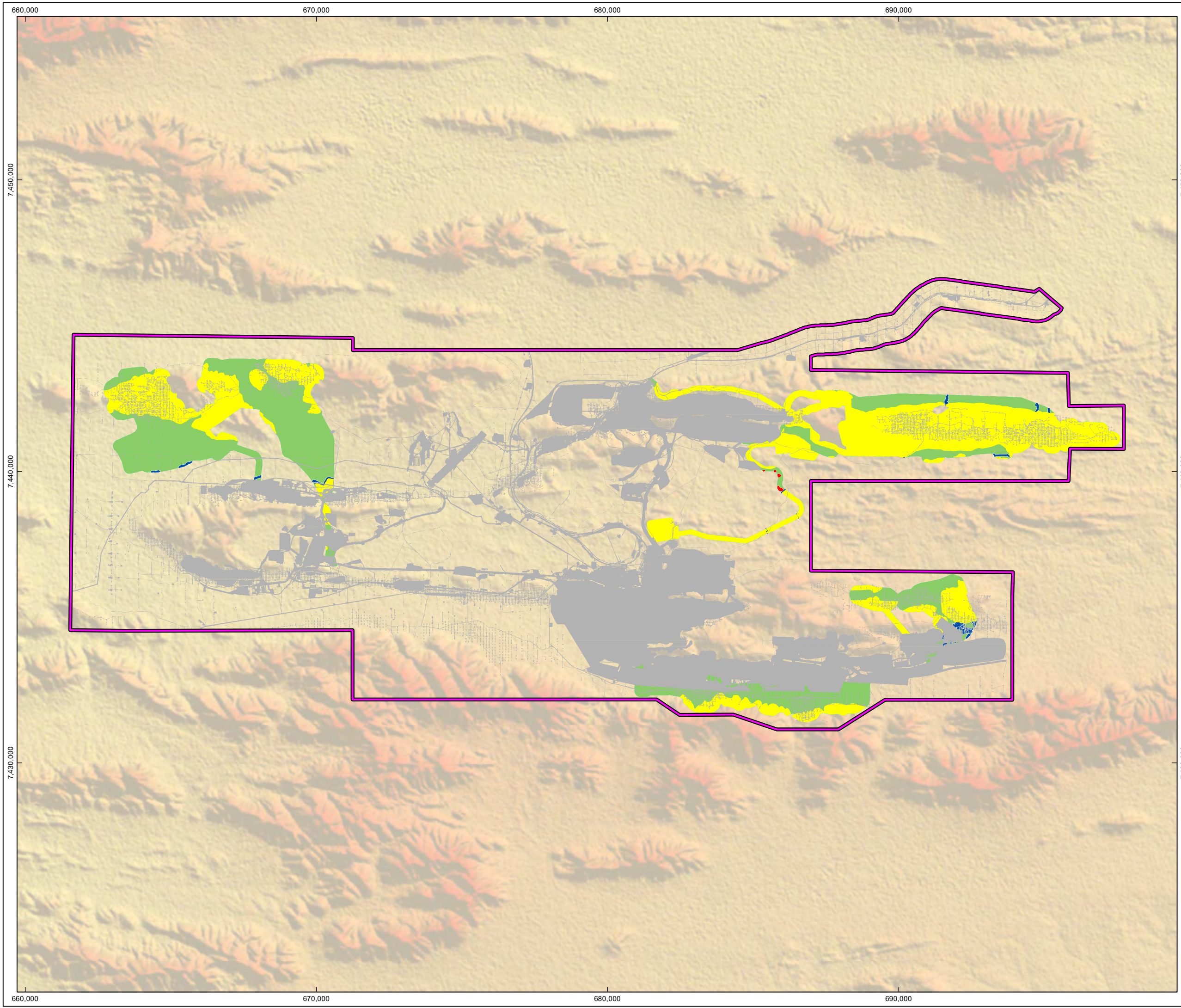
*12*Rate are as published at: <https://www.wa.gov.au/service/environment/business-and-community-assistance/program-pilbara-environmental-offsets-fund> and annually adjusted for inflation. Where environmental values overlap, only the highest applicable rate will be applied (e.g. riparian vegetation in good to excellent condition would be offset at the higher rate, not the sum of the base rate and higher rate).*

Figure 12-2
Environmental Values from the
Proposal that Require Offsets

Drawn: A.D.
Plan: RTIO-1030050v1
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development
- Disturbed
- Potential Critical Habitat for MNES
- Regional Significance Vegetation
- Riparian Vegetation
- Supporting Habitat for MNES
- Good to Excellent Condition Vegetation



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12.5.2. Greenhouse Gas Emissions

The Proponent will offset emissions where abatement is insufficient against the interim and long-term targets. Offsets will be delivered by retiring credible offsets units in 2025, 2030, 2035, 2040, 2045 and 2050 as follows:

- Calculate Safeguard Mechanism obligations purchased within the relevant five-year cumulative period to determine if ACCUs purchased met EPA requirements in these time periods
- Integrate principles of the ICROA in relation to the sourcing and use of credible offsets units for carbon offsetting
- Credible offset units sourced will be based on the principles outlined in ICROA's Technical Specification: real, measurable, permanent, and additional. Independently verified and unique
- Only credible offset units sourced from projects that are or will be validated, verified and registered.

12.6. Consistency with Offset Policies

The approach to offsetting the significant residual impacts associated with the Proposal is considered to be consistent with the six principles outlined in the WA Environmental Offset Policy (GoWA 2011) and with the eight offset principles outlined in the *EPBC Act Environmental Offsets Policy* (DSEWPaC 2012a). Table 12-6 and Table 12-7 summarise how these principles have been considered during the development of the offsets approach.

Table 12-6: Consideration of Principles of WA Offset Policy

Principle	Response
<p>Environmental offsets will only be considered after avoidance and mitigation options have been pursued</p>	<p>Avoidance and minimisation of impact have been included in the planning and design process. The Proponent has considered various options to avoid environmental impacts to areas of high significance habitats where practicable. In particular, the Proposal has been designed to avoid and minimise direct disturbance to the following:</p> <ul style="list-style-type: none"> • 37 significant caves (no direct disturbance) • Surface water systems, including Deposit H Waterhole (no direct disturbance) <p>By applying the mitigation hierarchy to the Proposal, the Proponent has ensured that all practicable avoidance and minimisation measures have been considered and pursued where appropriate. Offsets have only been considered for those significant residual impacts that cannot be avoided or minimised.</p>
<p>Environmental offsets are not appropriate for all projects</p>	<p>The identified significant residual impacts are considered appropriate to offset as they are neither minor (too minor to require an offset) nor likely to be considered environmentally unacceptable, regardless of offsets.</p>
<p>Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted</p>	<p>The Proponent commits to providing cost-effective, relevant and proportionate financial offsets to counterbalance the significant residual impacts to the identified environmental values.</p> <p>The offsets for vegetation clearing are considered appropriate because the significant residual impacts identified are not related to one specific Threatened species or community. Rather, they relate to the cumulative loss of vegetation and as such, habitat, due to clearing in the Pilbara. Therefore, the contribution to the PEOF will allow the implementation of offset projects that will benefit Pilbara vegetation and flora values more broadly and in turn, fauna habitat values.</p>
<p>Environmental offsets will be based on sound environmental information and knowledge</p>	<p>The Pilbara is predominantly Crown land, so traditional land acquisition offsets are not possible. Due to tenure constraints, on-ground conservation actions are difficult for a single proponent to implement. Contribution to the PEOF is not a traditional offset. For example, a single conservation project must consider sound environmental information and knowledge about a particular species or community. However, the conservation and research projects to be implemented at a broad scale through the PEOF are intended to address the cumulative impacts of mining in the Pilbara as identified by the EPA and provide a more detailed understanding of conservation values in the Pilbara region to improve decision making regarding conservation and management.</p>

Principle	Response
Environmental offsets will be applied within a framework of adaptive management	The Proponent understands that an adaptive management framework should be applied in relation to environmental offsets to account for the potential risks. One of the key risks associated with the PEOF as an environmental offset being applied for most projects in the Pilbara is managing the time lag between establishing offsets and generating the anticipated benefits. This challenge and the adaptive management framework around conservation outcomes are being addressed in developing the PEOF mechanisms, including partnerships, scheduling, procurement, funding arrangements, performance measures and reporting requirements in consultation with stakeholders. The Proponent has experience in on-ground implementation and adaptive management of offsets and, therefore, can contribute knowledge to this process.
Environmental offsets will be focussed on longer term strategic outcomes	The EPA recognises that establishing the PEOF is consistent with this principle in those strategic approaches, such as using the PEOF, will provide a mechanism to coordinate the implementation of offsets across a range of land tenures (GoWA 2014). The PEOF provides a strategic, coordinated approach to applying environmental offsets to achieve broad-scale biodiversity conservation outcomes for the Pilbara region. The Proponent recognises the commitment of the EPA to this strategic approach and has contributed by participating in the working group to establish the PEOF.

Table 12-7: Consideration of Commonwealth Offset Principles

Principles	Responses
Suitable offsets must deliver an overall conservation outcome that improves or maintains the viability of the protected matter	The offset contribution to the PEOF is expected to contribute to large environmental offset projects that deliver wider benefits to landscape scale values and threatened species.
Suitable offsets must be built around direct offsets but may include other compensatory measures	The proposed offset is a financial contribution to the PEOF, which will be used for on-ground improvement, rehabilitation and conservation.
Suitable offsets must be in proportion to the level of statutory protection that applies to the protected matter	The proposed offset rates reflect the impacted species' conservation status and the impacted habitat's significance. A higher offset rate applies when a species or significant population is known to occur.
Suitable offsets must be of a size and scale proportionate to the residual impacts on the protected matter	The proposed offset applies an offset contribution for each hectare of significant residual impact and is proportionate in size. Differing offset rates apply, with higher rates applicable to the most significant values impacted.
Suitable offsets must effectively account for and manage the risks of the offset not succeeding	The rate proposed for MNES offsets is consistent with that commonly applied to MNES in the Pilbara for the EPBC Act offsets and includes inherent consideration of the likelihood of offset project success.

Principles	Responses
Suitable offsets must be additional to what is already required, determined by law or planning regulations, or agreed to under other schemes or programs	The proposed offsets address the EP Act and EPBC Act requirements according to recent, similar offset determinations.
Suitable offsets must be efficient, effective, timely, transparent, scientifically robust and reasonable	The Proponent will provide a financial contribution to the PEOF for the significant residual impacts to MNES from the Proposal. Projects implemented under the PEOF will be designed and endorsed by the State Government, with implementation overseen by DWER.
Suitable offsets must have transparent governance arrangements, including being able to be readily measured, monitored, audited and enforced	The State Government oversees the PEOF in accordance with the Pilbara Environmental Offsets Fund Governance Framework (DWER 2019). Offsets are also documented in the publicly available Environmental Offsets Register.

12.7. Stakeholder Consultation Regarding Offsets

The Proponent has had preliminary discussions with the EPA regarding the provision of offsets for significant residual impacts to native vegetation in good to excellent condition and critical and supporting habitats for MNES (Section 13.3). Further consultation will be undertaken during the assessment process.

13. MATTERS OF NATIONAL ENVIRONMENTAL SIGNIFICANCE

To be consistent with the EPBC Act, the Proposal described in Section 2 of this document is referred to as the Proposed Action in this section.

This section provides a comprehensive assessment of the potential impacts of the Proposed Action on the MNES recorded or likely to occur in the Revised Development Envelope.

13.1. Controlled Action Provisions (EPBC 2021/8923)

The Proposed Action was determined by a Delegate of the Commonwealth Minister for the Environment to constitute a Controlled Action under s 75 of the EPBC Act. Therefore, it requires assessment and a decision on whether approval should be granted under the EPBC Act.

The controlling provisions listed threatened species and communities (s. 18 and 18A) and migratory species (s. 20 and 20A). The MNES species for this Proposed Action include:

- Northern Quoll (*Dasyurus hallucatus*) - Endangered
- Ghost Bat (*Macroderma gigas*) - Vulnerable
- Pilbara Leaf-nosed Bat (*Rhinoicteris aurantia*) - Vulnerable
- Pilbara Olive Python (*Liasis olivaceus barroni*) - Vulnerable
- Night Parrot (*Pezoporus occidentalis*) - Endangered
- Grey Falcon (*Falco hypoleucos*) - Vulnerable
- Fork-tailed Swift (*Apus pacificus*) - Migratory.

The Proposed Action was determined to be assessed by accredited assessment under the Bilateral Agreement between the Commonwealth and WA governments (s87 of the EPBC Act).

This ERD provides information to State and Commonwealth regulators as this is an accredited process. Noting this, in this MNES chapter only information relevant to the 'Proposed Action' is referenced. Accordingly, the content in the MNES chapter and Terrestrial Fauna chapter are slightly different due to the differences in how the State and Commonwealth assess the 'Proposal', 'Revised Proposal' and 'Proposed Action'.

13.2. Relevant Policy and Guidance

The significance and management of potential impacts on MNES have been assessed in the context of the following:

- Matters of National Environmental Significance Significant Impact Guidelines 1.1 (DoE 2013)
- The application of the mitigation hierarchy, including avoidance, minimisation, rehabilitation, and offset measures to the design and implementation of the Proposed Action
- Approved conservation advice and/or recovery plans, where available, for each relevant MNES, specifically whether:
 - A population is an important population
 - Available habitat in the Revised Development Envelope is critical habitat for the local population or species
 - Outcomes align with recovery plans or conservation advice actions for MNES likely to be impacted by the Proposed Action.

13.2.1. Significant Impact Guidelines

The Significant Impact Guidelines assist in determining whether an action is likely to have a significant impact on a threatened species or ecological community under the EPBC Act. In accordance with these guidelines, the impact assessment of 'Listed Threatened Species and Communities' addresses the following key concepts:

- Habitat critical to the survival of a species
- Any population for species listed as Endangered or Critically Endangered under the EPBC Act and any 'important population' for species listed as Vulnerable under the Act.

'Habitat critical to the survival of a species' refers to areas of habitat considered necessary:

- For activities such as foraging, breeding, roosting, or dispersal
- For the long-term maintenance of the species or ecological community (including the maintenance of species essential to the survival of the species or ecological community, such as pollinators)
- To maintain genetic diversity and long-term evolutionary development
- For the reintroduction of populations or recovery of the species or ecological community.

Such habitat may include but is not limited to, habitat identified in a recovery plan for the species or ecological community as habitat critical for that species or ecological community and/or habitat listed on the Register of Critical Habitat maintained by the Minister under the EPBC Act (DoE 2013).

An 'important population' is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans and/or that are:

- Key source populations either for breeding or dispersal
- Populations that are necessary for maintaining genetic diversity
- Populations that are near the limit of the species' range (DoE 2013).

An assessment of significance for each MNES species is presented in this section and reflects additional information provided by survey information presented after the submission of the EPBC referral.

13.2.2. Approved Conservation Advice and Recovery Plans

Approved conservation advice and recovery plans for MNES known or likely to occur in the Revised Development Envelope (or listed in the controlling action) are identified in Table 13-1. These guidance documents identify overall conservation objectives, critical habitats, important populations, key threats and priority management actions. They are relevant to the assessment process.

There are no recovery plans currently for the Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python, Grey Falcon or Fork-tailed Swift.

Table 13-1: Approved Conservation Advice, Listing Advice and Recovery Plans

Guidance	Objective/Priorities
Northern Quoll (<i>Dasyurus hallucatus</i>)	
Commonwealth Listing Advice on Northern Quoll (<i>Dasyurus hallucatus</i>) (TSSC 2005)	<p>Priority Recovery and Threat Abatement Actions:</p> <ul style="list-style-type: none"> • Investigate the need to establish captive breeding programs • Identify areas of critical habitat <p>The list does not encompass all actions that may benefit this species but highlights those considered the highest priority at the time of listing.</p>
National Recovery Plan for the Northern Quoll <i>Dasyurus hallucatus</i> (Hill and Ward 2010)	<p>Identifies the national recovery objective as: 'To minimise the rate of decline of Northern Quoll in Australia and ensure that viable populations remain in each of the major regions of distribution into the future.'</p> <p>Several recovery objectives are identified, including the following relevant to the Proposed Action:</p> <ul style="list-style-type: none"> • Identify potential refuge habitats in Western Australia where quolls might be most likely to persist in the long-term alongside Cane Toads • Halt Northern Quoll decline in areas not yet colonised by Cane Toads • Investigate factors causing declines in Northern Quoll populations not yet affected by Cane Toads • Manage key Northern Quoll populations in areas not currently affected by Cane Toads to halt population declines • Reduce the impact of feral predators on Northern Quolls
EPBC Act referral guideline for the endangered Northern Quoll <i>Dasyurus hallucatus</i> (DoE 2016b)	Identifies critical habitat and important populations, recommended survey methods, actions likely to result in significant impacts and management/mitigation measures that are effective and appropriate for this species.
Ghost Bat (<i>Macroderma gigas</i>)	
Conservation Advice <i>Macroderma gigas</i> Ghost Bat (TSSC 2016b)	<p>Identifies primary conservation actions as:</p> <ul style="list-style-type: none"> • Protect roosts from mining, human disturbance and collapse • Replace the top strands of barbed wire in fences near roost sites with single-strand wire <p>Conservation and Management Actions:</p> <ul style="list-style-type: none"> • Active mitigation of threats • Captive breeding • Quarantining isolated populations • Translocation • Community engagement • Reduce disturbance of roost sites <p>Survey and Monitoring Priorities:</p> <ul style="list-style-type: none"> • Survey to define definition better • Establish or enhance monitoring programs
Information Sheet A review of Ghost Bat ecology, threats and survey requirements (Bat Call WA 2021a)	This document addresses the following information gaps:

Guidance	Objective/Priorities
	<ul style="list-style-type: none"> • Roosting habitat descriptions, both natural, artificial, and critical habitat definitions • Guidance on mitigation measures for roost under threat • Information on population dynamics of the species • Guidance on foraging requirements and range
Pilbara Leaf-nosed Bat (<i>Rhinoicteris aurantia</i>)	
<p>Conservation Advice <i>Rhinoicteris aurantia</i> (Pilbara form) Pilbara Leaf-nosed Bat (TSSC 2016a)</p>	<p>National Conservation Objectives:</p> <ul style="list-style-type: none"> • Ensure activities within Pilbara Leaf-nosed Bat range do not have a significant impact under the EPBC Act • Eliminate key threats to the Pilbara Leaf-nosed Bat and halt predicted decline through best practice mining design and construction and better coordinated regional management • Protect and manage all known roost sites to support the recovery and long-term persistence • Identify and protect sufficient high-value foraging habitat around roost sites to support the long-term persistence of colonies • Support coordinated research on the occurrence, population size and ecological requirements of Pilbara Leaf-nosed Bat <p>Priority Conservation Actions:</p> <ul style="list-style-type: none"> • Discover new occurrences • Discover new roosts • Confirm diurnal roosts • Protect roosts • Monitor the population • Assess and protect foraging habitat • Develop and support coordinated research • Encourage submission of occurrence data • Suitably control public access to all known roost sites on both private and public lands • Implement a separate regional management plan
<p>Information Sheet A review of Pilbara Leaf-nosed Bat ecology, threats and survey requirements (Bat Call WA 2021b)</p>	<p>This document addresses the following information gaps:</p> <ul style="list-style-type: none"> • Roosting habitat descriptions, both natural, artificial, and critical habitat definitions • Guidance on mitigation measures for roost under threat • Information on population dynamics of the species • Guidance on foraging requirements and range
Other Species	
<p>Approved Conservation Advice for <i>Liasis olivaceus barroni</i> (Olive Python – Pilbara subspecies) (DEWHA 2008a)</p>	<p>Regional and Local Priority Actions:</p>

Guidance	Objective/Priorities
	<ul style="list-style-type: none"> • Habitat Loss, Disturbance and Modification • Identify populations of high conservation priority • Ensure road widening, maintenance activities, and gas infrastructure development (or development activities) in areas where the Olive Python (Pilbara subspecies) occurs do not adversely impact known populations • Manage any changes to hydrology that may result in changes to the water table levels, increased run-off, sedimentation or pollution • Investigate further formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure <p>Animal Predation or Competition:</p> <ul style="list-style-type: none"> • Implement a Threat Abatement Plan to control and eradicate Foxes and Cats in the local region <p>Conservation Information:</p> <ul style="list-style-type: none"> • Raise awareness of the Olive Python (Pilbara subspecies) within the local community • Use road signage to raise awareness of the Olive Python (Pilbara subspecies) among road users on or near roads <p>Enable Recovery of Additional Sites and/or Populations:</p> <ul style="list-style-type: none"> • Investigate options for linking, enhancing or establishing additional population
<p>Conservation Advice <i>Falco hypoleucos</i> Grey Falcon (TSSC 2020)</p>	<p>Identifies conservation actions as:</p> <ul style="list-style-type: none"> • Support improved fire and grazing management in areas where Grey Falcons are known to occur • Protect known nesting trees and include adequate exclusion buffers concerning proposed developments and land clearing activities • Support the establishment and survival of replacement nest trees in areas where Grey Falcon are known to breed • Retain artificial structures with known or potential Grey Falcon nests • Control invasive Cats in areas where Grey Falcons are known to occur, especially in known roosting and nesting areas
<p>Conservation Advice <i>Pezoporus occidentalis</i> (Night Parrot) (TSSC 2016c)</p>	<p>Identifies conservation actions as:</p> <ul style="list-style-type: none"> • Where known populations can be identified, monitor these to identify key threats • Monitor the progress of recovery, including the effectiveness of management actions and the need to adapt them if necessary • Liaise with managers/owners of any properties found to support the Night Parrot to ensure management practices support the requirements of the species • Investigate formal conservation arrangements such as the use of covenants, conservation agreements or inclusion in reserve tenure • In key areas, ensure impacts of livestock and feral herbivores are minimised • Implement appropriate management recommendations outlined in the Threat Abatement Plans for Predation by Feral Cats (DoE 2016b) and European Red Fox (DEWHA 2008b) • Develop and implement a management plan for the control and eradication of feral camels and other herbivores in the local region • Develop and implement a suitable fire management strategy for Night Parrot. The strategy should aim to restrict burning to discrete patches, at least until

Guidance	Objective/Priorities
	<p>studies can be completed on the fire ecology of the species and its key food plants</p> <ul style="list-style-type: none"> • Establish a captive breeding population for the species if a viable source population can be found • Investigate options for linking, enhancing or establishing additional populations
Night Parrot Interim recovery plan for Western Australia (1996 to 1998) (Blyth 1996)	<p>To decrease the probability of extinction of the Night Parrot by achieving the following aims:</p> <ul style="list-style-type: none"> • Find one or more populations of the Night Parrot that can be studied and monitored and learn how best to locate the birds in the wild • Research on movements, home range, activity patterns, food and feeding behaviour biology, detailed habitat requirements and major threat processes • Use the information gathered to; plan larger-scale searches and more detailed research programs, plan and conduct emergency management actions seen to be necessary to maintain the population(s) and be the basis for a recovery plan
Referral guideline for 14 birds listed as migratory species under the EPBC Act (DoE 2015a)	<p>There is no approved Conservation Advice, Listing Advice or Recovery Plan for Fork-tailed Swift (<i>Apus pacificus</i>).</p> <p>The referral guideline for migratory species identifies the following conservation objective:</p> <ul style="list-style-type: none"> • To retain the habitats and resources necessary for the species to migrate successfully and, where appropriate, breed throughout their natural range in Australia

13.2.3. Threat Abatement Plans

Threat abatement plans (TAPs) establish national frameworks to guide and coordinate Australia’s response to threats to biodiversity. These documents identify research, management and other priority actions required to protect threatened species. The Australian Government develops and facilitates the implementation of the TAPs by establishing partnerships and cooperative programs.

The TAPs and the associated objectives for each plan are outlined in Table 13-2.

Table 13-2: Relevant Threat Abatement Plans for the Proposed Action

Threat Abatement Plan	Objectives
TAP for predation by feral cats (DoE 2015b)	<p>The goal of this TAP is to minimise the impact of feral Cats on biodiversity by:</p> <ul style="list-style-type: none"> • Protecting affected threatened species • Preventing further species and ecological communities from becoming threatened <p>The TAP has four objectives:</p> <ol style="list-style-type: none"> 1. Effectively control feral Cats in different landscapes 2. Improve the effectiveness of existing control options for feral Cats 3. Develop or maintain alternative strategies for threatened species recovery 4. Increase public support for feral Cat management and promote responsible Cat ownership

Threat Abatement Plan	Objectives
<p>TAP for predation by the European red fox (DEWHA 2008b)</p>	<p>This TAP identifies localised Fox control measures applicable in specific areas of high conservation value and where:</p> <ul style="list-style-type: none"> • Chances of reinvasion must be nil or very close to it • All Foxes must be accessible and at risk during the control operation • Foxes must be killed at a higher rate than their ability to replace losses through breeding • Where local eradication is not practicable, two strategies for localised management can be used, as follows: <ul style="list-style-type: none"> ○ Sustained management, where control is implemented on a continuing, regular basis ○ Intermittent management, where control is implemented at critical periods of the year when damage is greatest and short-term control will reduce impacts to acceptable levels
<p>TAP for the biological effects, including lethal toxic ingestion, caused by Cane Toads (DSEWPaC 2011c)</p>	<p>This TAP focuses on how native animals and natural environments can be protected from Cane Toads. The plan aims to:</p> <ul style="list-style-type: none"> • Identify native species and ecosystems at risk due to Cane Toads • Reduce the impact of Cane Toads on native species and ecosystems • Communicate information about Cane Toads and their impacts <p>The TAP has three objectives:</p> <ol style="list-style-type: none"> 1. To identify priority native species and ecological communities (including those that are protected matters under the EPBC Act) at risk from the impact of Cane Toads 2. To reduce the impact of Cane Toads on populations of priority native species and ecological communities 3. To communicate information about Cane Toads, their impacts and this TAP
<p>TAP to reduce the impacts on northern Australia's biodiversity by the five listed grasses (DSEWPaC 2012c)</p>	<p>This TAP aims to minimise the adverse impacts of the five listed types of grass on affected native species and ecological communities. To achieve this goal, the TAP has six main objectives:</p> <ol style="list-style-type: none"> 1. Develop an understanding of the extent and spread pathways of infestation by the five listed grasses 2. Support and facilitate coordinated management strategies through the design of tools, systems and guidelines 3. Identify and prioritise key assets and areas for strategic management 4. Build capacity and raise awareness among stakeholders 5. Implement coordinated, cost-effective on-ground management strategies in high-priority areas 6. Monitor, evaluate and report on the effectiveness of management programs

Feral Cats (*Felis catus*) have been recorded within the Revised Development Envelope and are known to occur within the surrounding area (Biologic 2021c). Clearing native vegetation and habitat may create opportunities for feral Cats to increase their range. The actions documented in the *Threat abatement plan for predation by feral Cats* (DoE 2015b) are relevant to the Proposed Action.

No European Red Foxes (*Vulpes vulpes*) were recorded within the Revised Development Envelope (Biologic 2021c). The species typically inhabit areas near the coast, and the Proposed Action is unlikely to increase the opportunity for the species to move further inland. The actions documented in the *Threat*

abatement plan for predation by the European Red Fox (DEWHA 2008b) are not relevant to the Proposed Action.

The Cane Toad (*Rhinella marina*) is not yet established in the Pilbara, and the Proposed Action is not expected to introduce the species. The actions documented in the *Threat abatement plan for the biological effects, including lethal toxic ingestion caused by Cane Toads* (DSEWPaC 2011c), are not relevant to the Proposed Action, given that they relate to the research and identification of the impacts of Cane Toads.

There are no grass species from the *Threat abatement plan to reduce the impacts on northern Australia's biodiversity by the five listed types of grass* (DSEWPaC 2012c) within or surrounding the Revised Development Envelope. Therefore, the actions documented in this TAP are not relevant to the Proposed Action.

13.2.4. Other Policy and Guidance

The following policy and guidance statements were also considered in the design of Flora and Vegetation, Terrestrial Fauna and targeted MNES surveys and in the impact assessment for MNES:

- EPA Statement of Environmental Principles, Factors and Objectives (EPA 2021c)
- EPA Environmental Factor Guideline: Flora and Vegetation (EPA 2016b)
- EPA Technical Guideline: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016c)
- EPA Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d)
- EPA Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020a)
- EPA Technical Guidance: Sampling methods for Terrestrial vertebrate fauna (EPA 2020a)
- EPBC Act referral guideline for the endangered northern quoll *Dasyurus hallucatus* - EPBC Act Policy Statement (DoE 2016b)
- Interim guideline for preliminary surveys of Night Parrot (*Pezoporus occidentalis*) in Western Australia (DPaW 2017)
- Survey guidelines for Australia's threatened bats (DEWHA 2010a)
- Survey guidelines for Australia's threatened birds (DEWHA 2010b)
- Survey guidelines for Australia's threatened mammals (DSEWPaC 2011a)
- Survey guidelines for Australia's threatened reptiles (DSEWPaC 2011b)
- National Light Pollution Guidelines for Wildlife, including Marine Turtles, Seabirds and Migratory Shorebirds (DotEE 2020).

13.3. Existing Environmental Values Relevant to MNES

The following section provides an overview of the values for MNES 'Listed Threatened Species and Ecological Communities' under s.18 and 18A and "Listed Mitigatory Species" under s.20 and 20A of the EPBC Act recorded within the Revised Development Envelope.

13.3.1. Desktop and Field Survey Effort

Numerous flora, vegetation and terrestrial fauna surveys have been undertaken within the Revised Development Envelope and immediate surrounds since 1998. The key investigations are summarised in Table 8-2 (Flora and Vegetation) and Table 9-2 (Terrestrial Fauna). Survey results and habitat

mapping from historical terrestrial fauna surveys for previous proposed actions undertaken in 2014 and recent surveys undertaken in 2021 within the Revised Development Envelope (Ecologia 2014; Biologic 2021c) were reconciled and consolidated with methods and habitat classifications utilised in the current studies undertaken within the Revised Development Envelope.

The surveys undertaken to determine the presence of MNES species are presented in Table 13-3, the extent of the survey effort in relation to the Revised Development Envelope is presented in Figure 13-1. The survey reports prepared specifically to inform this assessment are provided as appendices. Table 13-3 includes several historical surveys conducted over areas adjacent to the Proposed Action and have also been used to inform this impact assessment.

Extrapolation of habitat mapping was undertaken for areas within and beyond the Revised Development Envelope that have not previously been ground-truthed, considering the adjacent mapped habitat, pre-European vegetation mapping, aerial imagery and topographic data (Biologic 2021d). This included the extrapolated mapping of fauna habitat in a 20 km radius surrounding the Revised Development Envelope (Table 13-7) to provide regional context for the habitat within the Revised Development Envelope.

Table 13-3: Summary of Technical Studies for MNES Fauna

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
Key Studies and Surveys				
<p>Targeted Flora and Fauna Survey Mt Ella East and Deposit J Pit and Waste Dump Footprints</p> <p>Biologic 2022d</p> <p>Appendix D.4</p>	August 2021	Targeted	<ul style="list-style-type: none"> Targeted searches were undertaken at 14 locations for a total of 53.5 person-hours Targeted searches comprised 28.5 person-hours targeting Northern Quoll, Pilbara Leaf-nosed Bat, Ghost Bat and Pilbara Olive Python, and 29 person-hours for Western Pebble-mound Mouse Ultrasonic bat recorders were deployed at six locations, including one in the Deposit J survey area and five within the Mt Ella East survey area. Recorders were deployed for three to four nights at each location for a total of 19 recording nights Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence 	Nil
<p>West Angelas Beyond 2020 Infrastructure Corridors Reconnaissance and Targeted Survey</p> <p>Biologic 2022a</p> <p>Appendix E.1</p>	February 2022	Desktop, Reconnaissance and Targeted	<ul style="list-style-type: none"> Desktop Assessment to review previous fauna habitat mapping Verification of fauna habitats previously mapped Water feature and cave assessments Targeted searched comprised 25 person-hours at 11 sites targeting Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, and Pilbara Olive Python, and Western Pebble-mound Mouse was opportunistically targeted Ultrasonic bat recorders were deployed at five locations. Recorders were deployed for three consecutive nights at each location equating to a total of 15 recording nights Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence 	Nil

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
West Angelas Beyond 2020 Mt Ella East and Dep J Detailed and Targeted Survey Biologic 2022b Appendix E.2	July 2022	Targeted	<ul style="list-style-type: none"> • Desktop Assessment to review previous fauna habitat mapping • Verification of fauna habitats previously mapped • Cave assessments • Targeted searched comprised 23.4 person-hours at 11 sites targeting Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python • Ultrasonic bat recorders were deployed at nine locations including one cave. Each recorder was deployed for three consecutive nights, in accordance with EPA (2020), except the recorder located at a cave which was deployed for two nights, equating to a total of 26 recording nights during the field survey • Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence 	Ghost Bat (~6,000 scats in cave CMEE-05)
West Angelas Beyond 2020 Deposit H and Deposit F North Reconnaissance Survey Biologic 2022c Appendix E.3	July 2022	Desktop and Reconnaissance	<ul style="list-style-type: none"> • Desktop Assessment to review previous fauna habitat mapping • Verification of fauna habitats previously mapped • Habitat assessments to define and delineate fauna habitats • Targeted searches for target species and suitable habitat comprised 5.5 person hours • Camera trapping at one transect site for a total of 40 sampling hours and ultrasonic bat recorders at 2 sites for a total of 6 recording nights • Opportunistic records included primary (direct observation of species) or secondary (burrows, scratching, digging and scats) evidence 	Nil

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
West Angelas Deposit G Basic and Targeted Vertebrate Fauna Survey Biologic 2022n Appendix E.4	February 2022	Desktop and targeted	Survey Effort: <ul style="list-style-type: none"> • Desktop Assessment • Study area comprised a single area covering 330.2 ha • Habitat assessments undertaken at nine locations • Active searches (9 person hours) • 20 minute bird census at all habitat assessment locations • Three ultrasonic recording nights 	Nil
West Angelas Fauna Habitat Mapping Biologic 2021d Appendix E.5	August 2021	N/A	<ul style="list-style-type: none"> • Desktop Assessment to review previous fauna habitat mapping • Make previously mapped area consistent with Biologic mapping, carried out as part of the Level 2 Fauna Assessment 2022 • Undertake Extrapolated mapping in regional areas within a 20 km radius of the Revised Development Envelope 	N/A

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
<p>West Angelas Beyond 2020: Targeted Vertebrate Fauna Survey Biologic 2021e Appendix E.6</p>	<p>June – July 2019</p>	<p>Targeted</p>	<p>Northern Quoll:</p> <ul style="list-style-type: none"> • Motion camera transects (8 transect sites with 10 motion cameras placed 100 m apart, completed over 320 sampling nights) • Single Motion Camera traps (40 locations completed over 139 sampling nights) • Long Term Camera traps (3 locations completed over 282 sampling nights) <p>Ghost Bat and Pilbara Leaf-nosed Bat:</p> <ul style="list-style-type: none"> • Cave searches and Assessments (28 targeted searches over 100-person survey hours) • Ultrasonic Recorders (Eight locations over a total of 92 survey nights) <p>Night Parrot:</p> <ul style="list-style-type: none"> • Acoustic recordings (39 locations over a total of 320 recording nights) <p>Greater Bilby, Pilbara Olive Python and Northern Brushtail Possum:</p> <ul style="list-style-type: none"> • Opportunistic recordings of primary or secondary evidence of species • Motion Camera deployment for Northern Quoll utilised to detect these species • On-foot traversal of unexplored potential Greater Bilby habitat 	<ul style="list-style-type: none"> • Ghost Bat • Evidence recorded in caves CWAN-03, CWAN-04, CWAN-06, CWAN-07, CWAN-28, CWAN-29 and CWAN-32 • Pilbara Leaf-nosed Bat • Evidence recorded in cave CWAN-04
<p>West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 & 2 Biologic 2021c Appendix E.7</p>	<p>October 2018 (Phase 1) and March 2019 (Phase 2)</p>	<p>Targeted</p>	<p>Systematic Sampling:</p> <ul style="list-style-type: none"> • Systematic trapping using pit, funnel, Elliot, and cage traps across twelve trapping sites. At each site, ten pit traps were installed in parallel transects), one funnel trap, and two Sheffield traps. The collective trapping effort covered 7,088 trapping nights • Avifauna surveys were conducted for 20 minutes at ten sampling sites across eight days • Avifauna censuses were conducted at six other locations <p>Targeted Sampling:</p>	<ul style="list-style-type: none"> • Northern Quoll • Evidence recorded at cave CWAN-04 • Ghost Bat • Evidence recorded at caves CWAN-01, CWAN04, CWAN-06, CWAN-07, CWAN-

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
			<ul style="list-style-type: none"> Targeted surveys were conducted at large crevasses, pools, caves, rocky habitats and sandy plains and comprised 16.5 person-hours Ultrasonic bat recorders were deployed at 25 locations and recorded for 68 sampling nights. The sites consisted of prospective roost sites and foraging habitat Acoustic recorders were deployed at 13 locations for a total of 30 sampling nights using Song Meter acoustic recorders Single Motion cameras were deployed at 40 locations (within high significance habitat to MNES species), covering a total 139 sampling nights Long-term motion cameras were deployed at three sites where Northern Quoll were likely to occur and recorded for 3,182 sampling nights Scat collection sheets were deployed at three cave structures, with two sheets per cave, during phase one and retrieved during phase 2 of the survey <p>Opportunistic Records:</p> <ul style="list-style-type: none"> Any evidence pertaining to species not previously recorded during the survey was recorded. This included direct observations and observations of secondary evidence Track logs were used to record the efforts to search unique microhabitats encountered 	<p>08, CWAN-09 and CWAN-11</p> <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat Evidence recorded at cave CWAN-04 Fork-tailed Swift Pilbara Olive Python Evidence recorded at cave CWAN-04 and water feature WB-WAH1
Supporting Studies and Surveys				
Targeted Flora and Fauna Survey for the West Angelas Managed Aquifer Recharge (MAR) Area Biologic 2021g	February 2021	Targeted	<ul style="list-style-type: none"> Targeted searches were undertaken at seven locations for a total of 14 person-hours Ultrasonic bat recorders were deployed at six locations for two nights at each location, totally 12 recording nights Any evidence pertaining to species not previously recorded during the survey was recorded. This included direct observations and observations of secondary evidence 	<ul style="list-style-type: none"> Northern Quoll Ghost Bat Evidence recorded at caves CMAR-01, CMAR-02, CMAR-03 and CMAR-04

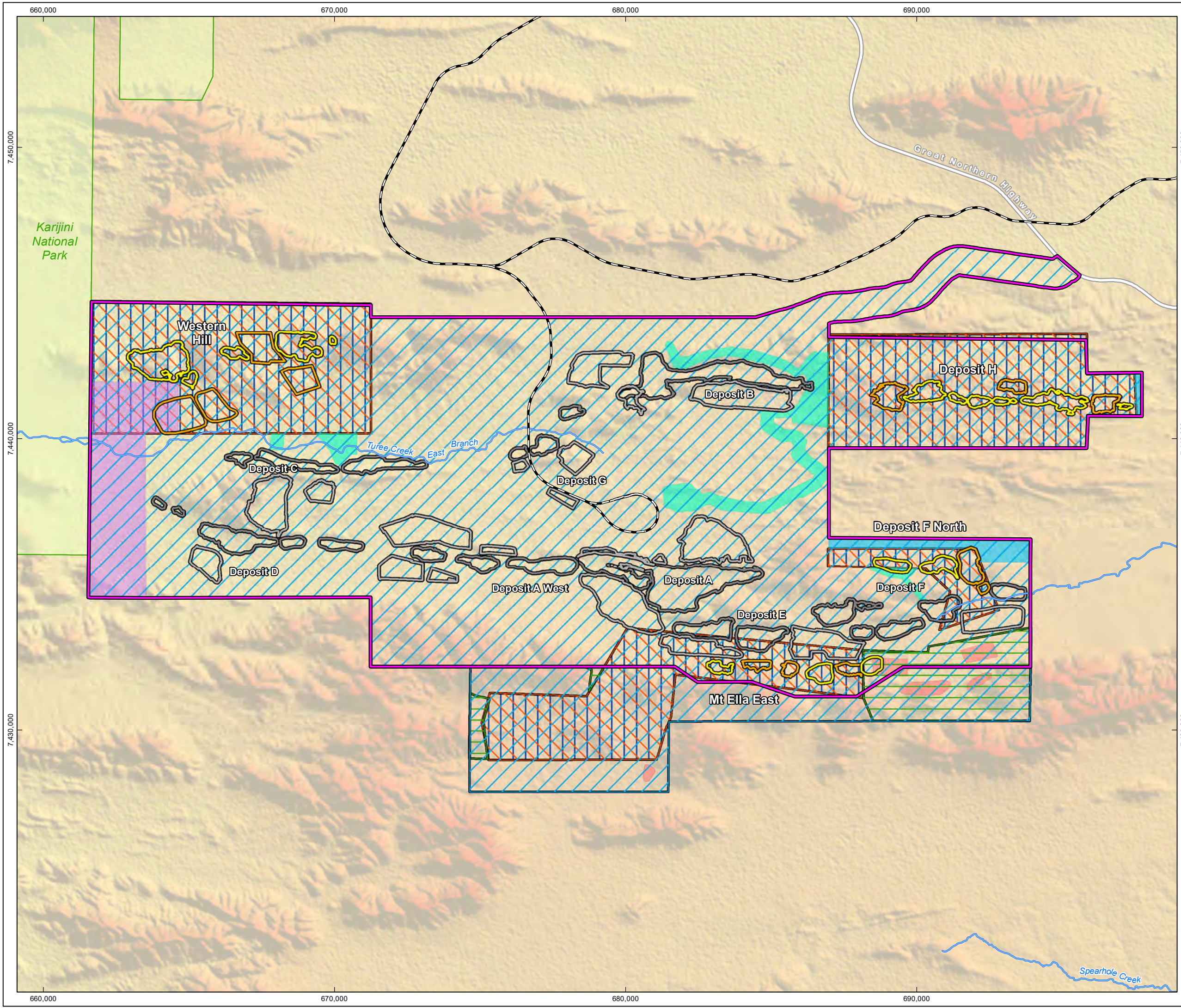
Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
West Angelas Night Parrot Bioacoustics Analysis Biologic 2019b	March 2019	Targeted	<ul style="list-style-type: none"> Bioacoustics recording at five sites Surveying over sixteen recording nights Used Wildlife Acoustic Song Meter 4 bioacoustics recording units 	Nil
West Angelas Deposits C, D & G Targeted Fauna Survey. Biologic 2018Addendum to West Angelas C, D & G Targeted Fauna Survey Biologic 2019a	December 2016, April 2017, March 2018 and December 2018	Targeted	<p>Northern Quoll and Pilbara Olive Python:</p> <ul style="list-style-type: none"> Twenty-two motion cameras were set up in three locations, equating to a total of 60 sampling nights Targeted searches were conducted through suitable habitat over four person days <p>Ghost Bat and Pilbara Leaf-nosed Bat:</p> <ul style="list-style-type: none"> Searches were conducted in and around suitable cave structures Song Meter ultrasonic recorders were deployed at 41 locations for 56 sampling nights <p>Night Parrot:</p> <ul style="list-style-type: none"> Acoustic Song Meter 4 units were set up at 15 locations and were deployed for a total of 56 sampling nights 	<p>Ghost Bat</p> <ul style="list-style-type: none"> Evidence recorded at caves CWAN-09, CWAN-10, CWAN-11, CWAN-12, CWAN-13, CWAN-16, CWAN-17, CWAN-20, CWAN-21, CWAN-22 and CWAN-23
Karijini/Upper Turee Creek Targeted Pilbara Leaf-nosed Bat Survey Bat Call WA 2018	November 2018	Targeted	<ul style="list-style-type: none"> Audio recordings at nine locations Surveying over three recording nights Used Songmeter SM4 audio detectors fitted with omnidirectional SMM-U1 microphones 	Pilbara Leaf-nosed Bat Evidence recorded in Karijini National Park
Rio Tinto Iron Ore Greater West Angelas Terrestrial Fauna Assessment Ecologic 2014	Spring 2012 and Autumn 2013	Two-phase Fauna	<ul style="list-style-type: none"> 12 trapping sites were open for 14 nights, totally 7,056 trap nights 53.8 hours spent surveying for birds 51.6 hours spent conducting diurnal searches 25 hours spent conducting nocturnal searches 576 hours of motion camera trapping 340 hours of bat call recordings analysis 	<ul style="list-style-type: none"> Pilbara Leaf-nosed Bat Fork-tailed Swift

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
Fauna Habitat and Fauna Assemblage at Deposit E and F at West Angelas Biota 2005b	May 2004	Systematic	<p>Systematic Sampling:</p> <ul style="list-style-type: none"> • Systematic surveying using pitfall traps, funnel traps and Elliot traps • Avifauna sampling across seven sites consisting of twenty-one 40 minutes censuses • Echolocation recording for bat calls <p>Non-systematic Sampling:</p> <ul style="list-style-type: none"> • Opportunistic sightings and recordings, including primary and secondary evidence • Targeted searches for significant species 	Nil
Ghost Bats at West Angelas: 2002 Survey Data Review and Future Directions Biota 2002	November 2002	Targeted	Ghost Bats were identified from primary or secondary evidence (i.e. scats)	<p>Ghost Bat</p> <ul style="list-style-type: none"> • Evidence recorded in caves AA1 and L3
West Angelas Iron Ore Project Vertebrate Fauna Assessment Survey Ecologia 1998a	June-October 1997	Detailed	<p>Systematic Sampling:</p> <ul style="list-style-type: none"> • Pits and Elliot traps • Microhabitat searching • Spotlighting • Mist-netting • A total of 590 pit trap and 1,380 Elliot trap nights across 13 systematic survey sites <p>Opportunistic Records:</p> <ul style="list-style-type: none"> • Opportunistic sightings and recordings, including primary and secondary evidence 	<ul style="list-style-type: none"> • Ghost Bat • Grey Falcon

Survey Title	Year of Survey	Survey Type	Survey Effort	MNES Species Recorded
West Angelas Project Ghost Bat <i>Macroderma gigas</i> Assessment Survey Ecologia 1998b	1998	Targeted	<ul style="list-style-type: none"> • Systematic surveying for caves • Caves were searched for primary and secondary evidence of Ghost Bats • One cave was mist-netted • One two-hour deployment of an echolocation recorder 	Ghost Bat <ul style="list-style-type: none"> • Evidence recorded in caves AA1, A1 and L2

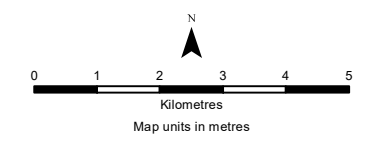
Figure 13-1
Spatial Extent of Key MNES surveys
within and surrounding the Revised
Development Envelope

Drawn: A.D.
Plan: PDE0186406v5
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- Targeted Flora and Fauna Survey for the West Angelas Managed Aquifer Recharge (MAR) Area (Biologic 2021)
- Targeted Flora and Fauna Survey: Mt Ella East and Deposit J pit and waste dump footprints (Biologic 2021)
- West Angelas Beyond 2020: Deposit H and F North Reconnaissance Survey (Biologic 2022)
- West Angelas Beyond 2020: Infrastructure Corridors Reconnaissance and Targeted Survey (Biologic 2022)
- West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2 (Biologic 2021)
- West Angelas Beyond 2020: Mt Ella East and Dep J Detailed and Targeted Survey (Biologic 2022)
- West Angelas Beyond 2020: Targeted Vertebrate Fauna Survey (Biologic 2021)
- West Angelas Fauna Habitat Mapping (Biologic 2021)
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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13.3.2. EPBC Act Protected Matter Search

A search of the EPBC Act Protected Matters Search Tool (PMST) was conducted to support the referral of the Proposed Action (DAWE 2021). The findings of the PMST are summarised below:

- Two flora species (*Pityrodia augustensis* – Vulnerable and *Thryptomene wittweri* – Vulnerable) protected under the EPBC Act were identified as having the potential to be present within 50 km of the Revised Development Envelope
- No ecological communities protected under the EPBC Act were identified as being present or having the potential to be present within 50 km of the Revised Development Envelope
- Nine Threatened terrestrial fauna species (four birds, four mammals and one reptile) were identified as having the potential to occur within the Revised Development Envelope (Table 13-4). In addition, nine migratory bird species were identified as potentially occurring within the Revised Development Envelope (Table 13-4).

