Robe River Mining Co. Pty. Limited

ABN: 71 008 694 246

Mesa J Hub Closure Plan

July 2018

Mineral Field: 08 – Ashburton

FDMS No: RTIO-HSE-0168839

Version 1.1

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EXECUTIVE SUMMARY

Overview

The Mesa J Hub deposits include Mesa J, Mesa K and Mesa H, and are located in the Pilbara region of Western Australia, approximately 16km from Pannawonica in the Shire of Ashburton. The deposits are located within the traditional lands of the Kuruma Marthudunera people and the area is managed by Robe River Mining Co Pty Limited, which is a member of the Rio Tinto Group.

The Mesa K mine commenced operations in 1988 and Mesa J in 1992, and comprise open cut operations utilising conventional drill-and-blast and load and haul mining methods. Ore is crushed on-site before being transported via rail to Cape Lambert for shipping. This closure plan incorporates the current Mesa J and K operation and has been extended to include the adjacent Mesa H deposit.

The currently approved Mesa J and Mesa K mines have an operational life of 13 years with completion of mining scheduled for 2029. The proposed development of Mesa H will incorporate mining until 2037. Mineral waste generated by mining will be placed in a small number of external dumps as well as progressively backfilled into pit voids as they become available. The site is expected to encounter some highly erodible materials which will be used for pit backfill or placed in external waste dumps with appropriate final parameters and/or capping with competent waste. The site has been assessed as having a low geochemical risk and is not expected to encounter acid or metalliferous drainage during mining or post closure.

Scope

This document, titled 'Mesa J Hub Closure Plan July 2018', represents the updated closure plan for the Mesa J and K operations and proposed Mesa H operations and supersedes previous closure plans. It is applicable to mine developments and all associated infrastructure at Mesa J Hub iron ore deposits within the following leases:

- ML248SA Section 103 (Part)
- ML248SA Section 104

The scope of the plan has been aligned to existing tenure boundaries, which may differ from the footprint approved or referred under Part IV of the *Environmental Protection Act 1986.*

Post-mining land use

Post-mining land use options in the Pilbara are generally limited due to the remote location. The proposed final land use assumes that the site will be rehabilitated to create a safe, stable and non-polluting landscape revegetated with native species, to maximise environmental and cultural heritage outcomes and ensure the site does not adversely impact on the current surrounding land use.

Due to the nature of the mining activity undertaken, the final landform will include large voids and waste dumps, and will therefore be unlikely to support pastoral activities in the immediate disturbed areas. However, it is recognized that surrounding areas are likely to remain subject to pastoral activity. For the purpose of this closure plan, it is assumed that the post closure landform will be shaped and rehabilitated to support ongoing pastoral activity and to ensure that the visual amenity and associated heritage and ecological values will be retained in the post closure landform. The final land use will be determined prior to closure during final planning phases and in consultation with relevant stakeholders.

Closure objectives

The following objectives have been developed in relation to the closure strategy contained within this closure plan:

- Public safety hazards have been managed.
- Contaminated sites are appropriately managed in accordance with the Contaminated Sites Act 2003 (WA).
- Final landform is stable and considers ecological and hydrological issues.
- Vegetation on rehabilitated land is self-sustaining and compatible with the final land use.
- Infrastructure has been appropriately managed.
- Robe River permanent pools function similar to the pre-mining state.

Indicative completion criteria have been proposed for each of these objectives; however these have not been the subject of consultation with stakeholders at this point, which is considered acceptable given the long timeframe for mining operations for this site.

Anticipated closure outcome

At closure all below water table pits (with the exception of pit 15 at Mesa J) will be backfilled to suppress the formation of pit lakes. Above water table pits will be backfilled opportunistically with waste. Several pits in the Mesa J mining area will be backfilled with waste fines and capped with inert waste rock. Mining exclusion zones will remain undisturbed as agreed. External waste dumps will be reprofiled to meet final design parameters. Disturbed surfaces will be rehabilitated including pit floors (excluding pit faces). Abandonment bunding or other appropriate means of access restriction will be placed around pits as described within the plan. Disturbed landform features will be rehabilitated with appropriate native species.

CLOSURE PLAN CHECKLIST

The following table provides cross reference to the requirements of the Department of Mines and Petroleum / Environmental Protection Authority *Guidelines for preparing mine closure plans* (2015).

	Mine Closure Plan (MCP) Checklist	Y/N/NA	Page No.	Comments	Change from previous version (Y/N)	Page No.	Comments
1	Has the Checklist been endorsed by a senior representative within the operating company?						
Public Availability							
2	Are you aware that from 2015 all MCPs will be made publically available?	Y	NA				
3	Is there any information in this MCP that should not be publicly available?	Y	Appendix C				
4	If "Yes" to Q3, has confidential information been submitted in a separate document / section?	Y	Appendix C				
Cover page, table of contents							
5	Does the MCP cover page include: Project Title, Company Name, Contact Details (including telephone numbers and email address) Document ID and version number, Date of submission (needs to match the date of this checklist)	Y					
Scope and purpose							
6	State why the MCP is submitted (e.g. as part of a Mining Proposal, a reviewed MCP or to fulfil other legal requirement)	Y	1				
Project overview							
7	Does the project summary include land ownership details, location of the project, comprehensive site plans and background information on the history and status of the project?	Y	3-47				

	Mine Closure Plan (MCP) Checklist	Y/N/NA	Page No.	Comments	Change from previous version (Y/N)	Page No.	Comments
Legal obligations and commitments							
8	Does the MCP include a consolidated summary or register of closure obligations and commitments been included?	Y	Appendix A				
Stakeholder engagement							
9	Have all stakeholders involved in closure been identified?	Y	12				
10	Does the MCP included a summary or register of historic stakeholder engagement been provided, with details on who has been consulted and the outcomes?	Y	Appendix B				
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	12				
Post mining land use(s) and closure objectives							
12	Does the MCP include agreed post-mining land use, closure objectives and conceptual landform design diagram?	Y	13, 13 and Appendix F	Preliminary final land use options, closure objectives and final landform design is presented in the plan. These will continue to be refined during operations and agreed with relevant parties prior to closure.			
13	Does the MCP identify all potential (or pre-existing) environmental legacies which may restrict the post mining land use (including contaminated sites)?	NA		There are no contaminated sites associated with the operation.			
14	Has any soil or groundwater contamination that occurred, or is suspected to have occurred, during the operation of the mine, been reported to DER as required under the Contaminated Sites Act 2003?	NA		There are no known or suspected contaminated sites associated with the operation.			

	Mine Closure Plan (MCP) Checklist	Y/N/NA	Page No.	Comments	Change from previous version (Y/N)	Page No.	Comments
Development of completion criteria							
15	Does the MCP include an appropriate set of specific completion criteria and closure performance indicators?	Y		14			
Collection and analysis of closure data							
16	Does the MCP include baseline data (including pre-mining studies and environmental data)	Y	18 and Appendix C				
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g. GARD Guide)?	Y	24				
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	Y	Appendix C				
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	49				
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	59				
Identification and management of closure issues							
21	Does the MCP include a gap analysis / risk assessment to determine if further information is required in relation to closure of each domain or feature?	Y	48 and Appendix D				
22	Does the MCP include the process, methodology and has the rationale been provided to justify identification and management of the issues?	Y	48 and Appendix D				

	Mine Closure Plan (MCP) Checklist	Y/N/NA	Page No.	Comments	Change from previous version (Y/N)	Page No.	Comments
Closure Implementation							
23	Does the MCP include a summary of closure implementation strategies and activities for the proposed operations or for the whole site?	Y	59				
24	Does the MCP include a closure work program for each domain or feature?	Y	59	To be developed prior to closure			
25	Does the MCP contain site layout plans to clearly show each type of disturbance as defined in Schedule 1 of the MRF Regulations?	Y	62	Mine layout is included in the plan and discussed in detail; however it is not categorised according to MRF regulations.			
26	Does the MCP contain a schedule of research and trial activities?	Y	Appendix E				
27	Does the MCP contain a schedule of progressive rehabilitation activities?	N		Indicative closure schedule provided. Opportunities for rehabilitation assessed annually			
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	66				
29	Does the MCP contain a schedule of decommissioning activities?	N		To be developed prior to closure			
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	67				
Closure monitoring and maintenance							
31	Does the MCP contain a framework, including methodology, quality control and remedial strategy for closure performance monitoring including post-closure monitoring and maintenance?	N		To be developed prior to closure			

	Mine Closure Plan (MCP) Checklist	Y/N/NA	Page No.	Comments	Change from previous version (Y/N)	Page No.	Comments
Financial provisioning for closure							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	68				
33	Does the MCP include a process for regular review of the financial provision?	Y	68				
Management of information and data							
34	Does the MCP contain a description of management strategies including systems and processes for the retention of mine records?	Y	69				

Corporate endorsement:

I hereby certify that to the best of my knowledge, the information within this Mine Closure Plan is true and correct and addresses the relevant requirements of the *Guidelines for Preparing Mine Closure Plans* approved by the Director General of Mines and Petroleum.

Graeme Weeks

General Manager Technical Services, Rio Tinto Iron Ore

Date: 05 July 2018

TABLE OF CONTENTS

APPENDICES

TABLES

FIGURES

ABBREVIATIONS

AEP	Annual Exceedance Probability
AMD	Acid or Metalliferous Mine Drainage
AWT	Above Water Table
BWT	Below Water Table
DER	Department of Environmental Regulation
DMP	Department of Mines and Petroleum
ENSO	El Niño Southern Oscillation
EPA	Environmental Protection Authority
ESP	Exchangeable Sodium Percentage
IBRA	Interim Biogeographic Regionalisation for Australia
ILUA	Indigenous Land Use Agreements
IOD	Indian Ocean Dipole
IODMS	Iron Ore Document Management System
K&M	Kuruma Marthudunera
MNES	Matters of National Environmental Significance
mRL	Metres above Relevant Level (Sea Level)
MS208	Ministerial Statement 208
MS776	Ministerial Statement 776
NVCP	Native Vegetation Clearing Permits
PAF	Potentially Acid Forming
PCO	Present Closure Obligation
SCARD	Spontaneous Combustion and Acid Rock Drainage
TPC	Total Projected Closure
ZOI	Zone of Instability

SCOPE AND PURPOSE

1. Purpose

Planning for closure of a site is a critical business process that demonstrates Rio Tinto's commitment to sustainable development. This closure plan follows the format and content requirements for mine closure plans as recommended in the Department of Mines and Petroleum (DMP) / Environmental Protection Authority (EPA) *Guidelines for preparing mine closure plans* (2015).