13.3.3. Likelihood of Occurrence

No flora listed under the EPBC Act were recorded within the Revised Development Envelope (Biota 2020) nor any habitat suitable to support any species identified in the PMST database search. They are not considered further in this section.

No TECs listed under the EPBC Act were recorded with the Revised Development Envelope (Biota 2020) and, therefore, not considered further in this section.

Five of the 16 listed fauna species under the EPBC Act identified by the PMST were recorded within the Revised Development Envelope, one of which was a migratory species (Biologic 2021e) comprising:

- Northern Quoll – Endangered
- Ghost Bat – Vulnerable
- Pilbara Leaf-nosed Bat – Vulnerable
- Pilbara Olive Python – Vulnerable
- Fork-tailed Swift – Migratory Species.

One further species, the Grey Falcon, was not recorded during the surveys of the Revised Development Envelope but is considered likely to occur.

Table 13-4 summarises the likelihood of occurrence within the Revised Development Envelope of MNES fauna identified in the PMST based on the presence of suitable habitat and/or nearby records. Other than the Night Parrot, species described in Table 13-4 as unlikely to occur within the Revised Development Envelope are not discussed further in this assessment as the Proposed Action is unlikely to affect those species. The Night Parrot remains a subject of this assessment, as it was included in the DCCEE (formerly DAWE) list of controlling provisions.

Table 13-4: EPBC Act Listed Fauna Species and Likelihood of Occurrence in the Revised Development Envelope

Species	Conservation Status (EPBC Act)	Species Broad Habitat Type Preference	Likelihood of Occurrence within Proposed Action Area	Likelihood of Occurrence within Revised Development Envelope	Comments
Mammals					
Northern Quoll (<i>Dasyurus hallucatus</i>)	Endangered	Rocky habitats which provide protection from predators and are productive with regards to the availability of resources (Braithwaite and Griffiths 1994; Oakwood 2000). Den sites include caves and rocky crevices, particularly near water sources (Woinarski et al. 2008).	Recorded	Recorded	Scats were observed in a cave (CWAN-04) at Western Hill Deposit within the Gorge/Gully habitat. Potential critical denning habitat occurs within the Gorge/Gully habitat type. Foraging and dispersal habitat occurs within Gorge/Gully, Hillcrest/Hillslope and Drainage Line habitats.
Ghost Bat (<i>Macroderma gigas</i>)	Vulnerable	Rocky gorges and outcrops with caves and crevices which are used as nocturnal, diurnal and maternity roosts. Foraging typically occurs up to 12 km from a diurnal roost (Bat Call WA 2021a).	Recorded	Recorded	Evidence was recorded in 29 caves throughout the Revised Development Envelope, within Gorge/Gully and Hillcrest/Hillslope habitat types. Echolocation calls have been recorded at four of these caves, and secondary evidence (scats) have been recorded at 18 caves. Two caves contained the remains of Ghost Bat pups, and a live Ghost Bat was sighted at two caves. Critical roosting habitat occurs within Gorge/Gully and Hillcrest/Hillslope habitat types. Foraging and dispersal habitat occurs in Drainage Line, Mixed Acacia Woodland, Footslopes and Plain and Cracking Clay habitat types, and is considered supporting habitat when within 12 km of critical habitat (category 2 caves and category 3 caves in apartment blocks).

Species	Conservation Status (EPBC Act)	Species Broad Habitat Type Preference	Likelihood of Occurrence within Proposed Action Area	Likelihood of Occurrence within Revised Development Envelope	Comments
Pilbara Leaf-nosed Bat (<i>Rhynonictis aurantia</i>)	Vulnerable	Roosting sites include caves, deep fissures or abandoned mine shafts with warm and humid climates (Armstrong 2000, 2001; Baudinette et al. 2000). Foraging occurs widely across almost all productive and semi-productive habitats (Bat Call WA 2021b).	Recorded	Recorded	Echolocation calls have been recorded at five locations within the Revised Development Envelope. Two of these were at the Western Hill deposit, with three calls recorded in a cave (CWAN-04) located within Hillcrest/Hillslope habitat, and one recorded in the Foothills and Plain habitat type (VVAW 87). Calls have also been recorded at Deposit A West, Deposit C and Deposit D. Nocturnal roosting habitat occurs within Gorge/Gully habitat. Foraging and dispersal habitat occurs within Hillcrest/Hillslope and Drainage Line habitat types.
Greater Bilby (<i>Macrotis lagotis</i>)	Vulnerable	Sand or sandy loam in hummock grassland (<i>Triodia</i> species) and or <i>Acacia</i> shrubland (Burrows et al. 2012)	Unlikely	Unlikely	Limited small patches of marginally suitable habitat are present within the Revised Development Envelope. Despite targeted survey efforts, this species has not been recorded (Biologic 2021e). Historically the species was recorded 5 km north of Deposit H in 1983 and 78 km and 99 km north of the Revised Development Envelope in 2013.
Northern Brushtail Possum (<i>Trichosurus vulpecula arnhemensis</i>)	Vulnerable	Gorges and major drainage lines that contain large, hollow-bearing eucalyptus (Biologic 2021e).	Unlikely	Unlikely	Possible denning habitat may occur in the Gorge/Gully habitat. However, the species is considered highly unlikely to occur based on the Revised Development Envelope being outside of any known species records. Despite the targeted survey effort, no individuals have been recorded (Biologic 2021e).

Species	Conservation Status (EPBC Act)	Species Broad Habitat Type Preference	Likelihood of Occurrence within Proposed Action Area	Likelihood of Occurrence within Revised Development Envelope	Comments
Reptiles					
Pilbara Olive Python (<i>Liasis olivaceus barroni</i>)	Vulnerable	Typically occurs in rocky ranges with permanent water holes and amongst riverine vegetation (Pearson 1993).	Recorded	Recorded	Recorded on a motion camera at a water feature in Gorge/Gully habitat (WB-WAH1) at Deposit H. Scats were recorded in cave CWAN-04 within the Western Hill deposit in Hillcrest/Hillslope habitat. Gorge/Gully habitat within the Revised Development Envelope provides critical breeding, shelter and foraging habitat. Foraging and dispersal habitat occurs in the Hillcrest/Hillslope and Drainage Line habitat types.
Birds					
Fork-tailed Swift (<i>Apus pacificus</i>)	Migratory	Variety of habitats This species is an aerial forager with no specific habitat within the Revised Development Envelope.	Recorded	Recorded	Twenty individuals were recorded flying over the Revised Development Envelope at the Western Hill deposit. However, given that the species is largely aerial, it would not depend on any of the habitats in the Revised Development Envelope.
Grey Falcon (<i>Falco hypoleucos</i>)	Vulnerable	Timbered lowland plains, particularly Acacia shrublands that are near tree-lined watercourses. It has been observed in treeless areas and tussock grassland, open woodland (Garnett et al. 2011).	Likely	Likely	The species has not been recorded within the Revised Development Envelope; however, it was recorded within 3 km of the Revised Development Envelope in 1997 and 10 km in 2008. Supporting foraging habitat may occur within Drainage Line, Mixed Acacia Woodland, Foothslopes and Plain habitat types. Suitable nesting habitat may occur where other birds have constructed nests in large trees or other structures within the Revised Development Envelope.
Night Parrot (<i>Pezoporus occidentalis</i>)	Endangered	Long-unburnt <i>Triodia</i> grasslands and chenopoda and samphire shrublands, in	Unlikely	Unlikely	Despite targeted survey efforts, this species has not been identified within the Revised Development Envelope.

Species	Conservation Status (EPBC Act)	Species Broad Habitat Type Preference	Likelihood of Occurrence within Proposed Action Area	Likelihood of Occurrence within Revised Development Envelope	Comments
		addition to the edges of water sources such as creek and salt lakes (McGilp 1931; Wilson 1937).			<p>Furthermore, there is a lack of species records within the region, and only marginal habitat exists. As such, the species is considered unlikely to occur within the Revised Development Envelope.</p> <p>There have been five contemporary records of this species within Western Australia:</p> <ul style="list-style-type: none"> • Near Fortescue Marsh – Pilbara (DBCA 2017b) • Near Wiluna – Goldfields (DBCA 2017b) • Lake Disappointment – Great Sandy Desert (DBCA 2017b) • Across 100 km of the Great Sandy Desert (Collins 2021) • Martu Country (extending from Wiluna in the south to the Great Sandy Desert in the North (Australian Geographic 2020)
Curlew Sandpiper (<i>Calidris ferruginea</i>)	Critically Endangered	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creek line flats, tidal flats or grassy edges of wetlands (DAWE 2022).	Highly Unlikely	Highly Unlikely	This species has not been recorded in the Revised Development Envelope or surrounding area, and suitable habitat does not occur.
Australian Painted Snipe (<i>Rostratula australis</i>)	Endangered	Shallow aquatic habitats, including wetlands, marshes, sewage ponds, river and creek line flats, tidal flats or grassy edges of wetlands (DAWE 2022).	Highly Unlikely	Highly Unlikely	This species has not been recorded in the Revised Development Envelope or surrounding area, and suitable habitat does not occur.

Species	Conservation Status (EPBC Act)	Species Broad Habitat Type Preference	Likelihood of Occurrence within Proposed Action Area	Likelihood of Occurrence within Revised Development Envelope	Comments
Grey Wagtail (<i>Motacilla cinerea</i>)	Migratory	Various habitat types with open waterbodies present (DAWE 2022).	Highly Unlikely	Highly Unlikely	This species is only present in Australia as a vagrant, and the Revised Development Envelope is outside the species' known distribution.
Yellow Wagtail (<i>Motacilla flava</i>)	Migratory	A variety of damp/wet habitats with low vegetation (DAWE 2022).	Highly Unlikely	Highly Unlikely	This species has not been recorded in the Revised Development Envelope or surrounding area, and suitable habitat does not occur.
Oriental Plover (<i>Charadrius veredus</i>)	Migratory	Various habitats, including coastal (mudflats, sandbanks, sandy or rocky beaches) and inland environments (arid or semi-arid grasslands) (DAWE 2022).	Highly Unlikely	Highly Unlikely	This species has not been recorded in the Revised Development Envelope or surrounding area, and suitable habitat does not occur.
Sharp-tailed Sandpiper (<i>Calidris acuminata</i>)	Migratory	Freshwater soaks, mangrove mudflats, river pools, saltwork ponds, sewage ponds, flooded samphire flats and grasslands (DAWE 2022).	Highly Unlikely	Highly Unlikely	This species has not been recorded in the Revised Development Envelope or surrounding area, and suitable habitat does not occur.
Common Sandpiper (<i>Tringa hypoleucos</i>)	Migratory	Claypans, reservoirs, dams, pools, lakes and billabongs; estuaries and deltas of streams (DAWE 2022).	Highly Unlikely	Highly Unlikely	This species has not been recorded in the Revised Development Envelope or surrounding area, and suitable habitat does not occur.

13.3.4. Habitat Suitability for MNES

The Significant Impact Guidelines (DoE 2013) provide broad definitions of critical habitat at the national level. However, this should not preclude using extensive Pilbara datasets for MNES species to inform a more detailed understanding and assessment of the significance of habitats and impacts at a local and regional level. Where sufficient scientific information exists, the detailed understanding of local species occurrence and habitat use in the Revised Development Envelope has been used to support a local definition of core habitat critical to the survival of the local population.

The habitats mapped within the Revised Development Envelope were assigned local significance ratings based on their ability to support significant fauna species (Biologic 2021c). Table 13-5 describes the criteria used to assign habitat significance ratings.

Table 13-5: Habitat Significance Assessment Criteria for MNES Fauna Species Under the EPBC Act

Significance	Criteria
High	Provides core breeding/refugia/shelter sites (i.e., denning, roosting or water sources) for MNES fauna species. These habitats are considered critical ³¹ to the survival of the MNES species within the Revised Development Envelope.
Moderate	Provides foraging and dispersal habitat for MNES fauna species. These habitats are considered supporting ³² habitats when they are within the range* of the MNES fauna species. These habitats are more widespread and of lower importance than the high significance (critical) habitats.
Low	Habitat does not directly support any MNES fauna species but may represent limited foraging and dispersal habitat. MNES fauna species are not dependent on this Habitat. This Habitat is widespread in the local and regional areas.
Nil	Disturbed or cleared areas that do not provide any fauna habitat.

*Species range differs depending on the MNES fauna species.

The MNES fauna species home range is defined as:

- Northern Quoll and Pilbara Olive Python – 1 km from critical habitat (known records)
- Ghost Bat – 12 km from critical habitat (category 2 caves and category 3 caves in apartment blocks)
- Pilbara Leaf-nosed Bat – 10 km from critical habitat (permanent diurnal roosts).

Six broad fauna habitat types have been mapped within the Revised Development Envelope: Gorge/Gully, Hillcrest/Hillslope, Drainage Line, Mixed Acacia Woodland, Footslopes and Plain, and Cracking Clay (Biologic 2021d; Table 13-6; Figure 13-2). These habitats have been mapped based on field observations, vegetation mapping, topographic data and interpretation of aerial photography (Biologic 2021d). Disturbed areas are also mapped.

Of the six habitat types identified within the Revised Development Envelope, two of the habitat types are considered to provide high significance habitat:

- **Gorge/Gully habitat:** This type of habitat occurs across 627 ha (2%) of the Revised Development Envelope, of which 178 ha occurs within Extension Areas. This habitat is considered high significance due to the microhabitats it provides, such as caves, deep rocky crevices and ephemeral pools (Biologic 2021c). The rocky shelter provides opportunities for denning, shelter,

³¹ For the purposes of this assessment, “critical habitat” is defined as denning, roosting and/or shelter and water sources for MNES species.

³² “Supporting habitat” is foraging and dispersal habitat within a MNES species’ home range.

roosting and foraging for significant fauna species such as the Northern Quoll (*Dasyurus hallucatus*), Ghost Bat (*Macroderma gigas*) and Pilbara Olive Python (*Liasis olivaceus barroni*)




- **Hillcrest/Hillslope:** This habitat occurs across 12,202 ha (33%) of the Revised Development Envelope, of which 4,160 ha occurs within Extension Areas. This habitat is considered high significance due to its microhabitats, such as caves and crevices. As with the Gorge/Gully habitat, this habitat (to a lesser extent) provides suitable roosting habitat for Ghost Bat and foraging and dispersal opportunities for Northern Quoll and Pilbara Olive Python.




The remaining four habitat types present within the Revised Development Envelope: Drainage Line, Footslopes and Plains, Mixed Acacia Woodlands and Cracking Clays, are considered of moderate to low significance. None of these habitats are confined to the Revised Development Envelope, and all are widespread throughout the wider Hamersley subregion (Biologic 2021c; Table 13-6).

In addition to broad-scale fauna habitat mapping, desktop extrapolated fauna habitat mapping was completed within a 20 km buffer of the Revised Development Envelope to define additional potential habitat for significant fauna species (Table 13-7).

A summary of fauna habitat types, their extent within the Revised Development Envelope and associated significance for relevant MNES species is presented in Table 13-6.

Table 13-6: MNES Fauna Habitat within the West Angelas Area, Revised Development Envelope and Extension Areas

Fauna Habitat Type	Fauna Habitat Description	Microhabitats within the Revised Development Envelope	Value for Significant Fauna	Mapped Extent *			Representative Photograph
				Extent within West Angelas Area**	Extent within Revised Development Envelope	Extent within Extension Areas	
High Significance							
Gorge/Gully <ul style="list-style-type: none"> Limited extent within Revised Development Envelope 	<p>Gorges and gullies are rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open (but not as open as Drainage Line habitat or valleys). Caves and deep, rocky crevices are most often encountered in this habitat type, as are water pools. Vegetation can vary and can be dense and complex in areas of soil deposition or sparse and simple where exposed outcropping or erosion has occurred. Limited extent within the Revised Development Envelope and widely distributed across the Pilbara.</p>	<p>It contains caves and deep, rocky crevices and ephemeral pools</p>	<p>Critical for:</p> <ul style="list-style-type: none"> Northern Quoll Ghost Bat Pilbara Olive Python <p>Supporting for:</p> <ul style="list-style-type: none"> Pilbara Leaf-nosed Bat 	1,082 ha (2.6%)	627 ha (1.7%)	178 ha (2.1%)	
Hillcrest/Hillslope <ul style="list-style-type: none"> Widespread within Revised Development Envelope 	<p>Hillcrest/Hillslope habitat tends to be more open and structurally simple than other fauna habitats. A common feature of this habitat is a rocky substrate, often with exposed bedrock and skeletal red soils. These can contain cracks and crevices, but not to the same extent as within rocky upland areas of Gorge/Gully habitat. This habitat is usually dominated by open Eucalyptus woodlands, Acacia and Grevillea scrublands and Triodia low hummock grasslands. Widespread within Revised Development Envelope and the wider region. Significance rating presumes the presence of caves considered critical for the survival of Ghost Bat populations.</p>	<p>May contain caves and crevices, but not to the same extent as Gorge or Gully</p>	<p>Critical for:</p> <ul style="list-style-type: none"> Ghost Bat <p>Supporting for:</p> <ul style="list-style-type: none"> Northern Quoll Pilbara Leaf-nosed Bat Pilbara Olive Python 	15,015 ha (36.2%)	12,202 ha (33.2%)	4,160 ha (49.2%)	
Moderate Significance							
Drainage Line <ul style="list-style-type: none"> Limited extent within Revised Development Envelope 	<p>Drainage Line habitat is variable in structure and condition. Temporary, semi-permanent – permanent water pools can occur within this habitat, usually after rainfall events. <i>Eucalyptus</i> or <i>Melaleuca</i> species often dominate this habitat over a variable understory comprising mixed small to medium shrubs (<i>Acacia</i> sp.) and tussock grasses over sandy creek beds. Vegetation adjacent to the main channel or channels is denser, taller and more diverse than adjacent terrain. The structure and condition of vegetation often vary seasonally, particularly following rainfall events. Vegetation conditions are often subject to heavy cattle grazing.</p>	<p>It contains leaf litter and woody debris, and small hollows</p>	<p>Supporting for:</p> <ul style="list-style-type: none"> Northern Quoll Ghost Bat Pilbara Leaf-nosed Bat Pilbara Olive Python Grey Falcon 	493 ha (1.2%)	378 ha (1.0%)	157 ha (1.9%)	

Fauna Habitat Type	Fauna Habitat Description	Microhabitats within the Revised Development Envelope	Value for Significant Fauna	Mapped Extent *			Representative Photograph
				Extent within West Angelas Area**	Extent within Revised Development Envelope	Extent within Extension Areas	
	The limited extent within the Revised Development Envelope but widespread in the surrounding region.						
Mixed Acacia Woodland <ul style="list-style-type: none"> Limited extent within Revised Development Envelope 	<p>Mixed Acacia Woodland habitat comprises dense <i>Acacia</i> vegetation, with a mixture of mulga (<i>Acacia aneura</i>), <i>Acacia maitlandii</i> and <i>Acacia pruinocarpa</i> over a mixture of sparse small shrubs and grasses, such as <i>Triodia</i> and <i>Senna</i> species and <i>Ptilotus</i> sp. Dense leaf litter and woody debris is a common features of this habitat type. The soils consist of loam clay with continuous layers of small ironstone pebbles on the surface. The habitat is mostly flat with no or very small drainage channels. Limited extent within the Revised Development Envelope but widespread through the Pilbara region.</p>	It contains leaf litter and woody debris and small hollows	Supporting for: <ul style="list-style-type: none"> Ghost Bat Grey Falcon 	3,240 ha (7.8%)	3,229 ha (8.8%)	487 ha (5.8%)	
Footslopes and Plain <ul style="list-style-type: none"> Widespread within Revised Development Envelope 	<p>Footslopes and Plain habitat comprise low-lying open plains and the rolling hills below upland areas. Vegetation within this habitat varies in composition; however, is generally dominated by scattered mulga and <i>Acacia pruinocarpa</i> forming an over-storey, with a mid-storey comprising <i>Eremophila</i> and <i>Ptilotus</i> spp., over low hummock grasslands of <i>Triodia wiseana</i>, <i>T. basedowii</i>, <i>T. longifolia</i> and <i>T. pungens</i>. Scattered <i>Corymbia hamersleyana</i>, <i>Eucalyptus leucophloia</i> and <i>E. gamophylla</i> were also present. Widespread within Revised Development Envelope and wider region.</p>		Supporting for: <ul style="list-style-type: none"> Ghost Bat Grey Falcon 	13,287 ha (32%)	12,051 ha (32.8%)	3,092 ha (36.6%)	
Cracking Clay <ul style="list-style-type: none"> Limited extent within Revised Development Envelope 	<p>Cracking Clay habitat is characterised by open and sparse low vegetation, with approximately half of its area being bare ground. Isolated shrubs of <i>Salsola australis</i>, <i>Boerhavia paludosa</i> and <i>Ptilotus nobilis</i> subsp. <i>nobilis</i> occur over open tussock grassland of <i>Aristida</i> sp., <i>Brachyachne</i> sp. and <i>Astrebla pectinata</i>. The soil is often dark orange sand-clay to clay with an undulating surface caused by crabholes and gilgai. Rocks and pebbles are often very rare; when present, the rock type is consistently ironstone. Limited extent within Revised Development Envelope.</p>		Supporting for: <ul style="list-style-type: none"> Ghost Bat 	435 ha (1.0%)	435 ha (1.2%)	0 ha (0%)	

Fauna Habitat Type	Fauna Habitat Description	Microhabitats within the Revised Development Envelope	Value for Significant Fauna	Mapped Extent *			Representative Photograph
				Extent within West Angelas Area**	Extent within Revised Development Envelope	Extent within Extension Areas	
Total Fauna Habitat				33,553 ha	28,922 ha	8,074 ha	
Disturbed/Cleared Areas	Cleared areas, or areas devoid of any vegetation	No value for fauna		7,931 ha (19.1%)	7,857 ha (21.4%)	383 ha (4.6%)	
Total Area				41,483 ha	36,779 ha	8,457 ha	

*Extent rounded to nearest ha **West Angelas Area includes the Revised Development Envelope, all survey areas and any reference sites

Table 13-7: Extrapolated Fauna Habitat Mapping within a 20 km Radius of the West Angelas Area

Extrapolated Habitat Type	Extent within 20 km of the West Angelas Area (ha)	
	ha	%
Gorge/Gully	22,068	6.77
Hillcrest/Hillslope	111,051	34.06
Drainage Line	3,387	1.04
Mixed Acacia Woodland	1,053	0.32
Footslopes and Plain	185,014	56.75
Disturbed	3,427	1.05
Total	326,000	100

The current approval under the EPBC Act within the Revised Development Envelope for Deposits C, D and G (DN 2018/8299) specifies limits for clearing Ghost Bat and Pilbara Leaf-nosed Bat habitat as shown in Table 13-8.

Table 13-8: Current Approved Habitat Clearing Limits (DN 2018/8922)

Fauna Habitat Type	DN 2018/8299 Clearing Limit Within Development Envelope (ha)~	MS 1113 Clearing Limit Within Development Envelope (ha)
Gorge/Gully	2	None specified
Hillcrest/Hillslope	484	None specified
Drainage Line	21	None specified
Mixed Acacia Woodland	None specified	None specified
Footslopes and Plain	None specified	None specified
Cracking Clay	None specified	20^

~ Applies to Deposits C, D and G Action only

^ Applies to all activities within the Revised Development Envelope

13.3.4.1. Significant Habitat Features

Significant habitat features are elements within a broader fauna habitat that provide important microhabitats that support MNES fauna species or have a highly diverse or abundant faunal assemblage. In the Pilbara, significant habitat features typically include caves and surface water expressions in the form of pools in drainage lines or gorges.

Two significant habitat feature types supporting MNES fauna occur within the Revised Development Envelope, each of which is discussed in detail in subsequent sections:

- Caves that support MNES fauna species, including Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python
- Ephemeral surface water features.

Caves

Caves are important features in the landscape that provide shelter, stable microclimates and protection for a range of fauna, including the MNES species Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat and Pilbara Olive Python (Biologic 2021c).

A total of 41 caves have been recorded within the Revised Development Envelope, of which 21 are located within the Proposed Action Area (Table 13-8; Figure 13-2). These caves provide potential and confirmed roosting and foraging habitats for two significant bat species: Ghost Bat and Pilbara Leaf-nosed Bat.

For Ghost Bats, across the Revised Development Envelope (Table 13-8) (Bat Call WA 2021a), this includes:

- Two (2) confirmed maternity roosts (category 2), one within the Proposed Action Area
- Five (5) potential maternity roosts (category 2), two within the Proposed Action Area
- Three (3) confirmed diurnal roosts (category 3), none within the Proposed Action Area
- Ten (10) potential diurnal roosts (category 3), five within the Proposed Action Area
- Twelve (12) confirmed night roosts (category 4), five within the Proposed Action Area
- Nine (9) potential night roosts (category 4), eight within the Proposed Action Area.

No category 1, 2 or 3 roosts for the Pilbara Leaf-nosed Bat have been recorded within the Revised Development Envelope, with all 41 caves providing potential nocturnal refuges (category 4) for the Pilbara Leaf-nosed Bat (Table 13-8) (Bat Call WA 2021b). Nineteen of the caves recorded in the Revised Development Envelope occur within the Gorge/Gully habitat type, with the remaining 22 caves in the Hillcrest/Hillslope habitat.

Ghost Bats were confirmed within 29 of the 41 caves within the Revised Development Envelope, eight of which occur within the Western Hill section of this Proposed Action Area (Table 13-8). The Pilbara Leaf-nosed Bat has not been confirmed in any caves recorded within the Revised Development Envelope.

Additional caves may be found throughout the Revised Development Envelope; however, it is very unlikely any further caves would provide critical habitat for Ghost Bat or Pilbara Leaf-nosed Bat due to the extensive searching and ultrasonic recording results, which identify bat activity.

Caves and their respective categories for significant bat species are described in further detail in Sections 13.7 and 13.8.

Water Features

Water is a limiting factor for many ecosystems, particularly within the arid and semi-arid zones such as the Pilbara, and water features often represent areas of comparatively high productivity. Within the Revised Development Envelope, five ephemeral pools have been recorded, with two occurring in the Approved Development Envelope and three within the Proposed Action Area (Biologic 2021c; Biologic 2021e). The two features within the Approved Development Envelope are located within the southwestern corner of the Revised Development Envelope (WMAR01 and WMAR-03) are protected from clearing under MS 1113. The Proposed Action will not affect these water features (see Section 7).

The three surface water fed ephemeral water features within the Proposed Action Area were recorded within the Gorge/Gully habitat type in October following a typical dry season (Biologic 2021c). The water in these pools likely came from the high rainfall in June 2018, three months prior. Following the lack of rainfall between June 2018 and the survey, the pools were drying up, indicating that they provide only temporary water sources following periods of rain (Biologic 2021c).

Surface water fed ephemeral water feature WB-WAH1 (Deposit H Waterhole; Table 13-9) was initially documented in August 2018, and by the time of the October survey of the same year, it had dried up substantially. A motion camera and ultrasonic bat recorder were installed at the site for four nights in October 2018 as part of targeted sampling efforts; however, no bat species of significance were recorded here during this time. One Pilbara Olive Python has been recorded at this pool (Biologic 2021c).

Surface water fed ephemeral water features WB-WAJ1 and WB-WAJ2 were located in the same rocky gully near Mt Ella East. Ten motion cameras were deployed at these sites between October 2018 and March 2019 (Biologic 2021c). No MNES species were recorded on these cameras. When the cameras were retrieved, recent rain had created a series of small, interconnected pools within the gully.

An ephemeral, semi-permanent pool known as Turtle Pool is located in a tributary of Weeli Wolli Creek. This pool is outside the Revised Development Envelope, approximately 700 m east of Deposit H, downstream of the Proposed Action (Figure 13-2).

These pools may provide drinking and foraging resources for part of the year (after rainfall) for various fauna species, including Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python. Details of the three pools within the Proposed Action Area are provided in Table 13-9.



Table 13-9: Caves Recorded within the Revised Development Envelope


ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
Caves Recorded within the Proposed Action Area					
CWAN-01	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 3 – in ‘apartment block’ Potential diurnal roost	10 Ghost Bat scats
CWAN-02	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 3 – in ‘apartment block’ Potential diurnal roost	No scats
CWAN-03	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 3 - in ‘apartment block’ Potential diurnal roost	20 Ghost Bat scats
CWAN-04*	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 2 - in ‘apartment block’ Confirmed maternity roost	~1,500 Ghost Bat scats recorded Dead Ghost Bat pup (skeleton) found Multiple Ultrasonic Calls
CWAN-05	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-06	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	~1,500 Ghost Bat scats recorded 1 Ghost Bat individual present Single Ultrasonic Call
CWAN-07	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	~5,000 Ghost Bat scats
CWAN-08	Hillcrest/Hillslope	Mount Ella East	Category 4 Potential nocturnal refuge	Category 4 Night roost	30 Ghost Bat scats
CWAN-09	Hillcrest/Hillslope	Deposit H	Category 4 Potential nocturnal refuge	Category 4 Night roost	7 Ghost Bat scats
CWAN-11	Hillcrest/Hillslope	Mount Ella East	Category 4 Potential nocturnal refuge	Category 4 Night roost	1 Ghost Bat scat
CWAN-26	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-27	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-28	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Night roost	5 Ghost Bat scats
CWAN-29	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	5 Ghost Bat scats Remains of Ghost Bat
CWAN-30	Hillcrest/Hillslope	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats

ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
CWAN-31	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	No scats Deep, dark cave
CWAN-32	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Night roost	5 Ghost Bat scats
CWAN-33	Gorge/Gully	Western Hill	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CWAN-34	Hillcrest/Hillslope	Mount Ella East	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No scats
CDHI-001	Hillcrest/Hillslope	Deposit B	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No Ghost Bat scats
CDHI-002	Hillcrest/Hillslope	Deposit B	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	No Ghost Bat scats
Caves within the Approved Development Envelope					
CMAR-01	Hillcrest/Hillslope	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	~300 old Ghost Bat scats
CMAR-02	Hillcrest/Hillslope	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	20 Ghost Bat scats
CMAR-03	Gorge/Gully	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	6 old Ghost Bat scats
CMAR-04	Gorge/Gully	MAR; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	1 old Ghost Bat scat
A1	Hillcrest/Hillslope	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Confirmed diurnal roost	Monitoring indicates cave is utilised by Ghost bat
A2	Hillcrest/Hillslope	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	Monitoring indicates cave is utilised by Ghost bat
I1	Hillcrest/Hillslope	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Potential night roost	Historical Ghost Bat scats
L2	Gorge/Gully	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	Monitoring indicates cave is utilised by Ghost bat

ID	Habitat Types	Deposit	Pilbara Leaf-nosed Bat	Ghost Bat	
			Category	Category	Evidence
L3	Gorge/Gully	Deposit B; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	Monitoring indicates cave is utilised by Ghost bat 1,000 Ghost Bat scats Ghost Bat ultrasonic calls recorded
AA1	Gorge/Gully	Deposit F; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Confirmed maternity roost	Monitoring indicates cave is utilised by Ghost bat
WA-09	Gorge/Gully	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	2 Ghost Bat scats
WA-10	Hillcrest/Hillslope	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	25 Ghost Bat scats
WA-11	Gorge/Gully	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 4 Night roost	20 Ghost Bat scats
WA-12	Hillcrest/Hillslope	Deposit D; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Confirmed diurnal roost	170 Ghost Bat scats
WA-13	Gorge/Gully	Deposit D; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	1,500 Ghost Bat scats
WA-17	Gorge/Gully	Deposit D; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	36 Ghost Bat scats
WA-20	Gorge/Gully	Deposit D; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Potential diurnal roost	250 Ghost Bat scats
WA-21	Gorge/Gully	Deposit D; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	1,500 Ghost Bat scats
WA-22	Hillcrest/Hillslope	Deposit C; within MS 1113 Restriction Area	Category 4 Potential nocturnal refuge	Category 3 Confirmed diurnal roost	20 Ghost Bat scats
WA-23	Gorge/Gully	Deposit C; within MS 1113 Exclusion Area	Category 4 Potential nocturnal refuge	Category 2 Potential maternity roost	2,000 Ghost Bat scats

Table 13-10: Surface Water Pools within the Proposed Action Area

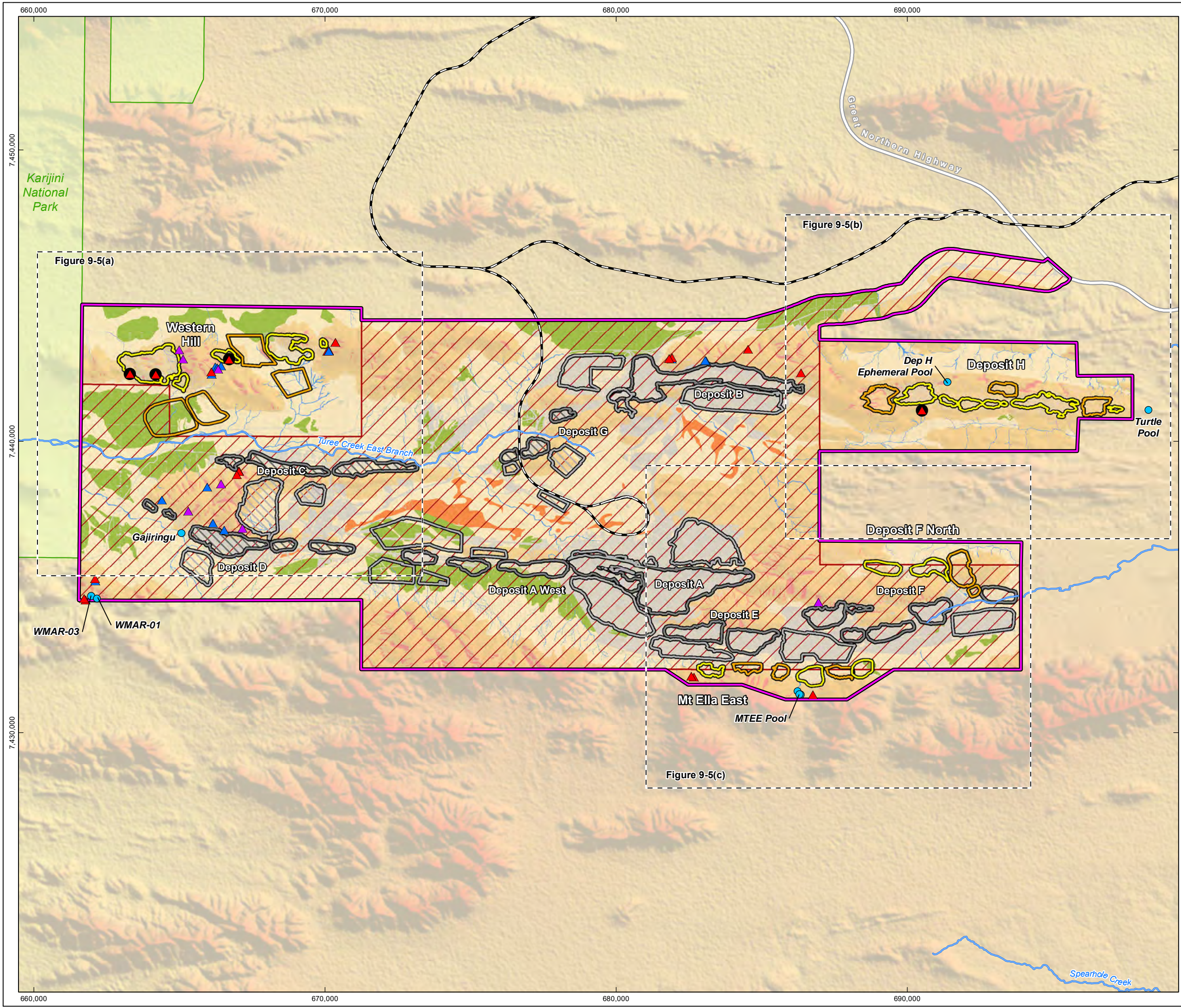
ID	Habitat Type	Deposit	Description	Photo
WB-WAJ1	Gorge/Gully	Mt Ella East	<p>This surface water pool is a small temporary rock pool located along the same rock gully as WB-WAJ2, which is fed by rainfall and surface water flows. No MNES species were recorded within or near the surface water pool WB-WAJ1.</p>	
WB-WAJ2	Gorge/Gully	Mt Ella East	<p>This surface water pool is a small temporary rock pool located along the same rock gully as WB-WAJ1 which is fed by rainfall and surface water flows. No MNES species were recorded within or near surface water pool WB-WAJ2.</p>	

ID	Habitat Type	Deposit	Description	Photo
WB-WAH1	Gorge/Gully	Deposit H	<p>This surface water pool is a small temporary rock pool that fills with rainwater over the wet season and generally dries out within four months of the last rains of the year.</p> <p>Despite the transient nature of surface water pool WB-WAH1, it is known to support the Pilbara Olive Pythons within the Revised Development Envelope.</p>	

Source: Biologic 2021c

Figure 13-2
MNES Fauna Habitat, Caves
and Water Features
within the Revised Development
Envelope - Overview

Drawn: L.Fuentes
Plan: PDE0186407v4
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Proposal Development
- Decision Notice 2018/8299 Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Dump

Approved Conceptual Layout

- Pit
- Waste Dump

(deposits assessed under DN2018/8299)

- Pit
- Waste Dump

- Water Feature

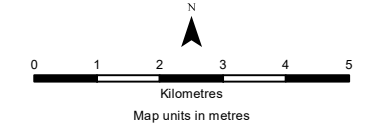
Caves

- Category 2
- Category 3
- Category 4
- Category 4 - Caves To Be Removed

Fauna Habitat

- Drainage Line
- Cracking Clay
- Gorge/Gully
- Footslopes and Plains
- Hillcrest and Hillslope
- Mixed Acacia
- Disturbed

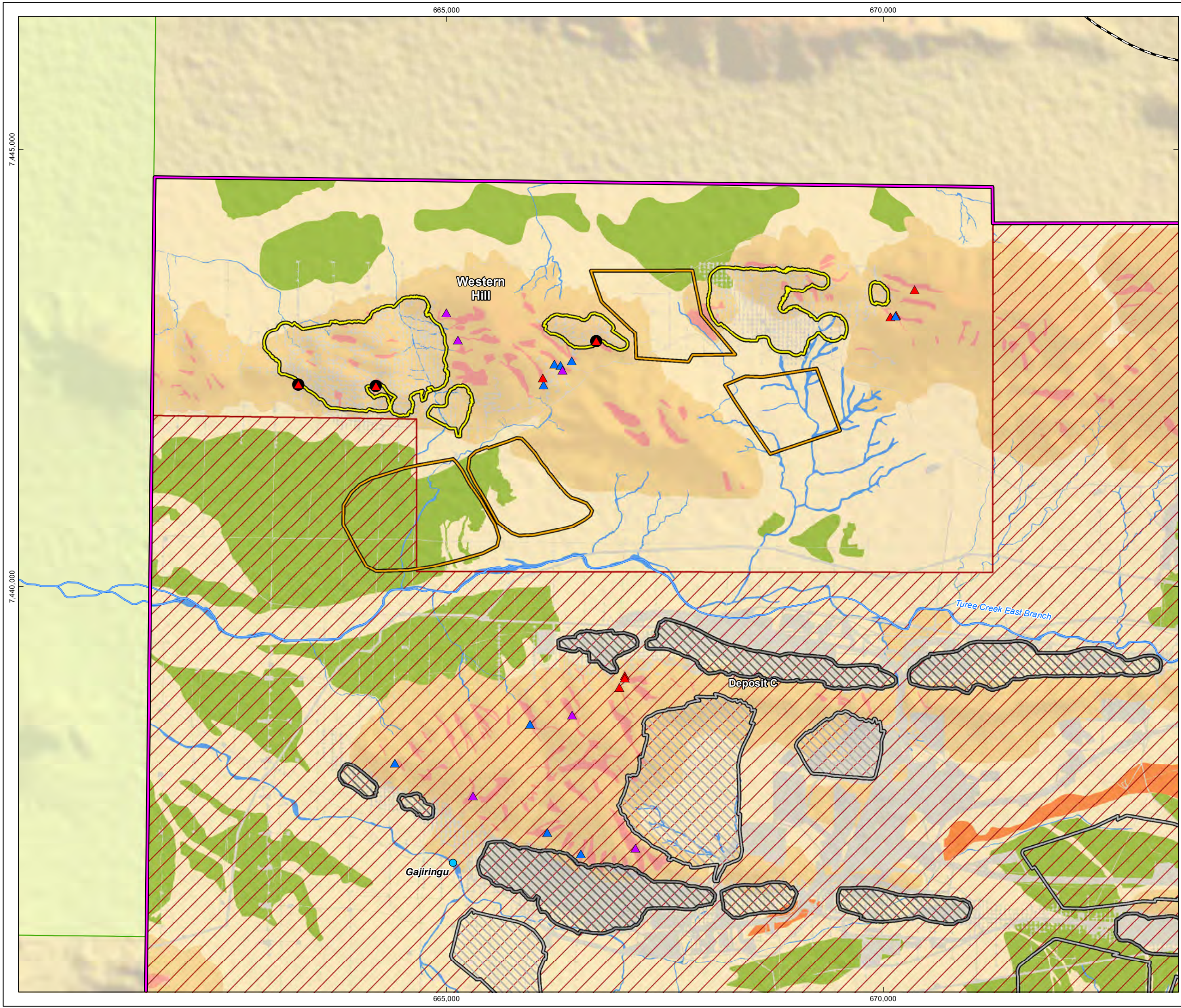
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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Figure 13-2(a)
MNES Fauna Habitat, Caves
and Water Features
within the Revised Development
Envelope - Western Hill

Drawn: L.Fuentes
Plan: PDE0186407v4
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Proposal Development
- Decision Notice 2018/8299 Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Dump

Approved Conceptual Layout

- Pit
- Waste Dump

(deposits assessed under DN2018/8299)

- Pit
- Waste Dump

- Water Feature

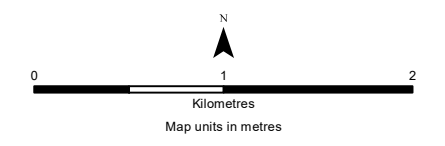
Caves

- Category 2
- Category 3
- Category 4
- Category 4 - Caves To Be Removed

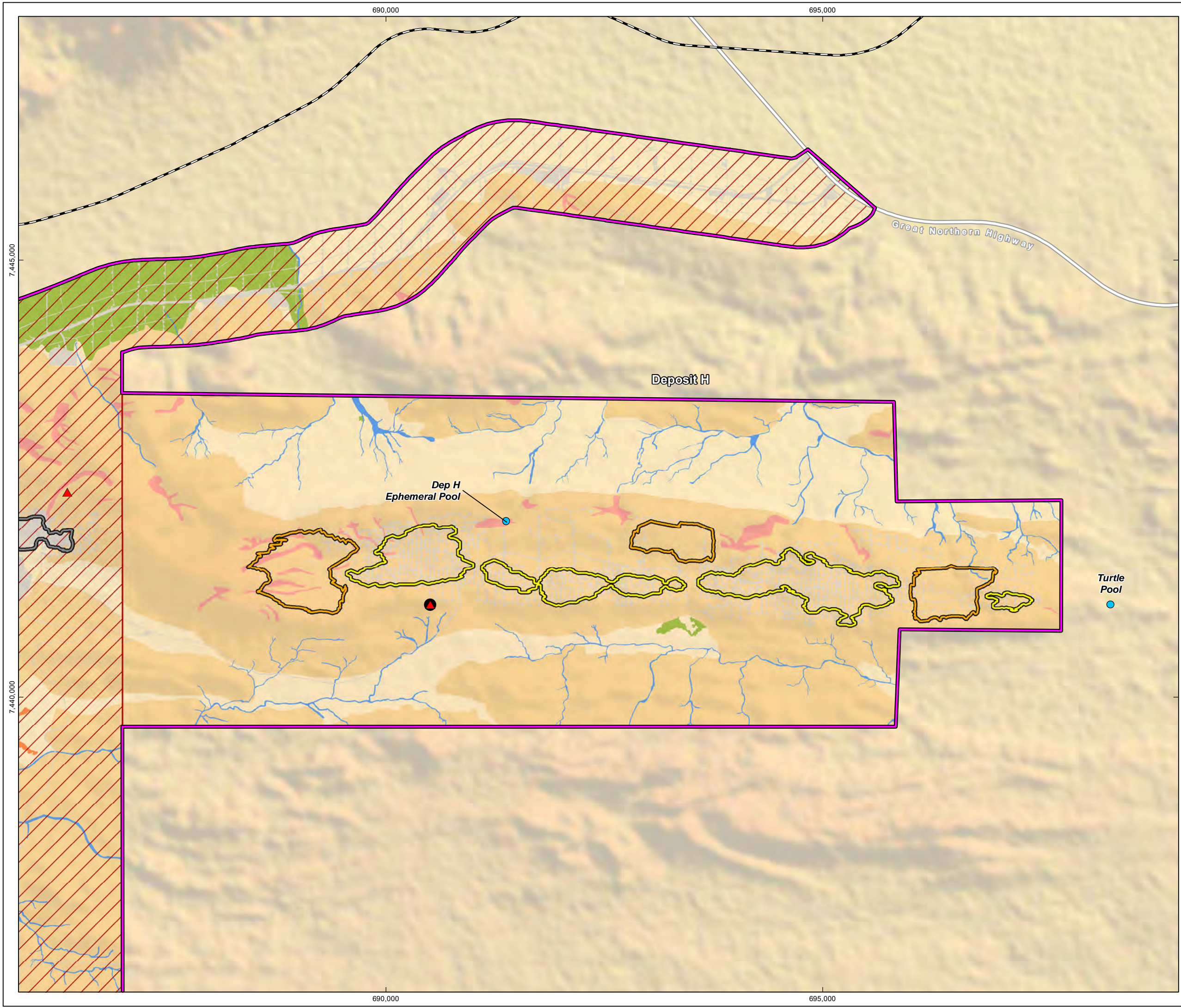
Fauna Habitat

- Drainage Line
- Cracking Clay
- Gorge/Gully
- Footslopes and Plains
- Hillcrest and Hillslope
- Mixed Acacia
- Disturbed

- National Park
- Rio Tinto Railway
- Major Creek



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Legend

- Revised Proposal Development
- Decision Notice 2018/8299 Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Dump

Approved Conceptual Layout

- Pit

- Water Feature

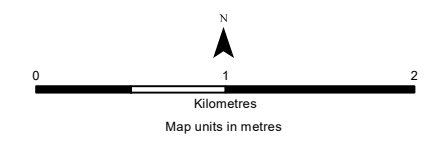
Caves

- Category 4
- Category 4 - Caves To Be Removed

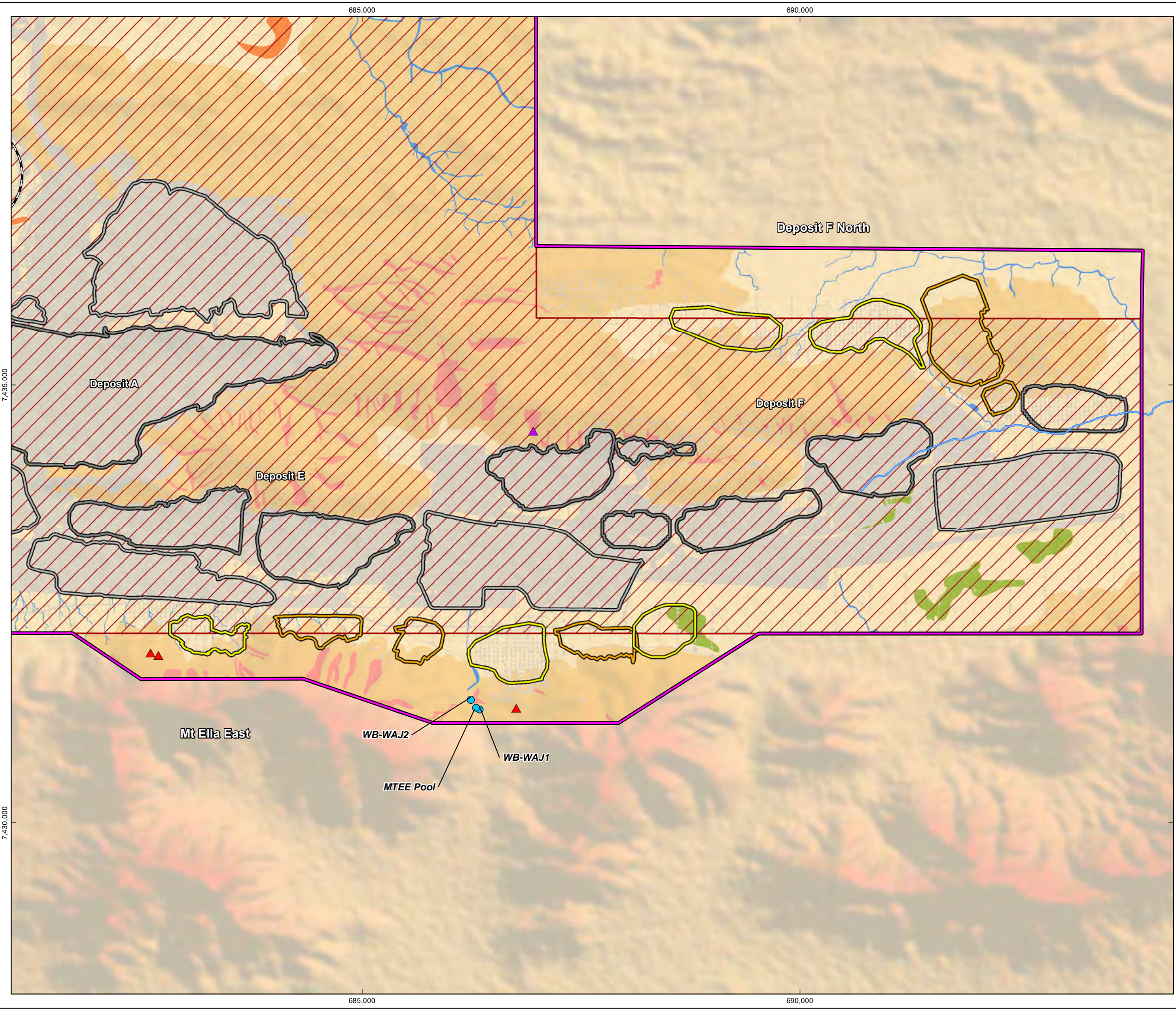
Fauna Habitat

- Drainage Line
- Cracking Clay
- Gorge/Gully
- Footslopes and Plains
- Hillcrest and Hillslope
- Mixed Acacia
- Disturbed

- Rio Tinto Railway
- Highway



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Legend

- Revised Proposal Development
- Decision Notice 2018/8299 Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Dump

Approved Conceptual Layout

- Pit
- Waste Dump

- Water Feature

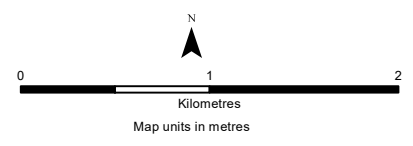
Caves

- Category 2
- Category 4

Fauna Habitat

- Drainage Line
- Cracking Clay
- Gorge/Gully
- Footslopes and Plains
- Hillcrest and Hillslope
- Mixed Acacia
- Disturbed

- Rio Tinto Railway
- Major Creek



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13.4. Summary of Potential Impacts the MNES and Existing Operational Management

13.4.1. Direct Impacts to MNES

Direct impacts on MNES comprise:

- Habitat loss/reduction and fragmentation as a result of clearing
- Loss of fauna individuals as a result of clearing (or other interactions).