This closure plan has been developed to achieve the following goals:

- to reflect the current knowledge and requirements for closure of Mesa H, Mesa J and Mesa K mines (collective known from here as the Mesa J Hub) and identify the future requirements to continue to progress towards a planned and managed closure of the site;
- to inform the development of closure provisions;
- to meet the internal requirements of the Rio Tinto Closure Standard (2015) mandated for all Rio Tinto businesses;
- for submission to the Department of State Development, to satisfy a request from that Department; and
- to support the environmental approval of the Mesa H Deposit.

2. Scope

This plan covers the current mining operations at Mesa J and K deposits, and the proposed development of the Mesa H deposit. The plan is applicable to areas and mine development features within the following leases[1],

- ML248SA Section 103 (Part);
- ML248SA Section 104.

The plan excludes the following:

- The Pannawonica town and associated access roads
- The mainline rail and associated infrastructure
- Previously developed deposits at Eastern Deepdale and Middle Robe
- The Coastal Water Project (a water supply borefield feeding into the public water system)
- Other undeveloped deposits in the Robe Valley.

The plan will refer to the areas described above as the 'Mesa J Hub' throughout this document.

This closure plan supersedes all previous closure, decommissioning and rehabilitation plans for the Mesa J Hub.

The Robe JV hold mineral leases pursuant to the RR Agreement Act over multiple undeveloped deposits in the Robe Valley. Development of several of these deposits will potentially require continued utilisation of the Mesa J Hub infrastructure after completion of mining at the Mesa J, K and H deposits. These future developments are excluded from the scope of this current Mesa J Hub closure plan, but will be included in future closure plan updates with improved certainty of the specifics of these developments.

[1] Note that the scope of the closure plan has been aligned to tenure boundaries, which may differ from the footprint approved or referred under Part IV of the *Environmental Protection Act 1986*.

2.1 Closure Planning Process

Closure planning is an iterative process that commences during the planning phase of the mine development and is regularly updated and refined during the operational phase (Figure 1). Closure plans are updated to account for changes resulting from:

- amendments to the mine plan;
- improvements of the site closure knowledge base (e.g. through daily activities, technical studies and research actions, progressive rehabilitation);
- new or amended regulation;
- changes to surrounding land uses; and
- evolving stakeholder expectations.

Reviews brings specialists together to discuss current performance, proposed mine changes and opportunities to improve closure outcomes. At the end of the review, improvement actions are assigned and the closure plan is updated.

A key output of closure planning is the development of a closure cost estimate. Closure provisions are subsequently integrated into our business planning processes to ensure funds will be available to close the site effectively.

The detail of each closure plan increases as the knowledge base develops. When the site approaches scheduled closure, studies will be completed to define how infrastructure, decontamination, rehabilitation, the workforce and communications will be managed throughout the mine closure period (and beyond). Stakeholder engagement continues and endorsement of completion criteria is conducted at this time.

In the final closure plan, location specific management plans are provided for each closure domain. These detailed plans cover the physical closure, dismantling and subsequent rehabilitation implementation requirements. The supporting technical reports that have been used to predict the post-closure outcomes are appended to the final closure plan.

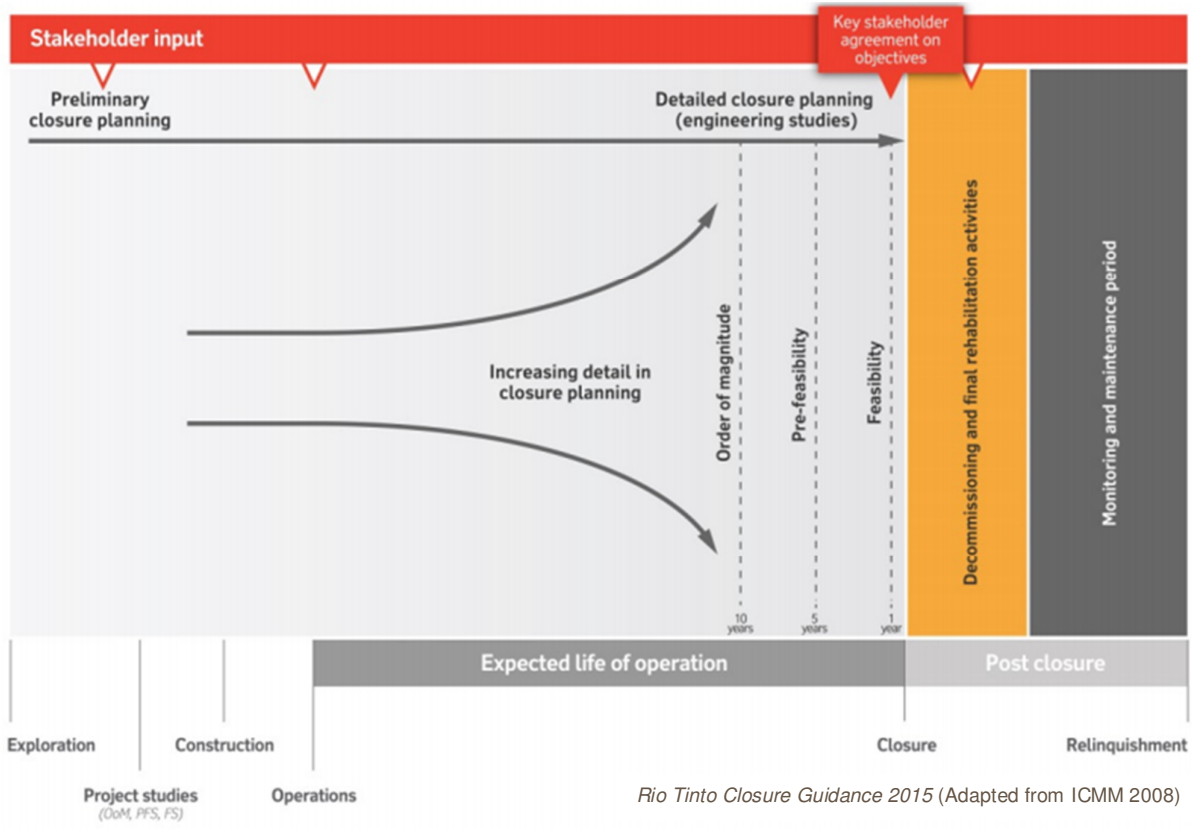


Figure 1: Progression of closure planning

PROJECT OVERVIEW

3. Description of the operation

3.1 Location

The Mesa J Hub includes Mesa H, Mesa J and Mesa K deposits, and is located in the Pilbara region of Western Australia, approximately 100km east of Onslow and 14km southwest of the township of Pannawonica (Figure 2, Figure 3).The area falls within the local authority of the Shire of Ashburton. Tenure associated with current and proposed mining activities is shown in Figure 4, and listed above in Section 2. The mine is located within the traditional lands of the Kuruma Marthudunera (K&M) people (Figure 5). The nearest Aboriginal community is a small settlement known as "The Block" located three kilometres north of Mesa H, which is not permanently occupied.

The Mesa J Hub is overlain by pastoral leases as shown in Figure 4. The eastern operations of Mesa J and K fall within the Yalleen Station (N049492) lease and the western side of Mesa J and H fall within the Yarraloola Station (N049500) lease. Both Yalleen and Yarraloola Stations are owned by Robe River Iron Associates, which is majority owned by Rio Tinto. Both stations are currently sub-leased, with Yalleen managed by Williambury Station Pty Ltd and Yarraloola managed by Cardoo Holdings.

The site is located in proximity to various sensitive environmental and cultural heritage receptors. The ephemeral Robe River is located immediately north of Mesa J and H and south of Mesa K, with permanent and semi-permanent pools occurring in proximity to the deposits. The Robe River and associated pools, together with the mesa landform, have significant cultural value for the local indigenous people. The Robe River and pools, and the breakaway landform on the mesa perimeter, also have value for local biodiversity. There are two Priority Ecological Communities (PEC's) associated with troglofauna communities in mesa landforms of the Robe Valley, comprising 'Subterranean invertebrate communities of mesas in the Robe Valley region' and 'Subterranean invertebrate community of pisolitic hills in the Pilbara'.

The Mesa J Hub is operated under a Joint Venture (JV) agreement of which Rio Tinto owns the majority share. The allocations are as follows;

- Rio Tinto (53%)
- Mitsui Iron Ore Development Pty Ltd (33%)
- Pannawonica Iron Associates (10.5%); and,
- Cape Lambert Iron Associates (3.5%).

3.2 Mine Operations

The Mining operations currently managed by the Robe JV have been active in the Robe Valley for over 40 years at multiple locations, facilitated by the *RR Agreement Act 1964* (Agreement Act). Robe JV deposits within the scope of this closure plan comprise the following:

- Mesa J deposit, which commenced mining in 1992.
- Mesa K deposit 1.5 km north-east of Mesa J, that commenced mining in 1988,
- Mesa H deposit, immediately west of Mesa J, which is proposed for development from 2019.

At Mesa J and K, iron ore is mined using conventional open cut mining methods of drilling and blasting, and load and haul. Waste rock is hauled to designated waste dumps or to back fill unused pits, with a priority to store in unused pits. Only a limited number of external dumps are proposed. Ore is hauled to the processing plants at Mesa J, with product transported to Cape Lambert via rail. Mining of the Mesa H deposit will follow a similar method with ore hauled to the Mesa J plants for processing. Minor expansion of the Mesa J plant facilities will occur.

The Mesa J, K and H deposits have a current combined operational life of 20 years with completion of mining scheduled for 2037. The current mine development schedule is outlined in Table 1 below. The mine schedules and plans are subject to regular review to ensure optimised performance of the operations and are therefore subject to change over time. The key landforms associated with the mine are shown in Table 2 below, and the proposed construction and rehabilitation design criteria for these landforms are included in Appendix F. The proposed mine layout is shown in Figure 6.