13.4.1.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

Habitat loss can lead to the direct mortality of individuals, forced relocation of fauna and reduction of foraging and breeding habitat. The Proposed Action will clear up to 5,350 ha of MNES fauna habitat (inclusive of six fauna habitat types and disturbed areas) within the 36,779 ha Revised Development Envelope.

The precise layout of the Proposed Action is still to be finalised, so the exact nature and extent of the clearing requirements may change. However, to ensure that environmental impacts are not greater than those presented in this document, MRZs and/or MEZs have been established around all retained caves (i.e. 17 of 21 caves) within the Proposed Action Area, including all category 2, and 3 caves (Table 13-19). An additional 20 caves are currently protected under MS 1113 Restriction and Exclusions Areas (Table 13-18). In addition, upper limits have been proposed for each of the high significance MNES fauna habitat types, with the remainder of the clearing taking place within moderate significance habitat types. Upper disturbance limits for clearing for high significance habitat types are presented in Table 13-10, and moderate and low significance habitat types in Table 13-11. Total clearing for the Proposed Action will not exceed 5,350 ha.

The implications of habitat loss (critical and supporting habitat) for each MNES species are discussed in Sections 13.6 to 13.12.

In addition to clearing habitat types, four category 4 caves (of the 41 caves recorded within the Revised Development Envelope) will be impacted by the Proposed Action.

The current approval under the EPBC Act within the Revised Development Envelope for Deposits C, D and G (DN 2018/8299) specifies limits for clearing Ghost Bat and Pilbara Leaf-nosed Bat habitat as shown in Table 13-3. As this Proposed Action is considered a Controlled Action under the EPBC Act, a separate Decision Notice will apply to the Revised Development Envelope for the Proposed Action. The combined clearing limit (previously approved and this Proposed Action) are shown in Table 13-13; however, it is understood that clearing limits will be specified in a separate Decision Notice relating to this Proposed Action.

Table 13-11: Estimated Proposed Action Disturbance - High Significance MNES Fauna Habitat Types

High Significance Fauna Habitat Type	Mapped Fauna Habitat Extent ³³		Proposed Action Impact (Upper Limit for Flexibility) ³⁴ (ha)
	West Angelas Area ³⁵ (ha)	Revised Development Envelope (ha)	
Gorge/Gully	1,082	627	126
Hillcrest/Hillslope	15,015	12,202	3,731
Total	16,097	12,829	3,856

Table 13-12: Indicative Disturbance - Moderate Significance MNES Fauna Habitat Types

Moderate Significance Fauna Habitat Type	Mapped Fauna Habitat Extent *		
	West Angelas Area ³⁵ (ha)	Revised Development Envelope (ha)	Approximate Impact from Proposed Action (ha)
Drainage Line	493	378	79
Mixed Acacia Woodland	3,240	3,229	374
Footslopes and Plain	13,287	12,051	1,787
Cracking Clay	435	435	132 ³⁶
Total	17,455	16,093	142,242
Disturbed (Nil Significance)	7,931	7,857	15430

³³ Area rounded to the nearest ha

³⁴ Total clearing for the Proposed Action will not exceed 5,350 ha

³⁵ Includes Revised Development Envelope and surveyed references areas (Deposit J and Mt Ella East)

³⁶ Upper clearing limit due to regional significance of vegetation type.

Table 13-13: Combined Proposed Action and Current Approved Habitat Clearing Limits

Fauna Habitat Type	Proposed Action Impact (Upper Limit for Flexibility) (ha)	Previous Approval Clearing Limit Within Approved Development Envelope (ha)	Combined Limit within Revised Development Envelope (ha)
Gorge/Gully	126	2*	128~
Hillcrest/Hillslope	3,731	484*	4,215~
Drainage Line	None specified (estimate 78 ha impacted)	21*	100~ (estimated disturbance, no limit proposed)
Mixed Acacia Woodland	None specified	None specified	None specified
Footslopes and Plain	None specified	None specified	None specified
Cracking Clay	2	20^	22`

* Specified in Decision Notice 2018/8299 and applies only to Deposits C, D and G. No clearing limits specified in MS 1113

^ MS 1113, no clearing limits specified in DN 2018/8299

~ Applies to Deposits C, D and G Action only. Action C, D, and G limits are specified in separate Decision Notices

` Applies to all activities within the Revised Development Envelope

13.4.1.2. Loss of Fauna Individuals

Fauna within the Revised Development Envelope may be vulnerable to injury or mortality from vehicle and machinery movements associated with the Proposed Action and entanglement in barbed wire fences, typically used to exclude cattle and other fauna from operations. Vehicle movements are likely to increase temporarily during the construction period; however, vehicle movements during the operational phase will not increase from the existing number or frequency of vehicle movements associated with the current operation.

The Proponent will implement management measures to minimise the loss of fauna individuals, such as:

- Progressive clearing to allow fauna to disperse into the adjacent habitat, away from clearing activities and machinery movements
- Implementation of MRZ/MEZs around significant MNES fauna habitat features, which will restrict ground disturbance in areas where there is a high likelihood of species occurring
- Majority of light vehicle movements outside of operating mine areas will occur during daylight hours, which will minimise interaction with nocturnal species
- Awareness training to identify significant fauna and habitat, relevant management measures, personnel/contractor responsibilities, and incident reporting requirements (i.e., reporting of fauna observations and incidents)
- Artificial water sources will have fauna egress points
- Vehicle speed limits to minimise the risk of fauna injury or mortality from vehicle strike
- Vehicle traffic will be confined to defined roads and tracks.

By implementing mitigation and management measures, vehicle and machinery movements are not anticipated to significantly impact the population of MNES species within the Revised Development Envelope.

Species-specific impacts, such as bat entanglement in barbed-wire fencing, are discussed in Sections 13.6 to 13.12.

13.4.2. Indirect Impacts

Indirect impacts on MNES comprise:

- Degradation or alteration of habitat as a result of altered hydrological regimes
- Degradation or Alteration of Habitat Features (Cave CWAN-04) as a Result of Supply Abstraction at Western Hill
- Habitat degradation associated with construction and operational activities, including an increase in weeds, dust and abundance of introduced and predatory fauna species and altered fire regimes
- Disturbance from noise, vibration and light, resulting in the displacement of fauna associated with construction and operational activities.

13.4.2.1. Degradation or Alteration of Habitat as a Result of Altered Hydrological Regimes

The Revised Development Envelope intersects three major catchment areas, all ephemeral. Implementing the Proposed Action will reduce catchment sizes and impact the natural flow volumes of surface water under certain conditions. This aspect of the Proposed Action is examined and modelled in Section 7. The hydrological assessment concludes the reductions in catchment size will not be sufficiently large enough to result in tangible changes to the natural hydrological regimes (which are

naturally highly variable). Consequently, negligible impacts on fauna habitats related to this aspect of the Proposed Action are expected.

On a smaller scale, proposed mining activities within Deposit H are expected to reduce the contributing catchment of a surface water fed ephemeral waterhole to the north of the deposit (Deposit H Waterhole WB-WAH1, Figure 13-2). Modelling indicates that the size (capacity) of the pool is very small compared to the volume of runoff from the catchment during a typical rainfall event. Consequently, negligible change to the hydrology of the pool is expected (discussed further in Section 7).

There is the potential for local-scale impacts to fauna habitat occurring around creek floodway crossings and culverts exists, however potential impacts on fauna habitat are considered minimal and highly localised.

13.4.2.2. Degradation or Alteration of Habitat Features (Cave CWAN-04) as a Result of Supply Abstraction at Western Hill

Groundwater levels across the West Angelas Development Envelope are generally deep and beyond the typical depth of vegetation root systems (~50mbgl). As such, habitat features such as Caves, particularly cave CWAN-04 (which sits high in the landscape) is unlikely to be connected to groundwater within the regional or orebody aquifer at Western Hill and potential groundwater drawdown of the orebody or regional aquifers as discussed in Section 7 will not result in a change to the temperature and/or humidity of the caves.

13.4.2.3. Habitat Degradation Associated with Construction and Operational Activities

Weeds

Several weed species have been recorded as occurring within the Revised Development Envelope. None of the species recorded has been identified as threats to any MNES species present or likely to be present within the Revised Development Envelope. However, the presence of weed species can cause a reduction in habitat quality by out-competing native vegetation and potentially altering natural fire regimes.

As part of the management, a survey and control program will be undertaken to review to identify and target high risk areas (e.g. environmental value, existing weed presence, status of weeds that are present, and potential for further transfer/dispersal e.g. waterways and high trafficable areas; EMP, Appendix A.8).

Dust

The Pilbara region is a naturally dusty environment, and the Proposed Action is located in and near an existing operational mine. Dust can be generated in all wind conditions but can be exacerbated during high wind conditions. Dust may be temporarily generated during clearing and operation, which may deposit on vegetation, adversely affecting fauna habitat quality. Native vegetation in the Pilbara tends to be tolerant of dust deposition; however, significant fauna habitats in and around the Revised Development Envelope, including bat caves and surface water fed ephemeral pools, may be sensitive to higher dust levels. Although there will be elevated dust levels resulting from the Proposed Action, local fauna are adapted to the dusty Pilbara climate.

Impacts from dust on fauna are typically non-lethal and generally take the form of behaviour changes, resulting in avoidance of an area. The amount of natural habitat surrounding the Proposed Action means that impacts are likely to be minimal and confined to the immediate area of the Proposed Action. Susceptible affected fauna are likely to move away from these sources. Furthermore, the dust generation and deposition are not expected to result in significant or permanent changes to fauna habitats given the Proposed Action timeframes and the effect of periodic rainfall.

The Proponent will implement well-established operational dust management measures to minimise dust emissions. The impacts of increased dust deposition as a result of the Proposed Action are expected to be minimal for the Northern Quoll and Pilbara Olive Python. Species-specific impacts for Ghost Bats and Pilbara Leaf-nosed Bats in relation to dust deposition at roosting sites are discussed in Sections 13.7 and 13.8.

Introduced Fauna

Six introduced fauna species have been recorded in the Revised Development Envelope, including the Cat (*Felis catus*), Dingo/Dog (*Canis familiaris*), Dromedary Camel (*Camelus dromedarius*), European Rabbit (*Oryctolagus cuniculus*), Cattle (*Bos taurus*) and House Mouse (*Mus musculus*) (Biologic 2021c). These species are known from the region surrounding the Revised Development Envelope. The development of new tracks and increased water points and the production of domestic waste has the potential to attract and increase the abundance and diversity of introduced species. This may increase competition with and predation of native fauna species.

The Cane Toad is an invasive species that threatens several MNES species (Northern Quoll and Ghost Bat) within the Revised Development Envelope. However, it is not currently present in the Pilbara region of WA, and the Proposed Action will not increase Cane Toads' potential to become established in the Revised Development Envelope or the wider region (Tingle et al. 2013).

The presence of European Red Foxes in an area can also cause detrimental effects to MNES species populations. However, no Foxes were recorded within the Revised Development Envelope (Biologic 2021c). The species typically inhabit areas near the coast, and the Proposed Action is unlikely to increase the opportunity for the species to move further inland.

Predation from, or competition with, feral Cats can impact Northern Quoll, Ghost Bats, Pilbara Olive Python and Grey Falcon populations. Feral Cats have been recorded within the Revised Development Envelope (Biologic 2021c). Feral Cats compete for food sources and shelter sites and predate on a number of the species above at some stage in their life cycle.

The Proponent has well-established management measures for controlling the presence of feral animals within the Approved Development Envelope (see EMP, Appendix A.8). Feral animal monitoring and control will be undertaken in high risk areas and/or high significance habitat within the Revised Development Envelope, consistent with EMP and in cooperation with regional control programs and Traditional Owners.

Altered Fire Regimes

Changes to the fire regimes can result in habitat degradation, including critical breeding and supporting foraging and dispersal habitat for MNES species. Too frequent, hot, or extensive fires during hot, dry times of the year can reduce habitat capacity to support diverse fauna assemblages by altering the vegetation structure and composition, resulting in changes in food quantity and quality and changes in cover and microhabitats (Griffiths and Brook 2014). The Proponent will implement standard fire management procedures (i.e., fire equipment in vehicles and training for site personnel). Given the management measures in place, the Proposed Action is considered unlikely to change the fire regime within the Revised Development Envelope.

The Proponent considers that by implementing mitigation measures addressing the fire risk, indirect impacts can be appropriately managed; therefore, no significant impacts to MNES species are expected concerning habitat degradation associated with construction and operation activities.

13.4.2.4. Disturbance from Light, Noise and/or Vibration, Resulting in the Displacement of Fauna Associated with Construction and Operational Activities

Noise

Increased noise can disturb fauna and cause interruptions in feeding and resting behaviour, reduced population densities, nest failure, abandonment of habitat area and roost sites, including caves and reduced hunting efficiency (e.g., interference in echolocation for bats) (Newport et al. 2014). Species sensitive to disturbance, such as the Ghost Bat, may abandon roost sites in proximity to noise sources for the duration of active mining activities.

There are no regulations applicable to Western Australia that specify noise limits for the habitat of significant fauna. Significant Impact Guidelines (DoE 2013) specify that activities should not disrupt the breeding cycle of an important population. This may occur within the Revised Development Envelope if Ghost Bat roosts were exposed to noise that disrupted their behaviour (Wood 2022).

The following mitigation measures for noise will be implemented:

- Implementation of MRZ/MEZs around category 2, 3 and retained category 4 Ghost Bat roosts will minimise noise at significant bat roosts
- Noise limits will apply to retained category 2 Ghost Bat caves in the Proposal Area to as per Table 13-19 and the EMP.
- Machinery will be fitted with noise mufflers in accordance with manufacturing specifications. Equipment design will be specified to be within Australian standard noise limits
- No blasting to be undertaken outside of daylight hours.

Species-specific potential disturbance from noise is discussed in Sections 13.6 to 13.12.

Vibration

Vibrations associated with blasting can result in loss of, or damage to, cave and rocky shelter microhabitats providing critical and supporting habitat for MNES species adjacent to mining, particularly those in Gorge/Gully and Hillcrest/Hillslope habitats.

The following mitigation measures for noise and vibration emissions will be implemented:

- Vibration limits will apply to significant Ghost Bat roosts (category 2 and 3) within the Revised Development Envelope to manage impacts from vibration and to maintain the structural integrity of caves (Table 13-19; EMP [Appendix A.8]).
- Implementation of MRZ/MEZs around category 2 and 3 Ghost Bat roosts will minimise vibrations at significant bat roosts.

Species-specific potential disturbance from vibrations is discussed in Sections 13.6 to 13.12.

Light

Light emissions can disorient flying birds, particularly during migrations, and cause them to divert from efficient migratory routes or collide with infrastructure (DotEE 2020). Artificial light may interfere with activities governed by the length of the day, including reproduction, dormancy, foraging and migration. In addition, light emissions may attract invertebrates and alter the foraging activities of nocturnal species.

Additional light emissions from the Proposed Action are not expected to impact MNES species' breeding or foraging behaviour significantly as:

- Lighting will be designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020):
 - Permanent lighting will only be installed where required, mainly in pit and operational areas
 - Permanent and temporary lighting will be shielded to minimise light spill

- Permanent lighting will be directed away from the sensitive area (e.g. MEZ, MRZ, significant caves, critical habitat Gorge/Gully and Hillcrest/Hillslope)
- Temporary lighting (e.g. trailer mounter units) may be required to provide safe working environments for short periods, where practicable. These will be positioned to minimise direct light spill into sensitive areas.

13.4.3. Cumulative Impacts

The Proposed Action will contribute to cumulative regional impacts on MNES fauna habitat and MNES species in the Revised Development Envelope. This is discussed further in Section 9.

13.5. Summary of Proposed Mitigation Relevant to MNES

A summary of the Proposed management of MNES fauna, including avoidance and minimisation, is provided in Table 13-14 and outlined in the EMP (attached in Appendix A.8).

Table 13-14: Summary of Residual Impacts to MNES Fauna Species Following Implementation of Management and Mitigation Measures

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual impact
Habitat loss/reduction and fragmentation as a result of clearing	<p>The Proposed Action has been designed to reduce the total extent of clearing from 7,200 ha (as referred) to 5,350 ha and reduced the Revised Development Envelope from 41,484 ha (as referred) to 36,779 ha (amended via a s. 43A under the EP Act).</p> <p>The Proposed Action has been designed, where possible, to avoid direct impacts to MNES habitat, including:</p> <ul style="list-style-type: none"> Potential critical habitat (Gorge/Gully) potential denning, roosting and shelter for Northern Quoll, Ghost Bat and Pilbara Olive Python Potential critical habitat (Hillcrest/Hillslope) roosting, foraging and shelter for Ghost Bat <p>The Proposed Action has been designed to avoid direct impacts to the following significant habitat features:</p> <ul style="list-style-type: none"> 37 of the 41 caves within the Revised Development Envelope, including: <ul style="list-style-type: none"> All Seven (7) recorded category 2 Ghost Bat roosts All Thirteen (13) recorded category 3 Ghost Bat roosts Seventeen (17) of the 21 recorded category 4 Ghost Bat roosts Three surface water fed ephemeral pools within the Proposed Action Area (WB-WAH1, WB-WAJ1 and WB-WAJ2) <p>Other avoidance measures include:</p> <ul style="list-style-type: none"> Approximately 455 ha of Gorge/Gully and 2,814 ha of Hillcrest/Hillslope habitat have been avoided by re-designing the Proposed Action and consequently the Conceptual Footprint and Revised Development Envelope MEZs (no direct impacts) will be established around Ghost Bat: category 2, 3 and 4 caves (with the exception of four category 4 caves intersecting with the Conceptual Footprint). No direct disturbance is permitted in a MEZ except for activities that support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP MRZs will be established around category 2 and apartment block caves and critical and supporting habitat linking roost clusters. MRZ permit low impact activities with disturbance up to 20% of the MRZ surface affected, which support monitoring, management and implementation of contingency 	<p>The Proposed Action will minimise impacts on critical potential denning, roosting and shelter habitat through the following:</p> <ul style="list-style-type: none"> Implementation of upper clearing limits for Gorge/Gully and Hillcrest/Hillslope habitat types Application of blasting (PPV) limits to category 2 and 3 caves (including apartment block caves) to ensure structural integrity is maintained (as detailed in Table 13-19 and the EMP (Appendix A.8) Key landform corridors such as drainage lines (i.e. Turee Creek) will remain as intact as possible to ensure habitat connectivity is maintained 	<p>The MCP (Appendix A.5) includes objectives to ensure that vegetation on rehabilitated land is self-sustaining and compatible with post-closure land use. Final landforms are required to be stable and consider ecological and hydrological factors. Linear infrastructure, including crossings, will be fully decommissioned if no longer required.</p> <p>The MCP will be regularly updated and consistent with DMIRS <i>Guidelines for Preparing Mine Closure Plans</i> (DMIRS 2020a).</p> <p>Rehabilitation will be conducted following the <i>Rio Tinto Iron Ore Rehabilitation Handbook</i>, including fauna and habitat monitoring.</p> <p>Rehabilitation will be undertaken progressively to minimise disturbed areas and therefore reduce fragmentation and barriers to fauna movement.</p>	<p>The Proponent considers that the following residual impacts are significant and that offsets will be required:</p> <ul style="list-style-type: none"> Clearing up to 126 ha of critical Gorge/Gully habitat (potential denning, roosting, breeding, shelter and foraging habitat) for the Northern Quoll, Ghost Bat and Pilbara Olive Python. This habitat also provides supporting habitat for the Pilbara Leaf-nosed Bat Clearing up to 3,731 ha of critical Hillcrest/Hillslope habitat for Ghost Bat. This habitat is also considered supporting habitat when within the range of Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python Clearing of approximately 2,242 ha of the remaining habitat types which provide supporting habitat for the Ghost Bat

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual impact
	<p>actions (if required) as outlined in an approved EMP (Appendix A.8)</p> <ul style="list-style-type: none"> • A Heritage Exclusion Area will be established around Deposit H Waterhole (WB-WAH1) (see Section 6) • MRZs and MEZs will be included in the Proponents GIS request system to ensure known locations are avoided • The Proponent shall ensure clearing only occurs in approved ground disturbance areas through continued implementation of the Proponent's Approvals Request system 			
Loss of fauna individuals		<p>The Proponent will minimise impacts to individual MNES species by:</p> <ul style="list-style-type: none"> • Limits to clearing (direct impact) of high significance habitat (Gorge/Gully and Hillcrest/Hillslope) Implementation of the West Angelas EMP • Limits to clearing (direct impact) of high significance habitat (Gorge/Gully and Hillcrest/Hillslope) • Clearing will be undertaken progressively to allow fauna to migrate away from cleared areas and machinery • Majority of light vehicle movements outside of operating mine areas will occur during daylight hours, which will minimise interaction with nocturnal species • Vehicle traffic will be confined to defined roads and tracks • Speed limits will be implemented to reduce risk to fauna from interactions with vehicles • Roadkill will be removed from trafficable areas to reduce the risk of attracting native or introduced fauna • Artificial water sources such as turkeys' nests and sediment ponds will have egress points • Avoid the use of barbed-wire fencing where practicable; however, where barbed wire fencing is required for legislative compliance, reflectors will be attached to make fencing more visible and reduce the risk of fauna injury or mortality due to entanglement. • Site induction programs will provide information on significant fauna, including their appearance and habitats. Training would also discuss standard operating procedures in the event of fauna interactions 	<p>Undertake rehabilitation activities progressively to minimise disturbed areas and therefore reduce interactions with MNES fauna</p> <p>Borrow pits will be designed, constructed, and rehabilitated to minimise surface water ponding.</p>	<p>The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.</p>

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual impact
<p>Degradation/alteration of habitat as a result of altered hydrological regimes</p>	<ul style="list-style-type: none"> Major infrastructure, including WRLs, have been preferentially located outside the ephemeral watercourses and their tributaries Direct impacts to surface water fed ephemeral pool WB-WAH1 (Deposit H Waterhole) will be avoided Surface water fed ephemeral pools WB-WAJ1 and WB-WAJ2 will be protected via Heritage site exclusion areas (refer Section 6). Flow to these pools will not be impacted by the Proposed Action as they are fed from catchments to the south of the pools, and the Proposed Action is located to the north 	<p>The Proponent will minimise impacts to habitat as a result of altered surface catchments by:</p> <ul style="list-style-type: none"> Isolating pits from significant creeklines to minimise the interception of catchment flows 	<p>Rehabilitation measures include:</p> <ul style="list-style-type: none"> Temporary infrastructure will be removed at closure to allow natural flow paths and catchments to be re-established in these areas The Proponent commits to the undertaking of progressive rehabilitation to restore any vegetation impacted by alterations to the hydrological regimes The MCP (Appendix A.5) includes objectives to ensure vegetation on rehabilitated land is self-sustaining and compatible with post-mining land use. Final landforms will be stable and consider ecological and hydrological factors Rehabilitation will be conducted in accordance with the <i>Rio Tinto Iron Ore Rehabilitation Handbook</i> and will include fauna and habitat monitoring 	<p>The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.</p>
<p>Habitat degradation associated with construction and operational activities, including an increase in weeds, dust and abundance of introduced and predatory fauna species and altered fire regimes</p>	<p>Refer to Section 8 Flora and Vegetation for weed avoidance measures.</p>	<p>The Proponent will implement the following minimisation measures:</p> <ul style="list-style-type: none"> Standard dust suppression measures (such as water carts) to minimise disturbance to fauna habitats Vehicles will be required to travel at safe operating speeds on unsealed roads and would be restricted from accessing rehabilitated surfaces except for management purposes as per current practices Feral animal monitoring and subsequent control in high risk areas and/or high significance habitat within the Revised Development Envelope as outlined in the EMP (Appendix A.8) and in cooperation with regional control programs and the Traditional Owners as per current practices Landfill facilities will be fenced, and putrescible wastes will be regularly covered to minimise the attraction of animals Borrow pits will be designed and constructed to minimise surface water ponding after rehabilitation Fire breaks will be maintained, and hot works procedures and fire equipment will be available in buildings and vehicles Fire response procedures and personnel training, including site induction on fire prevention and management, will be provided 		<p>The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.</p>

Potential Impact	Avoidance	Minimisation	Rehabilitation	Residual impact
<p>Disturbance from noise, vibration and light, resulting in the displacement of fauna associated with construction and operational activities</p>	<p>The Proponent will implement the following avoidance measures:</p> <ul style="list-style-type: none"> Avoidance of direct disturbance to 17 of the 21 Ghost Bat roosts recorded within the Proposed Action Area by implementing MRZs and MEZs, as per Table 13-19. An additional 20 caves are currently protected under MS 1113 Restriction and Exclusion areas, as per Table 13-18. 	<ul style="list-style-type: none"> The Proponent will implement the following minimisation measures: Vibration limits will apply to all significant category 2 and 3 Ghost Bat caves (including apartment block caves) within the Proposed Action Area to manage potential impacts from vibration to roosting bats and to maintain caves' structural integrity as per Table 13-19 and the EMP MRZ/MEZ buffers (Table 13-19) will minimise noise, vibration and light pollution received by the high significance habitat and structures within the area A Blast Management Plan will be implemented to manage impacts from vibrations and maintenance of the structural integrity of significant caves Equipment design will be specified to be within Australian standard limits and/or fitted with noise mufflers in accordance with manufacturing specifications No blasting to be undertaken outside of daylight hours. Lighting will be designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020). These include: <ul style="list-style-type: none"> Permanent lighting will be installed only where required, mainly in-pit and operational areas Permanent lighting and temporary lighting will be shielded and directed to active mine areas to minimise light spill Permanent lighting will be directed away from sensitive areas (e.g. MEZs, MRZs, significant caves, critical habitat) Temporary lighting (e.g. trailer mounted units) may be required to provide a safe working environment for short periods, where practicable, and while still providing a safe working environment; these will be positioned to minimise direct light spill into sensitive areas 	<p>No specific closure or rehabilitation actions are proposed.</p>	<p>The Proponent considers that the potential impacts can be managed and that residual impacts will not be significant.</p>

13.6. Northern Quoll (*Dasyurus hallucatus*)

The Northern Quoll is listed as Endangered under the BC Act and EPBC Act. It is a nocturnal, carnivorous mammal that preys on invertebrates, small mammals, reptiles, birds, carrion and fruit. Northern Quoll females weigh on average between 300 to 500 g, with males weighing between 400 to 500 g (Dunlop et al. 2019).

13.6.1. Habitat Preferences and Distribution

The Northern Quoll is currently restricted to five regional populations across Queensland, the Northern Territory and Western Australia on the mainland and offshore islands (DoE 2022). Northern Quolls occupy various habitats such as iron and sandstone ridges, scree slopes, granite boulders and outcrops, drainage lines, riverine habitats, dissected rocky escarpments, open forest of lowland savannah and woodland (Braithwaite and Griffiths 1994). Areas of rocky habitat are preferred due to protection from predators and resource availability (Braithwaite and Griffiths 1994 and Oakwood 2002).

A total of 4,537 records are scattered across the four subregions (Hamersley, Fortescue Plains, Chichester and Roebourne Plains) of the Pilbara bioregion (Dunlop et al. 2019). Records extend as far west as the Little Sandy Desert and as far south as Karijini National Park. In the Pilbara, the most recent records have come from the Rocklea, Macroy and Robe land systems (DoE 2022). The species' distribution is now considered fragmented and mostly confined to the larger conservation reserves such as Millstream Chichester National Park and the Burrup Peninsula (DoE 2022).

DBCA has previously conducted the Pilbara Northern Quoll Monitoring Project, which begun in 2012 to improve understanding of the distribution, ecology, abundance and demographics of the Northern Quoll in the region (Dunlop et al. 2019). Northern Quoll records from this project are uploaded to the DBCA online government database NatureMap. Extensive evidence of this species in the form of scats and motion camera captures have been identified in Karijini National Park, adjacent to the Revised Development Envelope. The Pilbara Northern Quoll Monitoring Project has confirmed an eastern range extension of over 200 km into Karlamilyi National Park (Rangelands 2018).

13.6.2. Key Threats and Recovery Actions

13.6.2.1. Key Threats

Key threats to Northern Quoll include habitat clearing, modification and land-use change, lethal toxic ingestion caused by Cane Toads, inappropriate fire regimes, weeds, disease and feral predators (Hill and Ward 2010).

13.6.2.2. Recovery Actions

The overall objective of the National Recovery Plan for the Northern Quoll is (Hill and Ward 2010): 'To minimise the rate of decline of Northern Quoll in Australian and ensure that viable populations remain in each of the major regions of distribution into the future.'

Several recovery objectives are identified in the National Recovery Plan, including the following relevant to the Proposed Action:

- Halt Northern Quoll decline in areas not yet colonised by Cane Toads
- Investigate factors causing declines in Northern Quoll not yet affected by Cane Toads
- Manage key Northern Quoll populations in areas not currently affected by Cane Toads to halt population declines
- Reduce the impact of feral predators on Northern Quolls.

DBCA has previously undertaken a Northern Quoll research program which was funded by environmental offsets provided by Rio Tinto (the Proponent) and other mining companies along with

Main Roads WA (Dunlop et al. 2019). This research program was to understand better the status and ecology of this species in the Pilbara region. The program has enhanced species records (collating additional records and previously unsurveyed areas) which has allowed for the development of an updated and accurate species distribution model, and dietary analysis has identified that the species has a flexible and opportunistic omnivorous habit. Interactions between Northern Quoll and predators were a focus of the program (Dunlop et al. 2019).

Table 13-12 provides mitigation that the Proponent will implement to reduce impacts on this species and habitat.

13.6.3. Important Populations and Critical Habitat

13.6.3.1. Important Population

Populations that constitute an 'important population' for the Northern Quoll include (DoE 2016b):

- High-density quoll populations that occur in refuge-rich habitat critical to the survival of the species and can include habitat where Cane Toads are present
- Populations free of Cane Toads and unlikely to sustain Cane Toad populations upon their arrival, for example, populations within a desert context and without permanent water
- Populations subject to conservation or research programs – that is, populations monitored by government agencies or universities.

The National Recovery Plan for the Northern Quoll identified four categories of important populations. These include populations in the Pilbara region as these are outside of the predicted range of Cane Toads (Hill and Ward 2010). Cane Toads have not yet been recorded in the Pilbara region. However, it is anticipated that they will naturally colonise the Pilbara mainland (and potentially its offshore islands) between 2026 to 2064. This is primarily due to the availability of permanent natural and artificial water bodies (Kearney et al. 2008 and Tingley et al. 2013, cited in Dunlop et al. 2019).

The EPBC Act referral guideline for the Northern Quoll (DoE 2016b) for the species indicate that a high-density population may be characterised by numerous camera triggers of multiple individuals across multiple cameras or trap sites. A low-density population may be represented by infrequent captures of one or two individuals confined to one or two traps or where trapping has captured no individuals, but there is latrine evidence.

13.6.3.2. Critical Habitat

Critical habitat as defined in the National Recovery Plan for the Northern Quoll (Hill and Ward 2010), is a habitat "where Northern Quolls are least exposed to threats or least likely to be in the future... two particular broad habitat types fall into this category: rocky areas and offshore islands. Daytime den sites, in particular, provide important shelter and protection for Northern Quolls from predators and weather," and rocky areas which contain these features can retain water and contain microhabitats, creating greater prey diversity than nearby non-rocky areas (Hill and Ward 2010). While the surrounding foraging and dispersal habitats are also important, they are generally more widespread, and clearing these habitats is likely less significant.

The EPBC Act referral guideline for the Northern Quoll (DoE 2016b) defines critical habitat for the Northern Quoll as habitat within the modelled distribution for the species, providing shelter for breeding, and refuge from fire and predation by Cane Toad (DoE 2016b). Critical habitat includes:

- Offshore islands where the Northern Quoll is known to exist
- Rocky habitats such as Ranges, Escarpments, Mesas, Gorges, Breakaways, Boulder fields, Major drainage lines or Treed creeks
- Structurally diverse woodland or forest areas containing; large diameter trees, termite mounds or hollow logs.

The referral guideline for Northern Quoll addresses the Kimberley, Northern Territory and Queensland populations of Northern Quolls, which have differing habitat usage and requirements to the Pilbara. In the Pilbara, especially inland areas of the Hammersley bioregion, Northern Quolls are restricted to rugged rocky habitats that provide refuge from feral predators and fire (Cramer *et al.* 2019); as such, drainage lines are not considered critical habitat, rather supporting habitat for Northern Quolls when within 1 km from confirmed critical habitat.

Habitat critical to this species' survival includes dispersal and foraging habitat associated with, or connecting populations important to, the species' long-term survival (DoE 2016b). As per the EPBC Act referral guideline for the Northern Quoll (DoE 2016b), foraging and dispersal habitat is any land that comprises:

- Predominantly native vegetation in the immediate area (i.e., within 1 km) of shelter or potential denning habitat
- Northern Quoll records
- Land containing mostly native vegetation connected to shelter habitats within the range of the species.

Based on the Recovery Plan and considering the referral guideline, this assessment has used the term potential critical habitat in relation to rocky habitats that support potential denning and shelter and defined supporting habitat as foraging and dispersal habitat within 1 km of confirmed records of Northern Quoll.

13.6.4. Occurrence within and Surrounding the Revised Development Envelope

Across the Revised Development Envelope, 14 Northern Quoll camera transects have been deployed (Biologic 2022b, 2022c, 2021c, 2021e), which include 10 motion cameras deployed for a minimum of 4 nights (up to 145 nights) and baited with either universal bait or a non-reward scent lure as per the referral guidelines for the species (DoE 2016b). The Northern Quoll transects equated to 3,380 camera nights across the Revised Development Envelope. To supplement the data from the camera transects, single baited cameras were deployed during the baseline survey in 42 locations for a total of 421 camera nights (Biologic 2021c).

The Northern Quoll has been recorded once within the Proposed Action Area via secondary evidence (approximately 200 scats) (Biologic 2021c; Biologic 2021e). The Northern Quoll scats recorded within the Proposed Action Area were found towards the back of a cave (CWAN-04 located in Hillcrest/Hillslope habitat at Western Hill) in a grass-lined cavity (Figure 13-3). The condition of the scats indicated that an individual had not visited this site for at least 12 months.

Despite considerable sampling effort throughout the Revised Development Envelope to date, records of the species are relatively sparse with just three other records of old scats in two caves (CMAR-01 and CMAR-03) and a rocky ledge in the southwest corner of the Revised Development Envelope. The scats recorded at Cave CWAN-04 were likely from an individual dispersing through the area, from a permanent population outside the Revised Development Envelope. The camera monitoring at the cave

entrance over five months seems to confirm no permanent population of Northern Quolls, as no individuals were recorded (Biologic 2021c). Under the EPBC Act Referral Guideline for Northern Quoll (DoE 2016b), this would be deemed a 'low density' population if present (i.e., where trapping has captured no individuals, but there is latrine evidence). Low-density populations do not represent important populations defined in the species Recovery Plan (Hill and Ward 2010).

For the remainder of the Revised Development Envelope, the species is considered to possibly occur due to the presence of suitable habitat; however, the species has not been sighted throughout the period of existing operations and only old scats recorded despite numerous surveys undertaken over multiple years (Biologic 2022d; Biologic 2021e; Biologic 2021c).

The species is known to occur within Karijini National Park (records approximately 71 km to the west of the Revised Development Envelope) and in the Hope Downs 1 and Hope Downs 2 development envelopes, which are approximately 17 km and 10 km away, respectively (Biologic 2021c and Astron 2019).

13.6.5. Habitat within and Surrounding the Revised Development Envelope

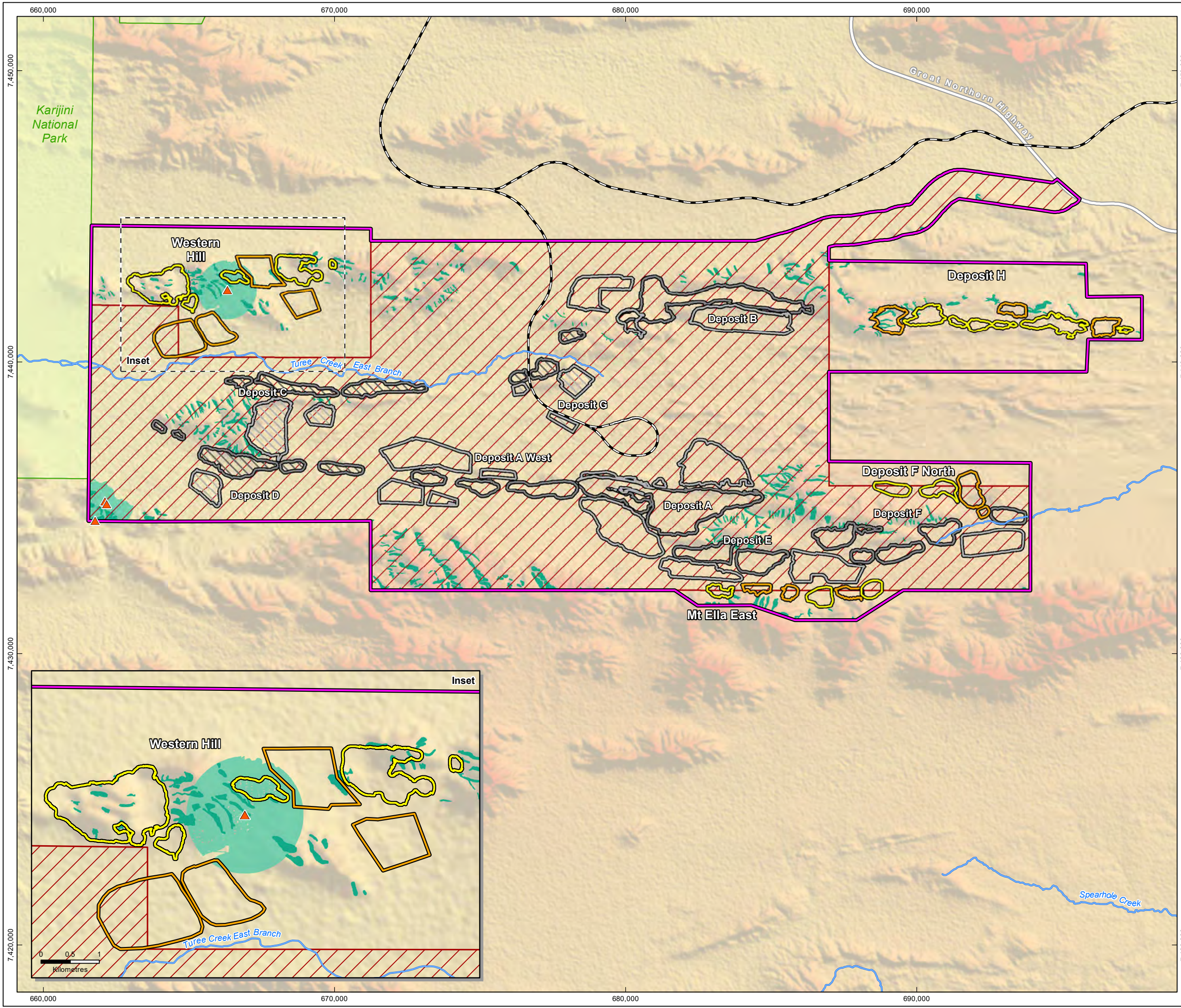
Potential critical denning and shelter habitat for the Northern Quoll occurs in the Revised Development Envelope within the Gorge/Gully habitat. It may be critical to the survival of the species as defined by the *National Recovery Plan* (Hill and Ward 2010) due to the presence of shelter, potential denning and foraging habitat (Biologic 2021e).

The Hillcrest/Hillslope and Drainage Line habitat types provide supporting habitat for the Northern Quoll when within 1 km of confirmed critical habitat (Northern Quoll records). These habitat types provide dispersal and foraging habitat, which support populations or provide connectivity between populations and are important to the species' long-term survival (DoE 2016b).

All other habitat types within the Revised Development Envelope are considered to be of low significance for the Northern Quoll and do not represent critical habitat (Biologic 2021e; Table 13-6).

Figure 13-3 Northern Quoll Records and Critical and Supporting Habitat within the Revised Development Envelope

Drawn: A.D.
Plan: PDE0186408v7
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

- Pit
- Waste Landform

(deposits assessed under DN2018/8299)

- Pit
- Waste Landform

Northern Quoll (Critical Habitat)

Habitat Value

- Potential Critical Habitat
- Supporting Habitat

National Park

Rio Tinto Railway

Highway

Major Creek

Scale: 0 1 2 3 4 5 Kilometres
Map units in metres

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13.6.6. Assessment of Impacts

The Proposed Action may have direct, indirect, and cumulative impacts on Northern Quoll. The following assessment of impacts specifically considers Northern Quoll, in addition to the impacts applying more broadly for all MNES species with the potential to occur within the Revised Development Envelope. Key impact pathways are described in Section 13.4.

13.6.6.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

The Proposed Action will clear up to 126 ha (20% of habitat within the Revised Development Envelope) considered potentially critical to the species' survival, comprising Gorge/Gully habitat, which provides potential denning, shelter and foraging habitat.

The Proposed Action will also clear approximately 187 ha of supporting habitat for the Northern Quoll, comprising Hillcrest/Hillslope and Drainage Line habitat, which provide foraging and dispersal habitat.

The remaining habitats do not represent critical or supporting habitats for the Northern Quoll and are considered of low significance.

Potential critical Gorge/Gully habitat and supporting Drainage Line and Hillcrest/Hillslope habitat will remain within the Revised Development Envelope. It should also be noted that Northern Quolls can disperse through various habitats. Therefore, other fauna habitat types extending beyond the Proposed Action's boundaries will also continue to allow the species to disperse around the landscape.

Ecological corridors will remain along the ridges, hillsides, and creek lines, allowing continued movement for the species around the mining areas and throughout the landscape.

The Proposed Action includes progressive mining (i.e., not all areas will be cleared and mined simultaneously) which will allow fauna to migrate to adjacent habitat. Progressive rehabilitation of areas no longer required for mine operation will occur to minimise disturbed areas. Habitat fragmentation is not expected to significantly affect Northern Quoll habitat connectivity or movement, given the remaining connected habitats and the species' mobile nature. Northern Quolls have been recorded within operational areas at other Pilbara mine sites and are capable of dispersing through these disturbed areas.

Clearing of critical Gorge/Gully and supporting Drainage Line and Hillcrest/Hilltop habitats for the Northern Quoll is considered a significant residual impact. Although records indicate a low density population, these impacts are proposed to be offset, as discussed in further detail in Section 12.

13.6.6.2. Habitat Degradation Associated with Construction and Operation Activity

Altered Fire Regimes

Changes to fire regimes can impact Northern Quoll through direct mortality, reduction in vegetation cover and food availability (DBCA 2019). Too-frequent fire can reduce the population size (DBCA 2019). However, it has been found that Northern Quolls can tolerate fire as long as these fires are low intensity, early in the season, and the impacts on vegetation structure and composition are not exacerbated by grazing from introduced herbivores (Woinarski et al. 2014). As the Northern Quoll in the Pilbara is associated with rocky landforms, any potential changes in fire regime may have less influence on habitat structure and quality (DBCA 2019). The Proponent will implement fire safety management procedures (i.e., including firefighting emergency response procedures, appropriate firefighting equipment and management procedures relating to high risk activities) to reduce fire risk within the Revised Development Envelope.

After applying mitigation measures (see Section 13.5), no significant impacts on Northern Quolls are expected from habitat degradation from altered fire regimes.

13.6.7. Significance of Impacts

An assessment of the Proposed Action impacts on Northern Quoll against the Significant Impact Criteria is provided in Table 13-15 (DoE 2013).

Table 13-15: Assessment of the Significance of Impacts to Northern Quoll

Significant Impact Criteria	Assessment of the Significance of Impacts to Northern Quoll
Potential to lead to a long-term decrease in the size of a population	<p>Clearing of 126 ha of potential critical habitat (Gorge/Gully) will likely reduce the long-term potential carrying capacity within the Revised Development Envelope for the Northern Quoll. However, despite extensive survey efforts throughout the Revised Development Envelope over numerous years, records of the Northern Quoll are limited to four records of scats (three of which are very old scats). This suggests the species occurs at low densities within the Revised Development Envelope or are only transient inhabitants of the area. The more recent record of the species at Western Hill is expected to be a dispersing individual from a permanent population outside the Revised Development Envelope. As such, the population within the Revised Development Envelope is not considered an important population for the Northern Quoll's long-term survival.</p> <p>Given the retention of potential critical and supporting habitat and dispersal corridors for the Northern Quoll within the Revised Development Envelope, and low-density population, the Proposed Action is unlikely to lead to a decrease in the size of a population important to the species' long-term survival, thereby affecting the recovery of the species.</p>
Potential to reduce the area of occupancy of the species	<p>'Area of occupancy' is defined as the area within a species' extent of occurrence which is occupied by the species (IUCN 2021).</p> <p>The Proposed Action can potentially reduce the area of occupancy of the Northern Quoll in the local context by the clearing of up to 20% of the potential critical habitat (Gorge/Gully) present within the Revised Development Envelope. The limited number of records for the Northern Quoll within the Revised Development Envelope indicates that the population is low in density. The species is expected to continue to exist in the remaining critical and supporting habitat within and surrounding the Revised Development Envelope following implementation of the Proposal. Rehabilitated landforms may also provide some modified habitat value following closure.</p>
Potential to fragment an existing population into two or more populations	<p>Significant corridors in different landforms, such as ridges, hillsides and drainage lines, will facilitate Northern Quoll's movement through the Revised Development Envelope and the surrounding area. Potential critical Gorge/Gully habitat and Drainage Line and Hillcrest/Hillslope supporting habitat will remain within the Revised Development Envelope (including a portion of Gorge/Gully and Hillcrest/Hillslope habitats preserved within the MEZ/MRZs), which will support and maintain connectivity of the local population of Northern Quoll.</p> <p>The Proposed Action includes progressive mining (i.e., not all areas will be cleared and mined simultaneously). Progressive rehabilitation of areas no longer required for mine operation will occur to minimise disturbed areas. As such, habitat fragmentation is not expected to significantly affect Northern Quoll habitat connectivity or movement. Northern Quolls have been recorded within operational areas at Pilbara mine sites and can disperse through these disturbed areas.</p> <p>The Proposed Action is not expected to fragment an existing population into two or more populations, given the low density (one record) within the Proposed Action Area, remaining critical and supporting habitat and the species' highly mobile nature.</p>
Potential to adversely affect habitat critical to the survival of a species	<p>The Proposed Action will result in clearing up to 126 ha of Gorge/Gully habitat (20% within the Revised Development Envelope), which is considered potentially critical to the survival of the Northern Quoll species. The Proposed Action will also clear</p>

Significant Impact Criteria	Assessment of the Significance of Impacts to Northern Quoll
	<p>approximately 187 ha of Drainage Line and Hillcrest/Hillslope habitat (23% in the Revised Development Envelope) within 1 km of Northern Quoll records, which is considered supporting habitat (foraging and dispersal) for the Northern Quoll.</p> <p>The remaining habitats represent limited foraging and dispersal habitat for the species and are considered of low significance.</p> <p>Potential critical Gorge/Gully habitat and Drainage Line and Hillcrest/Hillslope supporting habitat will remain within the Revised Development Envelope, and more is likely to be present in the wider region. Any individuals displaced by the clearing of this habitat (considered minimal due to the low-density local population) are likely to disperse and forage in the remaining critical and supporting habitat within and outside of the Revised Development Envelope.</p> <p>Clearing of potential critical Gorge/Gully habitat and supporting Drainage Line and Hillcrest/Hillslope habitat is considered a significant residual impact of the Proposed Action and is proposed to be offset (Section 12).</p>
<p>Potential to disrupt the breeding cycle of a population</p>	<p>Despite extensive survey efforts, the Northern Quoll has only been recorded once within the Proposed Action Area, inside CWAN-04 (category 2 Ghost Bat roost) (Biologic 2021e). The nature of the record indicated that the individual likely dispersed from a nearby permanent population. The scats' age in the cave indicated it had not been used in the last 12 months.</p> <p>Cave CWAN-04 and an additional 36 caves within the Revised Development Envelope will be retained and protected by MRZ and/or MEZs (as per Table 13-18 and Table 13-19).</p> <p>Given the low density of Northern Quoll records and the retaining of potential critical Gorge/Gully habitat (potential denning and foraging), and foraging and dispersal habitat, the Proposed Action is not expected to disrupt the breeding cycle of the local Northern Quoll population.</p>
<p>Potential to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p> <p>Introduce inappropriate fire regimes or grazing activities that substantially degrade habitat critical to the survival of the Northern Quoll or decrease the size of a population for the long-term survival of the species</p>	<p>Whilst the Proposed Action has the potential to modify, destroy, remove, isolate or decrease the availability or quality of Northern Quoll habitat, this will not be to the extent that the species, which was recorded in low densities within the Revised Development Envelope, is likely to decline.</p> <p>The Proposed Action will remove up to 126 ha of potential critical habitat (Gorge/Gully) (20% within the Revised Development Envelope), and approximately 187 ha of supporting habitat (Drainage Line and Hillcrest/Hillslope within 1 km of Northern Quoll records). Potential critical habitat will remain within the Revised Development Envelope. It will continue to provide critical potential denning and foraging habitat for the Northern Quoll. Hillcrest/Hillslope and Drainage Line habitat will remain to provide foraging and dispersal opportunities for the species. The remaining habitat is considered sufficient to support the current low-density local population and habitat loss will not be to the extent that the local population will decline.</p> <p>The Proposed Action will not increase the grazing pressure within the Revised Development Envelope (no changes to land use). Changes to fire regimes (i.e. too frequent) can impact vegetation; however, the Northern Quoll in the Pilbara are associated with rocky landforms and, therefore, less likely to be impacted by the fire. The Proponent will implement mitigation measures to manage fire risk within the Revised Development Envelope.</p>
<p>Potential to result in invasive species that are harmful to the</p>	<p>Cane Toads and feral predators (i.e. Cats) are known to be significant threats to the survival of the Northern Quoll (Hill and Ward 2010; Dunlop et al. 2018).</p>

Significant Impact Criteria	Assessment of the Significance of Impacts to Northern Quoll
species becoming established in the species' habitat	<p>Cane Toads are not currently in the Pilbara, and the Proposed Action will not increase their potential to become established in the Revised Development Envelope or the surrounding area.</p> <p>Feral Cats have been recorded within the Revised Development Envelope. The Proponent will undertake feral Cat monitoring and an appropriate control program throughout the Revised Development Envelope in response to feral animal sightings, particularly focussed on high-risk areas and/or critical habitat areas (see EMP; Appendix A.8).</p> <p>Five grass species listed under the TAP (DSEWPaC 2012c) have been identified as threats to the habitat of the Northern Quoll (Hill and Ward 2010). None of these species have been recorded within the Revised Development Envelope. The Proponent will implement vehicle hygiene and weed control measures to reduce the risk of introducing or spreading weed species.</p> <p>The Proposed Action is unlikely to have a significant impact on the Northern Quoll based on the implementation of the above mitigation measures.</p>
Potential to introduce disease that may cause the species to decline	<p>Currently, there are no known diseases harmful to Northern Quoll, nor its critical habitat. There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species, nor its critical habitat to decline to decline.</p>
Potential to interfere with the recovery of the species	<p>The proposed mitigation measures (Section 13.5) are not considered at variance with TAPS and the National Recovery Plan for the species (Hill and Ward 2010).</p> <p>The Northern Quoll population within the Revised Development Envelope is considered a low-density population, and no evidence of breeding or denning has been observed in the Revised Development Envelope. Alternative breeding and denning sites will be available for any individuals displaced by the Proposed Action. Therefore, it is considered unlikely that the Proposed Action will interfere with the recovery of the species.</p>

13.6.8. Consistency with Relevant Recovery Plans and Guidance

13.6.8.1. Recovery Plan

The National Recovery Plan for the Northern Quoll (Hill and Ward 2010) aims to minimise the rate of decline of the Northern Quoll in Australia and ensure that viable populations remain in each of the major distribution regions into the future. Table 13-16 discusses how the Proposed Action aligns with the objectives of this Recovery Plan.

Table 13-16: National Recovery Plan for the Northern Quoll

Objective	Actions	Proposed Action Assessment
Protect Northern Quoll populations on offshore islands from invasion and establishment of Cane Toads, Cats and other potentially invasive species	1.1 Maintain biosecurity of important offshore islands through quarantine measures on the mainland	The Proposed Action does not involve transfers to offshore islands.
	1.2 Monitor offshore islands supporting quoll populations to detect the presence of Cane Toads, Cats and any other potential invasive predator	
	1.3 Develop and, where required implement a strategy for rapid-response control of Cane Toad or Cat outbreaks on offshore islands occupied by Northern Quolls	
Foster the recovery of Northern Quoll subpopulations in areas where the species has survived alongside Cane Toads	2.1 Determine which factors affect the survival and recovery of Northern Quolls in areas with Cane Toad	The Cane Toad is not currently present in the Revised Development Envelope or the wider Hamersley or Pilbara region.
	2.2 Use information from Action 2.1 to assist surviving populations to recover in sympatry with Cane Toads	
	2.3 Identify potential refuge habitats in WA and NT where quolls might be most likely to persist in the long-term alongside Cane Toads	
Halt Northern Quoll declines in areas not yet colonised by Cane Toads	3.1 Collect baseline data on population densities and monitor trends of quolls at a series of key sites not currently occupied by Cane Toads	The Proponent has completed baseline investigations, including a targeted survey for the Northern Quoll to identify the Northern Quoll's possible resident populations within the Revised Development Envelope (an area not currently occupied by Cane Toads).
	3.2 Investigate factors causing declines in Northern Quoll populations not yet affected by Cane Toads	
	3.3 Manage key Northern Quoll populations in areas not currently affected by Cane Toads to halt population declines	
	3.4 Identify the effect of pastoral land management practices on Northern Quoll persistence	
	3.5 Interim fire management at potential key Northern Quoll populations in areas not currently affected by Cane Toads	
	3.6 Refine models of the current and expected distribution of Cane Toads and Northern Quolls, incorporating predictions of climate change	
Halt Northern Quoll declines in areas recently colonised by Cane Toads	4.1 Continue research into the susceptibility of Northern Quolls to Cane Toad poisoning	The Cane Toad is not currently present in the Revised Development Envelope or Pilbara region.
	4.2 Test the efficacy of control measures for Cane Toads and whether they allow local persistence of quoll populations	

Objective	Actions	Proposed Action Assessment
<p>Maintain secure populations and source animals for future reintroductions/ introductions if they become appropriate</p>	<p>5.1 Manage translocated populations of Northern Quolls on Astell and Pobassoo Islands</p>	<p>The Proposed Action will not be impacting areas of Northern Quoll habitat protected in National Parks and Conservation Agreements.</p>
	<p>5.2 NT and WA to maintain captive breeding populations of Northern Quolls</p>	
	<p>5.3 Protection of key secure populations through protection of habitat in National Parks and Conservation Agreements</p>	
	<p>5.4 NT and WA to determine the status of Northern Quolls on islands with suitable habitats and assess the potential for future translocations to these islands</p>	
<p>Reduce the risk of Northern Quoll populations being decimated by disease</p>	<p>6.1 Increase knowledge and vigilance of disease in Northern Quoll populations</p>	<p>The Proponent has completed baseline studies and a targeted survey to understand the population within the Revised Development Envelope. There are currently no known diseases impacting the conservation status for the Northern Quoll population in the Pilbara.</p>
<p>Reduce the impact of feral predators on Northern Quolls</p>	<p>7.1 Assess the impacts of feral predators on populations of Northern Quolls</p>	<p>The Proponent will document invasive species within the Revised Development Envelope. The Proponent will implement a feral Cat control program.</p>
	<p>7.2 Implement efforts to protect key Northern Quoll populations from the impacts of feral predators</p>	
<p>Raise public awareness of the plight of Northern Quolls and the need for biosecurity of islands and WA</p>	<p>8.1 Develop new and promote existing materials for educating the public on the need for quarantine measures at important island habitats for quolls and along major routes westward into Western Australia</p>	<p>The Proponent will implement site inductions for all on-site personnel to raise environmental awareness and identify on-site threats to Northern Quoll populations.</p>
	<p>8.2 Provide materials and support to Indigenous rangers and other groups responsible for habitat critical to survival for Northern Quolls to educate their communities on the importance of Cane Toad and Cat control and quarantine measures</p>	
	<p>8.3 Implement a broader public education and awareness campaign on quolls and feral species (particularly Cane Toads and Cats)</p>	
	<p>8.4 Develop and implement public education and awareness campaign on land management threats to quolls</p>	

13.6.8.2. Conservation Advice

There is no approved Conservation Advice for the Northern Quoll. The Commonwealth Listing Advice for the Northern Quoll (TSSC 2005) lists the following priority recovery and threat abatement actions required for the Northern Quoll:

- Minimise the impact of colonizing Cane Toads on the species
- Identify areas of critical habitat
- Investigate the need to establish a captive breeding program for the species
- Investigate the status of the species in Queensland, including the reasons for its survival following Cane Toad invasion.

The Cane Toad is currently not in the Pilbara, and the Proposed Action is unlikely to increase its chance of occurrence.

Potential critical habitat for the Northern Quoll has been identified within and surrounding the Revised Development Envelope and impacts to those habitats have been minimised.

13.6.8.3. Threat Abatement Plans

Feral Cats have been recorded within the Revised Development Envelope (Biologic 2021c). Mine sites can attract/increase the abundance of introduced fauna due to the additional resources (food scraps, water, shelter). The Proponent will record all introduced fauna sightings and undertake feral Cat control within the Revised Development Envelope within high risk areas and/or areas of critical habitat in response to sightings, as per the EMP (Appendix A.8). The Proposed Action will align with the TAP for predation by feral Cats (DoE 2015b).

13.6.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after the Proposed Action has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent or limit.

13.6.9.1. Residual Significant Impact

After application of mitigation measures, the following significant residual impacts are predicted for the Northern Quoll within the Revised Development Envelope:

- Clearing up to 126 ha (~20%) of potential critical Gorge/Gully habitat (potential denning and foraging) in addition to the 2 ha currently approved under DN 2018/8299. This clearing is proposed to be managed via upper limits of clearing as per Table 13-10 and will be offset as per Section 12
- Clearing approximately 187 ha of supporting habitat (Drainage Line and Hillcrest/Hillslope habitat (foraging and dispersal) within 1 km of Northern Quoll records. The clearing of up to 3,731 ha of Hillcrest/Hillslope is a proposed upper clearing limit as per Table 13-10 given it is also classified as potential critical habitat for Ghost Bat. Offsets are proposed for clearing supporting habitat, as per Section 12.

13.6.9.2. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposed Action, the anticipated environmental outcomes that apply to the Northern Quoll are set out below:

- For the Proposed Action, clearing will not exceed 5,350 ha of all habitat types within the Revised Development Envelope, including supporting habitats for the Northern Quoll (Drainage Line and Hillcrest/Hillslope), of which no more than:
 - 126 ha of Gorge/Gully habitat (potential critical for Northern Quoll)
 - 3,731 ha of Hillcrest/Hillslope habitat (which contains supporting habitat for Northern Quoll when within 1 km of Northern Quoll records, but potential critical habitat for Ghost Bat) within the Revised Development Envelope.
- Minimise direct and indirect impacts from the Proposed Action on the Northern Quoll habitat in accordance with the EMP (Appendix A.8).

The Proponent will implement the EMP as per Appendix A.8 to achieve these outcomes.

13.6.10. Conclusion

Following the implementation of the mitigation hierarchy, a significant residual impact is expected from the proposed clearing of up to 126 ha of critical Gorge/Gully and approximately 187 ha of supporting habitat (Hillcrest/Hillslope and Drainage Line within 1 km of Northern Quoll records) for the Northern Quoll. Environmental offsets are proposed for this clearing and are discussed in Section 12. Subject to conditions and implementation of offsets, the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the Northern Quoll's survival.

13.7. Ghost Bat (*Macroderma gigas*)

The Ghost Bat is listed as Vulnerable under EPBC Act. It is Australia's largest micro-bat, with a wingspan of approximately 60 cm wide and weighing up to 160g. It is carnivorous, feeding on insects, reptiles, frogs, birds and small mammals (Bat Call 2021a).

13.7.1. Habitat Preferences and Distribution

The Ghost Bat occupies rocky gorges and outcrops containing caves and crevices, used as nocturnal (night), diurnal (day), and maternity roosts. Ghost Bats require several suitable roosts, of varying shapes and sizes, throughout their home ranges to fulfil various ecological requirements. Roost systems need to have vegetation complexity that opens onto plains or riparian drainage lines to provide good foraging opportunities (TSSC 2016b). Roost sites used permanently are generally deep natural caves or disused mines with a relatively stable temperature of 23°C to 28°C and a moderate to high relative humidity of 50 to 100% (TSSC 2016b). Individuals also move between roosts seasonally or according to weather conditions, and populations tend to be widely dispersed when not breeding and concentrate in relatively few roost sites when breeding (TSSC 2016b). Mating generally occurs in July and August, with gestation extending from August to October and birth between September and November. Ghost Bats do not require free surface water for drinking. They forage after sunset and before sunrise (TSSC 2016b).

The species' current range is discontinuous, with geographically disjunct colonies occurring in the Pilbara, Kimberley, Northern Territory, Gulf of Carpentaria, coastal and near eastern coastal Queensland from Cape York to near Rockhampton and western Queensland (TSSC 2016b). The Ghost Bat has a patchy distribution in the Pilbara, with 903 records in Western Australia (DBCA 2021). The regional Pilbara Ghost Bat population is estimated at 1,300 to 2,000 individuals, and in the Hamersley subregion, approximately 350 individuals (TSSC 2016b).

13.7.2. Key Threats and Recovery Actions

13.7.2.1. Key Threats

The Conservation Advice for the Ghost Bat identifies several known threats to the species (TSSC 2016b). Loss of and disturbance to roosting sites due to mining are rated as having potentially severe consequences. Disturbance to maternity roosts from human visitation has moderate to severe consequences on the species. Modification of foraging habitat, poisoning by Cane Toads, and collision with barbed wire fences are moderate consequences (TSSC 2016b). Potential population decline associated with competition for prey with Red Foxes and Feral Cats has been rated an 'unknown' consequence.

13.7.2.2. Recovery Actions

There are currently no recovery plans for the Ghost Bat.

Section 13.5 provides mitigation that the Proponent will implement to reduce impacts on this species and habitat.

13.7.3. Important Populations and Critical Habitat

13.7.3.1. Important Population

The Ghost Bat population within the Pilbara region is genetically distinct and divergent. It has been assumed to be an important population based on the definition in the Significant Impact Guidelines "Key source population either for breeding or dispersal" (DoE 2013).

13.7.3.2. Critical Habitat

Critical habitat for the Ghost Bat has been defined in Bat Call WA's recently published study *A review of Ghost Bat ecology, threats and survey requirements* (Bat Call WA 2021a). Ghost Bats occupy rocky gorges and outcrops that contain caves and crevices. They generally require a range of these cave sites, which they move between seasonally or based on weather conditions (TSSC 2016b). The caves are generally near (within 2 km) plains or riparian drainage lines, providing good foraging opportunities. Within the Hamersley Range, the preferred roosting sites are found beneath bluffs of low round hills composed of Marra Mamba geology and larger hills of Brockman Iron Formation (TSSC 2016b).

Extensive survey activity and research in the last decade has led to the identification of four roosting habitat categories for Ghost Bats in the Pilbara region (Bat Call WA 2021a):

- Category 1: Maternity/diurnal roost sites with permanent Ghost Bat occupancy
- Category 2: Maternity/diurnal roost caves with regular occupancy
- Category 3: Diurnal roost caves with occasional occupancy
- Category 4: Nocturnal roost caves with opportunistic usage.

There are no category 1 roosts within the Hamersley Ranges and thus the Revised Development Envelope (Bat Call WA 2021a). Category 2 caves are considered critical habitat for the species. The grouping of category 3 caves immediately surrounding these caves is also considered critical and described as "apartment blocks" that support the viability of category 2 caves. Isolated category 3 or 4 caves are not considered critical habitat, as these caves are used opportunistically.

The Bat Call WA (2021a) categories have been used to prioritise mitigation of impacts to significant roosts (the terms used in the fauna surveys are still used as well throughout this ERD). Examples of each bat roost category 2 to 4 are provided in Plate 13-1, Plate 13-2 and Plate 13-3.



Plate 13-1: Example of Category 2 Ghost Bat Roost



Plate 13-2: Example of Category 3 Ghost Bat Roost



Plate 13-3: Example of Category 4 Ghost Bat Roost

13.7.4. Occurrence in the Revised Development Envelope

Survey effort for the Ghost Bat included:

- West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2 (Biologic 2021c): echolocation recorders were deployed across Western Hill, Deposit J & Mt Ella East, Deposit F North and Deposit equating to 25 different echolocation sampling sites and a total of 68 sampling nights across both post wet and dry seasons (6 months apart).
- Supplementary single season deployment of echolocation recorders in targeted surveys (Biologic 2022a, b, c, n; 2021e) equating to an additional 25 sites and 74 sampling nights. All echolocation recorders were deployed for a minimum of 2 nights.
- A total of 172.4 person hours spent undertaking targeted searches across the recent surveys (Biologic 2022a, b, c, n; 2021c, d, e)

A total of 37 records of Ghost Bat have been recorded within the Revised Development Envelope through several methods, including ultrasonic recordings (6), scats (26) and direct observations (comprising both alive (3) and deceased individuals (2)) (Figure 13-4).

The population of Ghost Bats occurring in the Revised Development Envelope represents a permanent breeding population due to:

- The presence of two confirmed category 2 (maternity) roosts, including one within the Proposed Action Area
- The range and extent of suitable habitats for roosting and foraging within the Revised Development Envelope.

The Ghost Bat population in the Revised Development Envelope is expected to meet the definition of an important population as defined in the Significant Impact Guidelines (DoE 2013).

13.7.5. Habitat within and Surrounding the Revised Development Envelope

13.7.5.1. Roosting Habitat

Of the 41 caves known from within the Revised Development Envelope (Table 13-8 and Figure 13-4):

- Two (2) are confirmed maternity roosts (category 2), with one within the Proposed Action Area
- Five (5) are potential maternity roosts (category 2), with two within the Proposed Action Area
- Three (3) are confirmed diurnal roosts (category 3), with none within the Proposed Action Area
- Ten (10) are potential diurnal roosts (category 3), with five within the Proposed Action Area
- Twelve (12) confirmed night roosts (category 4), with five within the Proposed Action Area
- Nine (9) potential night roosts (category 4), with eight within the Proposed Action Area.

There is only one apartment block complex within the Revised Development Envelope and it is located at the Western Hill deposit area within the Proposed Action Area, associated with category 2 roost CWAN-04. Nineteen of the caves within the Revised Development Envelope occur within the Gorge/Gully habitat type, and the remaining 22 caves occur in the Hillcrest/Hillslope habitat type.

The presence of seven category 2 caves within the Revised Development Envelope suggests that the species resides permanently within the Revised Development Envelope. The population of Ghost Bats within the Revised Development Envelope forms part of a key source population for breeding and dispersal and is, therefore, an 'important population' as defined by DoE (2013).

Due to the prevalence of caves within Gorge/Gully and Hillcrest/Hillslope habitats within the Revised Development Envelope, these habitats are considered potential critical habitat for the Ghost Bat.

13.7.5.2. Foraging Habitat

Ghost Bats are known to forage across a range of habitats; as such, foraging and dispersal habitat occurs within all six fauna habitat types present within the Revised Development Envelope (i.e. Gorge/Gully, Hillcrest/Hillslope, Drainage Line, Foothills and Plain, Mixed Acacia Woodland and Cracking Clay). Drainage Line, Foothills and Plain, Mixed Acacia Woodland and Cracking Clay habitat is considered supporting habitat for the Ghost Bat when within 12 km of critical habitat (category 2 caves and category 3 caves in apartment blocks).

13.7.5.3. Summary of Habitat within the Revised Development Envelope

A summary of the Ghost Bat habitat within the Revised Development Envelope is provided in Table 13-17 and shown in Figure 13-4.

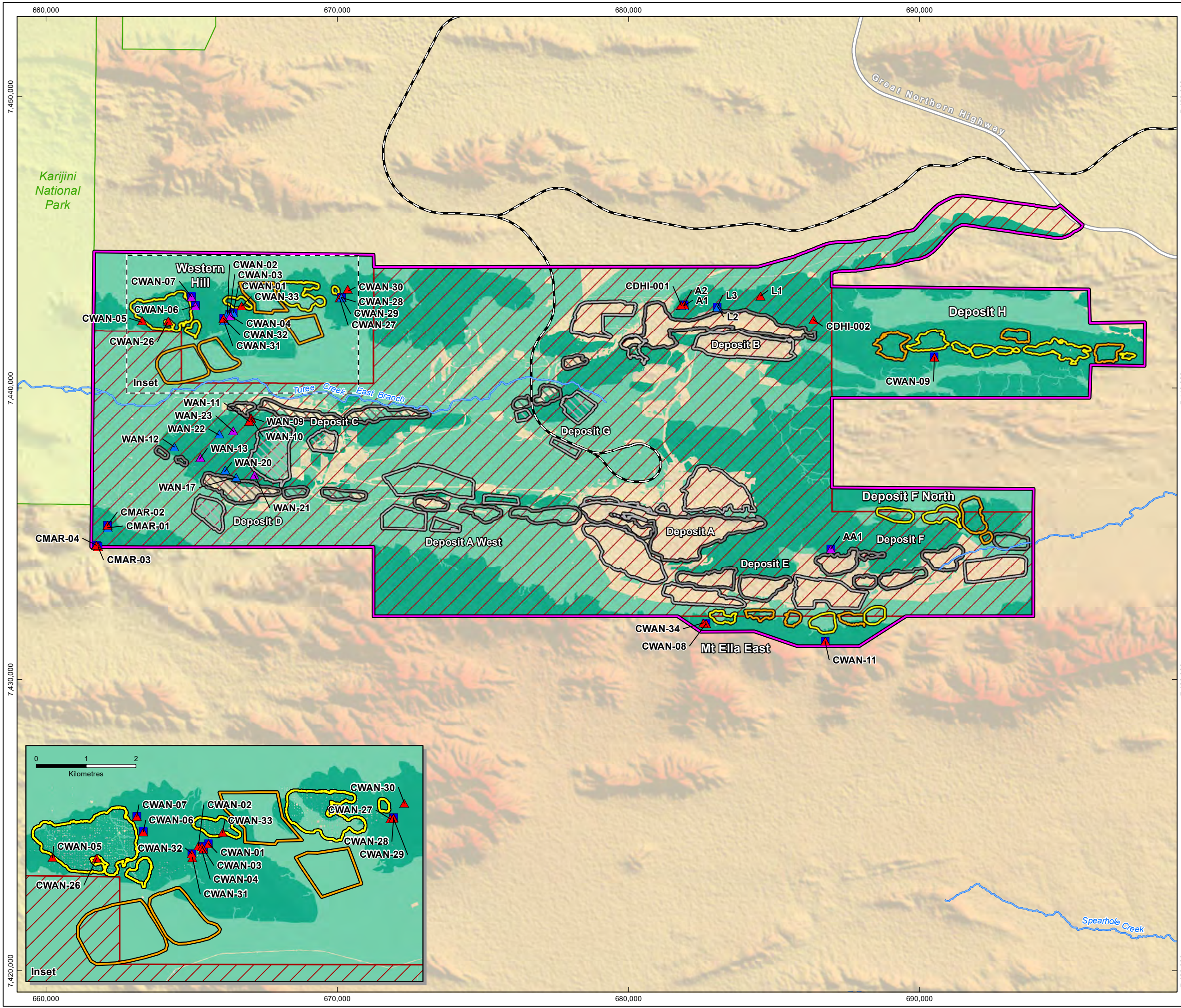
Table 13-17: Summary of Habitat for Ghost Bats within the Revised Development Envelope

Habitat Type	Significance for Ghost Bats	Roost within Habitat Type	
		Revised Development Envelope	Proposed Action Area
Gorge/Gully	Potential critical habitat - (Provides roosting and foraging habitat)	One confirmed maternity roost (category 2) (AA1) Four potential maternity roosts (category 2) (CWAN-07, WA-13, WA-21 and WA-23) Seven potential diurnal roosts (category 3) (CWAN-03, CWAN-29, CWAN-31, L2, L3, WA-17 and WA-20) Six confirmed night roosts (category 4) (CWAN-28, CWAN-32, WA-09, WA-11, CMAR-03 and CMAR-04) One potential night roost (category 4) (CWAN-33).	One potential maternity roost (category 2) (CWAN-07) Three potential diurnal roosts (category 3) (CWAN-03, CWAN-29 and CWAN-31) Two confirmed night roosts (category 4) (CWAN-28, CWAN-32) One potential night roost (category 4) (CWAN-33).
Hillcrest/Hillslope	Potential critical habitat - (Provides roosting and foraging habitat)	One confirmed maternity roost (category 2) (CWAN-04) One potential maternity roost (category 2)(CWAN-06) Three confirmed diurnal roosts (category 3) (WA-12, A1 and WA-22) Three potential diurnal roosts (category 3) (CWAN-01, CWAN-02 and CMAR-01) Six confirmed night roosts (category 4) (CWAN-08, CWAN-09, CWAN-11, A2, WA-10 and CMAR-02) Eight potential night roosts (category 4) (CMAR, CWAN-05, CWAN-26, CWAN-27, CWAN-30, CWAN-34, CDHI001 and CDHI002)	One confirmed maternity roost (category 2) (CWAN-04) One potential maternity roost (category 2) (CWAN-06) Two potential diurnal roosts (category 3) (CWAN-01 and CWAN-02) Three confirmed night roosts (category 4) (CWAN-08, CWAN-09 and CWAN-11) Seven potential night roosts (category 4) (CWAN-05, CWAN-26, CWAN-27, CWAN-30, CWAN-34, CDHI001 and CDHI002)
Drainage Line	Supporting habitat - (Provides foraging and dispersal habitat when within 12 km of critical habitat)	None	None
Footslopes and Plain		None	None
Mixed Acacia Woodland		None	None
Cracking Clay		None	None

Habitat Type	Significance for Ghost Bats	Roost within Habitat Type	
		Revised Development Envelope	Proposed Action Area
Disturbed	Negligible (Provides limited habitats)	None	None

Figure 13-4
Ghost Bat Records and Critical and Supporting Habitat within the Revised Development Envelope

Drawn: A.D.
Plan: PDE0186409v7
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout

- Pit
- Waste Landform

(deposits assessed under DN2018/8299)

- Pit
- Waste Landform

Cave/Roost

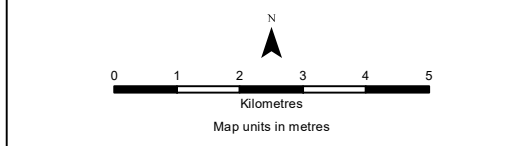
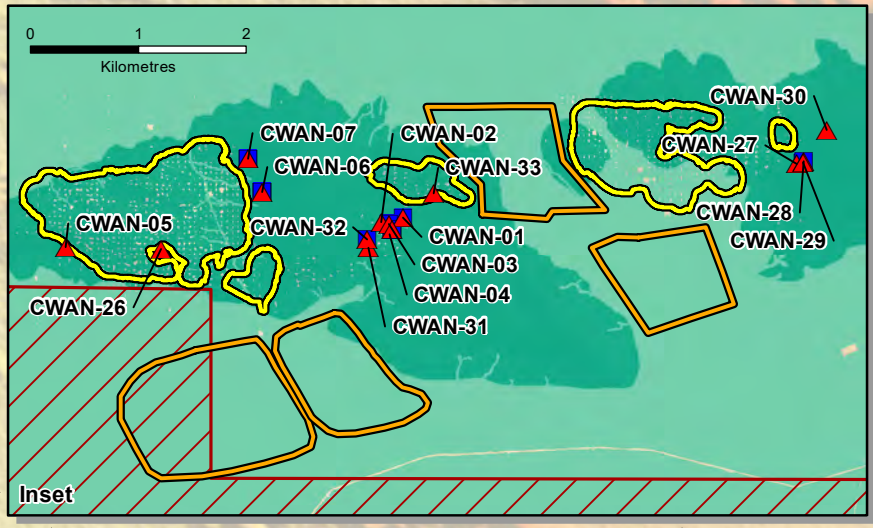
- Category 2 (Critical Habitat)
- Category 3
- Category 4
- Recorded Location

Habitat Value

- Potential Critical Habitat
- Supporting Habitat

Other Features

- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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13.7.6. Assessment of Impacts

The Proposed Action may result in direct and indirect impacts on Ghost Bat. The following assessment of impacts has been identified specifically for Ghost Bat. The impacts applying more broadly for all MNES species with the potential to occur within the Revised Development Envelope are described in Section 13.4.

13.7.6.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

The Proposed Action will clear up to 3,857 ha (30%) of habitat potentially critical to the survival of the Ghost Bat within the Revised Development Envelope, including:

- Up to 126 ha (20%) of Gorge/Gully habitat, which provides roosting and foraging habitat for the Ghost Bat
- Up to 3,731 ha (31%) of Hillcrest/Hillslope habitat, which provides roosting and foraging habitat for the Ghost Bat.

The Proposed Action will clear approximately 2,241 ha (14%) of supporting habitat, comprising all remaining habitat types within the Revised Development Envelope (Drainage Line, Foothills and Plain, Mixed Acacia Woodland and Cracking Clay). These habitats are considered supporting foraging and dispersal habitat for the Ghost Bat within 12 km of critical habitat (category 2 caves and category 3 caves in apartment blocks). The Proposed Action will not exceed the maximum combined clearing limit of 5,350 ha of habitat.

Potential critical Gorge/Gully and Hillcrest/Hillslope habitat and supporting Drainage Line, Mixed Acacia Woodland, Foothills and Plain and Cracking Clay habitat will remain throughout the Revised Development Envelope.

The clearing of potential critical and supporting habitat is considered a significant residual impact and is proposed to be offset by the Proponent (Section 12).

This species regularly disperses long distances and is unlikely to be impacted by the scale of the Proposed Action. Ghost Bats typically forage up to 12 km from a category 2 cave (diurnal roost) and have also been recorded travelling 20 to 30 km (Bat Call WA 2021a).

Habitat connectivity for this species will be maintained through the protection of significant caves which have been placed in MRZ/MEZs.

Caves

Of the 21 Ghost Bat roosts present within the Proposed Action Area, the Proposed Action will impact up to four category 4 caves. Category 4 caves are not considered critical habitat for the Ghost Bat (Bat Call WA 2021a).

The Proposed Action has been designed to avoid direct impacts to 17 of the 21 recorded caves within the Proposed Action Area, including all category 2 caves (confirmed and potential maternity caves) which are considered critical habitat for Ghost Bats. These caves also provide potential denning and shelter for Northern Quoll and Pilbara Olive Python.

Category 3 caves are considered critical habitat when in the immediate surrounds of category 2 caves and are described as “apartment blocks” (Bat Call WA 2021a). The Proponent has also designed the Proposed Action to avoid all category 3 roosts within the Proposed Action Area, including isolated and apartment block roosts.

An additional 20 caves within the Revised Development Envelope are retained within current MS 1113 Restriction and/or Exclusions Areas (Table 13-18; Figure 13-5). The Proponent has established MRZs and/or MEZs around all other category 2, 3 and apartment block caves throughout the Revised

Development Envelope to ensure that these caves are protected from direct impacts from the Proposed Action (Table 13-19).

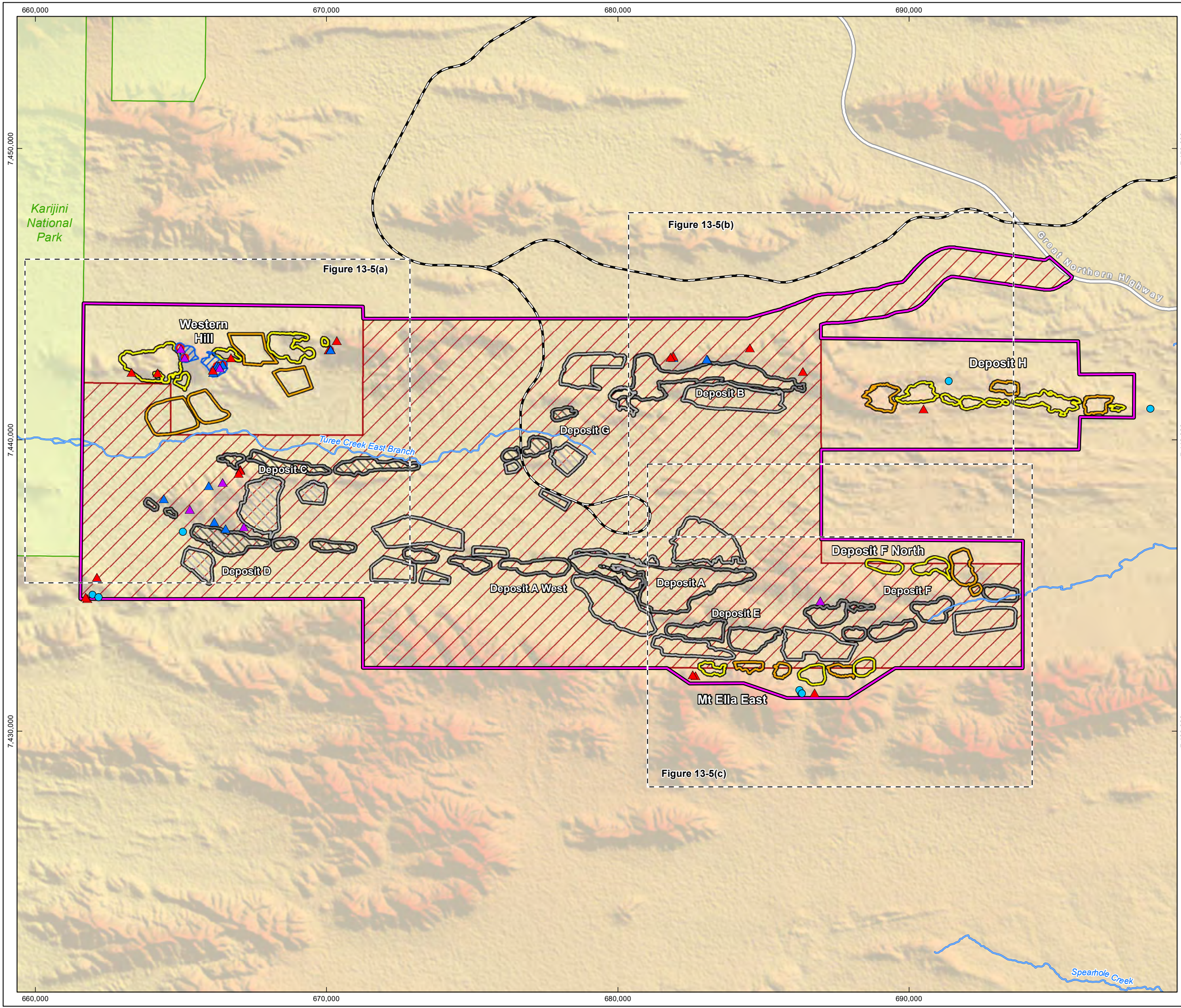
Adjacent Gorge/Gully habitat surrounding category 2 and apartment block complexes within the Western Hill Deposit area will be protected within an MRZ (Table 13-19; Figure 13-5). Although not considered critical habitat, category 4 roosts have been retained where they intersect an MRZ and/or MEZ around category 2, 3 or apartment block caves.

In addition to avoiding caves within the Revised Development Envelope, approximately seven caves (including one category 2) have been avoided by re-designing the Proposed Action and, consequently, the Conceptual Footprint and Revised Development Envelope. These caves are now outside the Revised Development Envelope and will not be directly impacted by the Proposed Action.

Figure 13-5 Mine Restriction and Exclusion Zones, Roosts and Water Features Overview

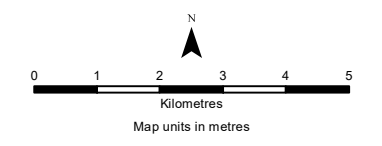
Drawn: L.Fuentes
Plan: PDE00979884v3
Date: November 2023

Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
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Legend

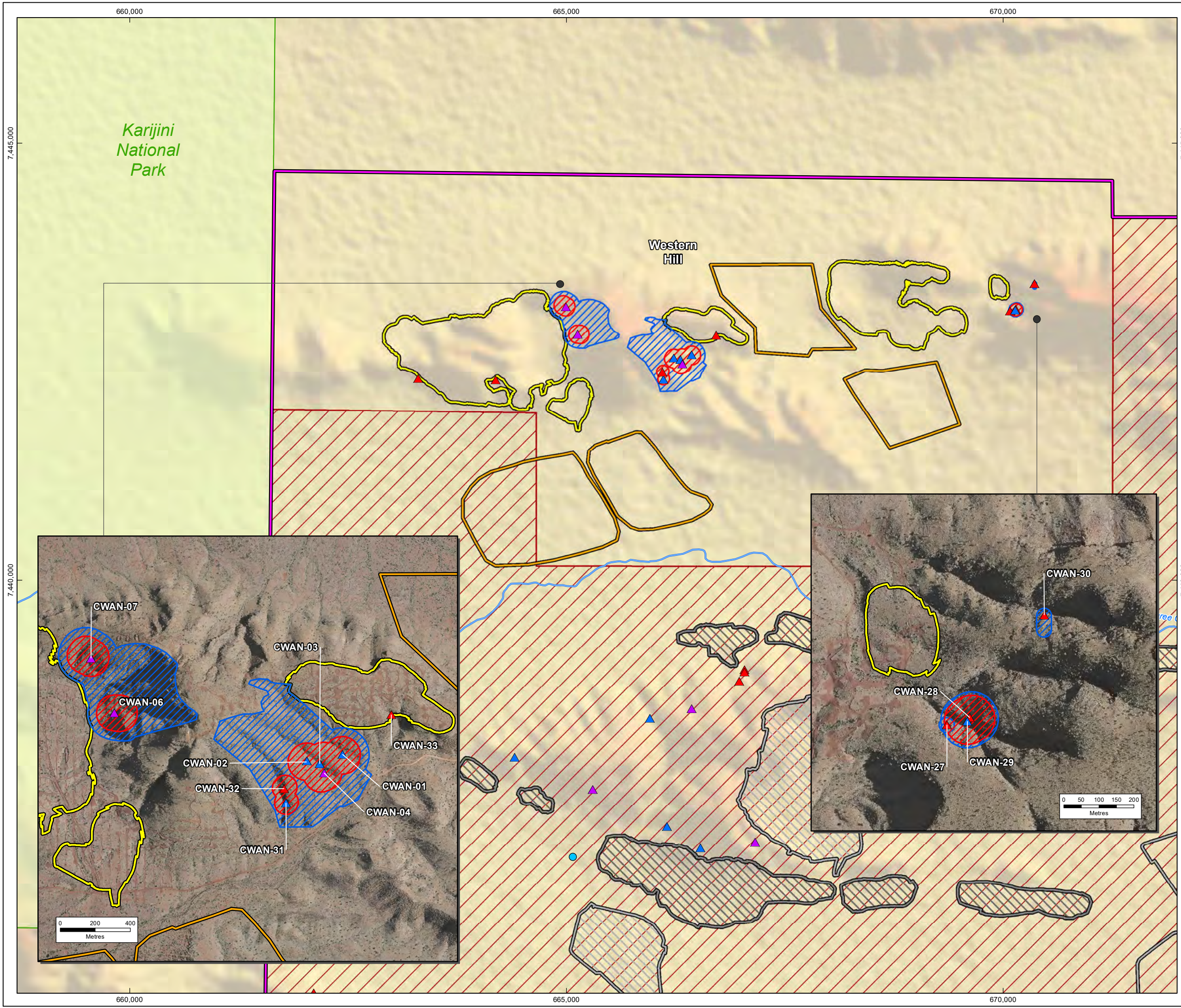
- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- (deposits assessed under DN2018/8299)
- Pit
- Waste Landform
- Mining Exclusion Zone
- Mining Restriction Zone
- Water Feature
- Caves**
- Category 2
- Category 3
- Category 4
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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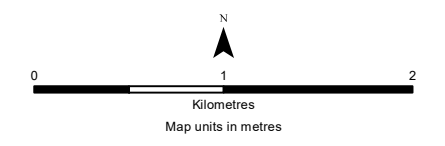
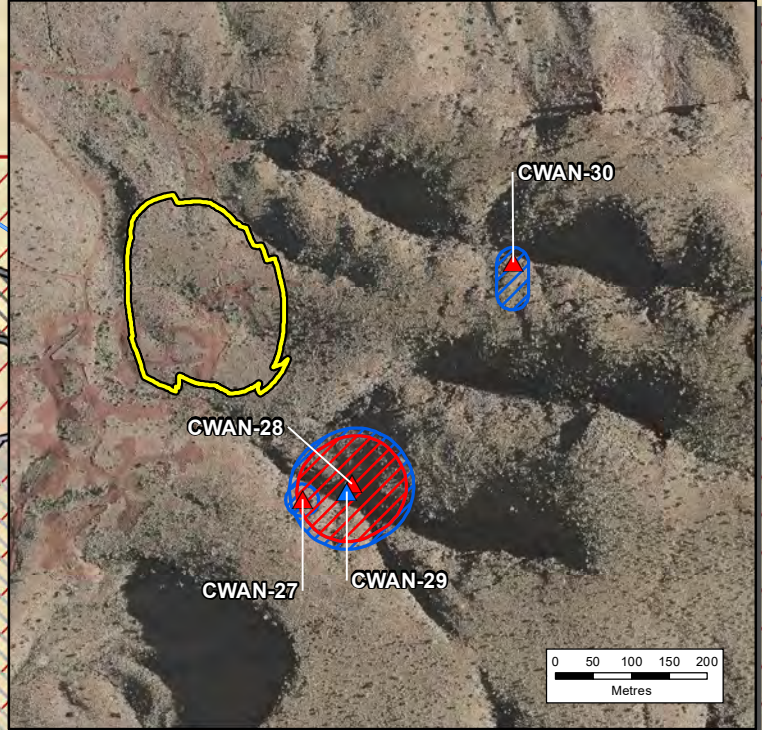
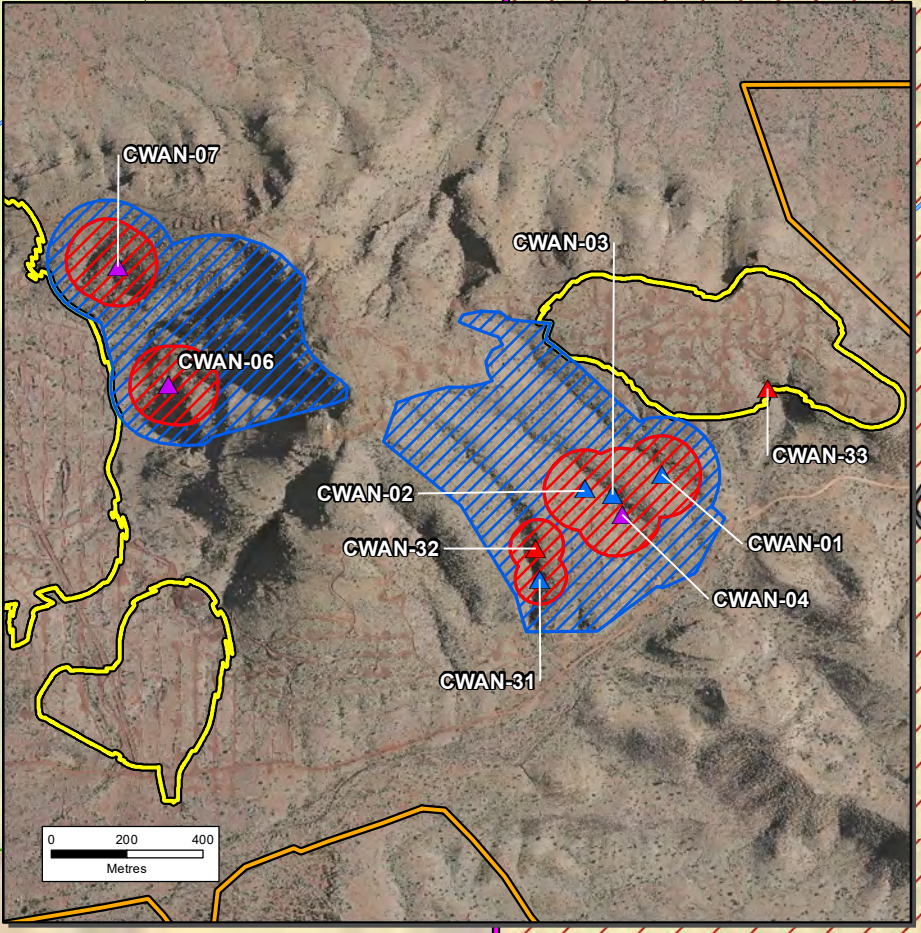
Figure 13-5(a)
Mine Restriction and Exclusion
Zones, Roosts and Water Features
Western Hill