Table 1: Indicative mining schedule

Deposit	Pit	Commencement	Completion	Description	Regulatory Status
Mesa H	Pit 1	2023	2027	BWT	Proposed
Mesa H	Pit 2	2028	2031	BWT	Proposed
Mesa H	Pit 3	2030	2032	BWT	Proposed
Mesa H	Pit 4	2030	2035	BWT	Proposed
Mesa H	Pit 5	2034	2036	BWT	Proposed
Mesa H	Pit 6	2020	2027	BWT	Proposed
Mesa H	Pit 7	2026	2034	BWT	Proposed
Mesa H	Pit 8	2026	2032	BWT	Proposed
Mesa H	Pit 9	2021	2026	AWT	Proposed
Mesa J	Pit 1	1992	1999	AWT	Complete
Mesa J	Pit 2	1992	2016	AWT	Complete
Mesa J	Pit 3	1993	2021	AWT	Complete
Mesa J	Pit 4	1993	TBC	AWT	Approved
Mesa J	Pit 5	1994	2021	AWT	Approved
Mesa J	Pit 6	2000	2025	BWT	Approved
Mesa J	Pit 7	1998	2019	BWT	Approved
Mesa J	Pit 8	2000	2021	BWT	Approved
Mesa J	Pit 9	2002	2019	BWT	Approved
Mesa J	Pit 10	TBC	TBC	BWT	Approved
Mesa J	Pit 11	2006	2021	BWT	Approved
Mesa J	Pit 12	2007	2020	BWT	Approved
Mesa J	Pit 14	2024	2028	BWT	Approved
Mesa J	Pit 15	1998	2020	BWT	Approved
Mesa K[2]	Pit 1	2021	2021	AWT	Approved
Mesa K	Pit 2	2021	2022	AWT	Approved
Mesa K	Pit 3	2022	2023	AWT	Approved
Mesa K	Pit 4	2023	2024	AWT	Approved
Mesa K	Pit 5	2023	2025	AWT	Approved
Mesa K	Pit 6	2024	2028	AWT	Approved

[2] Mesa K Pits were previously known as Gully, Central and Gravel Pits, and mined from 1988

Table 2: Waste landform inventory

Landform	Type	Description	Status	Completion Date
Mesa H NE Dump	Waste Dump	Non-hazardous waste	Proposed	2025
Mesa H SW Dump	Waste Dump	Non-hazardous waste	Proposed	2025
Mesa H SE Dump	Waste Dump	Non-hazardous waste	Proposed	2029
Mesa H Pit1 backfill	In pit Waste Dump	Non-hazardous waste	Proposed	2024
Mesa H Pit2 backfill	In pit Waste Dump	Non-hazardous waste	Proposed	TBC
Mesa H Pit3 backfill	In pit Waste Dump	Non-hazardous waste	Proposed	2034
Mesa H Pit4 backfill	In pit Waste Dump	Non-hazardous waste	Proposed	End mine life
Mesa H Pit6/8 backfill	In pit Waste Dump	Non-hazardous waste	Proposed	Post-closure
Mesa H Pit9 backfill	In pit Waste Dump	Non-hazardous waste	Proposed	2030
Mesa J Boondock WD	Waste Dump	Non-hazardous waste	Complete	Complete[3]
Mesa J Pit 11 inpit WD	In pit Waste Dump	Non-hazardous waste	Proposed	2025
Mesa J P12 WD	In pit Waste Dump	Non-hazardous waste	Active	2020
Mesa J P6 WD	In pit Waste Dump	Non-hazardous waste	Active	2020
Mesa J P7/15 WD	In pit Waste Dump	Non-hazardous waste	Proposed	End mine life
Mesa J TSF1	TSF	In-pit TSF	Rehabilitated	Rehabilitated
Mesa J TSF3	TSF	In-pit TSF	Active	2020
Mesa J TSF4	TSF	In-pit TSF	Active	2020
Mesa J TSF5	TSF	In-pit TSF	Active	2019
Mesa J Pit 7/14 TSF	TSF	In-pit TSF	Proposed	End mine life
Mesa J Pit 8 TSF	TSF	In-pit TSF	Proposed	2028
Mesa J Pit 9 TSF	TSF	In-pit TSF	Proposed	2029
Mesa K North WD	Waste Dump	Non-hazardous waste	Active	Complete
Mesa K WD	Waste Dump	Non-hazardous waste	Proposed	2023
Mesa K Pit 1 backfill	In-pit Waste Dump	Non-hazardous waste	Proposed	2026
Mesa K Pit 2 backfill	In-pit Waste Dump	Non-hazardous waste	Proposed	2029
Mesa K Pit 3 backfill	In-pit Waste Dump	Non-hazardous waste	Proposed	2033
Mesa K Gravel Pit WD	In pit Waste Dump	Non-hazardous waste	Rehabilitated	Rehabilitated

[3] Although Boondocksis complete, an extension has been proposed. This extension is subject to sterilisation drilling.

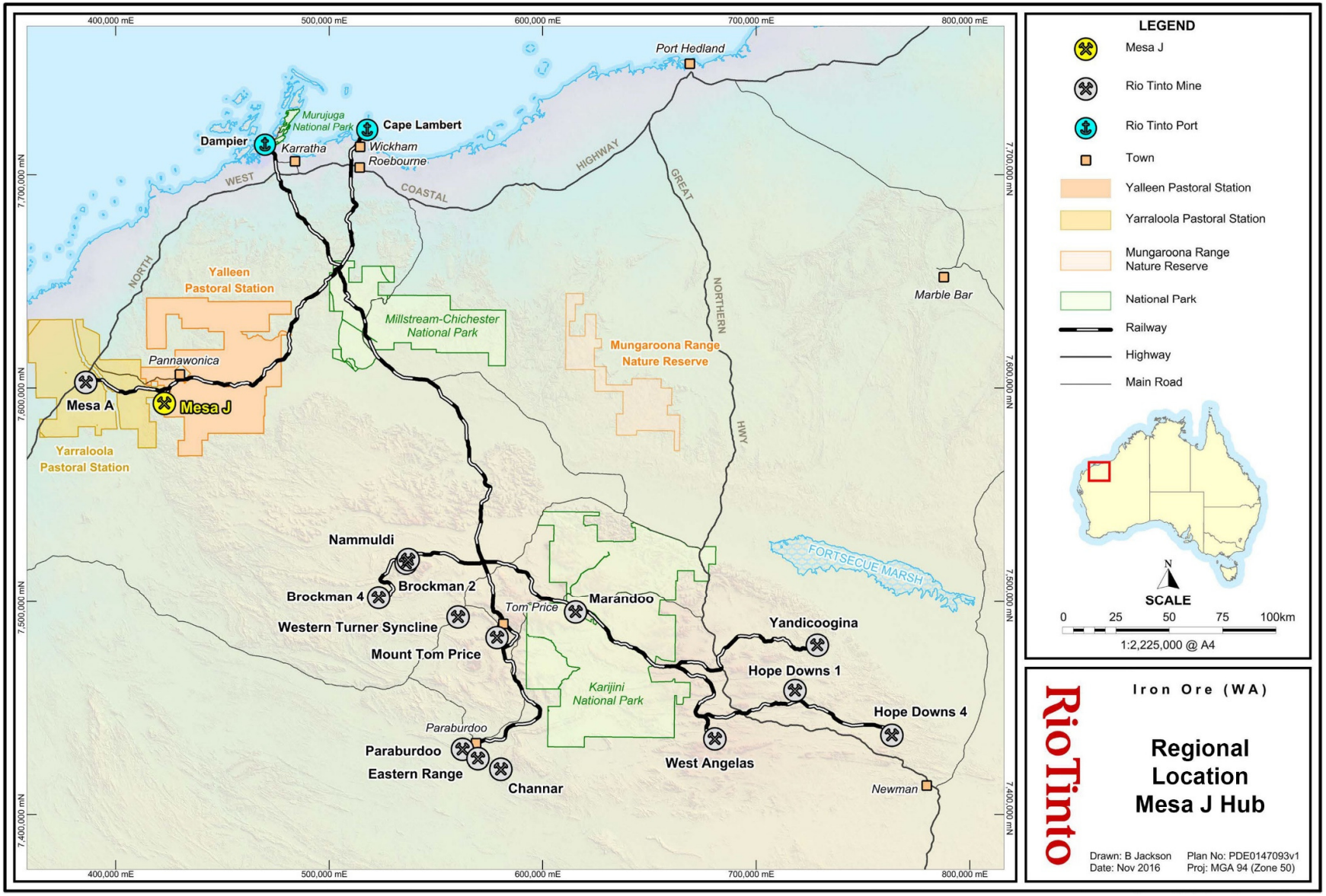


Figure 2: Regional location of Mesa J Hub

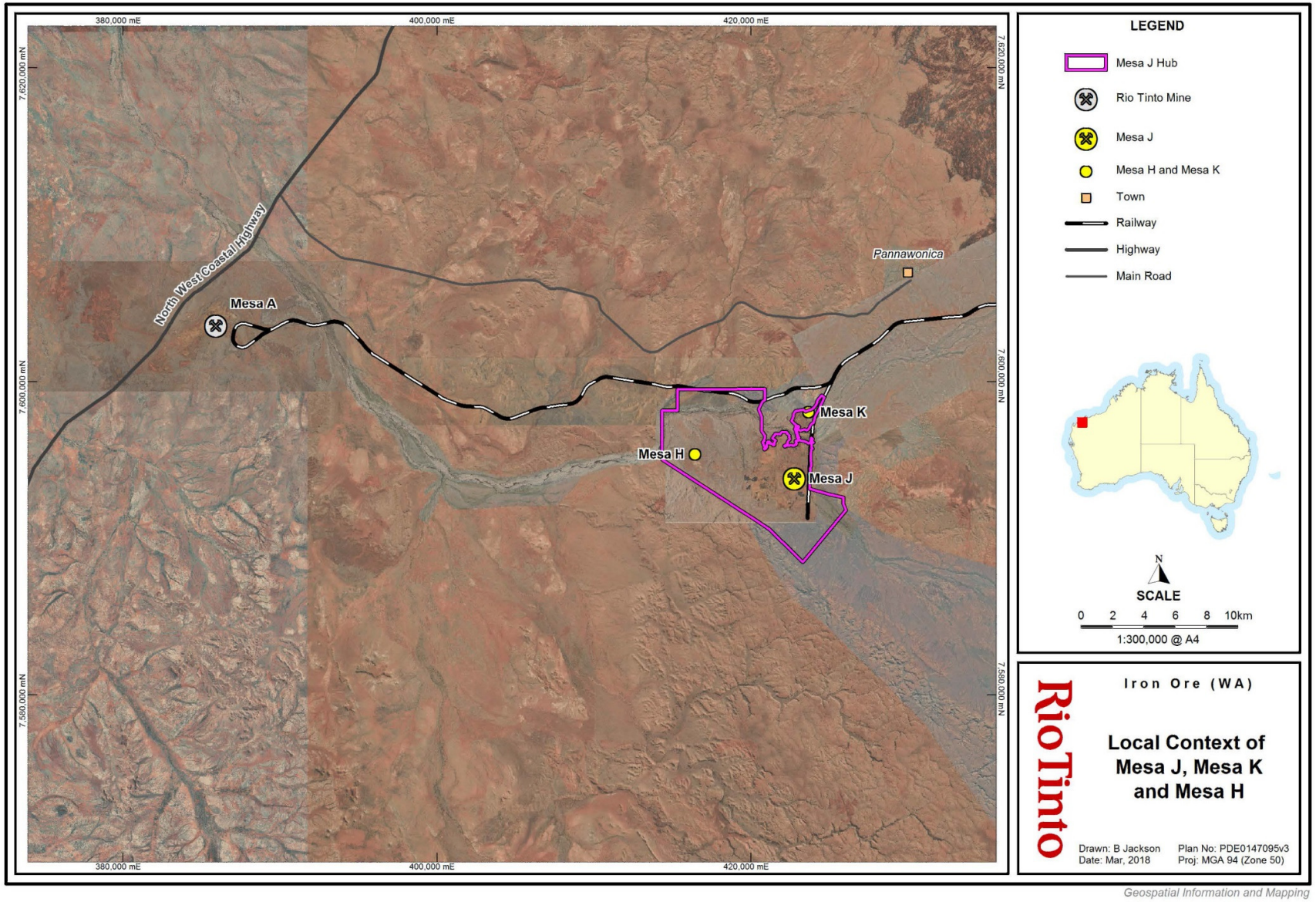


Figure 3: Local context of the Mesa J Hub in the Robe Valley

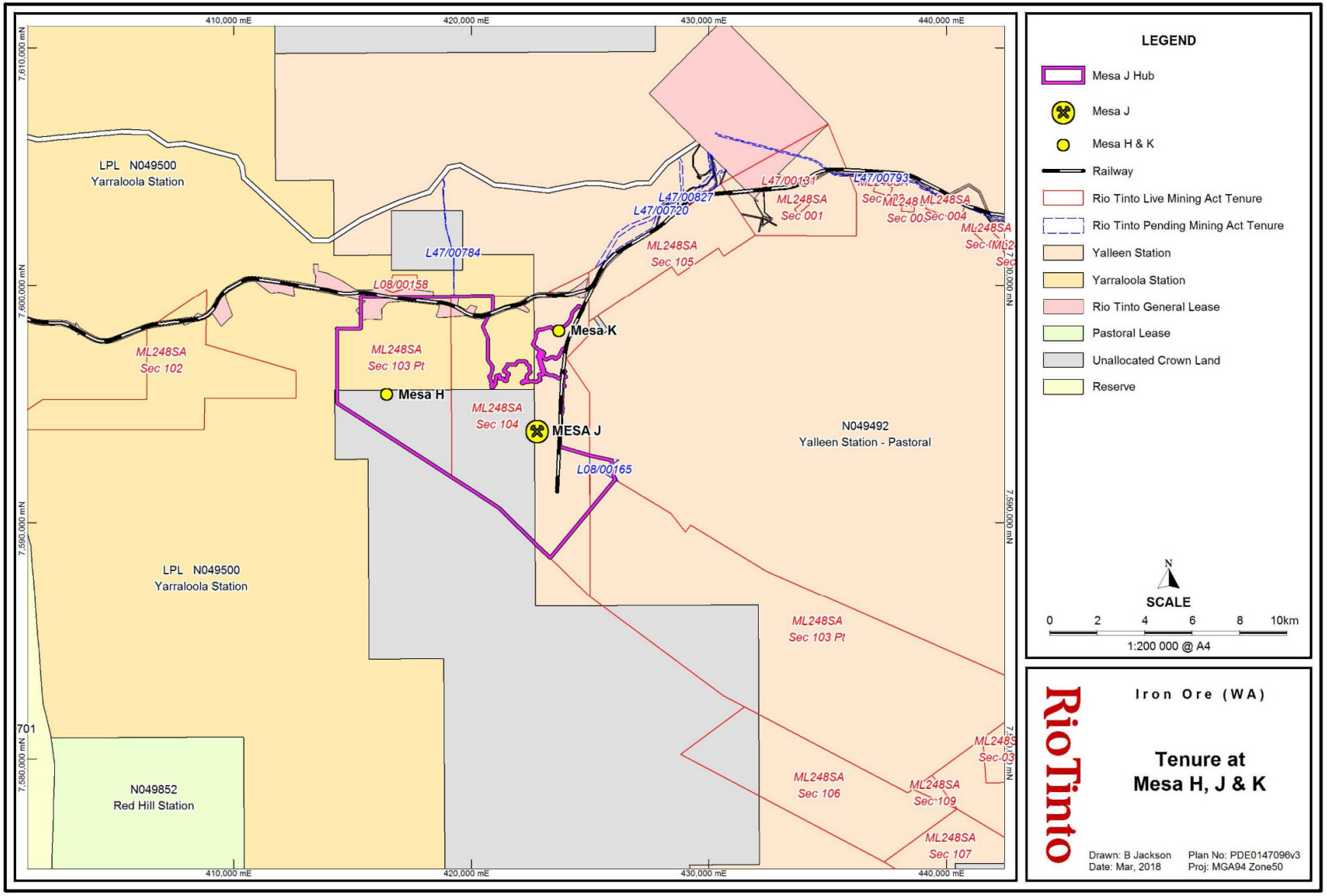


Figure 4: Tenure associated with Mesa J Hub mining activities

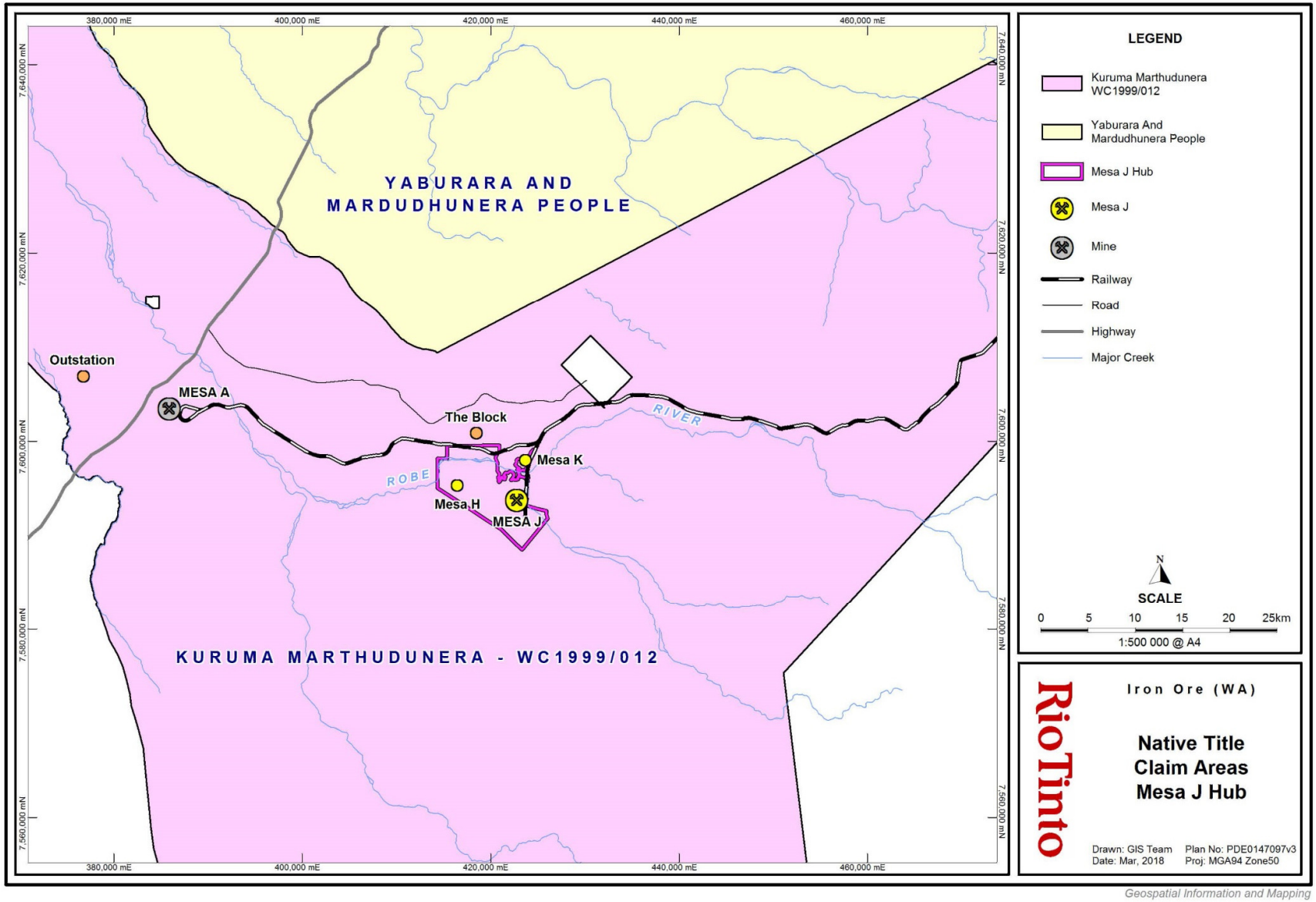


Figure 5: Traditional Owner locations

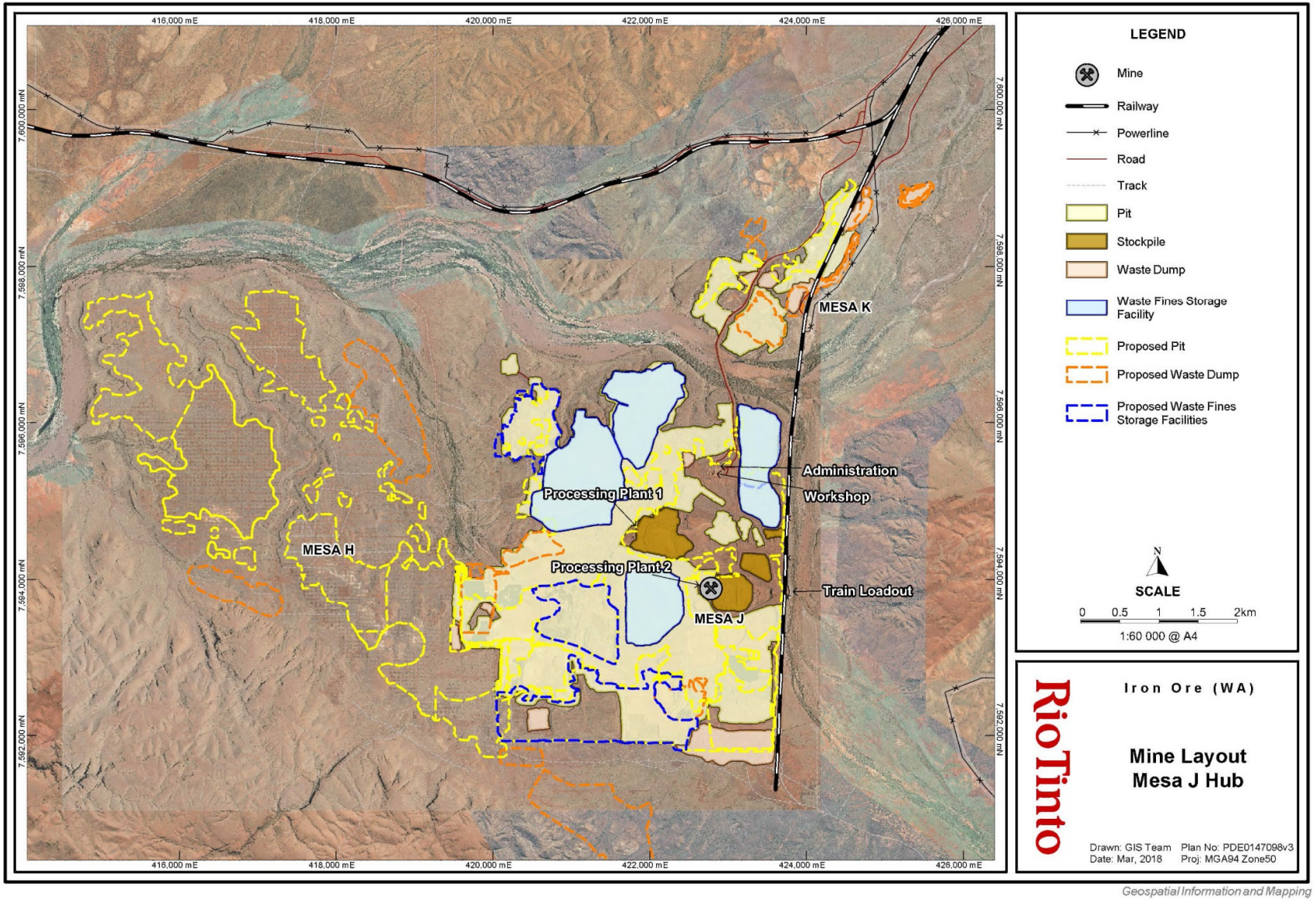


Figure 6: Mesa J Hub Mine Layout

IDENTIFICATION OF CLOSURE OBLIGATIONS AND COMMITMENTS

4. Legal obligations

A closure obligations register is presented as Appendix A. It contains details of legal obligations from the following instruments:

- *Iron Ore (Robe River) Agreement Act 1964*;
- Ministerial Statement 208 (Mesa J Iron Ore Development);
- Ministerial Statement 776 (Mesa K Remnant Mining Project);
- relevant Native Vegetation Clearing Permits (NCVP); and
- mineral leases issued under the *Mining Act 1978* pursuant to approval under the *Iron Ore (Robe River) Agreement Act 1964*.

The register also identifies legislation, standards and guidelines that may not apply to Mesa J Hub specifically, but that may be relevant to closure of mine sites generally.

STAKEHOLDER ENGAGEMENT

5. Stakeholder engagement

5.1 Engagement process

Stakeholder engagement is a key part of mine closure planning as it ensures that the expectations of stakeholders are understood by the mine operator and these can be considered and managed during the planning and implementation phase of closure. Rio Tinto has established processes for consultation with stakeholders, these are imbedded in both the Rio Tinto *Mine closure standard* (2015) and *Community and social performance standard* (2015). These standards are aligned with principles from the Australian and New Zealand Minerals and Energy Council and the Minerals Council of Australia (ANZMEC/MCA, 2000). Consultation commences at appropriate times during the early stages of exploration planning and will continue until the final relinquishment of the site.

As part of this process all likely impacted stakeholders are identified and recorded in a register. This register is used to ensure relevant and timely communications are held with stakeholders across a broad range of topics relevant to the mining operations, including closure, and is regularly reviewed and updated to maintain currency. Regular consultation is conducted with a wide range of stakeholders via a variety of forums, for example various State and Local Government agency briefing meetings and Traditional Owner consultation forums established under Indigenous Land Use Agreements. Discussions regarding closure and related activities are included in these meetings as appropriate. The level of closure specific content and detail will increase as closure approaches (see Figure 1).

A communications register specifically for closure of Mesa J Hub is maintained and a copy as at the time of writing is included in Appendix B. This register is used to ensure stakeholder feedback is tracked and monitored to ensure that appropriate actions are taken to address these issues in a timely manner.

POST-MINING LAND USE AND CLOSURE OBJECTIVES

6. Post-mining land use

6.1 Historical land use

The Pilbara is classified as an Extensive Land Use Zone. The lands surrounding the mine are the traditional lands recognised as belonging to the Kuruma and Marthudunera (K&M) people. Since European settlement land uses in the region have included cattle grazing, exploration and mining and conservation reserves. Prior to the commencement of this mine the immediate area was primarily used for pastoral purposes.