Drawn: L.Fuentes
Plan: PDE00979884v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
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Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Waste Landform
- (deposits assessed under DN2018/8299)
- Pit
- Waste Landform
- Mining Exclusion Zone
- Mining Restriction Zone
- Water Feature
- Caves**
- Category 2
- Category 3
- Category 4
- National Park
- Major Creek















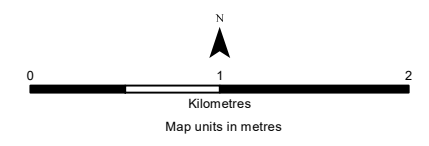
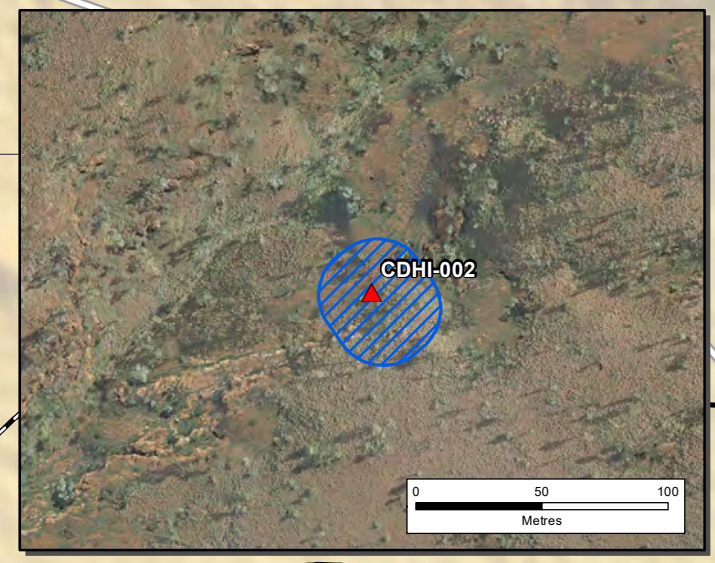
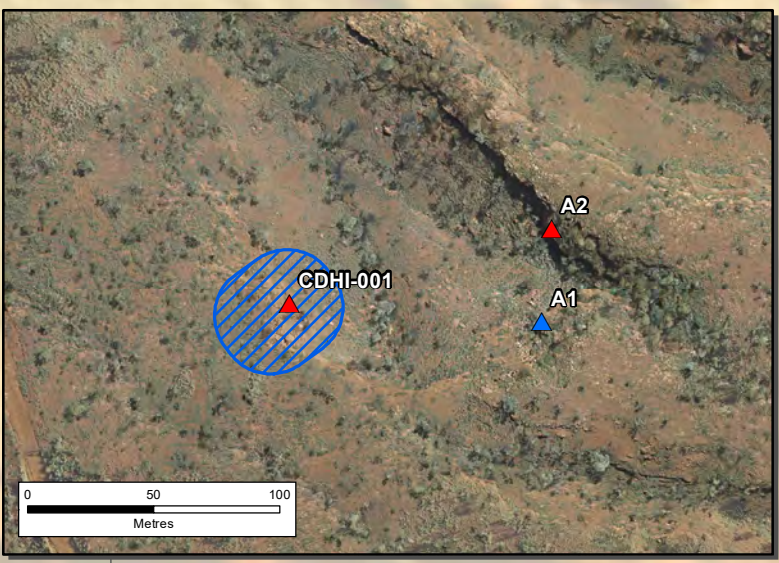
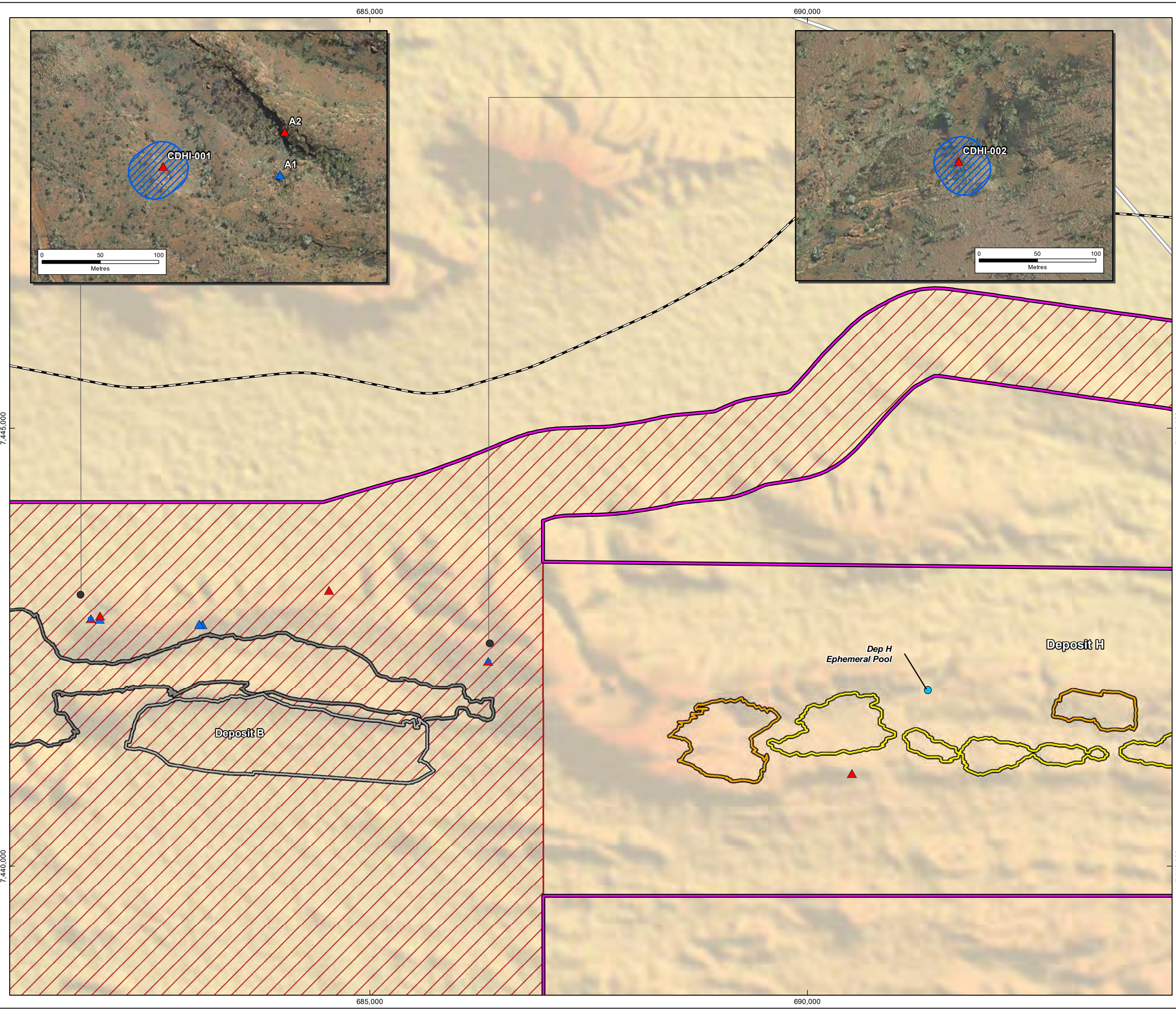
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Figure 13-5(b)
Mine Restriction and Exclusion
Zones, Roosts and Water Features
Deposit H

Drawn: L. Fuentes
Plan: PDE00979884v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com

Legend

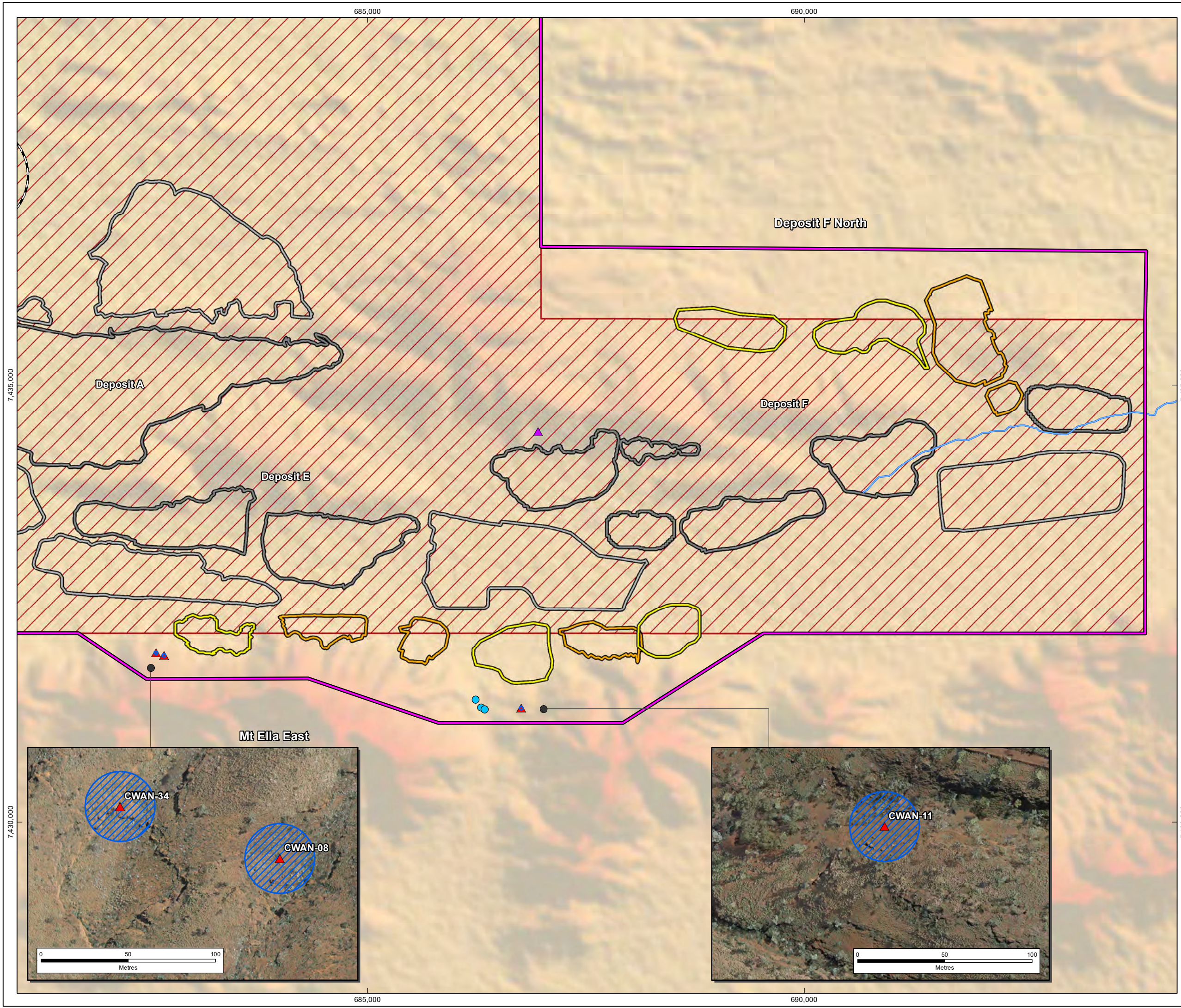
-  Revised Development Envelope
-  Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
-  Pit
-  Waste Landform
- Approved Conceptual Layout**
-  Pit
-  Waste Landform
-  Mining Restriction Zone
-  Water Feature
- Caves**
-  Category 3
-  Category 4
-  Rio Tinto Railway
-  Highway



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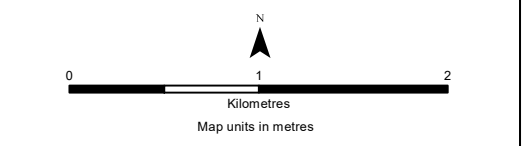
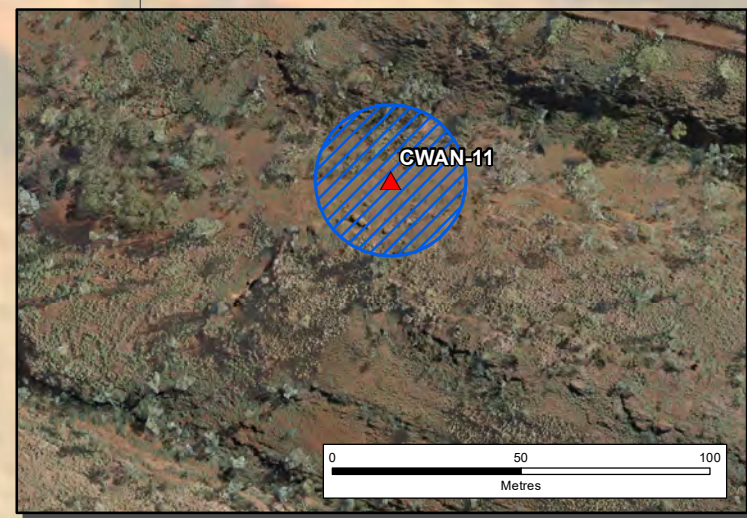
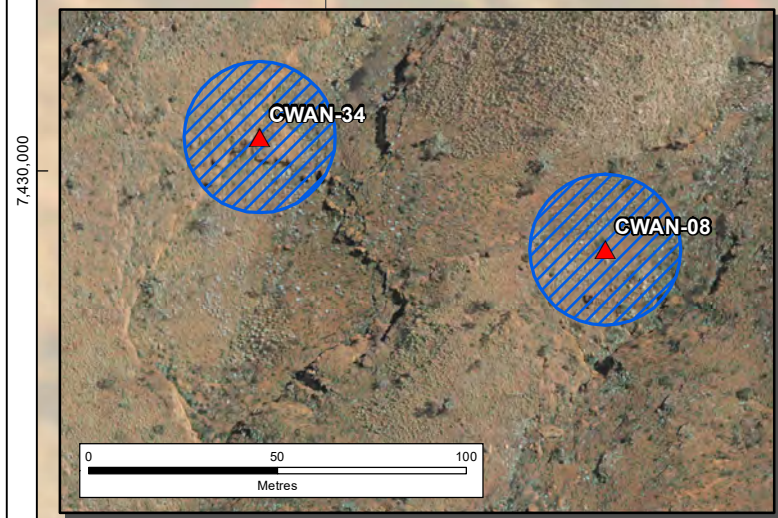
Figure 13-5(c)
Mine Restriction and Exclusion
Zones, Roosts and Water Features
Mount Ella and Deposit F

Drawn: L.Fuentes
Plan: PDE00979884v3
Date: November 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:40,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout*
 - Pit
 - Waste Landform
- Approved Conceptual Layout*
 - Pit
 - Waste Landform
- Mining Restriction Zone
- Water Feature
- Caves*
 - Category 2
 - Category 4
- Rio Tinto Railway
- Major Creek



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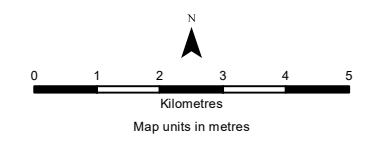
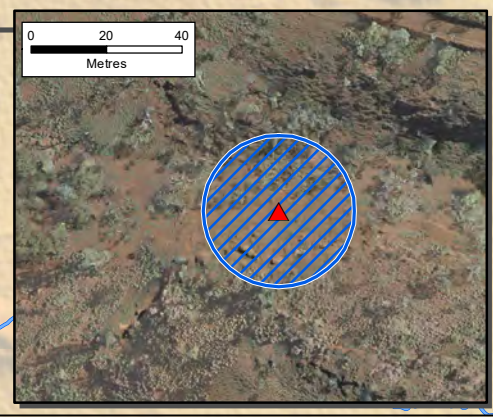
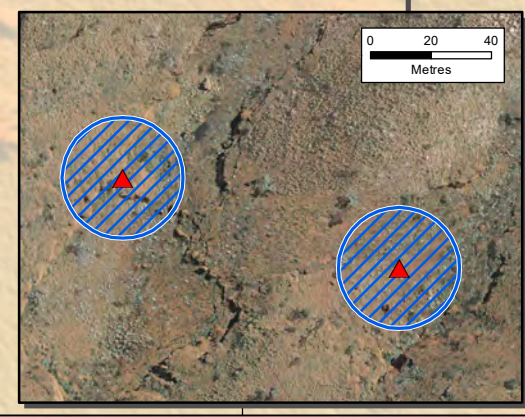
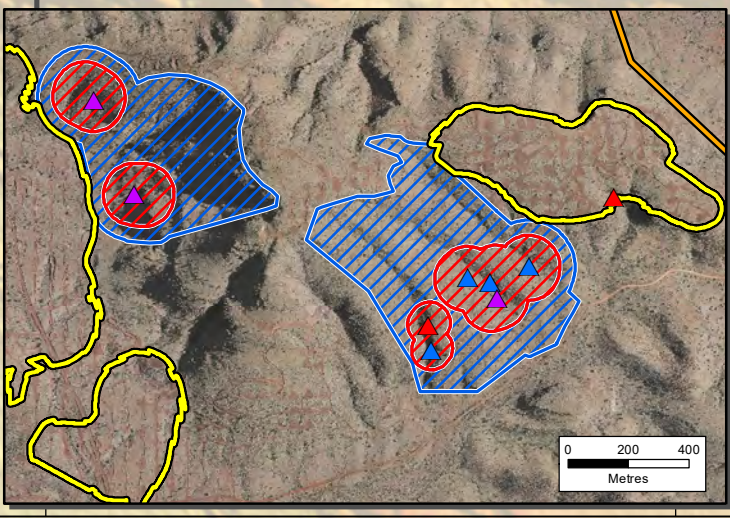
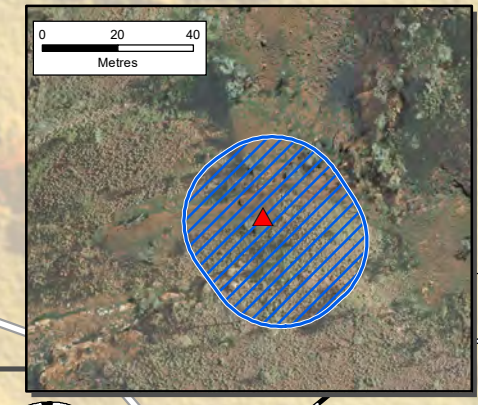
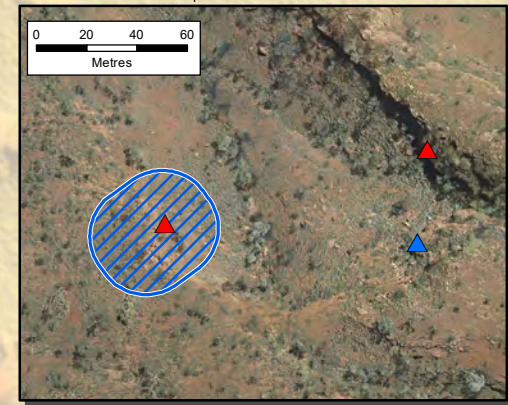
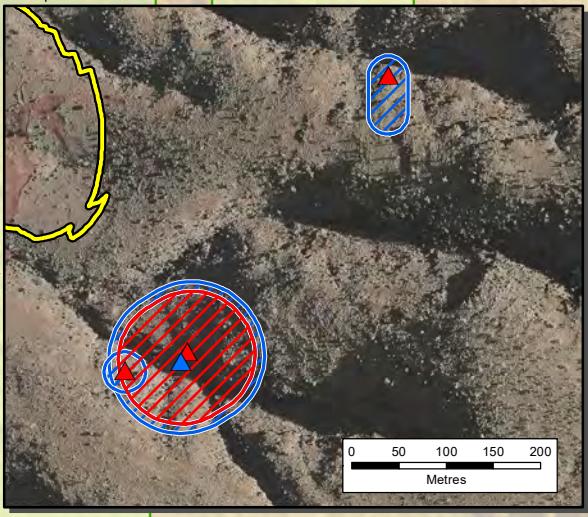
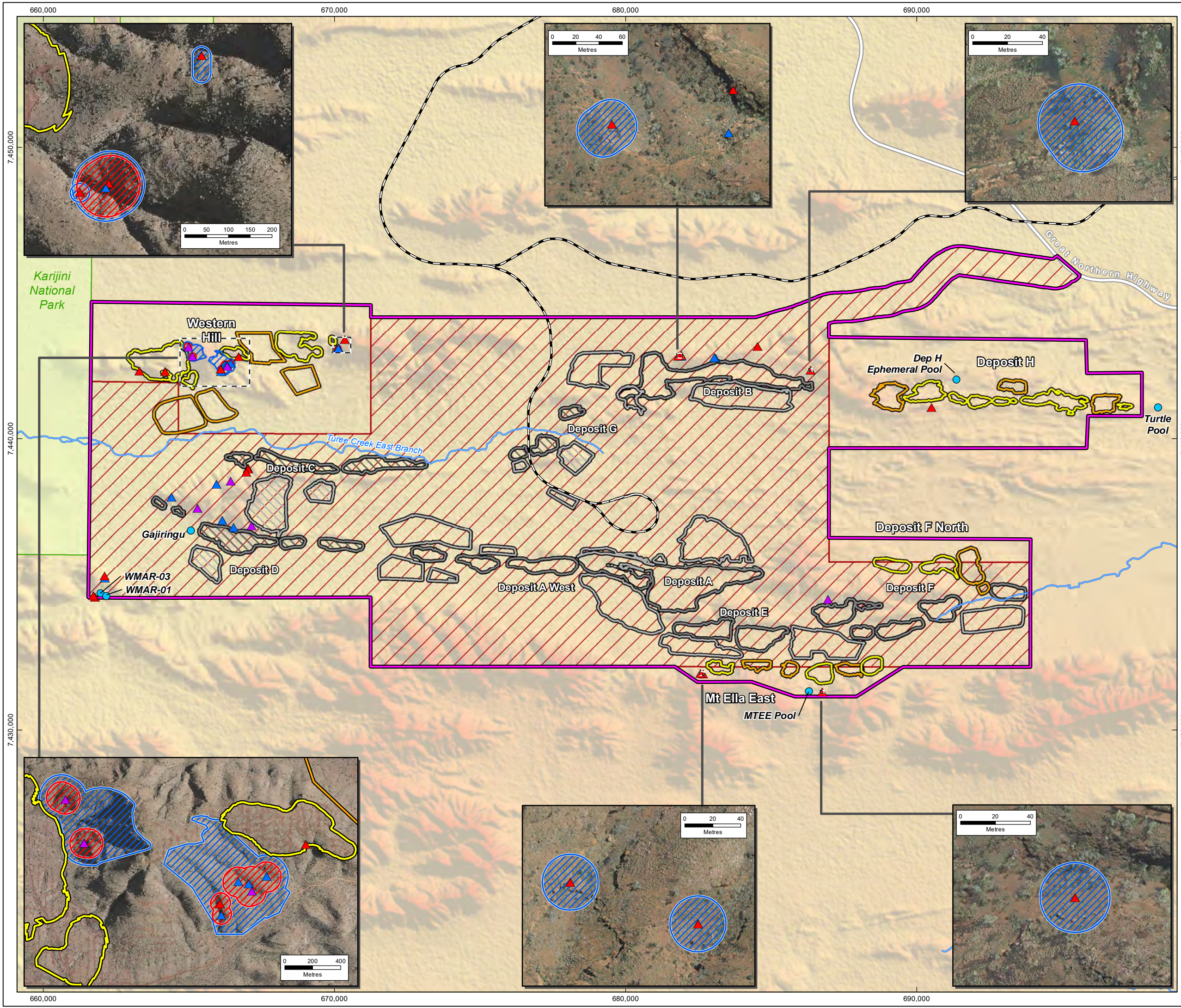
Figure 13-5
Mine Restriction and Exclusion
Zones, Roosts and Water
Features

Drawn: A.D.
Plan: PDE00979884v3
Date: August 2023

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

Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- (deposits assessed under DN2018/8299)
- Pit
- Waste Landform
- Mining Exclusion Zone
- Mining Restriction Zone
- Water Feature
- Caves**
- Category 2
- Category 3
- Category 4
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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13.7.6.2. Loss of Ghost Bat Individuals

Ghost Bats are known to become entangled in barbed wire fencing due to their low-elevation flying pattern. The use of barbed wire fencing will be avoided within the Revised Development Envelope as far as practicable. Where barbed wire fencing is legislated or required, the top strand will be replaced with single-strand wire, and reflectors will be installed to deter bat interaction. The potential impacts from other infrastructure related to the Proposed Action are expected to be low. With the implementation of mitigation and management measures, the loss of Ghost Bat individuals associated with the Proposed Action is not expected to cause significant impacts to the species.

13.7.6.3. Habitat Degradation Associated with Construction and Operational Activities

Dust

An air quality assessment has been undertaken to estimate the likelihood of increased dust deposition resulting from the Proposed Action impacting sensitive receptors within and surrounding the Revised Development Envelope (ETA 2022). Estimated dust deposition was assessed for 30 bat caves, and results determined that caves near the Proposed Action operations are predicted to experience elevated dust concentrations, noting that there are no numeric threshold criteria for dust levels at these sensitive receptors.

The Pilbara region is naturally dusty, and the Proposed Action is located in and near an existing operational mine. Although there will be elevated dust levels resulting from the Proposed Action, local fauna, including the Ghost Bat, are adapted to the dusty Pilbara climate. Implementing MRZ/MEZs around all retained Ghost Bat roosts within the Revised Development Envelope will minimise the impacts of dust deposition from construction and operational activities associated with the Proposed Action. Dust generation will not result in permanent changes to fauna habitat. The Proponent will implement well-established dust management measures to minimise dust emissions from clearing and vehicle movement. Continued implementation of existing dust suppression strategies to avoid prolonged dust emissions and dust cover on adjacent sensitive receptors, such as bat roosts, is expected to result in a low likelihood of dust adversely affecting Ghost Bats.

The effects of dust on Ghost Bats are not known and have not been adequately studied. However, being a predator that relies on its vision for detecting some of prey it is assumed that increased aerial dust may impact this species ability to forage. Blasting will be restricted to daylight hours to reduce the risk of dust produced during blasting affecting their foraging ability. Bat caves are naturally dusty environments and the cave itself will protect roosting individuals from some elements of localised dust impacts.

13.7.6.4. Degradation or Alteration of Habitat Features (Cave CWAN-04) as a Result of Supply Abstraction at Western Hill

Groundwater levels across the West Angelas Development Envelope are approximately ~50mbgl and beyond the typical depth of vegetation root systems. As such, habitat features such as Caves, particularly cave CWAN-04 (which sits high in the landscape) is unlikely to be connected to groundwater within the regional or orebody aquifer at Western Hill and potential groundwater drawdown of the orebody or regional aquifers as discussed in Section 7 will not result in a change to the temperature and/or humidity of the caves.

13.7.6.5. Disturbance from Noise, Vibration and Light, Resulting in the Displacement of Fauna Associated with Construction and Operational Activities

Noise and Vibration

There are no regulations in Western Australia that specify noise and vibration limits for the habitat of MNES fauna species (Wood 2022). However, the Significant Impact Guidelines (DoE 2013) specify that activities should not “disrupt the breeding cycle of an important population”. Ghost Bat behaviour may be disrupted if bat roosts are exposed to vibrations and noise levels greater than 70 dB(A) (Bullen and Creese 2014).

To protect category 2 and 3 (including associated apartment blocks) Ghost Bat roosts from vibration impacts associated with blasting activities, the Proponent has established maximum vibration limits for each cave category as per Table 13-18 and Table 13-19, which deposit-scale Blast Management Plans will support. These vibration limits, together with management and monitoring in relation to each of these caves is included within the EMP attached as Appendix A.8.

Table 13-18: Cave Structure Retained in MS 1113 Restriction and Exclusion Areas within the Revised Development Envelope

Cave Category	Cave ID	Proximity to Operations (m)	Ground Disturbance and PPV Limits
MS 1113 Restriction Area			
Category 3	L2	25 [^]	50 mm/s PPV for WA-17 75 mm/s PPV for L2, L3, WA-12, WA-20, A1
	L3	20 [^]	
	WA-17	140	
	WA-20	190	
	A1 [#]	120 [^]	
	WA-12 [#]	340	
	WA-22 ^{*#}	800	
Category 4	A2	130 [^]	75 mm/s PPV for category 4 roosts
	I1	300 [^]	
	WA-09	100	
	WA-10	110	
	WA-11	160	
MS 1113 Exclusion Area			
Category 2	AA1	160	Ground disturbance is restricted to within 100 m of retained category 2 roost. 40 mm/s PPV for Cave AA1 25 mm/s PPV for Cave WA-21
	WA-13 [*]	530	
	WA-21	250	
	WA-23 [*]	610	
Category 3	CMAR-01 [*]	1020	N/A
Category 4	CMAR-02 [*]	1000	N/A
	CMAR-03 [*]	1690	
	CMAR-04 [*]	1690	

^{*}PPV levels are not applicable to these caves as they are located greater than 300 m from the closest pit.

[#] Caves A1, WA-12 and WA-22 have been downgraded from category 2 to category 3 since initial assessment based on ongoing monitoring; however, the management has not altered.

[^] Distance to Proposed Conceptual Footprint (i.e. closest future operations)

Table 13-19: MEZ and MRZ around Cave Structures within the Proposed Action Area

Cave Category	Cave ID	Proximity to Conceptual Footprint (m)	MRZ and MEZ	PPV
Apartment Block – Primary Roosts	CWAN-04	160	MRZ: Low impact~ activities permitted within 150-100 m of primary category 2 roost. MEZ: Direct disturbance is not permitted^ within 100 m of primary category 2 roost.	10 mm/s PPV during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months LZ ₁₀ >70 db(Z) over one hour
Apartment block – Secondary Roosts	CWAN-01	100	MRZ: Low impact~ activities permitted within 150-100 m of secondary category 3 roost MEZ: Direct disturbance is not permitted^ within 100 m of secondary category 3 roost	10 mm/s PPV during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months, Category 3 roosts - 50 mm/s PPV LZ ₁₀ >70 db(Z) over one hour
	CWAN-02	170		
	CWAN-03	175		
Isolated Category 2	CWAN-06	150	MRZ: Low impact~ activities permitted within 150-100 m of isolated category 2 roost MEZ: Direct disturbance is not permitted^ within 100 m of isolated category 2 roost	10 mm/s PPV during breeding months (1 October to 31 December), or 25 mm/s PPV in non-breeding months LZ ₁₀ >70 db(Z) over one hour
	CWAN-07	150		
Retained Category 3	CWAN-29	65	MRZ: Low impact~ activities permitted within 65-75 m of retained category 3 roost. MEZ: Direct disturbance is not permitted^ within 65 m of retained category 3 roost	50 mm/s PPV
	CWAN-31	100		
Retained Category 4 within Category 3 cave MEZ/MRZ	CWAN-27	7	MEZ: Partial protection from overlap of nearby category 3 cave MEZ. MRZ: Low impact~ activities permitted within 20 m of retained category 4 roost.	N/A
	CWAN-28	60		
	CWAN-32	155		
Retained Category 4	CWAN-08	70	MRZ: Low impact~ activities permitted within 20 m of retained category 4 roost.	N/A
	CWAN-11	90		
	CWAN-30	105		
	CWAN-34	105		
	CDHI-001	25		
	CDHI-002	25		

*Distance from the cave structure and extent

~ Disturbance can be up to 20% of MRZ for low impact activities to support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP

^ except for activities that support monitoring, management and implementation of contingency actions (if required) as outlined in an approved EMP.

A noise assessment undertaken on 19 roosts within the Revised Development Envelope suggests that noise levels associated with the Proposed Action will not reach above the 70 dB(A) during all mining years assessed (Wood 2022).

Wood (2021) modelled vibration from blasting and concluded that blasts undertaken within 1.1 km of a cave system may exceed 10 mm/s PPV. The Proponent will implement an EMP (Appendix A.8) to ensure PPV levels do not exceed proposed vibration thresholds at significant retained (category 2 and 3) Ghost Bat roosts (Table 13-19).

Light

Light emissions from the Proposed Action are not expected to significantly alter nocturnal foraging activities as light emissions are already present in the current operational mining area at West Angelas. Additional light emissions from the Proposed Action are not expected to impact Ghost Bat roosting or foraging behaviour significantly due to the lighting being designed and managed in accordance with the National Light Pollution Guidelines (DotEE 2020), including:

- Permanent lighting will be installed only where required, mainly in-pit and operational areas
- Permanent lighting and temporary lighting will be shielded to minimise light spill
- Permanent lighting will be directed away from sensitive areas (e.g. MEZs, MRZs, significant caves, critical habitat)
- Temporary lighting (e.g. trailer mounted units) may be required to provide a safe working environment for short periods, where practicable, and while still providing a safe working environment; these will be positioned to minimise direct light spill into sensitive areas.

13.7.7. Significance of Impacts

An assessment of the Proposed Action impacts on the Ghost Bat is detailed in Table 13-20, with reference to the Significant Impact Guidelines (DoE 2013).

Table 13-20: Assessment of the Significance of Impacts to Ghost Bat

Significant Impact Criteria	Assessment of the Significance of Impacts on Ghost Bat
<p>Potential to lead to a long-term decrease in the size of an important population of a species</p>	<p>Ghost Bats within the Revised Development Envelope form part of a key population for breeding and dispersal and are, therefore, an important population defined by DoE (2013).</p> <p>A total of 41 caves within the Revised Development Envelope were identified as suitable roosting sites for the Ghost Bat, 21 of which occur within the Proposed Action Area. This includes seven category 2, 13 category 3 and 21 category 4 caves. Four category 4 caves will be impacted due to the Proposed Action. Category 4 caves are not considered critical habitat for the Ghost Bat (Bat Call WA 2021a). No category 2 or 3 caves, including associated apartment block caves, will be impacted by the Proposed Action. MEZs and/or MRZs will be established to protect 17 caves within the Proposed Action Area, as per Table 13-19. An additional 20 caves are currently protected within MS 1113 Restriction and Exclusion areas, as per Table 13-18.</p> <p>The Proposed Action will clear up to 3,857 ha (30%) of potential critical habitat for the Ghost Bat in the Revised Development Envelope. Approximately 2,241 ha (14%) of the supporting habitat will be removed from the Revised Development Envelope. Critical and supporting habitat will be retained within the Revised Development Envelope and surrounds which will support and maintain connectivity of the local population of Ghost Bat.</p> <p>There is evidence of the persistence of the Ghost Bat population in the Pilbara region alongside existing mining operations, including existing West Angelas operations within the Revised Development Envelope, therefore roosts and habitats retained in the Revised Development Envelope are expected to continue to be utilised by the species.</p> <p>Given the avoidance of 17 out of 21 caves within the Proposed Action Area, in addition to the 20 caves retained within the Approved Development Envelope under MS 1113, the retention of critical (category 2 and category 3 caves in apartment blocks) and potential critical roosting and foraging habitat (Gorge/Gully and Hillcrest/Hillslope) and the availability of roosting, foraging and dispersal habitat outside of the Revised Development Envelope, the Proposed Action is not expected to cause a long-term decrease in the size of an important population that occurs within the Revised Development Envelope.</p>
<p>Potential to reduce the area of occupancy of an important population</p>	<p>Ghost Bats have been recorded foraging 20 to 30 km from category 2 (diurnal roosts) (Bat Call WA 2021a). Three category 2 caves have been recorded within the Proposed Action Area. All category 2 caves will be retained and protected by MEZs and MRZs (Table 13-19). In addition, five category 3 and 13 category 4 roosts within the Proposed Action Area will also be retained. An additional 20 caves within the Revised Development Envelope, comprising four category 2, eight category 3 and eight category 4 caves, are currently protected within MS 1113 and EPBC Decision Notice 2018/8299 Exclusion and Restriction areas (as per Table 13-18).</p> <p>Critical, potential critical and supporting habitat will remain available within the Revised Development Envelope to provide roosting, foraging and dispersal habitat for the Ghost Bat, including a portion of these habitats preserved within the MEZ/MRZs. The species is expected to continue to exist within and surrounding the Revised Development Envelope and throughout the wider Pilbara region. Therefore, the Ghost Bat's occupancy area is unlikely to be significantly reduced due to the Proposed Action.</p>

Significant Impact Criteria	Assessment of the Significance of Impacts on Ghost Bat
<p>Potential to fragment an existing population into two or more populations</p>	<p>The retention of critical habitat caves within 20–30 km (typical nights flight range) will mitigate the risk of population fragmentation. Habitat connectivity will also be maintained by protecting significant roosts (category 2 and apartment block) placed in MRZ/MEZs and the retention of Drainage Line habitats which provide foraging corridors.</p> <p>Given the extensive foraging range and the retention of 17 of the 21 recorded caves within the Proposed Action Area, in addition to 20 caves within the wider Revised Development Envelope, including all critical category 2 caves and apartment blocks within the Revised Development Envelope and retention of critical Gorge/Gully and Hillcrest/Hillslope habitat, the Proposed Action is not expected to cause the current Ghost Bat population to fragment or become disconnected.</p>
<p>Potential to adversely affect habitat critical to the survival of a species</p>	<p>The Proposed Action will clear up to 3,857 ha of Gorge/Gully and Hillcrest/Hillslope habitat (126 ha and 3,731 ha respectively), which is considered potentially critical to the Ghost's Bat population within the Revised Development Envelope.</p> <p>The remaining habitat types within 12 km of critical habitat (Drainage Lines, Footslopes and Plains, Mixed Acacia Woodland and Cracking Clay) are supporting habitat in which the Ghost Bat forages and disperses.</p> <p>Critical and potential critical habitat will remain within the Revised Development Envelope to sustain the current Ghost Bat population. These habitats are not restricted to the Revised Development Envelope; similar habitats extend into the wider locality and region.</p> <p>Four of the 21 roosts within the Proposed Action Area will be impacted by the Proposed Action. The roosts proposed for impact are category 4 caves for the Ghost Bat, which are not considered critical habitat for the species (Bat Call WA 2021 a).</p> <p>The clearing of potential critical and supporting habitat is considered a significant residual impact and is proposed to be offset (Section 12).</p>
<p>Potential to disrupt the breeding cycle of an important population</p>	<p>There will be no direct impact on category 1 or 2 roosts (maternity and diurnal roosts, noting no category 1 roosts were recorded), isolated category 3 roosts or caves forming apartment blocks. A total of 17 of the 21 recorded caves within the Proposed Action Area will be retained and placed in MRZ/MEZs, of which three are category 2 caves. The 17 caves will be retained within MRZ/MEZs, with buffers as per Table 13-19 for protection. An additional 20 caves within the Revised Development Envelope are retained within current MS 1113 Restriction and/or Exclusion areas (Table 13-18). The Proposed Action will impact up to four category 4 caves, which are not considered critical or breeding habitat for the Ghost Bat.</p> <p>The Proposed Action will retain potential critical Gorge/Gully and Hillcrest/Hillslope habitat, where the caves have been recorded. This habitat provides roosting and foraging habitat for the Ghost Bat.</p> <p>On this basis, the Proposed Action is not expected to disrupt the breeding cycle of the local Ghost Bat population.</p>
<p>Potential to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>The Proposed Action has the potential to modify, destroy, remove, isolate, or decrease the availability or quality of habitat within the Revised Development Envelope. However, the Proposed Action will not impact any category 1 or 2 caves (maternity and diurnal roosts), isolated category 3 roosts or apartment blocks. Given the retention of 17 of the 21 recorded caves within the Proposed Action Area, an additional 20 caves within the Revised Development Envelope retained within current MS 1113 Restriction and/or</p>

Significant Impact Criteria	Assessment of the Significance of Impacts on Ghost Bat
	Exclusion areas, a portion of potential critical habitat retained within the MEZ/MRZ and retention of supporting habitat, Ghost Bats are expected to remain in the Revised Development Envelope and are unlikely to decline.
Potential to result in invasive species that are harmful to the vulnerable species becoming established in the vulnerable species' habitat	<p>Feral predators and weeds are not considered key threats to the Ghost Bat (TSSC 2016b). However, the Proponent will undertake the following mitigation actions to reduce any potential impacts to the Ghost Bats:</p> <ul style="list-style-type: none"> • Expand the existing feral Cat monitoring and control program to incorporate the Revised Development Envelope to target high risk areas and/or critical habitat • Continue to implement vehicle hygiene and weed control programs to reduce the risk of weeds being introduced or spread into the Revised Development Envelope. <p>The Proposed Action is located within an area where Cane Toads are not present and will not increase the potential for Cane Toads to become established within the Revised Development Envelope or the surrounding local area.</p> <p>The Proposed Action is not expected to increase the risk of invasive species becoming established and potentially impacting on the Ghost Bat or its habitat.</p>
Potential to introduce disease that may cause the species to decline	A possible herpes-type virus is reported to be affecting a population of Ghost Bats at Mt Etna in Queensland (TSSC 2016b). This virus has not been identified in the vicinity of the Revised Development Envelope or in Western Australia, and the Proposed Action will not increase the potential for this disease to be introduced to the local population as there is unlikely to be a transmission pathway.
Potential to interfere with the recovery of the species	<p>The Conservation Advice for the species identifies active mitigation of threats as a key management action, including protection of land with significant colonies, replacing and avoiding the use of barbed wire, protecting roost sites and surrounding foraging areas and preventing the collapse of roost sites.</p> <p>The Proponent commits to avoiding barbed wire as far as practicable. Where barbed wire is required by legislation, reflectors will be installed to prevent Ghost Bat interaction, and the top strand will be replaced with single-strand wire.</p> <p>The Proposed Action has been modified to minimise disturbance to critical habitat for the Ghost Bat, including the retention of 37 of the 41 recorded roosts within the Revised Development Envelope (17 of which occur within the Proposed Action Area), including all category 2 and apartment block roost caves, and the retention of potential critical Gorge/Gully and Hillcrest/Hillslope habitat types (a portion of which is preserved within the proposed MEZ/MRZ's).</p> <p>On this basis, the Proposed Action is not expected to interfere with the recovery of the Ghost Bat.</p>

13.7.8. Consistency with Relevant Recovery Plans and Guidance

There are no recovery plans for the Ghost Bat.

13.7.8.1. Threat Abatement Plans

Feral Cats have been recorded within the Revised Development Envelope (Biologic 2021c). Mine operations can increase the abundance of feral animals due to additional resources, such as food scraps, water and shelter. The Proponent will record all sightings of feral fauna and undertake feral animal control within high risk areas and/or areas of critical habitat in response to sightings, as per the EMP (Appendix A.8). The Proposed Action will align with the *Threat abatement plan for predation by feral cats* (DoE 2015b). To date no foxes have been recorded within the Development Envelope however the above measures for cats will mean the Proposed Action will align with the TAP for predation by feral foxes should they be found within the Development Envelope in the future.

13.7.8.2. Conservation Advice

The primary conservation actions from the Conservation Advice for Ghost Bat (TSSC 2016b) are outlined in Table 13-1. The Proponent has committed to the following:

- Auditing of retained Ghost Bat roost sites following the cessation of mining activities
- Protection of 17 recorded Ghost Bat roost sites from mining activities within the Proposed Action Area through the implementation of MEZs and MRZs around the roosts. An additional 20 Ghost Bat roosts within the Revised Development Envelope are currently protected within MS 1113 Restriction and/or Exclusion areas
- Avoidance of barbed wire fencing as far as practicable. Where barbed wire is required by legislation, reflectors will be installed to prevent Ghost Bat interaction and the top strand will be replaced with plain wire
- Education of personnel to not disturb roosting sites.

13.7.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a Proposed Action has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.7.9.1. Residual Significant Impact

After application of mitigation measures, the following significant residual impacts are predicted for the Ghost Bat within the Revised Development Envelope:

- Clearing up to 126 ha (~20%) of Gorge/Gully and 3,731 ha (~31%) of Hillcrest/Hillslope habitat types which provide potential critical roosting and foraging habitat. This clearing is proposed to be managed via upper limits of clearing as per Table 13-11 and will be offset as per Section 12
- Clearing approximately 2,241 ha (~14%) of Drainage Line (~78 ha), Footslopes and Plain (~1,787), Mixed Acacia Woodland (~374 ha) and Cracking Clay (2 ha) habitat types which provide

supporting habitat (foraging and dispersal) within 12 km of critical habitat. Offsets are proposed for clearing supporting habitat, as per Section 12.

13.7.9.2. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposed Action, the anticipated environmental outcomes that apply to the Ghost Bat are set out below:

- For the Proposed Action, clearing will not exceed 5,350 ha of all habitat types within the Revised Development Envelope, including supporting habitats for the Ghost Bat (Drainage Line, Cracking Clay, Foothills and Plain, and Mixed Acacia Woodland), of which no more than:
 - 126 ha of Gorge/Gully potential critical habitat within the Revised Development Envelope
 - 3,731 ha of Hillcrest/Hillslope potential critical habitat within the Revised Development Envelope
 - 2 ha of Cracking Clay supporting habitat within the Revised Development Envelope (upper clearing limit due to regional significance of the vegetation type) in addition to the 20 ha approved under MS 1113.
- Removal of up to four category 4 Ghost Bat potential roosts
- No direct or significant indirect impacts from the Proposed Action to category 2, 3 and 4 Ghost Bat roosts retained within MRZs and MEZs (shown in Figure 13-5)

The Proponent will implement the EMP as per Appendix A.8 to achieve these outcomes.

13.7.10. Conclusion

Following the implementation of the mitigation hierarchy, a significant residual impact is expected for the Ghost Bat from the proposed clearing up to 3,857 ha of potential critical habitat (Gorge/Gully and Hillcrest/Hillslope) and 2,241 ha of supporting (Drainage Line, Foothills and Plain, Cracking Clay, and Mixed Acacia Woodland) habitat within its home range of 12 km from critical habitat for the Ghost Bat. A non significant residual impact is expected for clearing of 4 roosts (CWAN-05, CWAN-09, CWAN-26 and CWAN-33), all of which are category 4 (non-critical) Pilbara Leaf-nosed Bat roosts (potential nocturnal roosts) and category 4 (non-critical) Ghost Bat roosts (night and potential night roosts). Environmental offsets are proposed for this clearing and are discussed in Section 12. Subject to conditions and implementation of offsets, the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the Ghost Bat's survival.

13.8. Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*)

The Pilbara Leaf-nosed Bat is listed as Vulnerable under the EPBC Act and BC Act. It is a moderate-sized bat weighing 8.7 to 9.3 g with a forearm length ranging 45.2 to 47.8 mm, with orange fur and a distinctive nose leaf surrounding the nostrils (Bat Call WA 2021b).

13.8.1. Habitat Preferences and Distribution

The Pilbara Leaf-nosed Bat is endemic to WA and ranges throughout the Pilbara and adjoining regions of the Ashburton and Little Sandy Desert bioregions. Within the Pilbara, the species is recognised as a geographically isolated population (or form) of the Orange Leaf-nosed Bat, distributed across northern Australia and separated from the Pilbara population by approximately 400 km of the Great Sandy Desert (Armstrong 2001). The Pilbara population represents a single interbreeding population comprising multiple colonies (TSSC 2016a). The most updated review of the ecology of the Pilbara Leaf-nosed Bat (Bat Call WA 2021b) states that there are 48 confirmed permanent diurnal category 1 and 2 roosts throughout the Pilbara region, including 17 known locations and 31 yet to be found. Thirty-eight are natural roosts in banded iron formations in the Hamersley Ranges and eastern Pilbara, and six are disused underground mines. It is considered that this may be an underestimate of the roosts present in the region.

In the Pilbara, natural roosts are restricted to roosts formed in gorges where at least semi-permanent water is nearby (TSSC 2016a). Pilbara Leaf-nosed Bats typically roost in undisturbed roosts, deep fissures or abandoned mine shafts (Armstrong 2000, 2001). The species' limited ability to conserve heat and water (Baudinette et al., 2000) means they require warm (28 – 32°C) and very humid (85 – 100%) roost sites to persist in arid and semi-arid climates (Armstrong 2001). Roost sites with such attributes are relatively uncommon in the Pilbara and the limiting factor of the species' distribution (Armstrong 2001). During the dry season (June to November), individuals are believed to aggregate in roosts that provide a suitably warm, humid microclimate (Armstrong 2000, 2001; Bullen & McKenzie 2011). While in the wet season (December to May), when conditions are generally wetter and more humid, individuals typically disperse roosting in seasonally suitable features (Armstrong 2000, 2001; Bullen & McKenzie 2011).