6.2 Proposed post-mining land use

Options for post-mining land use in this region are considered limited. However it is recognised that there is an increasing focus on seeking options for diversification of land use and options which are currently unidentified or not considered viable may eventually be implemented.

The proposed final land use assumes that the site will be rehabilitated to create a safe, stable and non-polluting landscape revegetated with native species, to maximise environmental and cultural heritage outcomes and ensure the site does not adversely impact on the current surrounding land use.

Due to the nature of the mining activity undertaken, the final landform will include large voids and waste dumps, and will therefore be unlikely to adequately support pastoral activities in the immediate disturbed areas. However, it is recognized that surrounding areas are likely to remain subject to pastoral activity, and the Mesa J Hub closure needs to be undertaken in such a manner that minimizes land use impacts.

Visual representation of the site at completion of mining, and after completion of proposed rehabilitation activities are included in Figure 28 to Figure 32.

7. Closure objectives

7.1 Rio Tinto vision for closure in the Pilbara

Closure objectives have been developed with consideration of Rio Tinto's general vision for closure, which is to:

- Relinquish its mining leases to the Western Australian State Government.
- Preserve, protect and manage the cultural heritage values of the area in cooperation with the Traditional Owners and other stakeholders.
- Develop and implement strategies for closure which consider the implications on local communities.
- Achieve completion criteria which have been developed with stakeholders and agreed with WA Government.
- Develop landforms that are safe and stable and compatible with the surrounding environment and post-mining land use.
- Achieve environmental outcomes that are compatible with the surrounding environment.
- Implement a workforce strategy which addresses the impacts of closure on employees and contractors.
- Achieve successful closure in a cost effective manner.

7.2 Mesa J Hub closure objectives

The site specific closure objectives that are proposed for the Mesa J Hub are shown in Table 3, along with the proposed criteria for how these objectives will be assessed and measured (completion criteria).

Due to the early stage of closure these objectives require further consultation with key stakeholders and are likely to evolve in future versions of this plan as knowledge of closure issues progresses and detailed closure discussions commence.

COMPLETION CRITERIA

8. Completion criteria

Completion criteria are defined as the indicators used to determine whether closure objectives have been met. They are used to measure the success of closure implementation against objectives, and to facilitate relinquishment of mining tenure.

The completion criteria, as detailed in Table 3, have been developed in consideration of the predicted closure outcomes. Measurement processes and the associated supporting data (evidence and / or metrics), that could be used to evaluate the success of closure at Mesa J Hub are also described in Table 3.

The completion criteria are subject to ongoing review and update, informed by the outcome from studies, monitoring and ongoing stakeholder consultation. Given the number of years until scheduled closure the completion criteria contained in this plan should be considered indicative only. As the site approaches scheduled closure the completion criteria will continue to be refined.