The Proponent previously commissioned Biologic to undertake a VHF tracking study on the Pilbara Leaf-nosed Bat at another mine site (Greater Paraburdoo) (Biologic 2020b). The study's objective was to understand the bat species' movement better and determine significant habitat types regarding foraging habitat (Biologic 2020b). The study found that the tagged bats spent approximately 70% of their time outside the VHF towers' detection range (approximately 314 ha), indicating that their preferred foraging habitat occurred outside of the detection range. The bats were regularly detected in plains habitat located north and north-east of the Paraburdoo Ranges and south of the Western Range. The data collected from the study suggests that the Pilbara Leaf-nosed Bats' preferred foraging habitats were located near drainage lines and ephemeral watercourses. The recent review of Pilbara Leaf-nosed Bat ecology (Bat Call WA 2021b) collated data from an extensive survey effort across the Pilbara, suggesting that the species forages widely, using nearly all productive and semi-productive habitats throughout the region.

13.8.2. Key Threats and Recovery Actions

13.8.2.1. Key Threats

Known threats to the Pilbara Leaf-nosed Bat include the loss of roosts, vegetation clearing, excavation, blasting and vehicle activity in the species' habitat, interruption of breeding activity, mine collapse and flooding, human entry of roosts, fencing and predation by feral species (TSSC 2016a).

13.8.2.2. Recovery Actions

There are currently no recovery plans for the Pilbara Leaf-nosed Bat.

13.8.3. Important Populations and Critical Habitat

13.8.3.1. Important Populations

The Pilbara Leaf-nosed Bat population of the Pilbara and Gascoyne regions is considered an important population. This is because it comprises multiple colonies forming one interbreeding population, which shows evidence of genetic divergence from other populations in Australia (TSSC 2016a). A total of 526 records of the Pilbara Leaf-nosed Bat occurrence are spread throughout the region (DBCA 2021).

13.8.3.2. Critical Habitat

Underground diurnal roosts are considered critical habitat for the Pilbara Leaf-nosed Bat's survival (TSSC 2016a). The species does not roost in shallow overhangs, given the species' reliance on warm and humid climates for heat maintenance and water balance.

Many roosts that are occupied for much of the year are important for reproduction and daily survival. A standardised nomenclature for these different types of roosts, based on the considerations of both breeding and daily survival, is provided in the Conservation Advice for the Pilbara leaf-nosed Bat (TSSC 2016a) and has been more recently refined in *A review of Pilbara Leaf-nosed Bat ecology, threats and survey requirements* (Bat Call WA 2021b):

- Category 1 (Priority 1): Permanent diurnal roosts are maternity roosts where seasonal presence of young is proven
- Category 2 (Priority 2): Permanent diurnal roosts occupied year-round but without the proven presence of young
- Category 3 (Priority 3): Semi-permanent diurnal roosts that are used diurnally during some part of the year, but not occupied year-round
- Category 4 (Priority 4): Nocturnal refuge occupied or entered at night for resting, feeding or other purposes, with perching not a requirement.

Category 1 to 3 caves are considered a critical habitat for the Pilbara Leaf-nosed Bat's survival. In contrast, category 4 caves are not considered critical habitat but important for local persistence.

The species has been recorded foraging widely and utilising almost all types of productive and semi-productive habitats within the Pilbara (Bat Call WA 2021b). Supporting habitat for the species is considered to be foraging habitat within 10 km of a diurnal roost (TSSC 2016a). The quality of these various habitat types has been classified by a foraging habitat rating, presented in Table 13-21.

Table 13-21: Pilbara Leaf-nosed Bat Habitat Types and Rating Scale (Bat Call WA 2021b)

Habitat Rating (HR)	Description	Habitat Type		
		Plains and Low Hills	Gullies, Ridgelines and Mesas	Deep Gorges
0 (Poor)	Pilbara Leaf-nosed Bats are unlikely to be detected in these areas.	Bare open ground such as salt pans and clay pans without vegetation	Bare mesa and ridge line tops	N/A
1 (Low)	Pilbara Leaf-nosed Bats are unlikely to forage in these areas but may traverse while crossing to more productive areas.	Open plain with one layer of vegetation structure (excluding scattered trees) Two layer, not complex, vegetation structure (excluding scattered trees)	Mesa and ridge line tops. Mesa side or long ridge line with simple geology and minimal caves and overhangs present. Sparse vegetation cover. Shallow non-incised gullies. Spinifex cover to gully floor	N/A
2 (Moderate)	Pilbara Leaf-nosed Bat may occasionally forage in these areas due to the presence of suitable vegetation, seasonal water and may also use areas as a flyway.	Two layer, not complex, vegetation structure (excluding scattered trees). Includes ephemeral watercourse. Open mine shaft entrances.	Mesa side or long ridge line with deeply incised gullies in weathered strata (45° sloping walls). Caves and overhangs present. Shrubs in gully base. Ephemeral watercourse in gully or nearby	N/A
3 (High)	Pilbara Leaf-nosed Bat are likely to forage in these areas if in range of a roost. They may be detected passing along creeklines, vegetation lines, rock faces or foraging in most productive areas.	Three-layer, complex vegetation structure. Includes ephemeral watercourse Includes mine adit or decline in dry locations.	Mesa side or long ridge line with deeply incised gullies in weathered strata (45° sloping walls). Caves and overhangs present. Shrubs in gully base. Ephemeral watercourse in gully or nearby	Dry deeply incised gorge into a ridge or mountain Complex 3-layer vegetation structure. Ephemeral water course
4 (Very High)	Pilbara Leaf-nosed Bats are very likely to forage and/or drink in these areas if in range of roost	Includes watercourses and other sites with semi-permanent or permanent surface water (natural or anthropogenic). Three layers in vegetation structure. Includes caves entrance or mine adits/declines with water nearby.	Mesa side or long ridge line with south, east or west facing, deeply incised gullies with vertical walls. Cave entrance or mine adit. Vegetation is complex. Semi-permanent or permanent water pools present Also north facing gullies with permanent water	Wet 'open' gorge with hills to the side. Wet 'closed' gorge with one or two vertical walls Complex 3-layer, dense vegetation structure. Semi-permanent or permanent
5 (Outside Diurnal Roosts)	Pilbara Leaf-nosed Bat are present pertinently and will be detected nightly.	Areas immediately outside a diurnal roost entrance.	Areas immediately outside a diurnal roost entrance.	Areas immediately outside a diurnal roost entrance.

13.8.4. Occurrence in the Revised Development Envelope

Survey effort for the Pilbara Leaf-nosed Bat included:

- West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2 (Biologic 2021c): echolocation recorders were deployed across Western Hill, Deposit J & Mt Ella East, Deposit F North and Deposit equating to 25 different echolocation sampling sites and a total of 68 sampling nights across both post wet and dry seasons (6 months apart)
- Supplementary single season deployment of echolocation recorders in targeted surveys (Biologic 2022a, b, c, n; 2021e) equating to an additional 25 sites and 74 sampling nights. All echolocation recorders were deployed for a minimum of 2 nights.

The Pilbara Leaf-nosed Bat has been recorded at 12 locations surrounding the Revised Development Envelope; and five locations within the Revised Development Envelope, two of which were within the Proposed Action Area (Biologic 2021c; Figure 13-6). Recent 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 Revised Development Envelope, foraging within the Revised 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 Revised 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 Revised 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).

13.8.5. Habitat within the Revised Development Envelope

13.8.5.1. Roosting Habitat

All of the 41 caves recorded within the Revised Development Envelope, which includes 21 within the Proposed Action Area, 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). Nineteen of the caves recorded within the Revised Development Envelope occur within the Gorge/Gully habitat type, with the remaining 22 caves in the Hillcrest/Hillslope habitat type.

Caves within the Revised Development Envelope can potentially be occupied by both Ghost Bat and Pilbara Leaf-nosed Bat species (Section 13.7).

13.8.5.2. Foraging Habitat

No habitat within the Revised Development Envelope is considered critical to the survival of the Pilbara Leaf-nosed Bat, as no category 1, 2 or 3 caves have been recorded.

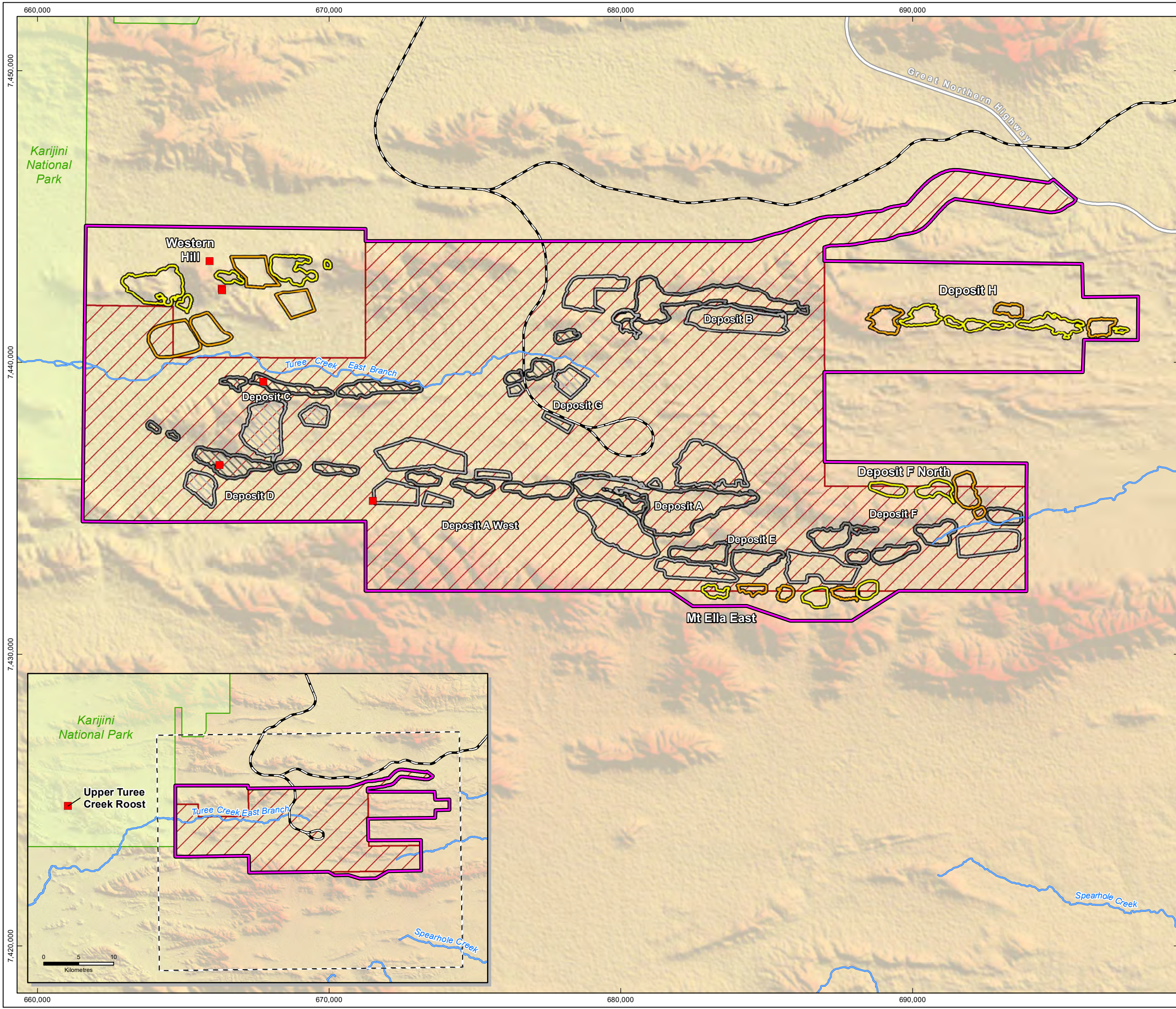
The Gorge/Gully, Drainage Line, and Hillcrest/Hillslope habitat types provide foraging and dispersal opportunities for the species (Biologic 2021c), but are unlikely to represent supporting habitat for the Pilbara Leaf-nosed Bat given the distance from any diurnal roosts.

Permanent water sources (such as pools) located near diurnal roosts are critical to the Pilbara Leaf-nosed Bat, as they provide drinking water and attract many invertebrates on which the bats forage (Bat Call WA 2021b). Three surface water fed ephemeral pools have been recorded within the Proposed Action Area, and all occur within the Gorge/Gully habitat. During multiple surveys, no Pilbara Leaf-nosed

Bat individuals were recorded at these water bodies. As such, it is considered unlikely that the species rely on these water sources; however, they could potentially be used opportunistically (Biologic 2021e).

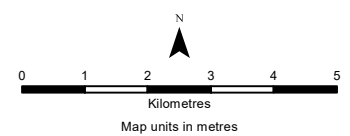
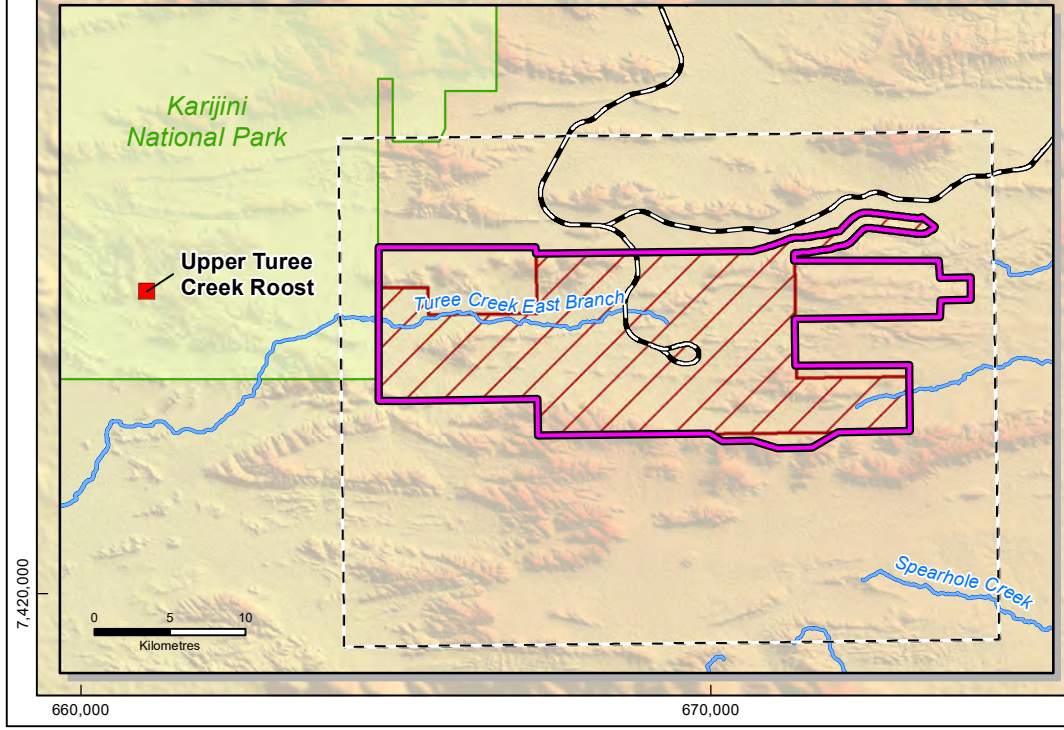
Figure 13-6
Records of Pilbara Leaf-nosed Bat
and Supporting Habitat within the
Revised Development Envelope

Drawn: A.D.
Plan: PDE0186410v7
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- (deposits assessed under DN2018/8299)
- Pit
- Waste Landform
- Pilbara Leaf-nosed Bat (Supporting Habitat)
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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13.8.6. Assessment of Impacts

The Proposed Action may, directly and indirectly, impact the Pilbara Leaf-nosed Bat. The following assessment of impacts has been identified specifically for Pilbara Leaf-nosed Bat; the impacts that apply more broadly for MNES species with the potential to occur within the Revised Development Envelope are described in Section 13.4.

13.8.6.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

Critical and Supporting Habitat

The Proposed Action will not clear any habitat that is critical to the survival of the Pilbara Leaf-nosed Bat due to the absence of category 1 to 3 caves or water sources linked to a roost (Bat Call WA 2021b) within the Revised Development Envelope. Despite extensive targeted survey efforts, the species has only been recorded at five locations within the Revised Development Envelope. The nearest category 2 cave (Upper Turee Roost) is approximately 13.5 km from the Revised Development Envelope in Karijini National Park. The species is considered an infrequent forager within the Revised Development Envelope.

The Gorge/Gully, Hillcrest/Hillslope and Drainage Line habitats within the Revised Development Envelope are considered suitable habitat for the Pilbara Leaf-nosed Bat; however, given the distance from the nearest permanent roost (over 13 km) and the small number of individuals recorded within the Revised Development Envelope, indicating that the Pilbara Leaf-nosed Bat in the area are not reliant upon the habitat within the Revised Development Envelope, this habitat is not considered supporting habitat. The Proposed Action will clear approximately 3,936 ha (~30%) of these habitat types that may provide refuge, foraging and dispersal opportunities for the species. The remaining habitats are of low significance to the species.

Gorge/Gully, Hillcrest/Hillslope, and Drainage Line habitats will remain throughout the Revised Development Envelope. They will continue to provide habitat connectivity, further maintained along Drainage Lines within and surrounding the Revised Development Envelope. These linkages will facilitate the connection of roosting and foraging habitats for the Pilbara Leaf-nosed Bat and enable dispersal and connection between individuals and populations. Habitat fragmentation is therefore not considered to represent a significant residual impact to the Pilbara Leaf-nosed Bat.

Caves and Surface Water Pools

Of the 41 caves recorded within the Revised Development Envelope, of which 21 occur within the Proposed Action Area, all represent category 4 caves for the species and while not considered critical habitat for the Pilbara Leaf-nosed Bat (Bat Call WA 2021b), are considered supporting habitat. Four of these caves will be impacted by the Proposed Action; however, as they are isolated, have no record of use by the species, are potential nocturnal refuges only, and 37 category 4 caves will remain available for use by the Pilbara Leaf-nosed Bat within the Revised Development Envelope, no significant impact on the Pilbara Leaf-nosed Bat is expected. Regardless, the removal of supporting habitat is considered to represent a residual impact to Pilbara Leaf-nosed Bat and is proposed to be offset (see Section 12).

In addition, MRZs and/or MEZs will be implemented around the 17 retained caves within the Proposed Action Area to avoid direct and minimise indirect impacts (Table 13-19). An additional 20 caves within the Revised Development Envelope are currently retained within MS 1113 Restriction and/or Exclusion areas (Table 13-18).

The Proposed Action will impact the size of the catchments which feed the pools within the Revised Development Envelope. However, this impact will be minimised and mitigated to ensure that sufficient surface water flow is maintained to these pools to ensure their ecological function is maintained. This is discussed in more detail in the Inland Waters Chapter (Section 7).

13.8.6.2. Loss of Pilbara Leaf-nosed Bat Individuals

The Pilbara Leaf-nosed Bat forages at low heights and is curious about light sources. These factors put them at risk of interacting with vehicles and machinery, which may result in the death or injury of the individual Pilbara Leaf-nosed Bat. To minimise the likelihood of these interactions, most light vehicle movement outside operating mine areas will occur during daylight hours, avoiding the nocturnal bats when they are most active. The clearing of vegetation will occur progressively, allowing fauna to move away from areas of disturbance.

Speed limits will be implemented to reduce risk to fauna from interactions with vehicles.

The Pilbara Leaf-nosed Bat is also at risk of entanglement in barbed wire fencing, causing injury or mortality. The Proponent commits to avoiding barbed wire fencing as far as practicable. Where barbed wire fencing cannot be avoided (i.e. where legislated), The Proponent will install reflectors to deter bat interaction, and the top strand will be replaced with single-strand wire.

On this basis, using vehicles and machinery associated with the Proposed Action is unlikely to result in injury or mortality of Pilbara Leaf-nosed Bats that will significantly impact the local population.

13.8.6.3. Habitat Degradation Associated with Construction and Operational Activities

Dust

An air quality assessment has been undertaken to estimate the likelihood of increased dust deposition resulting from the Proposed Action impacting sensitive receptors within and surrounding the Revised Development Envelope (ETA 2022). Estimated dust deposition was assessed for 30 bat caves, and results determined that caves near the Proposed Action operations are predicted to experience elevated dust concentrations, noting that there are no numeric threshold criteria for dust levels at these sensitive receptors.

The Pilbara region is naturally dusty, and the Proposed Action is located in and near an existing operational mine. Although there will be elevated dust levels resulting from the Proposed Action, local fauna, including the Pilbara Leaf-nosed Bat, are adapted to the dusty Pilbara climate. Implementing MRZ/MEZs around all retained bat roosts within the Revised Development Envelope will minimise the impacts of dust deposition from construction and operational activities associated with the Proposed Action. All caves within the Revised Development Envelope are category 4 (non-critical) for the Pilbara Leaf-nosed Bat. Dust generation will not result in permanent changes to fauna habitat. The Proponent will implement well-established dust management measures to minimise dust emissions from clearing and vehicle movement. Continued implementation of existing dust suppression strategies to avoid prolonged dust emissions and dust cover on adjacent sensitive receptors, such as bat roosts, is expected to result in a low likelihood of Pilbara Leaf-nosed Bats being adversely affected by dust.

13.8.6.4. Disturbance from Noise, Vibrations and Light, Resulting in the Displacement of Fauna Associated with Construction and Operational Activities

Active mining during the operational phase will generate noise and vibration emissions as a result of blasting activities. However, noise and vibration impact from mining operations are not expected to significantly impact the Pilbara Leaf-nosed Bat given there is no critical habitat or category 1 – 3 roosts within the Revised Development Envelope.

By implementing the noise and vibration mitigation measures described in Section 13.5, the Proponent will ensure the effects that noise and vibration from the Proposed Action have on the remaining cave structures (category 4 roosts) will be minimal and will not significantly impact the Pilbara Leaf-nosed Bat.

Light emissions from the Proposed Action are not expected to significantly alter nocturnal foraging activities for the Pilbara Leaf-nosed Bat, as light emissions are already present due to the Existing

Operations. Additional light emissions from the Proposed Action are not anticipated to significantly impact the foraging behaviours of the Pilbara Leaf-nosed Bat, given the implementation of mitigation measures as outlined in Section 13.5.

13.8.7. Significance of Impacts

An assessment of the Proposed Action impacts on the Pilbara Leaf-nosed Bat is detailed in Table 13-22 with reference to the Significant Impact Guidelines (DoE 2013).

Table 13-22: Assessment of the Significance of Impacts on Pilbara Leaf-nosed Bat

Significant Impact Criteria	Assessment of the Significance of Impacts on Pilbara Leaf-nosed Bat
<p>Potential to lead to a long-term decrease in the size of an important population of a species</p>	<p>The Pilbara population of the Pilbara Leaf-nosed Bat is considered a distinct population and important. All the individuals recorded within the Revised Development Envelope form a part of this important population.</p> <p>A high concentration of calls originates from a cave (known as Upper Turee Creek Roost) just outside the Revised Development Envelope within Karijini National Park. The number and frequency of calls indicate that this cave is a diurnal roost with bats in almost permanent residence (Biologic 2021c) and is the most likely origin of the individuals recorded (foraging) within the Revised Development Envelope.</p> <p>A total of 41 caves have been identified within the Revised Development Envelope, 21 of which occur within the Proposed Action Area, and all are categorised as category 4 caves (non-critical) for the Pilbara Leaf-nosed Bat. Four caves considered supporting habitat will be removed as a result of the Proposed Action. The remaining 17 caves within the Proposed Action Area will be protected with MEZs and MRZs as per Table 13-19. An additional 20 caves within the Revised Development Envelope are retained within current MS 1113 and EPBC assessment 2018/8299 Restriction and/or Exclusion areas (Table 13-18).</p> <p>The Proponent will not directly or indirectly impact the Upper Turee Creek Roost due to the Proposed Action.</p> <p>The Proposed Action will result in clearing approximately 3,936 ha (30%) of Gorge/Gully, Hillcrest/Hillslope and Drainage Line habitat within the Revised Development Envelope that is suitable for refuge, foraging and dispersal opportunities; however, retained habitat will be sufficient to support the transient foraging Pilbara Leaf-nosed Bat population within the Revised Development Envelope.</p> <p>There is evidence of the persistence of the Pilbara Leaf-nosed Bat population in the Pilbara region alongside existing mining operations, including at West Angelas, and habitat retained in the Revised Development Envelope is expected to continue to be utilised.</p> <p>Given the above, the Proposed Action is not expected to cause a long-term decrease in the size of an important population within the Revised Development Envelope.</p>
<p>Potential to reduce the area of occupancy of an important population</p>	<p>As mentioned above, the Pilbara population of Pilbara Leaf-nosed Bats are important; however, there is no permanent population within the Revised Development Envelope. The individuals use the habitat within the Revised Development Envelope to forage.</p> <p>The Proposed Action can potentially reduce the area of occupancy of the Pilbara Leaf-nosed Bat by clearing approximately 3,936 ha (30%) of suitable foraging habitat (Gorge/Gully, Hillcrest/Hillslope and Drainage Line habitat) within the Revised Development Envelope. However, the small number of individuals recorded within the Revised Development Envelope indicate that the Pilbara Leaf-nosed Bat is not reliant upon the habitat within the Revised Development Envelope. Given the retention of suitable habitat within the Revised Development Envelope including within the MEZ and MRZs, and retention of 37 of the 41 recorded category 4 caves (17 of which occur in the Proposed Action Area and 20 currently retained within current MS 1113 and EPBC assessment 2018/8299 Restriction and/or Exclusion areas), the species is expected to continue to occur and forage within the Revised Development Envelope and wider Pilbara region.</p>

Significant Impact Criteria	Assessment of the Significance of Impacts on Pilbara Leaf-nosed Bat
<p>Potential to fragment an existing population into two or more populations</p>	<p>There is no permanent population of Pilbara Leaf-nosed Bats within the Revised Development Envelope. Habitat connectivity will be maintained along the Drainage Lines within and surrounding the Revised Development Envelope. These linkages will facilitate the connection of nocturnal roosting and foraging habitats and enable dispersal and connection between individuals and populations outside of the Revised Development Envelope.</p> <p>The Pilbara Leaf-nosed Bat is a highly mobile species, and any individuals within the Revised Development Envelope are likely to originate from the Upper Turee Creek Roost, more than 13 km away. Given the extensive foraging range and the retention of 37 of the 41 recorded (category 4) caves (supporting habitat) within the Revised Development Envelope including within the MEZ and MRZs, the Proposed Action is not expected to cause the Pilbara Leaf-nosed Bat population to fragment or become disconnected.</p>
<p>Potential to adversely affect habitat critical to the survival of a species</p>	<p>No habitat considered critical for the Pilbara Leaf-nosed Bat is proposed to be cleared. The Proposed Action will clear approximately 3,936 ha (30%) of Gorge/Gully, Hillcrest/Hillslope and Drainage Line habitat, which is considered suitable habitat for refuge, foraging and dispersal; however, given the distance from a permanent diurnal roost, is not considered supporting habitat. Suitable habitat will remain within the Revised Development Envelope, including areas of habitat preserved within the MEZ / MRZs. These habitat types have been recorded as occurring outside the Revised Development Envelope and are likely to occur in Karijini National Park as there is a large known roost site.</p> <p>Of the 21 (category 4) caves within the Proposed Action Area, up to four will be impacted by the Proposed Action. These are not considered critical to the survival of the species. The remaining 17 caves will be retained within the Proposed Action Area, in addition to 20 category 4 caves retained within the wider Revised Development Envelope, to support individuals who utilise the habitat within the Revised Development Envelope.</p>
<p>Potential to disrupt the breeding cycle of an important population</p>	<p>None of the caves in the Revised Development Envelope represents maternity or diurnal roosting sites for the Pilbara Leaf-nosed Bat (category 1, 2 or 3). The closest permanent roost (inferred potential maternity roost) is Upper Turee Creek Roost, located more than 13 km away. The Proposed Action will not directly or indirectly impact the Upper Turee Creek Roost structure. Therefore, the Proposed Action is not expected to impact on the breeding cycle of the local population.</p>
<p>Potential to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>The Proposed Action has the potential to modify, destroy, remove, isolate and decrease the availability of the Pilbara Leaf-nosed Bat habitat due to the clearing of suitable habitat. Given that no breeding or diurnal roosts (category 1, 2 or 3) will be impacted and the species is not likely to be reliant on the habitat within the Revised Development Envelope, Pilbara Leaf-nosed Bats are not expected to be impacted to the extent which would cause the decline of the species.</p>
<p>Potential to result in invasive species that are harmful to the vulnerable species becoming established in the vulnerable species' habitat</p>	<p>The approved conservation advice for the species suggests that invasive species are not expected to significantly impact the Pilbara Leaf-nosed Bat (TSSC 2016a).</p> <p>Cane Toads are identified as a threat to the species; however, the Cane Toad is not present in the Pilbara. The Proposed Action will not increase the potential for Cane Toad to become established in the Revised Development Envelope.</p>

Significant Impact Criteria	Assessment of the Significance of Impacts on Pilbara Leaf-nosed Bat
	<p>Feral Cats may be a potential threat to the species, and have been recorded within the Revised Development Envelope. The Proponent will undertake feral Cat monitoring and a control program in high risk areas and/or critical habitat within the Revised Development Envelope in response to feral animal sightings, as per the EMP (Appendix A.8).</p>
<p>Potential to introduce disease that may cause the species to decline</p>	<p>Currently, there are no known diseases harmful to the Pilbara Leaf-nosed Bat. There is also no evidence to suggest that the Proposed Action would introduce a disease into the population, which would cause the species to decline.</p>
<p>Potential to interfere substantially with the recovery of the species</p>	<p>Key management actions for the recovery of the species include the protection of land with significant colonies, replacement of barbed wire fencing, protection of roosts and protection of the structural integrity of roosts (TSSC 2016a).</p> <p>There will be no direct or indirect damage to the closest significant roost site (Upper Turee Creek Roost) and 37 of the 41 category 4 caves within the Revised Development Envelope will be retained within MRZs and/or MEZs.</p> <p>The Proponent will avoid using barbed wire as far as practicable. Where barbed wire fencing is required by legislation, the Proponent will replace the top strand with plain wire and place reflectors to deter the species.</p> <p>On this basis, the Proposed Action will not interfere with the recovery of the Pilbara Leaf-nosed Bat.</p>

13.8.8. Consistency with Relevant Recovery Plans and Guidance

There are no recovery plans for the Pilbara Leaf-nosed Bat.

13.8.8.1. Threat Abatement Plans

There are no TAPs identified as being relevant for the Pilbara Leaf-nosed Bat.

13.8.8.2. Conservation Advice

The primary conservation actions from the Conservation Advice for Pilbara Leaf-nosed Bat (TSSC 2016a) are outlined in Table 13-1. The Proposed Action has contributed to / will contribute to the following primary conservation actions:

- Discovery of new potential roosts and occurrences through field surveys across the Revised Development Envelope and surrounding areas
- Protect known potential roosts with the implementation of MRZs and/or MEZs (Table 13-19)
- Protection of foraging/dispersal habitat with the implementation of avoidance and minimization measures associated with land clearing activities.

13.8.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a Proposed Action has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.8.9.1. Residual Significant Impact

A very low-density population of Pilbara Leaf-nosed Bats has been recorded within the Revised Development Envelope. After application of mitigation measures, the following significant residual impacts are predicted for the Pilbara Leaf-nosed Bat:

- Removal of four category 4 caves considered supporting habitat for the Pilbara Leaf-nosed Bat.

13.8.9.2. Predicted Environmental Outcome

In consideration of the low density population in combination with the proposed avoidance and management measures and likely residual impacts associated with the Proposed Action, the anticipated environmental outcomes that apply to the Pilbara Leaf-nosed Bat are set out below:

- For the Proposed Action, clearing will not exceed:
 - 126 ha of Gorge/Gully habitat (suitable habitat for Pilbara Leaf-nosed Bat) within the Revised Development Envelope
 - 3,731 ha of Hillcrest/Hillslope habitat (suitable habitat for Pilbara Leaf-nosed Bat) within the Revised Development Envelope but critical habitat for Ghost Bat) within the Revised Development Envelope

- Removal of up to four category 4 Pilbara Leaf-nosed Bat potential roosts (supporting habitat)
- Minimise direct and indirect impacts from the Proposed Action on Pilbara Leaf-nosed Bat habitat in accordance with the EMP (Appendix A.8)
- No direct or significant indirect impacts from the Proposed Action to Pilbara Leaf-nosed Bat roosts retained within MRZs and/or MEZs (shown in Figure 13-5)

The Proponent will implement the EMP as per Appendix A.8 to achieve these outcomes.

13.8.10. Conclusion

Following implementation of the mitigation hierarchy, a significant residual impact is expected from the proposed removal of four category 4 caves considered supporting habitat for the Pilbara Leaf-nosed Bat. Environmental offsets are proposed for this impact and are discussed in Section 12. Subject to conditions and implementation of offsets, the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the Pilbara Leaf-nosed Bat's survival.

13.9. Pilbara Olive Python (*Liasis olivaceus barroni*)

The Pilbara Olive Python is listed as Vulnerable under the EPBC Act. It is a dull olive-brown to pale fawn or rich brown python with a white/cream belly, pale lips finely dotted with pale grey or brown. This species can grow up to 4 m in length but has an average size of 2.5 m. Females are slightly longer than males (DEWHA 2008a).

13.9.1. Habitat Preferences and Distribution

The Pilbara Olive Python is only known to occur within the Pilbara bioregion of Western Australia and the Dampier Archipelago off the coast of the state (DEWHA 2008a). The species has a widespread distribution within the bioregion, with populations known to occur around Pardoo and Tom Price. The species has a cryptic nature and as such the overall population size is difficult to determine but has been reported as being sizable in large areas of contiguous habitat.

Within the Pilbara, the Pilbara Olive Python favours water holes and deep gorges within the ranges (DEWHA 2008a). The species spends the winter months in caves and rock crevices and moves widely amongst water holes and rocky outcrops in the summer. Within the Hamersley region, the species is typically found amongst riverine vegetation or rocky ranges with water holes (Biologic 2021e). The Pilbara Olive Python uses water features to hunt by striking prey from a submerged stance. There is a common misconception that the Pilbara Olive Python is restricted to habitats that contain permanent water sources. However, the species is typically attracted to such areas due to their high productivity and abundance of prey, including water birds, rock-wallabies, wallaroos, fruit bats and occasionally Northern Quoll (Pearson 2003 in Biologic 2021e).

13.9.2. Key Threats and Recovery Actions

13.9.2.1. Key Threats

The approved Conservation Advice for the Pilbara Olive Python (DEWHA 2008a) identifies the key threats to include predation and resource competition by feral Cats and Foxes and the destruction of habitat due to mining and gas development. The species population is also being impacted by increased road kills (due to increased road traffic) and death due to mistaken identification as the poisonous Eastern Brown Snake (DEWHA 2008a).

13.9.2.2. Recovery Actions

The Perth Zoo and Curtin University are conducting DNA research on the species through blood samples (Perth Zoo 2021). This is in an attempt to map the genetic makeup of the Pilbara Olive Python to make environmental DNA (eDNA) analysis feasible to determine the species' presence. The eDNA process is regarded as a more efficient and cost-effective way to determine the presence of the species compared to the traditional visual capture techniques due to the cryptic and elusive nature of the species. Similar studies have also been conducted by EnviroDNA (2021) in collaboration with Spectrum Ecology.

DPaW (2014) developed the Pilbara Threatened Fauna Data Entry System (accessible through Nature Map). This portal allows members to register, view, and contribute distribution records derived from several sources. This provides a central database that provides current and up to date information. This database expands distribution knowledge for the Pilbara Olive Python and other threatened fauna species in the Pilbara (DPaW 2014).

13.9.3. Important Populations and Critical Habitat

13.9.3.1. Important Populations

No species-specific policy guidelines specify what an important population is for this species. For this assessment, an important population is the presence of multiple records (both sightings and secondary evidence, i.e. scats) or any indication of breeding (i.e. evidence of eggs or juveniles).

There are currently 190 records of the Pilbara Olive Python across the Pilbara region (DBCA 2021), including populations at Pannawonica, Millstream, Tom Price, and the Burrup Peninsula. The Revised Development Envelope is located within the modelled distribution of Pilbara Olive Python, and any individuals within this area are likely to be a part of an important population.

The Pilbara Olive Python also occurs within the Rangelands (WA) Natural Resource Management Region. Part of its habitat is conserved in Karijini National Park, which is adjacent to the eastern edge of the Revised Development Envelope.

13.9.3.2. Critical Habitat

To date, there are no species-specific policy guidelines on what constitutes critical habitat for the species. However, for this assessment, the definition of critical habitat is any habitat used 'for activities such as foraging, breeding, roosting and dispersal' as this is the definition set out in the Significant Impact Guidelines (DoE 2013). This typically includes rocky areas and gorges, particularly when those areas are near to water sources.

13.9.4. Occurrence in the Revised Development Envelope

To adequately survey for Pilbara Olive Python 172.4 hours of targeted searched in appropriate habitats (Gorge/Gully, inside caves and water pools) was undertaken (Biologic 2022a, b, c, n; 2021c, d, e) which included searching for the presence of individuals, scats, remains and shed skins. Motion cameras (totalling 3,801 camera nights) across these surveys also provided supplementary sampling for the Pilbara Olive Python.

The Pilbara Olive Python has been recorded twice within the Proposed Action Area, with one record via scat sample at the Western Hill deposit and the other record via motion camera at a water feature (WB-WAH1), located in Gorge/Gully habitat, within Deposit H (Biologic 2021e) (Figure 13-7). Due to the highly cryptic nature of the species, more individuals likely reside permanently within the Proposed Action Area and wider Revised Development Envelope.

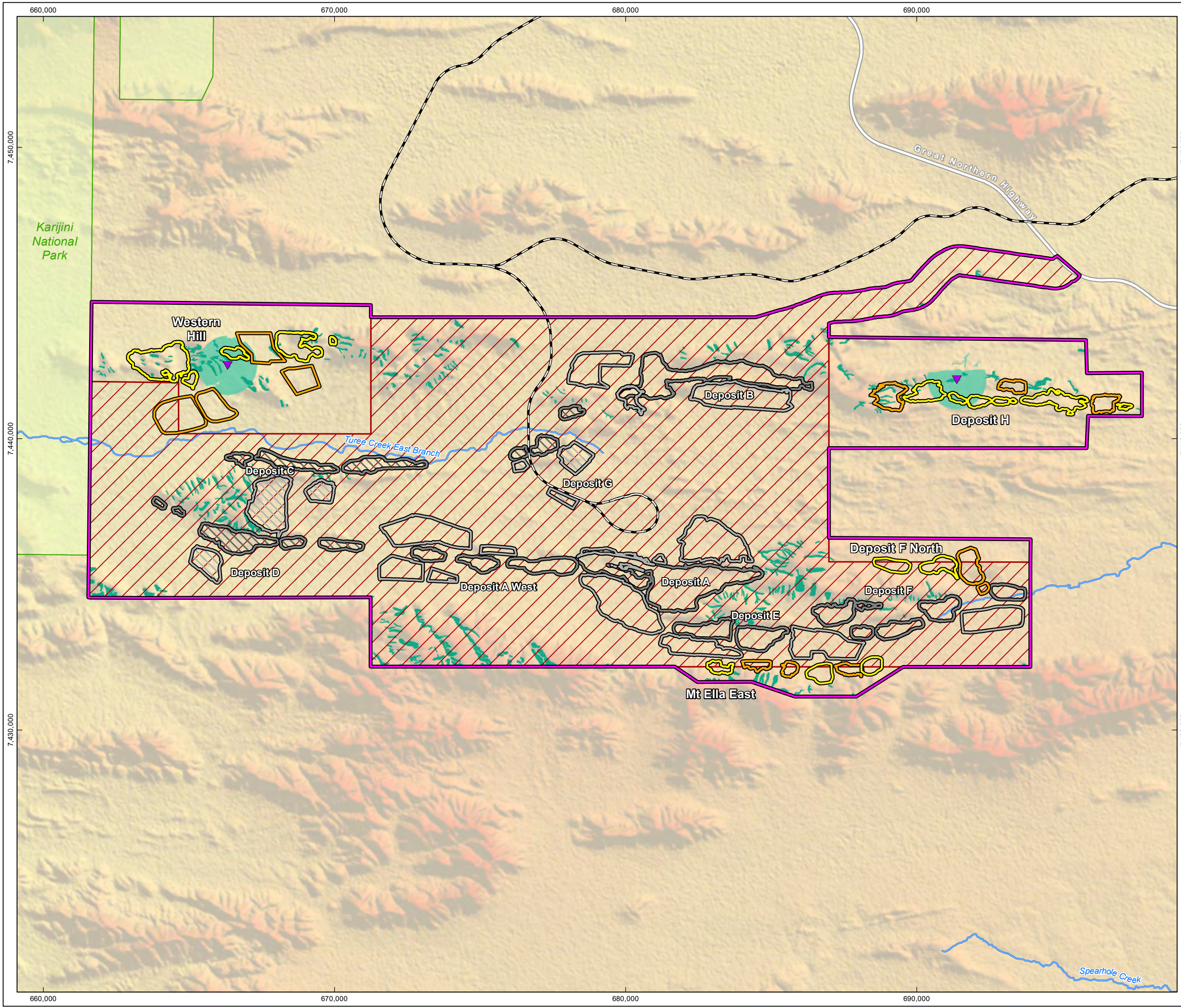
13.9.5. Habitat within the Revised Development Envelope

The Revised Development Envelope contains suitable habitat for the Pilbara Olive Python, including habitat potentially critical for the species' survival (DoE 2013; Biologic 2021c; e; Figure 13-7). Gorge/Gully habitat within the Revised Development Envelope is considered potential critical habitat for the Pilbara Olive Python as it can provide important denning, shelter, foraging and dispersal habitat for the species and includes the presence of water features, caves and crevices (Biologic 2021c; e; Figure 13-7). The Drainage Line habitat within the Revised Development Envelope lacks the permanent water features required by the species to meet the criteria of critical habitat for the Pilbara Olive Python. Both Drainage Line and Hillcrest/Hillslope habitat types are considered supporting habitat when within 1 km of Pilbara Olive Python records (Figure 13-7). All other fauna habitats within the Revised Development Envelope are of low value to the species. Five ephemeral surface water features have been recorded within the Revised Development Envelope, three of which occur within the Proposed Action Area (Table 13-10). The Pilbara Olive Python record from Deposit H was via a motion camera that was pointed toward one of the water features (WB-WAH1), which recorded the individual emerging from the ephemeral pool to investigate a macropod that was drinking from the pool (Biologic 2021c; e). The other

two ephemeral water features within the Proposed Action Area are minor and likely short term pooling after heavy rain (Section 13.3.4; Table 13-10).

Figure 13-7
Pilbara Olive Python Records and
Critical and Supporting Habitat within
the Revised Development Envelope

Drawn: GIS Team
Plan: PDE0186411v7
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope

Proposed Conceptual Layout

- Pit
- Waste Landform

Approved Conceptual Layout
(deposits assessed under DN2018/8299)

- Pit
- Waste Landform

Pit

Waste Landform

Pilbara Olive Python (Critical Habitat)

Habitat Value

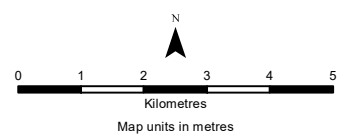
- Potential Critical Habitat
- Supporting Habitat

National Park

Rio Tinto Railway

Highway

Major Creek



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13.9.6. Assessment of Impacts

The Proposed Action may, directly and indirectly, impact Pilbara Olive Python. The following assessment of impacts specifically considers Pilbara Olive Python, in addition to the impacts applying more broadly for all MNES species with potential to occur within the Revised Development Envelope. Key impact pathways are discussed in Section 13.4.

13.9.6.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

Critical and Supporting Habitat

The Proposed Action will clear up to 126 ha of habitat potentially critical to the survival of the Pilbara Olive Python, comprising the Gorge/Gully habitat type which provides breeding, shelter and foraging habitat.

The Proposed Action will also result in clearing approximately 355 ha of Hillcrest/Hillslope and Drainage Line habitat within 1 km of Pilbara Olive Python records, which is considered supporting habitat for the Pilbara Olive Python. This habitat provides shelter, foraging and dispersal opportunities for the species. The remaining habitats are not considered critical or supporting habitat for the species' survival.

The clearing of potential critical and supporting habitat for the Pilbara Olive Python is considered to represent a significant residual impact and is proposed to be offset (Section 12).

Remaining habitat within the Revised Development Envelope, including within the MEZ/MRZs will continue to provide habitat connectivity, further maintained along Drainage Lines within and surrounding the Revised Development Envelope. These linkages will facilitate the connection of foraging and dispersal habitats for the Pilbara Olive Python and enable dispersal and connection between individuals and populations. Habitat fragmentation is therefore not considered to represent a significant residual impact to the species.

Surface Water Pools

Surface water bodies, or pools, are considered to be critical habitat for the Pilbara Olive Python (DEWHA 2008a). The Proposed Action will not directly impact the pools from clearing activities but the Proposed Action would result in the catchment reduction of one surface water fed ephemeral pool (WB-WAH1). The Pilbara Olive Python would likely use this pool opportunistically, and the pool will remain viable for use by the species. Therefore, the reduction of the surface water catchment of this ephemeral pool is unlikely to significantly impact the species.

This impact is discussed in more detail in the Inland Waters Chapter (Section 7).

13.9.6.2. Loss of Pilbara Olive Python Individuals

The Pilbara Olive Python is slow-moving and nocturnal and is vulnerable to injury or mortality from vehicle and machinery movements (DAWE 2022). Most light vehicle movement outside operating mine areas will occur during daylight hours, and the species has only been recorded twice within the Revised Development Envelope, minimising the potential for interaction with this species. The Proponent will implement management measures to mitigate the loss of fauna individuals, such as:

- Progressive clearing to allow fauna to migrate away from clearing activities or machinery movements
- Awareness training to identify conservation significant fauna and habitat, relevant management measures, personnel/contractor responsibilities, and incident reporting requirements (i.e., reporting of fauna observations and incidents)
- Vehicle speed limits to minimise the risk of fauna injury or mortality from vehicle strike.

By implementing mitigation and management measures, the loss of Pilbara Olive Python individuals associated with the Proposed Action is not expected to cause significant impacts to the species.

13.9.6.3. Disturbance from Light, Noise and/or Vibration Resulting in the Displacement of Fauna Associated with the Construction and Mining Operations

Snakes use the inner ear to identify prey and avoid predators by detecting ground vibrations. Noise and vibration from blasting associated with the Proposed Action will be intermittent and of short duration. The sporadic and brief nature of the blasting activities means that related vibrations are not expected to interfere with the Pilbara Olive Python's ability to detect prey and avoid predators. It is not expected to impact individuals that may utilise nearby habitats significantly.

No significant impacts on Pilbara Olive Python are expected from increased light, noise, and vibration disturbance.

13.9.7. Significance of Impacts

An assessment of the Proposed Action impacts on Pilbara Olive Python is detailed in Table 13-23, with reference to the Significant Impact Guidelines (DoE 2013).

Table 13-23: Assessment of the Significance of Impacts on Pilbara Olive Python

Significant Impact Criteria	Assessment of the Significance of Impacts to Pilbara Olive Python
<p>Potential to lead to a long-term decrease in the size of an important population of a species</p>	<p>The Revised Development Envelope is located within the species' modelled distribution, and as such, any individuals present may be part of an important population (DoE 2013). However, only two records have been recorded of this species within the Proposed Action Area and Revised Development Envelope (one sighting and one scat) and no evidence of breeding (eggs or juveniles). Even though it is expected to occur throughout the Revised Development Envelope, it is considered unlikely to be an important population.</p> <p>The Proposed Action will remove up to 126 ha (~20%) of potential critical Gorge/Gully habitat and approximately 355 ha of supporting Drainage Line and Hillcrest/Hillslope habitat from the Revised Development Envelope. These habitat types will remain within the Revised Development Envelope, including retention within the MEZ/MRZs. The Proponent has minimised the impact on Drainage Lines which will facilitate habitat connectivity and the movement of the Pilbara Olive Python through the Revised Development Envelope.</p> <p>Given the retention of potential critical habitat within the Revised Development Envelope, including suitable foraging and denning sites, the Proposed Action is not expected to cause the long-term decline in the size of the important population within the Revised Development Envelope.</p>
<p>Potential to reduce the area of occupancy of an important population</p>	<p>The Pilbara Olive Python has been recorded across the Pilbara bioregion (Section 13.9.1), and the Revised Development Envelope is within the species' known distribution. As such, individuals within the Revised Development Envelope may be part of an important population. However, due to a lack of records (two within the Revised Development Envelope), it is unlikely that these records represent an important population. The Proposed Action can potentially reduce the area of occupancy of the species in the local context through the loss of critical habitat. However, the species is expected to continue to exist within and surrounding the Revised Development Envelope, given the retention of critical and supporting habitat within the Revised Development Envelope and occurrence within the surrounding area.</p>
<p>Potential to fragment an existing important population into two or more populations</p>	<p>The Pilbara Olive Python is a highly mobile species, with males moving up to 4 km through the landscape to find females during mating season. Habitat connectivity will be sufficiently retained, with critical habitat being retained within the Revised Development Envelope and habitat corridors along Drainage Lines. The Proposed Action is not expected to cause the fragmentation of an important Pilbara Olive Python population into two or more populations due to the retention of connected habitat including the Drainage Line corridors and as it is unlikely the population within the Revised Development Envelope is an important population.</p>
<p>Potential to adversely affect habitat critical to the survival of a species</p>	<p>The Proposed Action will result in clearing up to 126 ha (~20%) of Gorge/Gully habitat considered potentially critical to the survival of the Pilbara Olive Python within the Revised Development Envelope. The Proposed Action will also result in clearing approximately 355 ha (~23%) of Drainage Line and Hillcrest/Hillslope habitat, which is considered supporting habitat for the Pilbara Olive Python when located within 1 km of records. The Revised Development Envelope will retain Gorge/Gully habitat and Drainage Line and Hillcrest/Hillslope habitat, including a portion of these habitats within the MEZ/MRZs. Habitat is also known to be present in the local area as mapped in reference areas and extrapolated mapping. Nevertheless, clearing of potential critical and supporting habitat is a significant residual impact and is proposed to be offset (Section 12).</p>

Significant Impact Criteria	Assessment of the Significance of Impacts to Pilbara Olive Python
Potential to disrupt the breeding cycle of an important population	<p>No evidence of Pilbara Olive Python breeding has been recorded within the Revised Development Envelope (i.e no gravid females, eggs or juveniles records). Male Pilbara Olive Pythons can move up to 4 km in search of a female during the breeding season and require access to shelters such as caves and breakaways for shelter (DEWHA 2008a). These shelters are generally found in the Gorge/Gully habitat type, which will be retained within the Revised Development Envelope including habitat retained within the MEZ/MRZs.</p> <p>Thirty-seven (37) of the 41 caves present within the Revised Development Envelope will be retained and protected by MEZs and/or MRZs. This will provide males with sufficient shelter and hunting habitat whilst traversing the Revised Development Envelope in search of mates.</p> <p>Given the retention of potential critical Gorge/Gully habitat (including habitat retained within the MEZ/MRZs), which provides breeding and shelter habitat for the Pilbara Olive Python, the Proposed Action is not expected to disrupt the breeding cycle of the local Pilbara Olive Python population.</p>
Potential to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	<p>The Proposed Action has the potential to modify, destroy, remove, isolate or decrease the availability or quality of habitat for the local Pilbara Olive Python population. The Proposed Action will result in the clearing of up to 126 ha (~20%) of potential critical habitat (Gorge/Gully) and approximately 355 ha of supporting habitat (Drainage Line and Hillcrest/Hillslope) for the species within the Revised Development Envelope. These habitat types will be retained within the Revised Development Envelope and impacts to surface water fed ephemeral pools will be minimised to ensure their ecological function is maintained. Furthermore, additional critical and supporting habitat occurs outside the Revised Development Envelope within the West Angelas Area. The remaining potential critical and supporting habitat, caves and surface water fed ephemeral pools are expected to be sufficient to support the persistence of the local Pilbara Olive Python population at its current size.</p>
Potential to result in invasive species that are harmful to the vulnerable species becoming established in the vulnerable species' habitat	<p>European Red Foxes and Feral Cats are a known threat to the Pilbara Olive Python, especially to juveniles.</p> <p>No Foxes have been recorded within the Revised Development Envelope and are unlikely to be introduced into the area due to the Proposed Action.</p> <p>The Proponent will expand the current feral Cat monitoring and control program within the Revised Development Envelope in high risk areas and/or critical habitat in response to feral animal sightings, as per the EMP (Appendix A.8).</p>
Potential to introduce disease that may cause the species to decline	<p>There are no known diseases harmful to the Pilbara Olive Python. There is also no evidence to suggest that the Proposed Action would introduce disease into the population, which would cause the species to decline.</p>
Potential to interfere substantially with the recovery of the species	<p>Regional and local priority actions have been identified for Pilbara Olive Python, including ensuring that development in areas where the species occurs does not impact known populations, managing changes to hydrology, and implementing TAPs to control and eradicate Foxes and Cats.</p>

Significant Impact Criteria	Assessment of the Significance of Impacts to Pilbara Olive Python
	<p>The Proposed Action will result in clearing up to 126 ha (~20%) of potential critical habitat. Potential critical habitat will remain within the Revised Development Envelope, including a portion retained within the MEZ/MRZs and the broader West Angelas Area. Habitat is also likely to be present throughout the wider Pilbara region.</p> <p>The mitigation measures are not considered at variance with the recovery actions on the conservation advice and TAPs. Therefore, the Proposed Action is not expected to interfere with the recovery of the species.</p>

13.9.8. Consistency with Relevant Recovery Plans and Guidance

There are no recovery plans for the Pilbara Olive Python.

13.9.8.1. Threat Abatement Plans

Feral Cats have been recorded within the Revised Development Envelope (Biologic 2021c). Mine operations can increase the abundance of feral animal species due to additional resources, such as food scraps, water and shelter. The Proponent will record all sightings of feral animals and undertake feral animal control within high risk areas and/or critical habitat in response to sightings, as per the EMP (Appendix A.8). As such, the Proposed Action will align with the TAP for predation by feral Cats (DoE 2015b).

13.9.8.2. Conservation Advice

The primary conservation actions from the Conservation Advice for Pilbara Olive Python (DEWHA 2008a) are outlined in Table 13-1. The Proposed Action has contributed to the following primary conservation actions:

- Identification of populations of high conservation priority
- Managing changes to hydrological regimes
- Implementation of control and eradication of feral animals in the local region
- Raise awareness with the community
- Implementation of road signage to raise awareness with road users on nearby roads.

13.9.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a Proposed Action has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.9.9.1. Residual Significant Impact

After application of mitigation measures, the following significant impacts are predicted for the Pilbara Olive Python within the Revised Development Envelope:

- Clearing up to 126 ha (~20%) of Gorge/Gully habitat which provides potentially critical breeding, shelter and foraging habitat. This clearing is proposed to be managed via upper limits of clearing as per Table 13-11 and will be offset as per Section 12
- Clearing of approximately 355 ha of supporting Hillcrest/Hillslope and Drainage Line habitat within 1 km of Pilbara Olive Python records, which provides shelter, foraging and dispersal habitat. The

clearing of up to 3,731 ha of Hillcrest/Hillslope is a proposed upper clearing limit. Offsets are proposed for the clearing of supporting habitat, as per Section 12.

13.9.9.2. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures and likely residual impacts associated with the Proposed Action, the anticipated environmental outcomes that apply to the Pilbara Olive Python are below:

- For the Proposed Action, clearing will not exceed 5,350 ha of all habitat types within the Revised Development Envelope, including supporting habitats for the Pilbara Olive Python (Drainage Line and Hillcrest/Hillslope within 1 km of records) of which, no more than:
 - 126 ha of Gorge/Gully habitat (potential critical habitat for the Pilbara Olive Python) within the Revised Development Envelope or
 - 3,731 ha of Hillcrest/Hillslope habitat (supporting habitat for the Pilbara Olive Python when within 1 km of records, but potential critical habitat for Ghost Bat) within the Revised Development Envelope will be cleared
- Minimise direct and indirect impacts from the Proposed Action on Pilbara Olive Python habitat in accordance with the EMP (Appendix A.8).

The Proponent will implement the EMP as per Appendix A.8 to achieve these outcomes.

13.9.10. Conclusion

After implementing the mitigation hierarchy, the significant residual impact to Pilbara Olive Python is clearing up to 126 ha of potential critical Gorge/Gully habitat and approximately 355 ha of supporting habitat (Hillcrest/Hillslope and Drainage Line). Environmental offsets are proposed for this clearing and are discussed in Section 12. Subject to conditions and implementation of offsets, the Proponent considers that the potential impacts from the Proposed Action can be managed and that residual impacts will not significantly affect the Pilbara Olive Python.

13.10. Night Parrot (*Pezoporus occidentalis*)

The Night Parrot is a nocturnal ground-feeding bird, listed as Endangered under the EPBC Act.

13.10.1. Habitat Preferences and Distribution

The Night Parrot has been historically recorded as occurring within most of Australia's arid and semi-arid regions, with large populations within northern Western Australia and western Queensland (Higgins 1999). Recently, the recorded sightings of this species have significantly reduced with the species thought to be extinct until its rediscovery in 2013 (DBCA 2017b). Most recent sightings have occurred in western Queensland and near interior salt lakes in Western Australia's northern and central parts.

The habitat for this elusive species is generally dense low vegetation which includes:

- Spinifex (*Triodia* spp.) grasslands on stony or sandy terrain and generally in association with nearby water bodies (Blyth 1996)
- Samphire (*Sarcocornia* spp.) and Chenopod shrublands on claypans, floodplains or the margins of salt lakes, creeks or other water bodies (Higgins 1999).

It has been suggested that the species moves between these two vegetation types seasonally in response to the seeding of the different species that make up these vegetation types (Blyth 1996).

13.10.2. Key Threats and Recovery Actions

13.10.2.1. Key Threats

The primary threats to the Night Parrot are (TSSC 2016c):

- Predation by feral Cats and Red Foxes
- Changes to fire regimes
- Competition for food with livestock and feral herbivores as well as the degradation of their habitat by the same species
- Reduced availability of water due to competition with feral Camels and livestock and reduced maintenance by indigenous peoples.

13.10.2.2. Recovery Actions

Due to the species' cryptic nature, simply locating populations to protect and perform recovery actions is a major challenge. To date, the conservation activities have focused on effectively managing fire regimes, feral Cat populations and minimising grazing pressures on habitats suitable to support the species (National Environmental Science Program Threatened Species Research Hub 2019).

In 2014, through a collaborative effort between the Queensland Government, Australian Government and the University of Queensland, the Pullen Pullen Reserve was established specifically for the conservation of the Night Parrot (National Environmental Science Program Threatened Species Research Hub 2019). This included the erection of parrot friendly fences to exclude predators and livestock. The population within the Reserve is constantly monitored to understand the ecology of the species better to further refine conservation techniques as well as find additional populations.

13.10.3. Important Populations and Critical Habitat

13.10.3.1. Important Populations

It is estimated that the current population of the Night Parrot is approximately 100 mature adult individuals (National Environmental Science Program Threatened Species Research Hub 2019). Most of this population (80%) occurs within Western Australia, with the remaining 20% occurring within Western Queensland. All of the individuals within Western Queensland are located within the Pullen Pullen Reserve and Diamantina National Park. The current trend for the overall population is stable; however, the amount of confidence placed on this is low due to the absence of sufficient population data.

13.10.3.2. Critical Habitat

Currently, no species-specific policy guidelines define habitat critical to the species' survival. However, for this assessment, the definition of critical habitat is any habitat used 'for activities such as foraging, breeding, roosting or dispersal' as this is the definition set out in the Significant Impact Guidelines (DoE 2013). The habitat for this elusive species is generally dense low vegetation which includes:

- Spinifex (*Triodia* spp.) grasslands on stony or sandy terrain and generally in association with nearby water bodies (Blyth 1996)
- Samphire (*Sarcocornia* spp.) and Chenopod shrublands on claypans, floodplains or the margins of salt lakes, creeks or other water bodies (Higgins 1999).

13.10.4. Occurrence in the Revised Development Envelope

The Night Parrot has not been recorded within or around the Revised Development Envelope (Biologic 2021c; Biologic 2021e). A targeted Night Parrot survey was undertaken within and surrounding the Revised Development Envelope, which involved deploying bioacoustics recording units at five sites for a total of 16 recording nights (Biologic 2019b). No confirmed records of Night Parrot were recorded during this targeted survey or any other fauna surveys undertaken within the Revised Development Envelope (Biologic 2019b). An additional targeted survey was undertaken in 2021, comprising 269 acoustic recording nights (Biologic 2021e). No Night Parrots were recorded during this survey. The closest sighting location for the species is over 100 km north of the Revised Development Envelope, near the Fortescue Marsh (DBCA 2017b). The lack of records does not irrefutably indicate that the species is absent from the Revised Development Envelope, as the species is notoriously cryptic; however, survey effort for the species has been adequate to confidently determine that it is unlikely to occur within the Revised Development Envelope (Biologic 2021e).

13.10.5. Habitat within the Revised Development Envelope

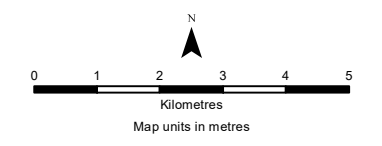
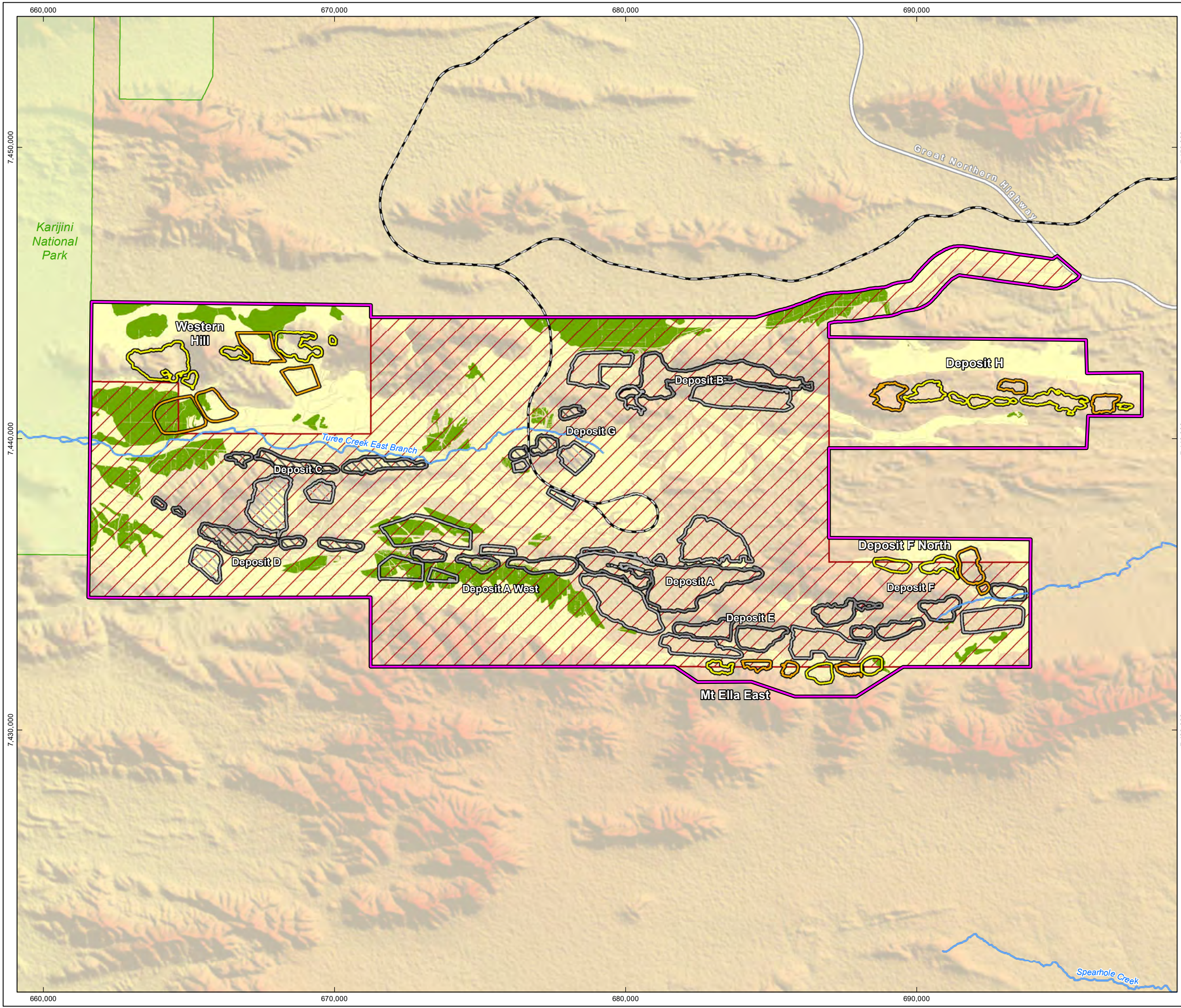
The absence of any habitat within the Revised Development Envelope of high or moderate significance to the species strongly indicates that the Night Parrot is unlikely to be present. The Mixed Acacia Woodland and Footslopes and Plain habitats within the Revised Development Envelope are considered the most likely to provide potential nesting and/or foraging opportunities for the Night Parrot (Biologic 2021e). Due to the lack of recorded evidence for the Night Parrot and only marginal habitat being present within the Revised Development Envelope, it is unlikely for the Night Parrot to be present as either a resident or a frequent foraging visitor.

Figure 13-8
Potential Habitat Suitable for
Night Parrot within the Revised
Development Envelope

Drawn: A.D.
Plan: RTIO-0971695v5
Date: August 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform(deposits assessed under DN2018/8299)
- Fauna Habitat**
 - Footslopes and Plains
 - Mixed Acacia Woodland
- National Park
- Highway
- Rio Tinto Railway
- Major Creek



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13.10.6. Assessment of Impacts

The Proposed Action may result in direct and indirect impacts on Night Parrot. The following assessment of impacts specifically considers Night Parrot, in addition to the impacts applying more broadly for all MNES species with potential to occur within the Revised Development Envelope. Key impact pathways are discussed in Section 13.4.

13.10.6.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

None of the habitat types within the Revised Development Envelope are of high or moderate significance for the Night Parrot. Mixed Acacia Woodland and Foothills and Plain habitats do have some capacity to support the nesting and foraging of the species; however, the potentially suitable extent of these habitats are minimal. Given this, the limited records of the species within Western Australia and lack of records within the Revised Development Envelope despite targeted survey efforts, the Night Parrot is considered unlikely to occur in the Revised Development Envelope as either a resident or a frequent foraging visitor (Biologic 2021e).

The Proposed Action will result in clearing approximately 2,161 ha (~14%) of low significance Mixed Acacia Woodland and Foothills and Plain habitat from within the Revised Development Envelope.

Due to the absence of any high significance habitat or recorded evidence for the Night Parrot within the Revised Development Envelope, clearing this vegetation is not considered to significantly impact any potential Night Parrot populations. No mitigation is proposed in relation to this species.

13.10.7. Significance of Impacts

An assessment of the Proposed Action impacts on the Night Parrot is detailed in Table 13-24, with reference to the Significant Impact Guidelines (DoE 2013).

Table 13-24: Assessment of the Significance of Impacts to Night Parrot

Significant Impact Criteria	Assessment of the Significance of Impacts to Night Parrot
Potential to lead to a long-term decrease in the size of a population	The Night Parrot was not recorded within the Revised Development Envelope and is not likely to be present as only low significance (marginal) habitat for the species is present. As such, the Proposed Action is highly unlikely to have any impact on the long-term size of the Night Parrot population in the Pilbara.
Potential to reduce the area of occupancy of the species	Some suitable habitat is present in the Proposed Action Area and Revised Development Envelope, but it is of low significance to the species due to the lack of large patches of long-unburnt <i>Triodia</i> hummock grasses. Despite targeted acoustic surveys of suitable habitats, there is no evidence to suggest the species occurs within the Revised Development Envelope or in the surrounding landscape. As such, the removal of low significance habitat is unlikely to result in a reduction in the area of occupancy for the species.
Potential to fragment an existing population into two or more populations	The Night Parrot is a highly mobile species and known to fly up to 40 km in a night to forage. It is considered likely to fly more than 100 km per night between roosting and foraging habitat during drought conditions (Murphy et al. 2017). Given the lack of species records and suitable habitat within the Revised Development Envelope, the Proposed Action is not expected to fragment an existing population.
Potential to adversely affect habitat critical to the survival of a species	No habitat that is considered to be critical for the survival of the Night Parrot is found within the Revised Development Envelope.
Potential to disrupt the breeding cycle of a population	No habitat within the Revised Development Envelope is considered suitable to support Night Parrot breeding.
Potential to modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline	None of the habitats in the Revised Development Envelope are of high or moderate significance for the Night Parrot and are not considered suitable to support a permanent population. Furthermore, targeted surveys for the species have not identified any individuals within the Revised Development Envelope, with the nearest record occurring approximately 100 km north near the Fortescue Marsh. Clearing of low significance habitat within the Revised Development Envelope is unlikely to result in the decline of the Night Parrot population in the Pilbara.
Potential to result in invasive species that are harmful to the species becoming established in the species' habitat	European Red Foxes and Feral Cats are a known threat to the Night Parrot. No Red Foxes have been recorded within the Revised Development Envelope and are unlikely to be introduced into the area due to the Proposed Action. The Proponent will expand the current feral Cat monitoring and control program within the Revised Development Envelope in high risk areas and/or critical habitat in response to feral animal sightings, as per the EMP (Appendix A.8). The Proposed Action is not expected to increase the risk of invasive species becoming established and potentially impacting on the Night Parrot.

Significant Impact Criteria	Assessment of the Significance of Impacts to Night Parrot
Potential to introduce disease that may cause the species to decline	There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species to decline.
Potential to interfere with the recovery of the species	Due to the high unlikelihood for a Night Parrot population to be present within the Revised Development Envelope, as indicated by the lack of suitable high or moderate significance habitat and recorded historical or current evidence, the Proposed Action is unlikely to interfere with the recovery of the species. In the unlikely event that an individual disperses into the Revised Development Envelope, low significance habitat will remain within the Revised Development Envelope.

13.10.8. Consistency with Relevant Recovery Plans and Guidance

13.10.8.1. Recovery Plans

There are no recovery plans for the Night Parrot.

13.10.8.2. Conservation Advice

The priority conservation action from the approved Conservation Advice for the Night Parrot is outlined in Table 13-1. The Proponent will implement feral animal control within the Revised Development Envelope within high risk areas and/or critical habitat in response to sightings (as per the EMP (Appendix A.8)) and implement mitigation measures to minimise alteration of fire regimes.

13.10.8.3. Threat Abatement Plans

Feral Cats have been recorded within the Revised Development Envelope (Biologic 2021c). Mine sites can attract/increase the abundance of feral animals due to the additional resources (food scraps, water, shelter). The Proponent will record all introduced fauna sightings and undertake feral Cat control within the Revised Development Envelope in response to sightings within high risk areas and/or critical habitat, as per the EMP (Appendix A.8). The Proposed Action will align with the TAP for predation by feral Cats (DoE 2015b).

13.10.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a Proposed Action has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.10.9.1. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures, the anticipated environmental outcomes that apply to the Night Parrot are set out below:

- No high or moderate significance habitat for the Night Parrot occurs within the Revised Development Envelope
- No significant residual impacts to the Night Parrot.

13.10.10. Conclusion

After implementing the mitigation hierarchy, the Proponent considers that there will be no significant impact to the Night Parrot.

13.11. Grey Falcon (*Falco hypoleucos*)

The Grey Falcon is a medium-sized falcon and is the rarest Australian species in the *Falco* genus (TSSC 2020). It is listed as Vulnerable under the EPBC Act.

13.11.1. Habitat Preferences and Distribution

The Grey Falcon occurs almost exclusively in the arid and semi-arid areas of the Australian continent (TSSC 2020), with the breeding range of the species becoming more restricted to these areas in recent years (Oslen 1986). The Grey Falcon is present in all continental states of Australia, typically in arid and semi-arid areas and where the annual rainfall is less than 500 mm (TSSC 2020). The population densities across the continent are generally low, with an estimated population size being 1,000 individuals or 500 breeding pairs (DBCA 2021).

The preferred habitat for the species is timbered lowlands, particularly acacia shrublands, which possess tree-lined watercourses. The species also inhabit treeless tussock grasslands and open woodlands (Schoenjahn 2018). Woodlands and watercourses (permanent and ephemeral) are of high importance for the species as they nest almost exclusively in tall trees.

13.11.2. Key Threats and Recovery Actions

13.11.2.1. Key Threats

Key threats to Grey Falcons, as identified in the Conservation Advice, include predation by feral Cats, changes to climate, habitat loss and fragmentation resulting in a loss of nesting sites, and direct mortality as a result of a collision with traffic and fences (TSSC 2020).

13.11.2.2. Recovery Actions

As outlined in the Conservation Advice, the primary conservation actions are to support initiatives to improve habitat management and control feral Cat and Camel populations within Australia's arid and semi-arid regions (TSSC 2020). However, these are subject to change due to the current poor understanding of threatening processes for the species.

Some recovery actions include the protection of critical habitats and breeding populations within conservation estates, such as Sturt National Park in New South Wales (Government of NSW 2018).

Extensive research is also being conducted to understand the species better and how to manage threats. This includes mitochondrial DNA sequencing to determine levels of variation within the species due to low diversity (Mullin et al. 2020). The finding of this research was that despite the species having a low level of genetic diversity, there is no evidence that the population is or was affected by a genetic bottleneck. This finding means that the species can be managed as one population, which spans the Australian continent.

13.11.3. Important Populations and Critical Habitat

13.11.3.1. Important Populations

Due to the species' low genetic diversity, all individuals are regarded as part of one nationwide population and are an important population. The current estimated population of the Grey Falcon is <1000 individuals across 5 million km² of Australia's arid and semi-arid region (TSSC 2020).

13.11.3.2. Critical Habitat

To date there are no species-specific policy guidelines on what constitutes critical habitat for the species. However, for this document, the definition of critical habitat is any habitat that is used 'for activities such as foraging, breeding, roosting and dispersal' as this is the definition set out in the Significant Impact

Guidelines (DoE 2013). The species is known to breed in the old nests of other bird species in tall trees along watercourses.

13.11.4. Occurrence in the Revised Development Envelope

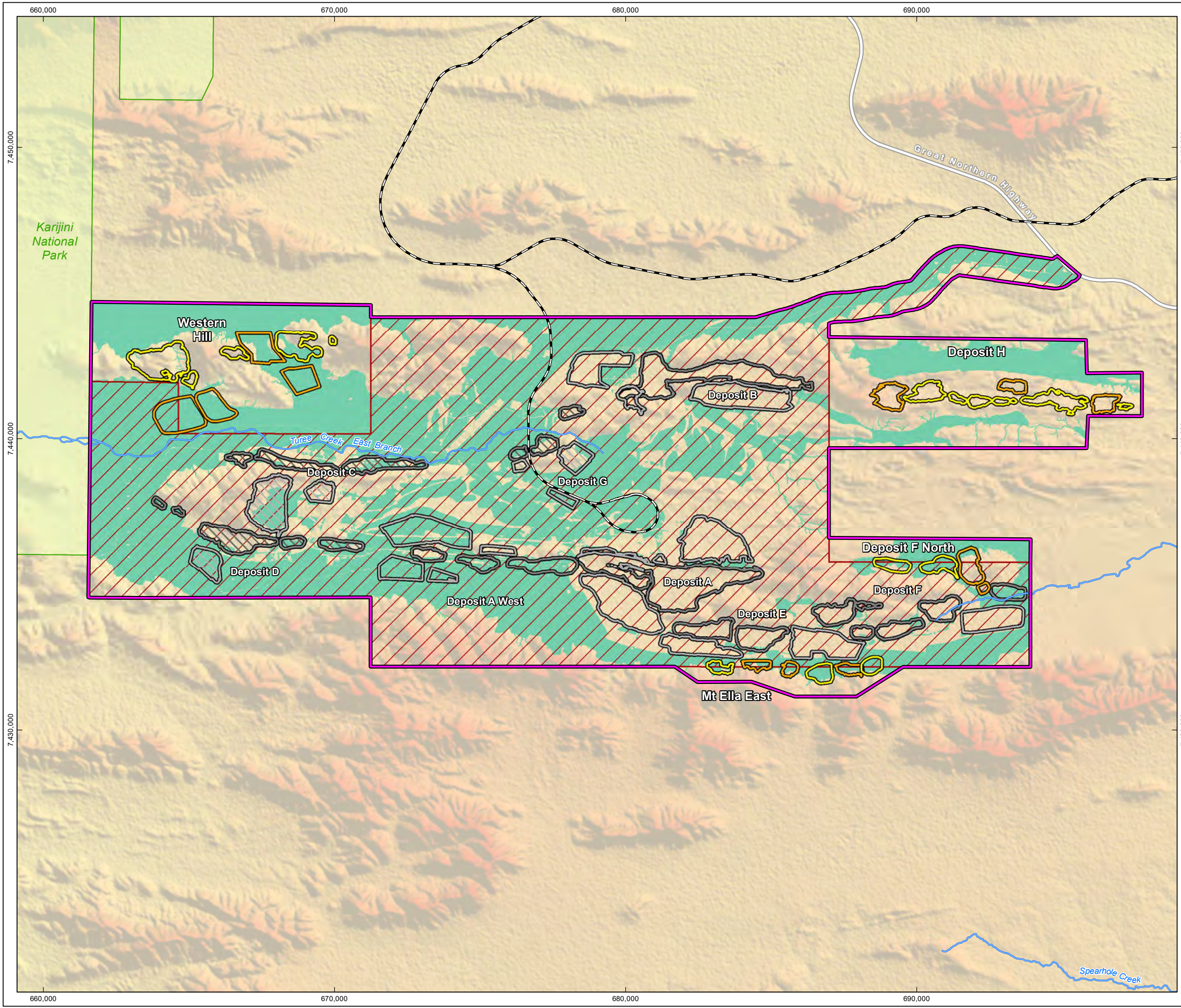
Despite extensive survey efforts (168 people survey days, 68.7 hours of bird census and opportunistic records), there are no Grey Falcon records within the Proposed Action Area or Revised Development Envelope. However, there are species records within 10 km of the Revised Development Envelope, one of which occurs in Karijini National Park (Biologic 2021c and Biologic 2021e). Grey Falcons (including in the Pilbara) often nest in telecommunication towers (radio towers, powerlines and mobile phone towers) (TSSC 2020). The existing telecommunication towers in the West Angelas area and mine sites are not currently nor have historically been used as nest sites for this species. Grey Falcons also reuse the same successful nest site for multiple years with young often staying with the parents for up to 12 months after fledging (TSSC 2020). As such, the indication of nesting in an area can be assessed via the presence of records/individuals over multiple years, the presence of juveniles along with parents and of course the identification of nests being used. None of which have occurred during the recent or historic ecological surveys. This species is highly nomadic and vagrant by nature. As such, the Grey Falcon is unlikely to rely solely on habitat within the Revised Development Envelope.

13.11.5. Habitat within the Revised Development Envelope

The Revised Development Envelope contains habitat types of moderate significance supporting habitat for the Grey Falcon, including the Drainage Line, Footslopes and Plain, and Mixed Acacia Woodland habitat types. The Drainage Line habitat type provides potential nesting trees, while the other two habitat types provide potential foraging habitat for the species (Biologic 2021c; Figure 13-9).

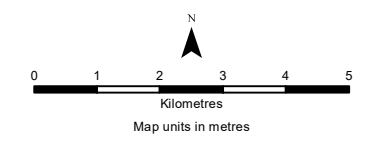
Figure 13-9
Supporting Habitat for Grey Falcon
within the Revised
Development Envelope

Drawn: A.D.
Plan: RTIO-0979885v3
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com



Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
- Pit
- Waste Landform
- Approved Conceptual Layout**
- Pit
- Waste Landform
- (deposits assessed under DN2018/8299)
- Pit
- Waste Landform
- Supporting Habitat
- National Park
- Rio Tinto Railway
- Highway
- Major Creek



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13.11.6. Assessment of Impacts

The Proposed Action may result in direct and indirect impacts on Grey Falcon. The following assessment of impacts specifically considers the Grey Falcon, in addition to the impacts applying more broadly for all MNES species with potential to occur within the Revised Development Envelope. Key impact pathways are discussed in Section 13.4.

13.11.6.1. Habitat Loss/Reduction and Fragmentation as a Result of Clearing

The Proposed Action will result in clearing approximately 2,241 ha (~14%) of supporting habitat (Drainage Line, Foothills and Plains, and Mixed Acacia Woodland) from the Revised Development Envelope. Supporting habitat will remain available to Grey Falcon individuals that may occur within the Revised Development Envelope.

Although supporting habitat occurs, the species would not be solely reliant on or restricted to the habitat types within the Revised Development Envelope. As such, clearing of supporting habitat within the Revised Development Envelope is not expected to impact the Grey Falcon significantly. No mitigation is proposed in relation to this species.

13.11.7. Significance of Impacts

An assessment of the Proposed Action impacts on the Grey Falcon is detailed in Table 13-25, with reference to the Significant Impact Guidelines (DoE 2013).

Table 13-25: Assessment of the Significance of Impacts to Grey Falcon

Significant Impact Criteria	Assessment of the Significance of Impacts on Grey Falcon
<p>Potential to lead to a long-term decrease in the size of an important population of a species</p>	<p>The Grey Falcon has not been recorded within the Proposed Action Area or Revised Development Envelope; however, the Drainage Line, Footslopes and Plain and Mixed Acacia Woodland habitats within the Revised Development Envelope are considered to provide supporting habitat for the species.</p> <p>The Proposed Action will result in clearing approximately 2,240 ha (~14%) of supporting habitat (Footslopes and Plain, Drainage Lines and Mixed Acacia Woodland). Supporting habitat will remain within the Revised Development Envelope and within the broader West Angelas Area. It is also highly unlikely that clearing will result in increased competition with other Grey Falcons due to the highly dispersed nature of the population.</p> <p>On this basis, the Proposed Action is not expected to cause a long-term decline in the size of an important Grey Falcon population.</p>
<p>Potential to reduce the area of occupancy of an important population</p>	<p>The removal of approximately 2,240 ha (~14%) of supporting Grey Falcon habitat is highly unlikely to result in a reduction in the area of occupancy of the population. The Grey Falcon population encompasses all individuals of the species, which currently occur across the 500 million ha of the Australian continent. The clearing of this habitat within the Revised Development Envelope due to the Proposed Action represents only 0.000645% of the species' current occupancy area. Additionally, supporting habitat will be retained within the Revised Development Envelope.</p>
<p>Potential to fragment an existing population into two or more populations</p>	<p>The Grey Falcon is a highly mobile species due to its ability to fly long distances. This is shown by the large home ranges of the species and the ability for all individuals within Australia to be considered as one population (suggesting a highly connected population). Furthermore, despite extensive survey efforts, the Grey Falcon has not been recorded within the Revised Development Envelope. As such, the removal of approximately 2,240 ha (~14%) of supporting habitat is highly unlikely to result in the fragmentation of a population of the species.</p>
<p>Potential to adversely affect habitat critical to the survival of a species</p>	<p>No high significance habitat, considered critical to the species' survival, has been recorded within the Revised Development Envelope. As such the Proposed Action will not impact on any habitat critical to the survival of the Grey Falcon.</p>
<p>Potential to disrupt the breeding cycle of an important population</p>	<p>Some areas in the Drainage Line habitat type contain tall trees that can potentially be roosting sites for the Grey Falcon. These are mainly concentrated around the larger drainage lines within the Revised Development Envelope, such as Turee Creek. However, no evidence of nesting has been recorded within these areas nor has any been recorded for any other falcon species. The Proposed Action has been designed to minimise disturbance to these larger drainage lines and hence the resultant potential impact is minimal.</p> <p>As such the Proposed Action is not expected to disrupt the breeding cycle of the Grey Falcon population.</p>

Significant Impact Criteria	Assessment of the Significance of Impacts on Grey Falcon
<p>Potential to modify, destroy, remove or isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline</p>	<p>All of the habitat proposed to be directly or indirectly impacted by the Proposed Action is of moderate significance and is non-critical to the survival of the Grey Falcon. As such, the Proposed Action is not likely to cause the decline of the species.</p>
<p>Potential to result in invasive species that are harmful to the vulnerable species becoming established in the vulnerable species' habitat</p>	<p>Feral Cats are a known threat to the Grey Falcon.</p> <p>The Proponent will expand the current feral Cat monitoring and control program within the Revised Development Envelope in high risk areas and/or critical habitat in response to feral animal sightings, as per the EMP (Appendix A.8).</p> <p>The Proposed Action is not expected to increase the risk of invasive species becoming established and potentially impacting on the Grey Falcon.</p>
<p>Potential to introduce disease that may cause the species to decline</p>	<p>There is no evidence to suggest that the Proposed Action would introduce disease that may cause the species to decline.</p>
<p>Potential to interfere substantially with the recovery of the species</p>	<p>Despite extensive survey efforts, no Grey Falcons have been recorded within the Revised Development Envelope; however, the presence of supporting habitat in the Revised Development Envelope makes it likely for the species to occur within the Revised Development Envelope, but due to its nomadic nature not solely reliant on the habitat.</p> <p>The Proposed Action will clear approximately 2,240 ha (~14%) of supporting habitat. The remaining supporting habitat is expected to support the small number of Grey Falcons likely to utilise the habitat within the Revised Development Envelope.</p> <p>On this basis, the Proposed Action is unlikely to interfere with the recovery of the Grey Falcon species.</p>

13.11.8. Consistency with Relevant Recovery Plans and Guidance

13.11.8.1. Recovery Plans

There are no recovery plans for the Grey Falcon.

13.11.8.2. Threat Abatement Plans

Feral Cats have been recorded within the Revised Development Envelope (Biologic 2021c). Mine sites can attract/increase the abundance of introduced fauna due to the additional resources (food scraps, water, shelter). The Proponent will record all introduced fauna sightings and undertake feral Cat control within the Revised Development Envelope in areas of high risk and/or critical habitat in response to sightings, as per the EMP (Appendix A.8). The Proposed Action will align with the TAP for predation by feral Cats (DoE 2015b).

13.11.8.3. Conservation Advice

The primary conservation actions from the approved Conservation Advice for Grey Falcon are outlined in Table 13-1. The Proponent will implement feral animal control within the Revised Development Envelope as per the EMP (Appendix A.8) and implement mitigation measures to minimise alteration of fire regimes.

13.11.9. Environmental Outcome

An environmental outcome, in the context of EIA, is the state of the environment at a point in time during implementation or after a Proposed Action has been implemented. Environmental outcomes:

- Reflect specific and measurable environmental states
- Have a clear boundary, size, extent or limit
- Are associated with the achievement of one or more of the EPA's objectives for the environmental factor.

13.11.9.1. Predicted Environmental Outcome

In consideration of the proposed avoidance and management measures, the anticipated environmental outcomes that apply to the Grey Falcon are set out below:

- Impacts to supporting habitat (Footslopes and Plain, Mixed Acacia Woodland and Drainage Line) will be minimised as far as practicable.

13.11.10. Conclusion

After implementing the mitigation hierarchy, the Proponent considers that there will be no significant residual impacts to the Grey Falcon.

13.12. Fork-tailed Swift (*Apus pacificus*)

The Fork-tailed Swift is listed as a Migratory species under the EPBC Act. The species is recorded sporadically within WA, with its distribution scattered along the coast of the south-west Pilbara and north throughout much of the Pilbara region. It can also be found in the north and east Kimberley region. This species is found in various habitats, including riparian woodland and tea-tree swamps, low scrub, and heathland; they can also be found in grasslands and sandplains covered with spinifex (DAWE 2020b).

The Fork-tailed Swift has been recorded flying overhead within the Proposed Action Area and Revised Development Envelope (Ecologic 2014; Biologic 2021c; Figure 13-10). This species is exclusively an aerial forager with an extensive foraging range and occurs as a non-breeding visitor within Australia (DAWE 2020b). Whilst the species may sporadically fly over the Revised Development Envelope. It would not depend on any of the habitats.

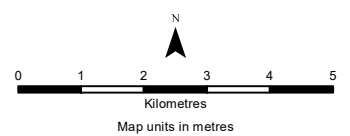
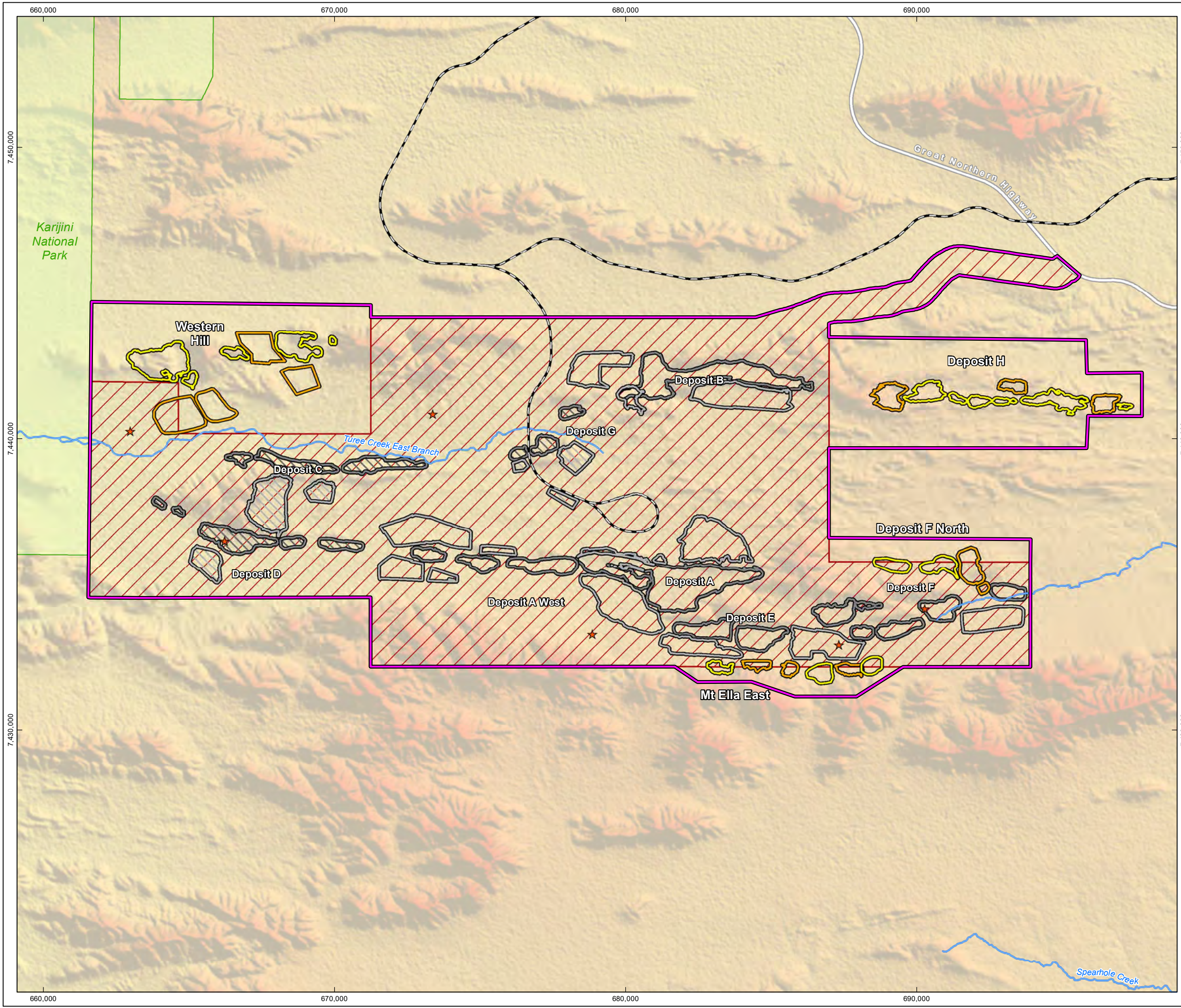
The Proposed Action is highly unlikely to cause significant loss or modification of important habitat for this species or cause disruption to an ecologically significant proportion of the population (1% or 1,000 individuals) (DoE 2015a). It is considered there will be no significant impact to this species from the Proposed Action, and no specific mitigation for this species is proposed.

Figure 13-10
Fork-tailed Swift Records
within the Revised
Development Envelope

Drawn: A.D.
Plan: PDE0186412v5
Date: March 2023
Proj: GDA 1994 MGA Zone 50
Scale: 1:120,000 @A3
GIS.Team@riotinto.com

Legend

- Revised Development Envelope
- Decision Notice 2018/8299 Development Envelope
- Proposed Conceptual Layout**
 - Pit
 - Waste Landform
- Approved Conceptual Layout**
 - Pit
 - Waste Landform(deposits assessed under DN2018/8299)
- Pit
- Waste Landform
- Fork-tailed Swift
- National Park
- Highway
- Rio Tinto Railway
- Major Creek



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13.13. Summary of Significant Residual Impacts of Offset Requirements for MNES

13.13.1. Significant Residual Impact

Significant residual impacts of the Proposed Action, which remain post mitigation are presented in Table 13-26 and include:

- Clearing up to 126 ha (~20%) of potential critical Gorge/Gully habitat for Northern Quoll, Ghost Bat and Pilbara Olive Python. This habitat also provides suitable habitat for the Pilbara Leaf-nosed Bat. This clearing is proposed to be managed via upper clearing limits as per Table 13-11 and will be offset as per Section 12
- Clearing up to 3,731 ha (~30%) of potential critical Hillcrest/Hillslope habitat for Ghost Bat. This habitat is also considered supporting habitat when within the home range of the Northern Quoll, Pilbara Leaf-nosed Bat and Pilbara Olive Python records. This clearing is proposed to be managed via upper clearing limits as per Table 13-11 and will be offset as per Section 12
- Clearing approximately 2,241 ha (~14%) of the remaining habitat types, which provide supporting habitat for the Ghost Bat. This clearing will be offset as per Section 12.

Table 13-26: Significant Residual Impact Resulting from the Clearing of Critical and Supporting MNES Habitats within the Revised Development Envelope for the Proposed Action

Habitat Type	Clearing within the Revised Development Envelope (ha)
Critical Habitat – Upper Limit	
Gorge/Gully	126
Hillcrest/Hillslope	3,731
Critical Habitat Total Upper Limit³⁷	3,857
Supporting Habitat – Approximate Clearing	
Drainage Line	78
Mixed Acacia Woodland	374
Footslopes and Plain	1,787
Cracking Clay	2*
Supporting Habitat approximate total³⁸	2,241
Total Maximum Clearing for the Proposed Action	5,350

*Due to being representative of a Priority 1 PEC.

³⁷ Total clearing of critical habitat will not exceed 3,857 ha, but may be less than this number. An upper limit is proposed to allow operational flexibility whilst ensuring that key values are protected and this assessment has been undertaken using the upper limit.

³⁸ Total clearing of supporting habitat is approximate, however the combined clearing totals of critical and supporting habitat will not exceed 5,350 ha

The MNES fauna species home range is defined as:

- Northern Quoll – 1 km from critical habitat (Northern Quoll records)
- Ghost Bat – 12 km from critical habitat (category 2 caves and category 3 caves in apartment blocks)
- Pilbara Olive Python – 1 km from critical habitat (Pilbara Olive Python records)
- Pilbara Leaf-nosed Bat – 10 km from critical habitat (category 1 to 3 caves).