Table 3: Indicative completion criteria

Objective	Indicative completion criteria	Verification process/method	Evidence
Public safety hazards have been managed.	1) Safety and health risks have been identified. 2) Measures to mitigate the identified public safety (and fauna where appropriate) and human health hazards have been agreed with key stakeholders and have been implemented. 3) Transfer of any residual liabilities is agreed with stakeholders.	1) Risk assessment conducted and mitigation actions implemented. 2) Relevant stakeholders have been engaged on risk mitigation measures to be employed. 3) Independent audit(s)/review to confirm that hazard mitigation measures have been implemented. 4) Process for transfer of residual liabilities is documented.	1) Risk assessment report. 2) Audit report to confirm effectiveness of controls. 3) Records of stakeholder engagement. 4) Liability transfer agreement/s.
Contamination risks have been appropriately managed.	1) Requirements under the Contaminated Sites Act 2003 (WA) have been met for the identification, recording, management, remediation and transfer of any contaminated sites as appropriate.	1) The site has been appropriately assessed for the presence of suspected or known contaminated sites. 2) Suspected or known contaminated sites have been appropriately reported under the Contaminated Sites Act 2003. 3) Appropriate management measures to address contamination have been implemented. 4) Process for transfer of residual liabilities is documented.	1) Contaminated sites investigation report/s. 2) Reports submitted to the Department of Environment Regulation (if required). 3) Liability transfer agreement/s. (if required).

Objective	Indicative completion criteria	Verification process/method	Evidence
Final landform[4] is stable and considers ecological and hydrological factors.	1) There are no erosion features present that compromise landform integrity, and if present, erosion features are stable. 2) The final landform was designed and constructed with consideration given to its stability during intense rainfall and large flood events. 3) Final landforms are outside predicted zones of instability of pits. 4) Mining exclusion zones remains as per approval. 5) Ground water levels and quality are trending towards acceptable ranges to support stygofauna and ground water dependant ecosystems (outside mining areas). 6) Backfill of the final landform (with the exception of Pit 15) has been undertaken to prevent formation of pit lakes and facilitate ground water recovery. 7) Operational drainage structures have been constructed or modified to consider local surface water regimes post closure.	1) Rehabilitation monitoring program including quantitative evaluation of behaviour of rills and gullies (if required) over time. 2) Analysis of aerial imagery to provide qualitative analysis of landform stability. 3) Post-closure landform review to confirm that risks have been appropriately managed. 4) Survey of exclusion zones.	1) Rehabilitation monitoring results. 2) Post closure landform evaluation report. 3) Façade assessment. 4) Survey data assessment. 5) Ground water monitoring report 6) Drainage design report
Vegetation on rehabilitated land is self-sustaining and compatible with the final land use.	1) Seed used in rehabilitation works is of local provenance[5]. 2) Native plants within rehabilitated areas are observed to flower and/or fruit. 3) Recruitment of native perennial plants is observed. 4) Species richness[6] of native perennial plants within rehabilitated areas is not less than reference sites. 5) Any weed species recorded within rehabilitation areas are present within the local area. 6) Erosion from landforms does not threaten surrounding significant natural ecosystems (Robe River Pools).	1) Rehabilitation monitoring/site inspections. 2) Analysis of historical monitoring data.	1) Rehabilitation monitoring reports. 2) Ecological monitoring reports.

[4] 'Landform' includes all post mining constructed features: waste dumps, waste fines storage facilities, abandonment bunds and pits.

[5] Note: Some seed used in rehabilitation predates accurate recording of collection area. Note 2: Local is defined as Pilbara IBRA

[6] Richness is defined as the number of different species in the defined area.

Objective	Indicative completion criteria	Verification process/method	Evidence
Infrastructure appropriately managed.	1) Legal agreement to transfer residual liability completed (if required). 2) Where transfer of liability is not established, infrastructure has been decommissioned and removed.	1) Appropriate agreements and transfer processes in place and communicated for any infrastructure remaining post closure.	1) Agreements in place with party assuming liability for infrastructure. 2) Close out report 3) Visual inspection
Robe river pools (in proximity to Mesa J Hub) function similar to the pre-mining state.	1) Water quality in Robe River pools is comparable to natural local ecosystems. 2) Ecological function of the pools is comparable to natural local ecosystems incorporating climate changes.	1) Surface and groundwater quality monitoring. 2) Environmental and Ecological monitoring.	1) Water quality reports. 2) Ecological monitoring reports.

COLLECTION AND ANALYSIS OF CLOSURE DATA

The closure knowledge base (Appendix C) is a collection of baseline studies, models and interpretations, which are used to inform the closure planning process presented in this closure plan. The knowledge may be specific to the site or generally applicable to the Pilbara region; and includes information on the performance of closure-related trials completed at other Pilbara mining operations (when appropriate). At this stage of the closure plan development, only summaries of these reports are provided and the relevant information is summarised in this section. The relevant knowledge base reports will be included in the final closure plan.

9. Climate

The closest official Bureau of Meteorology weather recording station is at Pannawonica (station 005069), which is approximately 15km to the northeast of the Mesa J Hub. Climatic information has been captured from this site since 1971. In addition, Rio Tinto maintains an automatic weather station at Mesa J itself. Information in this closure plan is sourced from both stations.

9.1 Climate and significant weather events

The climate in the area can be characterised as arid tropical with two distinct seasons, hot wet summers and cooler dry winters. Mean daily maxima temperatures range from 41°C in summer to 27°C in winter (Figure 7).

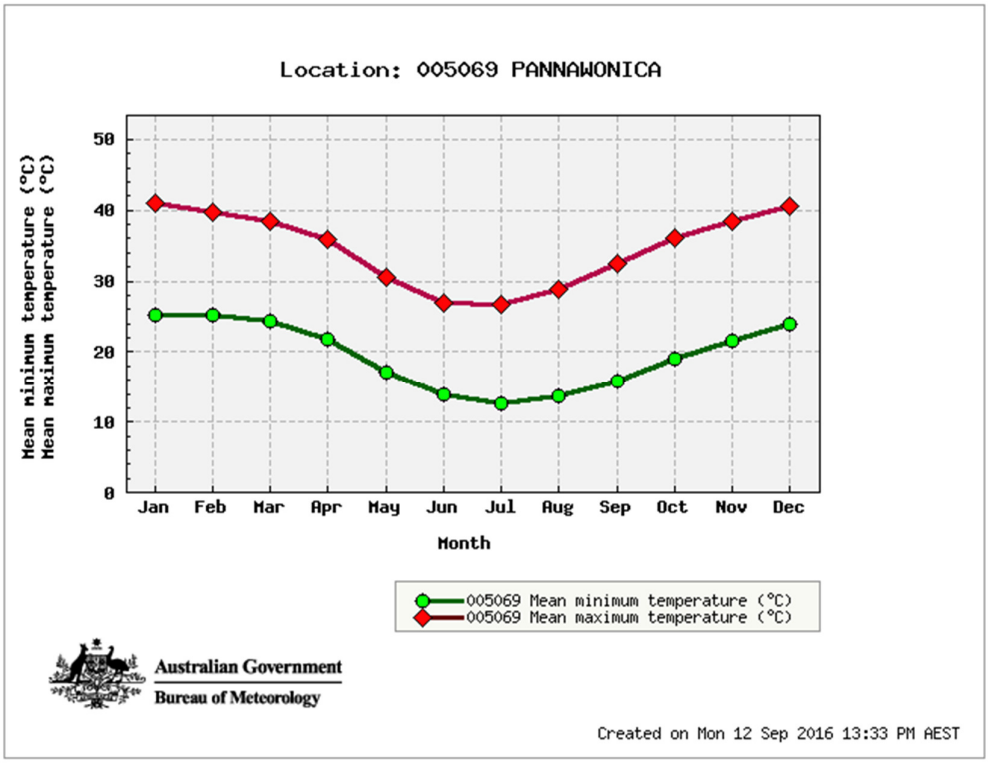


Figure 7: Mean monthly temperatures, Pannawonica 1971-2015.

The north/north-western coastline of Australia has experienced more tropical cyclones than anywhere else on mainland Australia. Most tropical cyclones are observed during the late summer, occurring between November and April. Tropical cyclones can produce damaging wind gusts in excess of 150 km per hour, with heavy rains resulting in regional flooding. Seven tropical cyclones are expected off the coast of the Pilbara each year, with three expected to make landfall.

Precipitation is driven by summer cyclonic activity, with the months of August, September and October have the lowest average rainfall, and January February and March the highest average rainfall (Figure 8). Annual rainfall is also highly variable, (Figure 9). Evaporation rates in the region greatly exceed rainfall, which is typical for similar climate conditions around Australia. Annual average pan evaporation rate is 3200-3600 mm/year (Figure 10).

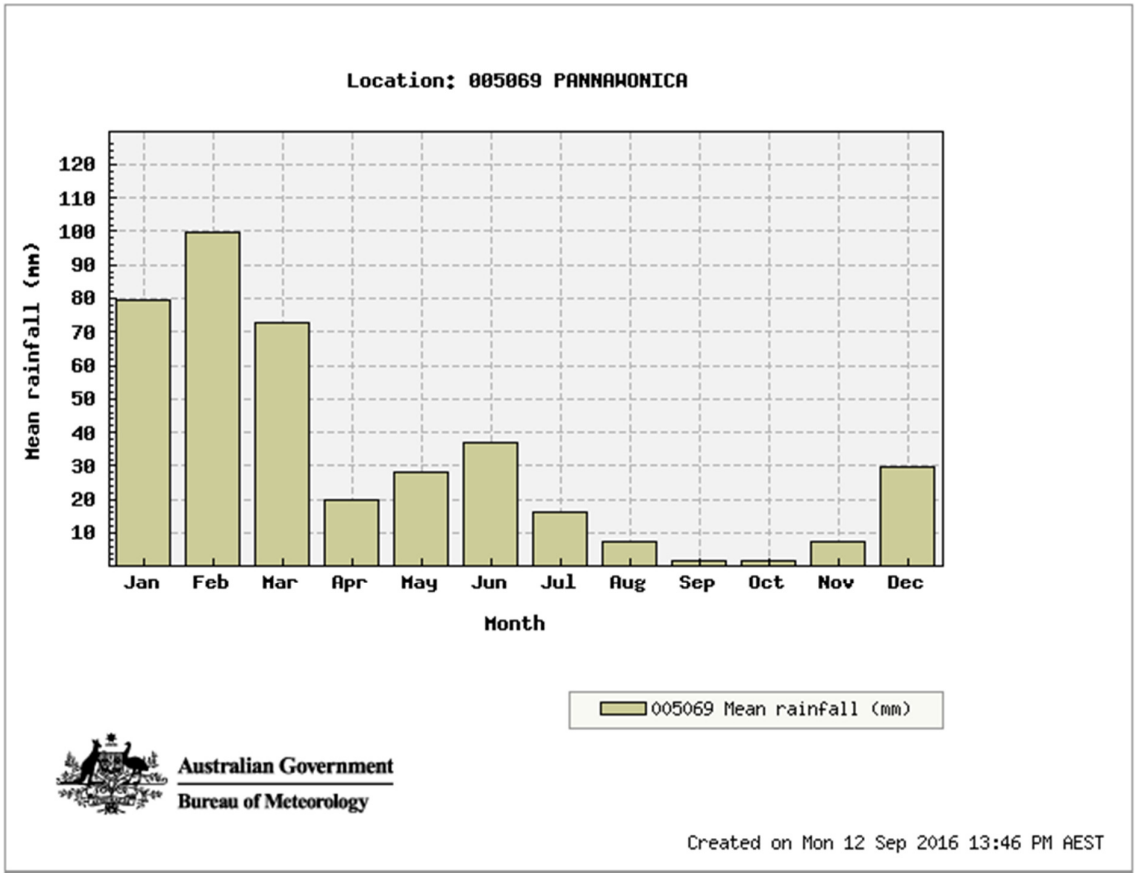


Figure 8: Mean monthly rainfall (1971 to 2015) at Pannawonica

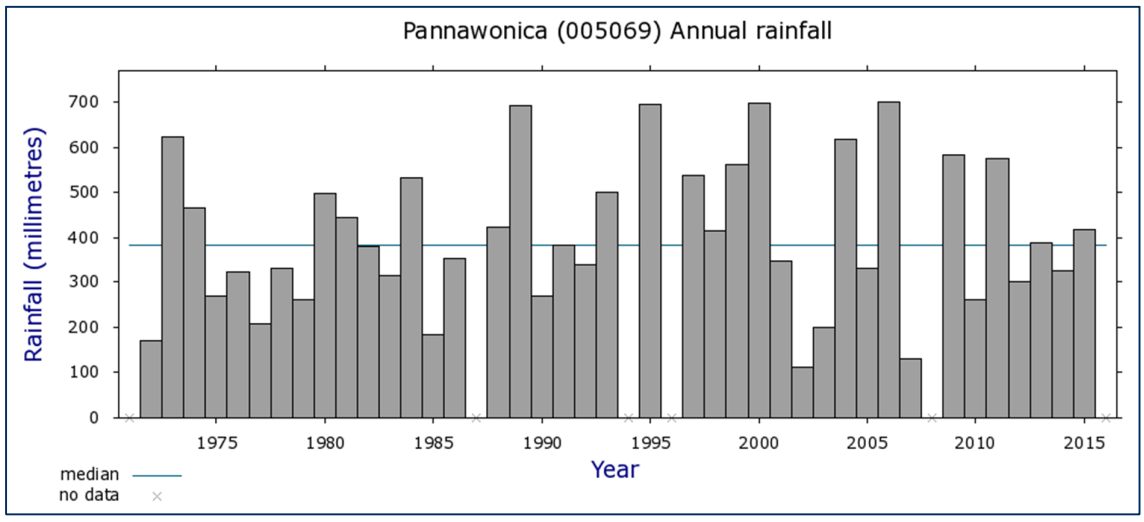


Figure 9: Historical annual rainfall (1971 to 2015) at Pannawonica

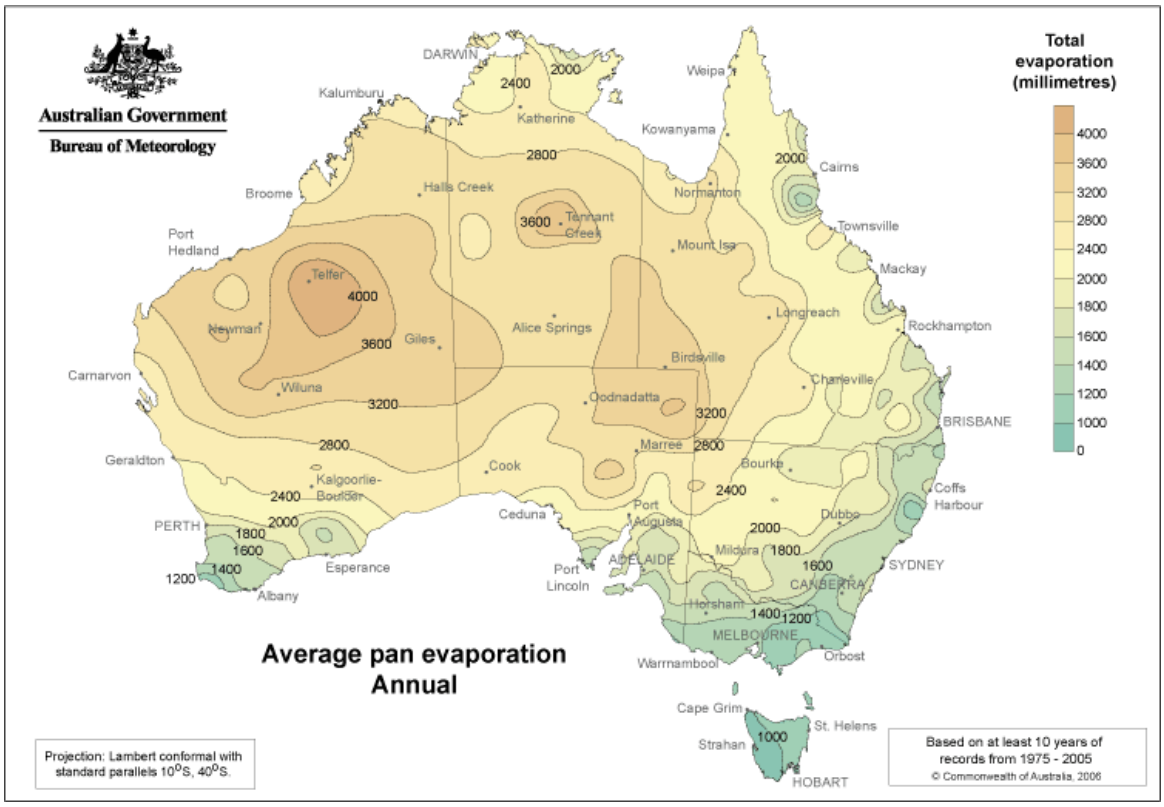


Figure 10: Average annual pan evaporation rates across Australia

9.2 Climate and landform stability

The heavy, intense rainfall experienced in the Pilbara makes rainfall the key climatic factor that influences surface stability in built landforms. Rainfall erosivity (measured in mega joule millimetre per hectare per hour per year - MJ.mm/ha/hr/yr) is the term used to describe the erosive force of rain. For Pilbara sites, long-term annual erosivity values range from ~1,000-1,600 MJ.mm/ha/hr/yr. Rainfall in the Pilbara is typically more erosive than Perth's rainfall, even though it only receives on average half the rainfall that Perth receives on an annual basis. For comparison, average annual erosivity values for Perth are ~1000 MJ.mm/ha/hr/yr from an average of 780 mm of rain a year.

Rainfall erosivity is highly variable for each rainfall event. Studies of Pilbara rainfall concluded that at Tom Price, for example, erosivity for the period 1998 to 2009 ranged from 212 – 6,349 MJ.mm/ha/hr/yr. A review of data in the Paraburdoo area indicates that the most erosive year recorded was 2007, where 421mm fell during February, with only a further 283mm during the rest of that year. This singular rain period embodied 11,994 MJ.mm/ha/hr/yr of erosive force, or 89% of the entire erosivity of rain for that year. Given the pattern of intense and infrequent rainfall events in the Pilbara, it can be expected that only a few events every year (~1-3 events) will generate the majority of runoff and erosion of that occurs each year.

The studies showed a rapid decline in erosion or sediment yield occurs when annual rain decreases below about 300mm per year due to a corresponding decline in rainfall volumes and rainfall erosivity. However, when annual rainfall increases above ~300mm, vegetation growth increases and becomes increasingly effective in controlling soil erosion. Hence, there is a point of maximum erosion potential at an annual rainfall value of ~200-400 mm such that surface (vegetation) cover is low due to lack of rain and ineffective for controlling erosion, yet rainfall erosivity is sufficiently high to cause erosion, as observed in the Pilbara. Outcomes from these studies have informed development of the *Rio Tinto Iron Ore (WA) Landform Design Guidelines* for achieving stable waste dumps.

9.3 Climate and vegetation growth

Water is generally the limiting factor for plant growth in the Pilbara's arid environment. As a consequence of the hot temperatures, high evaporative demand and infrequent and irregular rainfall, much of the vegetation displays xeromorphic adaptations (plant structural adaptations for survival in dry conditions). These adaptations include the ability to regulate water loss from leaves, extract water from very dry soils and match reproductive strategies with wetter periods. Many species are ephemeral and persist in soil seed banks in between wetter periods.

The adaptive capacity of Pilbara species implies a degree of resilience to changes to hydrological regimes. However, the impacts to Pilbara vegetation as a consequence of climate change are not clear. Changes in vegetation density and water use will alter the amount of runoff that occurs after a rainfall event, which in turn will alter creek flows and groundwater recharge.

Some initial studies within the wider Pilbara are underway to understand how the presence and absence of water affects vegetation growth within riparian corridors. The outcomes from these studies and other evolving research on climate change will be monitored and integrated into future closure studies to inform assumptions on climate influences and impacts.

9.4 Climate change

The understanding of how climate will change in the future in the Pilbara is guided by the outcomes of climate modelling, commissioned privately by Rio Tinto and other Australian government agencies. The main climate drivers for the Pilbara are the El Niño Southern Oscillation (ENSO) and Indian Ocean Dipole (IOD) ocean currents. However, these ocean currents are not well represented in most global climate models, and as a result climate predictions for the northwest of Western Australia vary significantly. Consequently the impact of climate change, the change in water availability and influence on ecosystems, in the Pilbara is still unclear.

The ENSO and IOD ocean currents are currently being researched by CSIRO. At the same time, modelling is being progressively improved by various Australian Government agencies to expand our understanding of the climate drivers in the southern hemisphere, to understand the associated impacts on water availability and to predict changes to existing ecosystems.