13.13.2. Offset Requirements

Offsets are proposed for the significant residual impacts on fauna caused by the clearing of the following habitat for the Proposed Action:

- Up to 3,857 ha of high significance habitat comprising:
 - 126 ha of Gorge/Gully habitat
 - Critical habitat for Northern Quoll, Ghost Bat and Pilbara Olive Python
 - Supporting habitat for Pilbara Leaf-nosed Bat
 - 3,731 ha of Hillcrest/Hillslope habitat
 - Critical habitat for Ghost Bat
 - Supporting habitat for Northern Quoll, Pilbara Olive Python and Pilbara Leaf-nosed Bat
- Approximately 2,242 ha of moderate significance fauna habitat comprising:
 - Footslopes and Plains, Mixed Acacia Woodland, Drainage Line, and Cracking Clay
 - Supporting habitat for Ghost Bat
 - Drainage Line only supporting habitat for Northern Quoll, Ghost Bat, Pilbara Leaf-nosed Bat, Pilbara Olive Python and Grey Falcon.

This is discussed further in Section 12.

14. HOLISTIC IMPACT ASSESSMENT

This ERD provides a detailed assessment of the potential environmental impacts associated with the Proposal and the application of the mitigation hierarchy concerning each environmental factor. However, the environment is a complex dynamic of connections and interactions, and while an effect on a particular factor(s) may be minor in isolation, its impact across these interconnections may result in a significant impact.

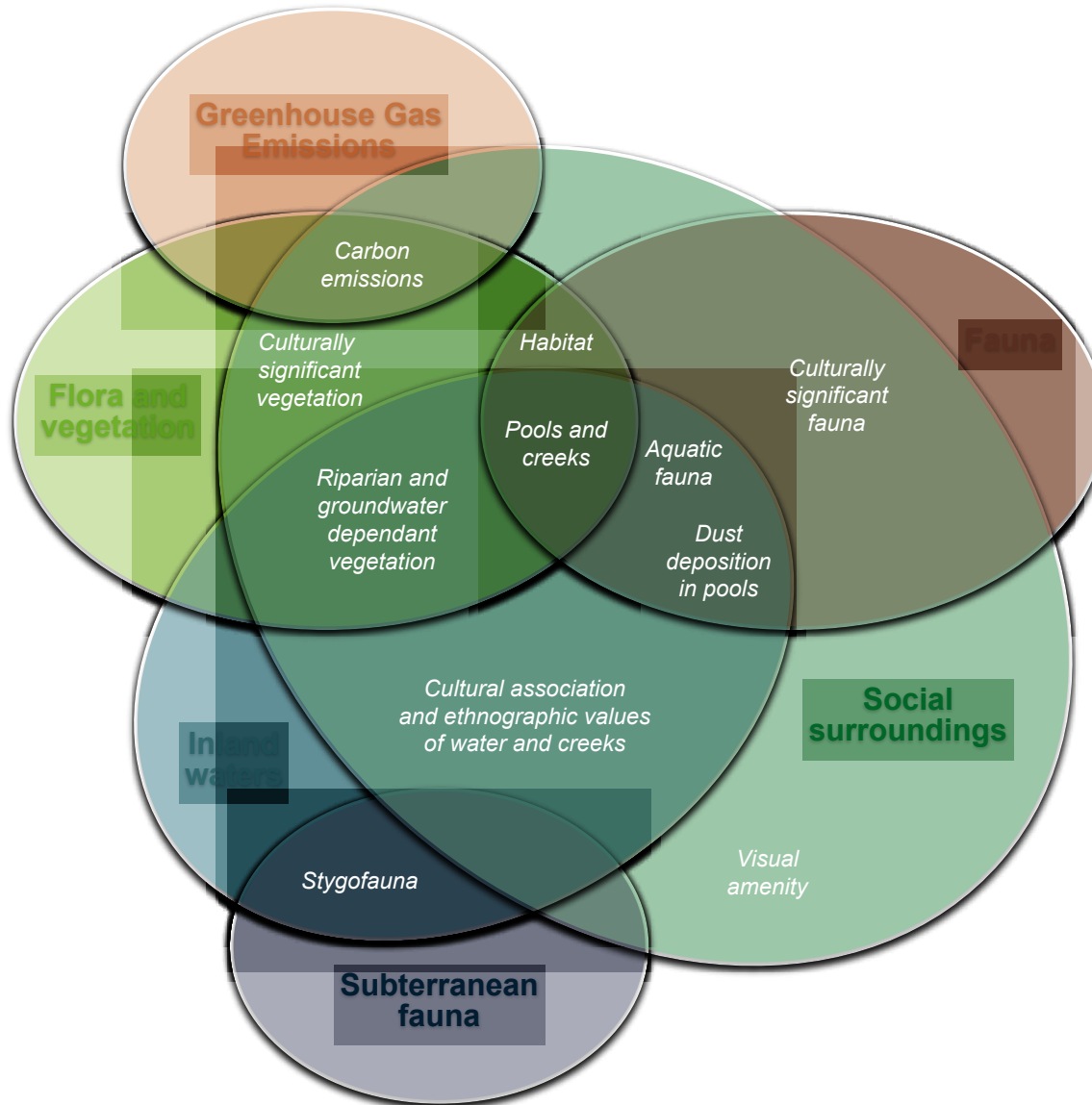
The Proponent has also sought to understand the environment as a whole, informed by a detailed understanding of environmental values and processes and the holistic views and concerns raised through consultation with the Yinhawangka People and Ngarlawangga People. The inputs and perspectives of the Traditional Owners continues to be vital in growing this understanding of the whole environment and the balance between its many interconnected elements.

14.1. Connections and Interactions Between Environmental Factors

The environmental surveys and studies undertaken for the Proposal have considered and assessed potential local and regional impacts. The results of these surveys have informed the Proposal impact assessment and mitigation measures. While the Proposal's predicted outcomes have been considered independently in relation to the environmental principles and the EPA's environmental objectives for each preliminary environmental factor, the Proponent recognises the complex linkages between Flora and Vegetation, Terrestrial Fauna, Inland Waters and Social Surroundings.

In the Pilbara, the most important cultural values often coincide with elements of the landscape with high visual amenity, botanical diversity and fauna habitat values; therefore, additional combined environmental effects may become significant and require additional mitigation. The high level of connectivity between the environmental factors: Social Surroundings, Inland Waters, Flora and Vegetation and Terrestrial Fauna is illustrated in Figure 14-1.

The key impacts that have little interaction across factors, when viewed at the timescale of the life of the mine, are GHG emissions and the loss of Subterranean Fauna habitat. These impacts are assessed in detail in the factor assessments and require no further holistic consideration.



14.2. Consideration of Holistic Effects

This section provides information on the environmental effects on the environment as a whole to determine whether this raises any additional considerations for assessment. For this holistic assessment, the following have been applied:

1. Where an impact(s) has been completely avoided, it will not contribute to holistic impacts and does not require consideration.
2. Where an impact is already considered potentially significant, and the mitigation hierarchy is applied in relation to one or more factors, additional mitigation measures to address combined environmental effects are unlikely to be required.
3. Where an impact(s) has been considered to likely result in a significant impact across two or more factors, and the mitigation hierarchy has been applied in isolation per factor, consideration will be given if further measures are required to mitigate this combined impact
4. Where there are multiple overlapping minor impacts, or a minor impact affects multiple values and has been assessed as insignificant in the context of an individual factor, these may require further holistic consideration.
5. The environmental principles of intergenerational equity, and conservation of biological diversity and ecological integrity are considered the most relevant and have been a foundation when considering potential significance of the holistic effect of the Proposal.

Where holistic effects on the environment have been identified, their potential impacts on the environment as a whole have been considered in accordance with Section 4.1 of the *Environmental Impact Assessment Procedures Manual* (EPA, 2021). The following Section outlines and discusses these holistic effects as it relates to the implementation of the Proposal.

14.2.1. Land Disturbance

As discussed in previous sections, the Proposal will directly disturb 5,350 ha of native vegetation, of which 4,922 ha is good to excellent condition, and the remaining is previously disturbed. The combined impacts associated with this land disturbance include:

- Loss of priority flora and supporting habitat
- Potential loss of conservation significant fauna species and supporting habitat
- Potential direct fauna mortality
- Altered surface water regimes resulting in a potential increase in flooding and erosion events, loss in catchment area
- Groundwater drawdown resulting in a potential impact on stygofauna, pGDE and threatened fauna supporting habitat
- Long-term localised loss in ecological diversity and values of cultural significance (including culturally significant plants and animals), due to the creation of permanent pit voids and waste rock landforms which will limit the ability to rehabilitate land to return it to pre-mining condition post closure.

While the above effects will result in localised impacts, these impacts can also influence the dynamics of the environment in a regional context when considered against other similar activities. It has been demonstrated that cumulatively, the Proposal will not result in a significant increase in the combined impacts within the regional area. The Proposal's implementation will not contribute to the reduction in regional vegetation extent by more than 4%, and all regional vegetation associations will remain above 89% when combined with other significant projects.

The clearing of vegetation, when assessed at a regional scale, will not lead to compounding impacts, resulting in significant effects on the identified environmental values and their connections, including the provision of habitat for conservation and culturally significant flora and fauna species.

The longer-term effects of the Proposal to the identified environmental values will be largely counterbalanced through progressive and post-mining rehabilitation works, which will seek to restore environmental values impacted through the implementation of the Proposal. Subject to the completion of successful rehabilitation, the Proposal will not result in a significant long-term effect on the identified environmental values of the local area.

While noting the above, mitigation measures proposed across each relevant environmental factor also work together to reduce the combined impact of the holistic effects. These measures include:

- Reduction in overall Development Envelope to minimise potential impacts on sites of significant cultural value, in particular, the 'Range' which has limited the extent of potential land disturbance and impacts to 7 potential Ghost bat roost sites and 3,269 ha of critical habitat and 1,363 ha of supporting habitat for threatened species
- No below water table mining at Western Hill and no dewatering of the aquifer via abstraction bores at Deposit H (sump pumping only). No additional surplus water discharge from the Proposal and limited impacts to water courses from the Proposal (no diversions of named creeks, no creek capture), and no expected impacts to regionally significant Deposit H Waterhole and Turtle Pool (outside the Development Envelope)
- Sump pumping at Deposit H and dewatering at Deposit F North will not impact groundwater-dependent ecosystems, creeklines or pools/habitats supporting riparian vegetation, MNES and stygofauna values. No BWT mining is proposed at Western Hill or Mt Ella East
- No direct disturbance to Deposit H Waterhole, as detailed in Section 7. The Proposal will reduce the catchment supporting the Deposit H Waterhole but will not impact the filling frequency or level of the pool in comparison to the pre mining scenario. Proposed mitigation measures (Section 7.5) will ensure sufficient water flows to the pool to maintain the hydrological function of the pool and cultural value throughout the life of the mine and post-closure (Rio Tinto 2023b). There may be changes to the density of vegetation downstream of the Deposit H Waterhole, however the species composition is unlikely to change and any changes are likely to be insignificant in terms of the function of the ecosystem
- Establishment of Mining Exclusion Zones and Mining Restriction Zones to preserve significant biological values within the Development Envelope
- Identification of culturally ecologically important areas within the Development Envelope to be recorded on the Rio Tinto GIS database as special places to influence final mine design
- Culturally important plants to be incorporated into closure and rehabilitation planning, including but not limited to, inclusion in revegetation seed mixes where suitable species are identified.

In consideration of the scale of the Proposal (5,350 ha of native vegetation, of which 4,922 ha is good to excellent condition), the broader distribution of biological values across the local area and surrounds, the application of the mitigation hierarchy to minimise effects, and the established framework of EMPs and environmental offsets, when the separate environmental factors for the Proposal are considered together, the effects of the Proposal to the biological values are not considered to be environmentally significant nor inconsistent with the EPA's objectives.

Through these mitigation measures, the Deposit H Waterhole will persist within the Proposal Area, and Revised Development Envelope, as described in Section 7 and 8.

14.2.2. Creeklines

Surplus water generated from the mine operation will be discharged into a tributary of Turee Creek East (already being used for Existing Operations), which flows westwards through the Karijini National Park. All creeks in the area are naturally ephemeral, and the Proponent is required to manage discharge so that surface water in the tributary does not come within 2 km of the park boundary under natural no-flow conditions, consistent with the wording of MS 1113. This Proposal will not increase the discharge to Turee Creek East.

Discharge water quality is subject to the conditions of the Part V EP Act licence held by the Proponent for the West Angelas operations and administered by DWER. Quarterly sampling for hydrocarbons, key metals, and suspended solids is carried out at discharge points and compared to Australian water quality guidelines, with results reported annually.

The water management strategy has also been designed to minimise impacts on water from the Proposal. There will be no determinable change to the volume, rate and quality of controlled surface discharge from dewatering as a result of the Proposal; therefore, the impact to Turee Creek East is considered minimal.

The water quality, vegetation and fauna assemblages will continue to be affected within the approved wetting fronts, but no significant environmental impacts have been identified as a result. The water management strategy will minimise the impacts of the Proposal on environmental and cultural values associated with water in the Revised Development Envelope and downstream.

14.2.3. Karijini National Park

The western boundary of the Revised Development Envelope abuts Karijini National Park, which is within the traditional lands of the Yinhawangka People, and connected to the Proposal hydrologically by both the Turee Creek East branch and the Wittenoom Formation, which is the regional groundwater aquifer.

Important heritage places, including the Guburingu heritage site, and high social values exist within the national park. A potential GDE also occurs within and approximately 7 km downstream from the park boundary.

BWT ore is known to be present at the Western Hill deposit within this Proposal; however, in acknowledgement of the value of Karijini National Park, AWT mining is only proposed at this site in this Proposal, noting that abstraction for supply is proposed. Drawdown from Approved Proposals (Deposits C and D) was identified as having the potential to extend to the west and into Karijini National Park. To ensure drawdown does not extend into Karijini National Park, the Proponent has constructed a MAR scheme located between the Existing Operations and the national park. The avoidance of BWT mining at Western Hill will ensure no significant groundwater drawdown risk to the potential GDE in Karijini National Park.

Mt Meharry, located within Karijini National Park and approximately 13 km north of the Revised Development Envelope, is regularly visited by tourists as the highest point in the State. Views from Mt Meharry take in existing mines, including the Existing Operations and BHP Area C Southern Flank operations (Rio Tinto 2021b). The Conceptual Footprint has been optimised to reduce the extent of total disturbance, as this is expected to minimise the visual impact to Karijini National Park.

On completion of mining at Western Hill and other areas, all disturbances will be rehabilitated in accordance with the approved MCP. Post-closure creek flow regimes (such as flow pathways and water quality) will be similar to pre-mining regimes and impacts to any downstream surface water values, including the potential GDE and the Guburingu heritage site within Karijini National Park are unlikely.

14.2.4. Other Environmental Effects – Dust

Dust emissions will increase slightly due to the Proposal, but the overall impact is predicted to be minor. Dust emissions from mining and vehicle movements have been assessed in relation to the following environmental factors: Social Surroundings, Inland Waters, Flora and Vegetation and Terrestrial Fauna. Negligible and minor impacts may occur in relation to habitat value, water quality (if dust washes into or settles in pools) and visual amenity. Studies have found no evidence to support the perception that dust accumulation on plants causes negative effects (Matsuki et al. 2016). Visual amenity will be affected in terms of airborne dust and settled dust on vegetation, but this will be limited to areas close to active mining activities and where required for sensitive receptors particular focus on dust monitoring will occur (such as Deposit H Waterhole).

No significant impacts, holistic or by factor, associated with dust emission have been identified, given the management approaches that the Proponent will apply. However, given the cumulative dust emissions in the Pilbara and concerns raised by Traditional Owners and stakeholders about amenity, cultural values and potential avoidance behaviour by culturally significant fauna (e.g. kangaroos), the Proponent recognises the importance of reducing and maintaining low levels of dust across their operations in the Pilbara (Figure 14-3). Dust also has the potential to affect neighbouring communities and the workforce. The Proponent is implementing a Pilbara-wide dust management improvement project to reduce dust emissions from their operations. The project includes establishing a Dust Mitigation Working Group responsible for localised improvement initiatives, the Iron ore Dust Management Awareness training package for all employees and contractors, governance processes and alternative dust suppression/capture trials for haul roads. These measures have already commenced and are not linked to a specific project.

14.2.5. Social Surroundings

The mining activities associated with the Proposal lie with the traditional lands of the Yinhawangka and Ngarlawangga People, and it is acknowledged that through their connection to Country, the link between the Traditional Owners and the environment is highly valued.

It is also acknowledged that water and associated pools or waterholes are of high ecological and cultural significance in the area, as they are indicators of the health of Country which in turn reflects the health of culture. In noting the interconnections between the flora and vegetation, terrestrial fauna, inland waters and their importance to the Yinhawangka and Ngarlawangga People, there is potential that the Proposal may result in impacts to local sites of importance to the both Peoples through:

- Increased dust, noise and vibration levels as a result of mining and associated activities
- Changes to local landforms (including creation of pit voids and waste rock landforms) which will result in altered visual landscapes within the region and at specific areas supporting social, cultural and heritage values
- Disturbance of Country, places and sites of social, cultural and heritage significance
- Changes to Country, places and sites of social, cultural and heritage significance
- Altered social activities, relationships or cultural practices due to changes to special places.

As outlined in Section 6 impacts to cultural sites and values within and adjacent to the Proposal will be mitigated through:

- Avoidance of known significant areas, such as the 'Range', Deposit H water hole and Turtle Pool
- Identification and recording of 'Special Places' including relevant exclusion zones
- Implementation of the WAN RP Yinhawangka SCHMP and Ngarlawangga SCHMP
- Ongoing consultation and collaboration with the Yinhawangka and Ngarlawangga People on relevant aspects of mine planning and closure and rehabilitation planning
- Identification of areas to which the Yinhawangka and Ngarlawangga People wish to retain access during operations and/or post-closure to inform mine planning
- Facilitating access for Yinhawangka and Ngaralwanagga People during operations and post-closure
- Mitigation measures if known special places or any other locations confirmed through consultation that are being maintained in-situ cannot be safely accessible to Traditional Owners.

In considering the above and noting the outcomes presented in Section 6.13 following the implementation of management and mitigation measures, the combined effects of the Proposal as a whole are no greater than the effects on individual factors when considered.

14.3. Conclusion

Particular landscape features, rocky landforms, caves, creeklines and pools support higher biodiversity and are culturally important. The tendency for these key values to co-occur in landscape features in the Pilbara means that mitigation measures are often relevant to multiple factors. The Proposal has been developed to minimise impacts on pools (particularly Deposit H Waterhole and Turtle Pool) and caves (Ghost Bat category 2, 3 and apartment blocks), protection of culturally significant features (particularly The Range) and minimisation of impacts to creeklines, Gorge/Gully habitat and the values of Karijini National Park as the priorities for applying the mitigation hierarchy. Therefore, assessment of the potential environmental effect of the Proposal as a whole does not require different or additional mitigation to those applied when factors were assessed in isolation. The synergies between landscape features, the location of various environmental values, and the mitigation already applied are shown in Figure 14-2 and summarised above.

There are no additional significant residual impacts or additional mitigation required in relation to these landscape features.

The Proposal has been developed with the protection of pools (particularly Deposit H Waterhole), particular areas of cultural significance and the minimisation of impacts to creeklines, caves, Gorge/Gully habitat, and the values of Karijini National Park as priorities for applying the mitigation hierarchy. Therefore, the assessment of the Proposal as a whole does not require different or additional mitigation to the individual factor assessments.

The holistic impact assessment identified that dust is not expected to have a significant impact on the environment as a whole, but in the context of the potential for cumulative emissions in the Pilbara, the Proponent is committed to investigating ways to improve dust emissions.

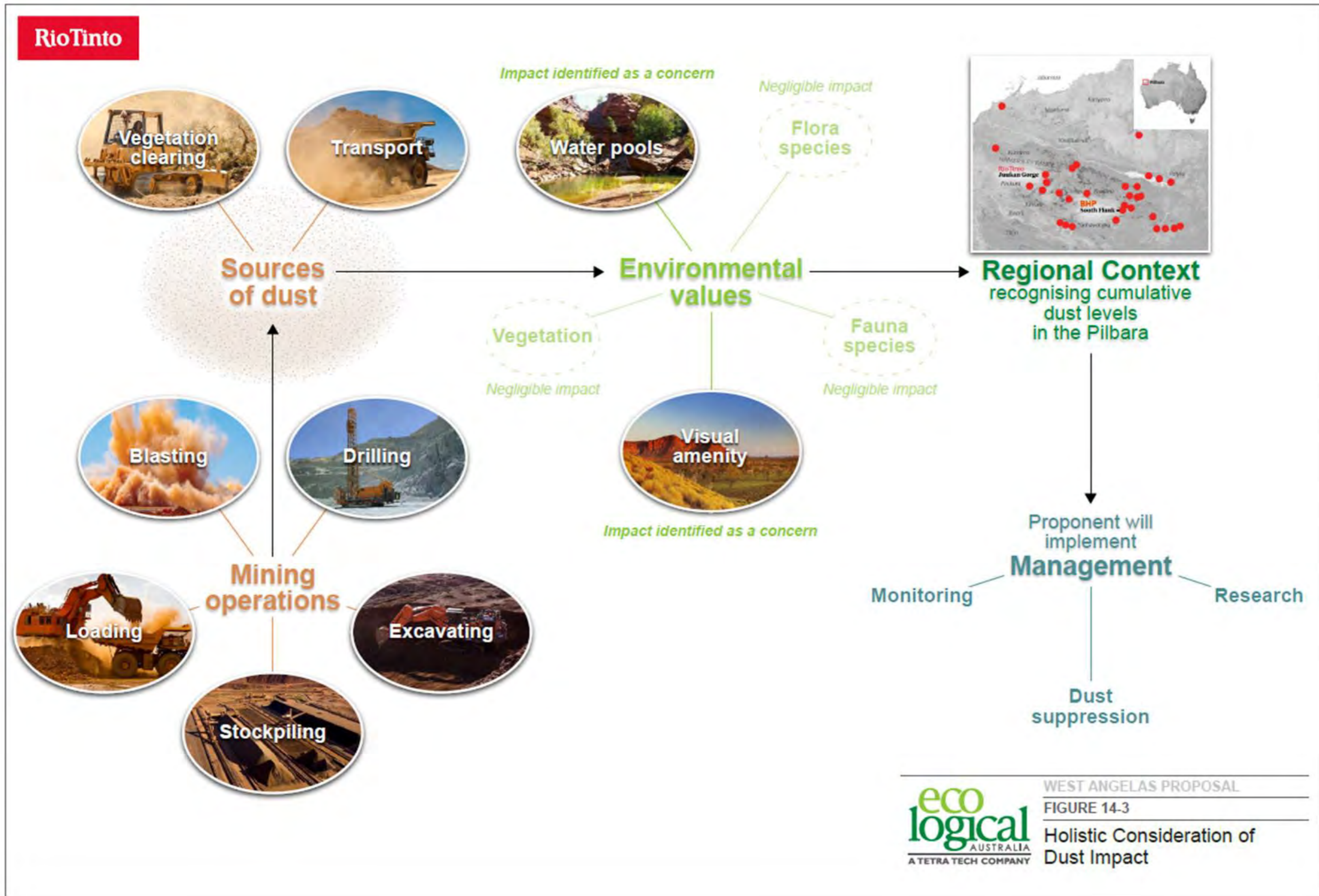


Figure 14-3: Holistic Consideration of Dust

15. CUMULATIVE ENVIRONMENTAL IMPACT ASSESSMENT

Cumulative environmental impacts are the successive, incremental, and interactive impacts on the environment of a proposal with one or more past, present and reasonably foreseeable future activities (EPA 2021a). The EPA (2021a) defines reasonably foreseeable future activities as:

- Third party (or proponent) activities that are already approved, are in a government approvals process, or are otherwise reasonably likely to proceed:
- For proposals assessed at the level of environmental review – at the time an Environmental Review Document for a proposal is accepted
- For proposals assessed at the level of assessment on referral information - at the time the final referral or required additional information is accepted
- Existing activities that are reasonably expected to be ongoing.

15.1. Existing and Reasonably Foreseeable Projects

Numerous existing and reasonably foreseeable projects within the Hamersley subregion have a cumulative impact on the environmental values within the Hamersley subregion. However, only some of them have sufficient publicly available data for an accurate assessment to be carried out on the extent of these cumulative impacts. It is also noted that not all of the projects were used to assess each factor's cumulative impacts, as not all factors occur simultaneously. All the relevant projects used to assess at least one factor are listed in Table 15-1.

Table 15-1: Existing and Reasonably Foreseeable Projects within the Hamersley Subregion (within 100 km of the Proposal)

Project Name	Status	Location
Approved Projects*		
West Angelas Iron Ore Mine Existing Operations (Deposits A, B, C, D E, F and G)	Operational	The Approved Conceptual Layout is within the Revised Development Envelope
Hope Downs Iron Ore Mine - Hamersley Hope Management Services Pty Ltd (2000)	Operational	Adjacent to the Revised Development Envelope approximately 2 km to the northeast
Pilbara Expansion Strategic Proposal: Jinidi Iron Ore Mine – BHP Billiton Iron Ore Pty Ltd (2012)	Operational	20 km
Mining Area C Southern Flank – BHP Billiton Iron Ore Pty Ltd (2020)	Operational	20 km
Yandicoogina Iron Ore Project Expansion - Hamersley Iron Pty Ltd (2011)	Operational	35 km
Hope Downs 4 Iron Ore Mine - Hamersley Hope Management Services Pty Ltd (2013)	Operational	40 km
Koodaideri Iron Ore Mine and Infrastructure Project - Mount Bruce Mining Pty Ltd (2015)	Construction commenced	40 km
Marandoo Iron Ore Project – Hamersley Iron Pty Ltd (2015)	Operational	65 km
Revised Iron Valley Iron Ore Project – BC Pilbara Iron Ore Pty Ltd (2016)	Operational	81 km

Project Name	Status	Location
Greater Paraburdoo Iron Ore Hub Proposal - Hamersley Iron Pty Ltd (2020)	Approved*	100 km
Reasonably Foreseeable Projects**		
Hope Downs 2 – Hamersley HMS Pty Ltd (2021)	Referred	Adjacent to the Revised Development Envelope approximately 1 km east

**Includes projects that have been approved but are yet to be implemented **Defined as projects that have not yet been approved but have currently been referred*

Further details on these projects are provided in Section 2.3.

15.2. Summary of Cumulative Assessment for Key Environmental Factors

Cumulative environmental impacts have been assessed for each factor. A summary of the cumulative impacts is provided below.

15.2.1. Social Surroundings

Existing operations in the region have retained prominent landscape features and avoided impacts to many significant sites and places of high cultural heritage value. However, many heritage sites have been approved to be disturbed and the cultural use and enjoyment of the area has been affected.

The Proposed Amendment has the potential to contribute to cumulative impacts to Social Surroundings values at a local scale in the Pilbara region of Western Australia through:

- Alteration of visual amenity of the local area and areas of social and cultural significance
- Increase of dust in the local area and areas of social and cultural significance which has been modelled against proposed localised and existing cumulative regional inputs
- Increase noise and vibration in the local area and areas social and of cultural significance
- Alteration of surface water regimes in the local area and areas of cultural significance
- Loss and displacement of culturally significant native flora, vegetation and fauna and their habitat
- Potential disturbance to sites of cultural significance or to Aboriginal heritage places.

The Proponent has been designed to avoid impacting Heritage Places and places of cultural significance (where acceptable) and subsequently developed appropriate mitigation strategies through ongoing consultation with the Ngarlawangga People and Yinhawangka People. Where the Proponent cannot avoid direct impact to Heritage Places, the Proponent will consult with the relevant Traditional Owner Group and seek the relevant Heritage Approvals under the AH Act and ACH Act.

The Proponent will continue to consult with Ngarlawangga, Yinhawangka, Turee Creek Pastoral Station along with other key stakeholders where relevant via existing consultation forums or via dedicated forums to incorporate consideration of their involvement, feedback and values into cumulative impacts particularly to landscape impacts, water use and dust related outcomes.

The Proposal adds to existing impacts to Social Surroundings, including effects upon amenity, heritage and culture and Care for Country practices and outcomes. The Proposal will add to those permanent cumulative impacts to landscape changes, sense of place, use and enjoyment of Country and heritage sites as well as to temporary cumulative impacts to water and from dust.

The Proposal has been designed to avoid potential significant cumulative impacts to Social Surroundings due to impacts to cultural and heritage values at Deposit H Waterhole site complex, Turtle Pool, Mt Ella East site complex, Western Hill site complex, the Range, which are of high cultural significance to Ngarlawangga and/or Yinhawangka Traditional Owners

Consultation to date with the Ngarlawangga People and Yinhawangka People (and guided by leading practice and Social Surroundings guidelines) has informed the development of co-designed SCHMPs for the Proposal that aim to:

- Establish frameworks and processes to identify social, cultural, and heritage values in consultation with the Ngarlawangga and Yinhawangka Traditional Owners
- Avoid where possible and minimise disturbance to culturally significant places, including Heritage Places - Deposit H Waterhole site complex, Turtle Pool, Mt Ella East site complex, Western Hill site complex, the Range all of which are of high cultural significance to Ngarlawangga and/or Yinhawangka Traditional Owners
- Proactively manage and minimise potential indirect impacts, including visual, noise, dust and vibration impacts to places of cultural significance including specific management plans and additional monitoring as well as having committed to avoiding direct and indirect impacts to these sites by establishing heritage site boundaries and undertaking geotechnical assessments at sensitive site features
- Where possible, maintain access to Country (including places of cultural significance) with the inclusion of a Land Access Protocol for both Ngarlawangga and Yinhawangka People to ensure safe access and processes are maintained.
- Minimise unauthorised access to places of cultural significance and Heritage Places by employees and contractors with additional Cultural Awareness Training considered for building present and future workforce knowledge.
- Avoid where possible and minimise impacts to culturally significant flora and fauna
- Avoid where possible and minimise changes to hydrological regimes, including impacts to water level/quantity, water quality, or modification of flow paths, at culturally significant water sources
- Recognises the importance of Ngarlawangga and Yinhawangka involvement in rehabilitation and closure planning and implementation
- Establish a framework for ongoing consultation with the Ngarlawangga and Yinhawangka Traditional Owners through the life cycle of the Proposal regarding implementation and compliance with the SCHMP.

Engagement and consultation with the Ngarlawangga and Yinhawangka People continues to be ongoing to further inform the Proponent's understanding of the potential impacts on social surroundings values within and surrounding the Proposal.

The expected cumulative impact from the Proposal and surrounding operations on Turee Creek East catchment area, including parts of Karijini National Park and Turee Creek Pastoral Station, is a 6.3% reduction in catchment size, representing approximately 1.75% of the Turee Creek (total) catchment – this impact not considered significant in relation to environmental values and catchment function.

The Proponent will continue to consult with Ngarlawangga, Yinhawangka, Turee Creek Pastoral Station along with other key stakeholders where relevant via existing consultation forums or via dedicated forums to incorporate consideration of their involvement, feedback and values into cumulative impacts particularly to landscape impacts, water use and dust related outcomes.

15.2.2. Inland Waters

For groundwater-related values, none of the expected drawdowns associated with the Proposal interacts with potential or existing drawdowns associated with the Existing Operations. Consequently, there is no scope for cumulative impacts to groundwater hydrological regimes due to the Proposal and consultation with Ngarlawangga and modelling to date showing that maximum pit designs will retain sufficient catchment to maintain the hydrological regime (filling and overflow) of the Deposit H surface water fed ephemeral pool. Drawdown from other projects within the regional aquifer are unlikely to significantly impact the aquifer when combined with Proposal impacts. As such, cumulative impacts to groundwater levels as a result of the Proposal are considered negligible.

The total expected cumulative impact on Turee Creek East catchment area from the Proposal and surrounding operations is 6.3% (reduction in catchment size), representing approximately 1.75% of the Turee Creek catchment. No pools or surface water dependent ecosystems are identified in the upper reaches of Turee Creek East. The reduced catchment area has the potential to impact the potential GDE (feature 22, zone c) and Guburingu heritage site within the Karijini National Park at the western extent of Western Hill.

There are limited cumulative impacts for the potential GDE (feature 22, zone c) and Guburingu heritage site within Karijini National Park. This is due to the location of the other projects being downstream of these values. The Approved Proposal and this Proposal are the main contributors to the reduction of the Turee Creek East catchment (upstream of these values). No significant impacts on the environmental values of the Turee Creek East catchment, including the potential GDE and Guburingu heritage site, are likely to occur (see Section 7.6.1).

The total expected cumulative impact on the Weeli Wolli Creek catchment areas from the Proposal and surrounding operations is ~7.7%. Due to the location of Deposit H on the catchment divide, cumulative impacts from surrounding operations on Turtle Pool are similar to those of the Proposal as there are no other projects located upstream of this ephemeral pool in the Weeli Wolli catchment. Considering the above and that the Proposal does not substantially contribute to the cumulative reduction of the Weeli Wolli Creek catchment, no significant impacts to the environmental values of Weeli Wolli Creek catchment are anticipated to occur.

For the Approved Proposal, supply water is abstracted from the Turee Creek borefield located to the southwest of the mining operations via Groundwater Licence 98740(13). No changes to abstraction volume is proposed in relation to the Proposal. Under the requirements of MS 1113 for the Approved Proposal, the Proponent is required to manage discharge so that surface water in the tributary does not come within 2 km of the Karijini National Park boundary under natural no-flow conditions. No changes to this limit are proposed for the Proposal.

15.2.3. Flora and Vegetation

15.2.3.1. Native Vegetation

The 2019 extent of vegetation within the Pilbara bioregion and Hamersley subregion is 17.7 million ha and 5.6 million ha, respectively (GoWA 2019a). Based on the predicted impacts discussed in Section 8.4, the cumulative impact will contribute approximately 0.03% and 0.1% to vegetation clearing in the bioregion and subregion, respectively.

The Revised Development Envelope intersects with three vegetation associations, as mapped by Beard (1975), Hamersley 18, 29 and 82. These vegetation associations are widespread throughout the Hamersley subregion, with their Pre-European Extents being 576,541 ha, 170,748 ha and 2,165,224 ha, respectively.

The cumulative impact from the Proposal, Approved Proposal and all other major projects within the subregion (with appropriate data) is clearing approximately 89,545 ha (15.5%) of Hamersley 18,

80,514 ha (47%) of Hamersley 29, and 143,854 ha (6.7%) of Hamersley 82. Despite the implementation of this Proposal and the cumulative impact of all other major projects within the subregion (with appropriate data), approximately 85% of Hamersley 18, 53% of Hamersley 29 and 93% of Hamersley 82 will remain within the subregion. None of these impacts are considered to be significant as they comply with the National Objective and Targets for Biodiversity Conservation by maintaining more than 30% of the pre-European extent of existing vegetation (Commonwealth of Australia 2001).

However, the EPA has identified that the cumulative clearing in the Pilbara bioregion is an area of concern (EPA 2014). As such, clearing native vegetation in good to excellent condition associated with this Proposal is considered a significant cumulative impact. The Proponent will offset this impact by contributing to the PEOF (Section 12).

15.2.3.2. Significant Flora

Of the 28 Priority Flora species within the Revised Development Envelope, 16 have been identified as being impacted by existing or foreseeable surrounding projects within the Hamersley sub-region and therefore have the potential to be impacted cumulatively by the Proposal (Table 8-17). The estimate of the number of plants potentially impacted by other projects includes all individuals within their development envelopes, not the disturbance footprints indicated by publicly available information. Therefore, they are considered conservative estimates.

As a result of the Proposal's implementation and reasonably foreseeable projects, four P2 flora species within the Hamersley subregion are expected to be impacted cumulatively. This includes (Table 8-17):

- ~1,057 individuals (9.7% of recorded individuals in the state) of *Aristida lazaridis* (P2)
- ~23 individuals (0.3% of the recorded individuals in the state) of *Eremophila pusilliflora* (P2)
- ~592 individuals (9.8% of the recorded individuals in the state) of *Hibiscus* sp. Gurinbiddy Range (M.E. Trudgen MET 15708) (P2)
- ~14 individuals (2.1% of the recorded individuals in the state) of *Oxalis* sp. Pilbara (M.E. Trudgen 12725; P2).

The recorded extents of these species have been calculated based on the Rio Tinto and DBCA database, which includes records of Priority flora species across the Pilbara region. Given that none of the Priority 2 species listed above will be impacted by more than 10% (based on upper limits), the cumulative impacts are not considered to be significant.

For P3 and P4 flora species, the cumulative impacts (based on other projects' development envelopes) to most species will range from 1.8% to 25.4% of individuals recorded in the state (Table 8-17). Given that at least 80% of the species records remain in the region, the cumulative impacts to these species are not considered significant.

There are approximately 838 *Indigofera gilesii* (P3) individuals and 1,247 *Acacia bromilowiana* (P4) individuals which may be removed from the region following the Proposal's implementation and other reasonably foreseeable projects (Table 8-17). This represents 26% of *Indigofera gilesii* and 30% of *Acacia bromilowiana* State records. Given that at least 70% of both species will remain intact, these cumulative impacts are not considered significant.

Cumulative impacts to significant flora species within the Revised Development Envelope that also occur across multiple projects within the Hamersley subregion are unlikely to alter the conservation status of any of the Priority flora species within the Revised Development Envelope. Therefore, cumulative impacts on Priority species are not expected to be significant (Section 8.6).

15.2.4. Terrestrial Fauna

All significant fauna species that occur or are likely to occur within the Revised Development Envelope may be affected by cumulative impacts from existing or foreseeable projects. However, these species occur widely in the Hamersley sub-region and can move through the local landscape. Retaining a high significance fauna habitat will minimise the impact on significant fauna species in the area.

It is not possible to quantify the cumulative extent of habitat loss that satisfies the specific habitat requirements for each species, given the lack of detailed fauna habitat mapping for the entire subregion. Given the extent of fauna habitat, which will remain within the Revised Development Envelope (i.e., over 23,572 ha (80%) of all fauna habitat and 8,973 ha (70%) of high significance habitat), cumulative impacts to fauna habitats within the Revised Development Envelope are unlikely to be significant. Of the 41 potential roost caves recorded within the Revised Development Envelope, 37 will remain, with four category 4 Ghost Bat/Pilbara Leaf-nosed Bat roosts impacted by the Proposal.

The estimated cumulative impacts from this Proposal and reasonably foreseeable projects on the land systems within the Hamersley subregion are anticipated to total 133,053 ha (4%). This is based on the development envelopes of existing and foreseeable nearby projects rather than the clearing footprints, therefore overestimating the actual cumulative impact on land systems. This Proposal's contribution is 5,350 ha (<1%).

The cumulative impacts on land systems from existing or foreseeable projects are small, with the highest loss being approximately 10% within the Boolgeeda Land System (Table 9-20).

Given that the majority of these land systems and associated habitat will remain throughout the Hamersley subregion and that the species associated with the Proposal are known to occur throughout the region, the cumulative impacts to these species are not expected to be significant at a local or regional scale (Section 9.6.3).

The cumulative loss of vegetation and fauna habitat due to mining in the Hamersley subregion is recognised as potentially significant as per the EPAs *Cumulative Environmental Impacts of Development in the Pilbara Region* (EPA 2014) and therefore is addressed through the PEOF (Section 12).

15.2.5. Subterranean Fauna

Cumulative impacts represent the combination of 'combined' impacts, with impacts from known and reasonably foreseeable third-party operations surrounding the Revised Development Envelope (refer Section 10.4.3). This is only possible where the direct impacts from known and reasonably foreseeable third-party operations occur within the known occurrence range of the important troglofauna and stygofauna species and habitat values as detailed in Section 10.3.3.

There are no third-party mining projects within the immediate vicinity of the Revised Development Envelope (refer Section 10.4.4). Therefore, any cumulative impacts to troglofauna or stygofauna habitat values are as a result of the combined Approved Proposal and this Proposal.

15.2.5.1. Stygofauna

The combination of direct impacts (creation of pits and groundwater extraction) from the Approved Proposal and this Proposal in the West Angelas Region was quantified and assessed by Biologic (2022b). Based on this assessment, combined impacts are only anticipated to occur at Western Hill orebody aquifer and the surrounding regional synclinal aquifer. Deposits H, F North, and Mt Ella East will not be subject to combined impacts as they either have no current or approved mining operations (Deposit H), lack significant stygofauna species or habitat values (Deposit F North and Mt Ella East), or lack impacts to groundwater (Mt Ella East).

The combined direct reduction of suitable habitat throughout the West Angelas Region was considered Low (17% habitat reduction) (Table 10-19 and Biologic 2022b). Modelling indicates that the remaining suitable habitat is extensive (approximately 83%), with only minor reduction in thickness and extent, and no significant reduction of habitat connectivity (Figure 10-21). This extent of combined direct habitat loss (17%) is only slightly greater than that predicted for direct loss as part of the Proposal (14%) (Section 10.6.2.3).

15.2.5.2. Troglifauna

Combined impacts on troglifauna habitat and species values within the Revised Development Envelope are considered Low, with approximately 88% of the suitable modelled troglifauna habitat expected to be retained post mining. Combined impacts are only present in the vicinity of existing pits within the Deposit F North section and, to a negligible degree, at Mt Ella East (Section 10.6.1.3). There are no combined impacts at Western Hill and Deposit H. Overall, only 12% of suitable troglifauna habitat within the Revised Development Envelope and West Angelas Region will be impacted by combined impacts, and local habitat loss ranged from 3 – 22%, which is considered to be a Low impact rating in all sections.

15.2.6. GHG Emissions

Mine production included in the Proposal will sustain rather than increase annual throughput associated with the existing operations within the Revised Development Envelope. The Proposal will extend total mine life as the approved mines reach the end of their productive life. Therefore, the Proposal represents a continuation of iron ore mining. As a result, the Revised Proposal (Deposits C, D and G subject to MS 1113 and deposits associated with this Proposal) is expected to contribute approximately 104,167 t CO₂-e per annum (average), as follows:

- Scope 1 emissions: up to 88,404 t CO₂-e per annum
- Scope 2 emissions: up to 15,763 t CO₂-e per annum.

Through the LoM, the West Angelas Project (including the Proposal) is expected to contribute approximately 2,916,678 t CO₂-e Scope 1 and 2 emissions.

The benchmarking assessment indicates that the performance of the Proposal is comparable to other recent iron ore developments in the Pilbara.

Abatement of Scope 1 and 2 emissions in accordance with targets as set out in the GHG EMP is currently estimated at 558,963 t CO₂-e.

15.3. Predicted Cumulative Outcomes

Based on the above assessment, the Proponent does not consider that the Proposal presents a significant risk relative to current, proposed or cumulative impacts for each key environmental factor.

Further, as discussed throughout this document, it is considered that the existing obligations and commitments prescribed under a range of regulatory instruments and decision-making processes are appropriate to manage potential cumulative impacts associated with the Proposal in addition to new conditions proposed for consideration by the EPA.

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APPENDIX A CHAPTER 1-5

- A.1: Environmental Scoping Document
- A.2: Other Matters Required by Schedule 4 of the EPBC Regulations
- A.3: Ministerial Statement 1113
- A.4: Proposal Content Document
- A.5: Mine Closure Plan
- A.6: Consultation Register
- A.7: Greenhouse Gas Management Plan
- A.8: Environmental Management Plan
- A.9: Groundwater Environmental Management Plan

APPENDIX B SOCIAL SURROUNDINGS

- B.1: Traditional Owner Consultation Overview
 - a. Consultation Framework
 - b. Social Surroundings Consultation Process and Progress
- B.2: Commercial-In-Confidence – Ngarlawangga Social Surroundings
 - a. CONFIDENTIAL Final Report of Ngarlawangga Aboriginal Corporation WAN Social Surroundings Consultations (Herrmann and Millett 2022)
 - b. CONFIDENTIAL Ngarlawangga – Rio Tinto Iron Ore Social Surroundings Consultations regarding the West Angelas Proposal (Stevens 2023)
 - c. CONFIDENTIAL Ngarlawangga Traditional Ecological Knowledge (TEK) – Ethnobotanical Survey 1 August 2021 – Interim Report (Long & Associates 2021)
 - d. CONFIDENTIAL Ngarlawangga Social Cultural Heritage Management Plan – SCHMP
 - e. CONFIDENTIAL Ngarlawangga Aboriginal Corporation Board letter of acknowledgement
 - f. CONFIDENTIAL Ngarlawangga Social Surroundings Assessment Recommendations
- B.3: Yinhawangka Social Surroundings
 - a. Final Report of a Social Surroundings Assessment for West Angelas Revised Proposal (Yinhawangka CLH and Archae-aus 2022)
 - b. Yinhawangka Social Cultural Heritage Management Plan – SCHMP
 - c. Yinhawangka Aboriginal Corporation Board letter of acknowledgment
 - d. Yinhawangka Social Surroundings Assessment Recommendations
- B.4: Commercial-in-Confidence Cultural Heritage Survey Assessment Results
 - a. CONFIDENTIAL Ngarlawangga Heritage Survey Assessment Results
 - b. CONFIDENTIAL Yinhawangka Heritage Surveys Assessment Results

B.5: West Angelas Beyond 2020 Proposal Visual Impact Assessment (Rio Tinto 2021)

B.6: West Angelas Revised Proposal: Air Quality Assessment (ETA 2022)

B.7: West Angelas Revised Proposal Noise and Vibration Impact Assessment (Wood 2022)

APPENDIX C INLAND WATERS

C.1: Hydrology and Floodplain Assessment for the West Angelas Beyond 2020 Study

C.2: Site Inspection and surface water monitoring at Guburingu heritage area Western Hill

C.3: Site inspection and monitoring of ephemeral pool, Deposit H

C.4: Western Hill Hydrogeological Impact Assessment

C.5: Deposit H Hydrogeological Impact Assessment

C.6: Deposit F North Hydrogeological Conceptualisation

C.7: West Angelas Geochemical Characterisation

C.8: Acid Mine Drainage Source Hazard Risk Assessment West Angelas

C.9: Greater West Angelas AMD Risk Assessment

C.10: West Angelas Western Hill Project Groundwater Assessment Peer Review

APPENDIX D FLORA AND VEGETATION

D.1: West Angelas Beyond 2020 Infrastructure Corridors Reconnaissance and Targeted Survey

D.2: West Angelas Beyond 2020 Mt Ella and Deposit J Detailed and Targeted Survey

D.3: West Angelas Beyond 2020 Deposit H and Deposit F North Reconnaissance Survey

D.4: Targeted Flora and Fauna Survey Mt Ella East and Deposit J pit and waste dump footprints

D.5: West Angelas: Baseline Groundwater Dependent Ecosystem Assessment for the Greater West Angelas Areas

D.6: West Angelas Development Envelope Vegetation Condition Assessment

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D.8: West Angelas Beyond 2020 Deposit G Reconnaissance and Targeted Survey

D.9: West Angelas Development Envelope Consolidated Vegetation Mapping (Angelo River)

D.10: West Angelas Development Envelope Consolidated Vegetation Mapping

D.11: West Angelas Beyond 2020 Detailed Flora and Vegetation Survey: Phases 1 and 2

APPENDIX E TERRESTRIAL FAUNA

E.1: West Angelas Beyond 2020 Infrastructure Corridors Reconnaissance and Targeted Survey

E.2: West Angelas Beyond 2020 Mt Ella East and Dep J Detailed and Targeted Survey

E.3: West Angelas Beyond 2020 Deposit H and F North Reconnaissance Survey

E.4: West Angelas Deposit G Basic and Targeted Vertebrate Fauna Survey

E.5: West Angelas Fauna Habitat Mapping

E.6: West Angelas Beyond 2020 Targeted Vertebrate Fauna Survey

E.7: West Angelas Beyond 2020: Level 2 Vertebrate and SRE Invertebrate Fauna Assessment Phase 1 and 2

E.8: West Angelas Revised Proposal Short-Range Endemic Invertebrate Fauna Environmental Impact Assessment

E.9: West Angelas: Short-Range Endemic Invertebrate Fauna Risk Assessment

APPENDIX F SUBTERRANEAN FAUNA

F.1: West Angelas: 3D Subterranean Habitat Modelling and Assessment

F.2: West Angelas: Subterranean Fauna Survey

F.3: West Angelas Revised Proposal: Environmental Impact Assessment of Subterranean Fauna

APPENDIX G OFFSET

G.1: Impact Reconciliation Procedure