From the modelling completed to date, our understanding of Pilbara climate change suggests the region will experience the following climate trends:

- A shift in the historical tropical cyclone season, with an earlier start and potentially later finish.
  - For the period 2051 to 2099, compared to present day, tropical cyclone frequency could decrease by half, and the duration of a given tropical cyclone by 0.6 days on average. Projections also suggest that tropical cyclones could increase in size and intensity
- Continuation of the highly variable multi-decadal scale rainfall trends.
  - Projected rainfall reductions range from 1 to 24 percent for mid-century, and 9 to 24 percent for the end of the century
- A significant warming trend, influencing maximum temperatures, with the largest changes during the January to March period.
  - On average, maximum temperatures are expected to increase by 2.1 to 3.2 ˚C by mid-century and by a total range of 3.8 to 4.6 ˚C by the end of the century. For minimum temperatures the corresponding averaged increases are 1.9 to 2.4 ˚C (mid-century) and 4.1 to 4.6 ˚C (end of the century).

These changes, if realised as modelled, are likely to make successful rehabilitation in the Pilbara more challenging. Current landform designs are conservative, providing contingency for increased erosion factors, however lower average rainfall will impact ability to establish vegetative cover.

10. Land

10.1 Biogeographic overview

The Mesa J Hub lies within the Pilbara Craton, a bioregion defined by the Interim Biogeographic Regionalisation for Australia (IBRA). The Pilbara bioregion is divided into four subregions: Chichester, Fortescue Plains, Hamersley and Roebourne Plains. The study area is located in the Hamersley subregion which is described as a "Mountainous area of Proterozoic sedimentary ranges and plateaux with Mulga low woodland over bunch grasses on fine textured soils and Snappy Gum over *Triodia brizoides* on skeletal sandy soils of the ranges".

10.2 Geological setting

Mesa H, Mesa J and Mesa K are three of a group of pisolitic goethite-hematite iron deposits of Tertiary age which have formed in ancestral drainage channels (palaeochannels) of the Robe River (commonly known as a Channel Iron Deposits (CID), in the western Pilbara region of WA. This group is known as the Lower Robe (or Deepdale) group and comprises a series of mesas formed by the erosion of the surrounding landscape which has exposed the more competent CID paleochannel, thus creating and inverted topography. Subsequent erosion has dissected the outcropping CID paleochannel creating isolated mesa formations.

The Mesa J deposit consists of up to 50 metres thickness of CID (the Robe Pisolite), overlying basement rocks of Proterozoic age. The CID outcrops along the Robe River, and underlies Quaternary sediments elsewhere in the region. The CID at Mesa J occupies an area of approximately 3 x 3.5 km on the south-western side of the Robe River - Jimmawurrada Creek confluence.

The geology of Mesa K is homogenous on a large scale. The dominant geological formation is of dehydrated CID. On a smaller scale the geology varies with the amount of clay pods, rock fractures, alluvium sediment and hardcap.

The Mesa H deposit covers approximately 6.5 x 3 km of CID, at up to 80 m in thickness. It is dissected through the middle and bound to the east by incised drainage channels. The mineralised sequence outcrops as a low mesa-form hill in the north, rising up to 20 m above plain level (176 mRL) and bounded in the north west by the current Robe River. To the south the pisolite sequence is concealed by recent, unconsolidated fluvial gravel, clay, and localised calcrete. The Buckland Hills form the southern boundary along a north-westerly strike and rises up to 266 mRL.

Stratigraphy is shown in Figure 11, Figure 12 and Figure 13. The key formations comprise:

- Alluvial Cover.
- Surficial Unit: Surficial deposits comprise nodules of massive, dark brown goethite surrounded by yellow clay. Where goethite nodules occur at topographic highs they are commonly silicified and contain minor crystalline carbonate. These calcite-dolomite-bearing deposits are essentially calcrete. Alluvial deposits associated with Jimmawurrada Creek mainly comprise coarse ‘shingle’ with red clay. Elsewhere, bedded red to grey clay dominates. Sandy alluvium appears to be rare.
- Hardcap Tertiary Pisolite (HTP): Which is the weathered and lateritised zone predominantly at the top of the Robe Pisolite. This zone ranges from 5m to 10m in thickness, and contains secondary soils, silica and alumina. The transition between the HTP and the underlying TP/TPH is gradational and visually difficult to identify. Hardcap Tertiary Pisolite often contains clay horizons.
- The upper ore zone: Tertiary Pisolite (TP) forms the main ore zone in the Mesa J and Mesa K deposits, but is less prominent at Mesa H, where it has undergone more weathering and is transitional to HTP. It has a pisolitic texture and is cemented together by a goethitic matrix. Internal zones of poorer quality material exist in the form of clay (TPC) or as hydrated/denatured pisolite (TPH/TPD), but these are infrequent.
    - Limonite zone: A limonite-rich zone is present at Mesa J in the vicinity of the water table and limonite persists below the water table. It appears to be coarser grained and the rocks show evidence of abundant secondary processes. Clay bodies are also far more irregularly distributed.
    - Clay Zone: A thick clay rich Tertiary Pisolite unit (TPC) is present extensively throughout Mesa H and extending in to the very southernmost portion of Mesa J. This unit marks the base of the upper ore zone and can be up to 20m in thickness.
- The lower Tertiary Pisolite zone: The Mixed/Massive Sub-Grade Pisolite (TPM), Found in the southern half of Mesa J, underlying the TP, and at Mesa H in a deep north westerly trending channel below the TPC zone. It is characterised by a limonitic, denatured/massive appearance and clay is common throughout. This zone has been subjected to a palaeo-water table, which has resulted in a significant hydration effect in comparison to the upper TP/TPH.
- The deepest parts of the CID are characterised by an enriched/denatured pisolite zone (TPD). It occurs at Mesa J in the south of the deposit and at Mesa H in the deep north westerly trending channel. It is a discreet, semi continuous unit of enriched pisolite that ranges in thickness from 2 m to 10 m. Geologically the unit consists of predominantly goethitic minerals with a minor hematitic component. Goethite, ochreous goethite and clay are most common.
- Basal Pisolite: The Basal Unit (TPB) is dominated by clay and reworked channel deposits, which may include conglomerate coarse pisolites. The Basal Unit also contains laterite, both as reworked remnants of a laterite profile developed on basement rocks, and as the products of extensive in situ lateritisation.
- Basement rock: Basement rocks comprises a number of rock types: Marra Mamba Iron Formation, Jeerinah Formation, duricrust and reworked pisolite and clay. The Marra Mamba Iron Formation and Jeerinah Formation are to be considered the basement and the duricrust, reworked pisolites and clay should be considered a basal unit of the Robe Pisolite sequence.

The Mesa deposits comprise a combination of low, medium and high erodibility wastes. Further discussion on the management of waste materials is contained in section 18.2. Table 4, Table 5 and Table 6 below illustrates the anticipated waste volumes for each deposit.

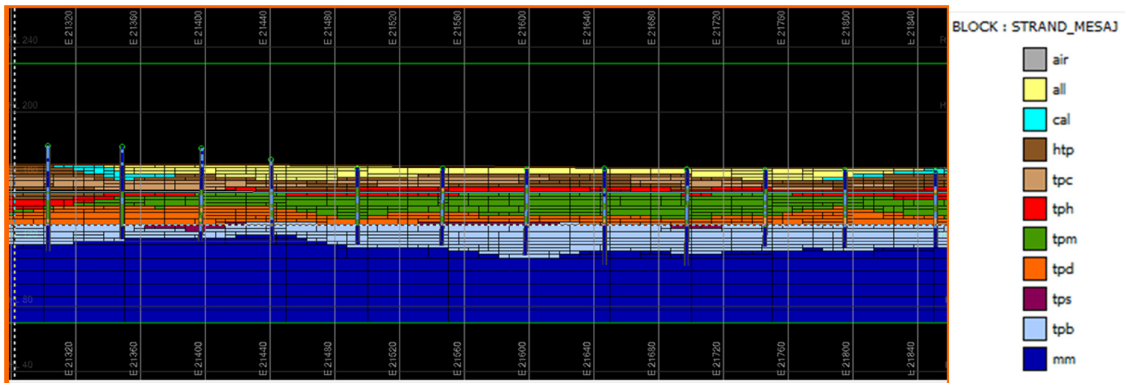


Figure 11: Mesa J stratigraphy

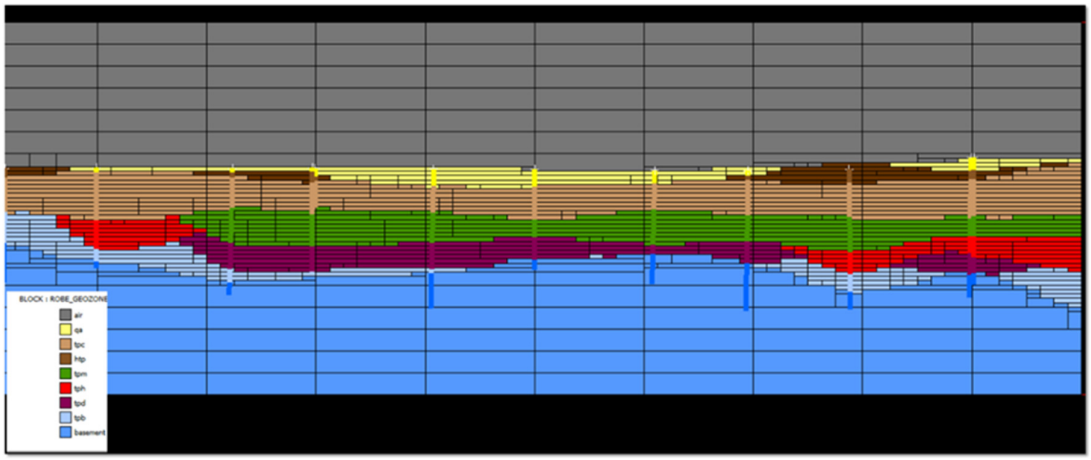


Figure 12: Mesa H stratigraphy (key as above, Figure 11)

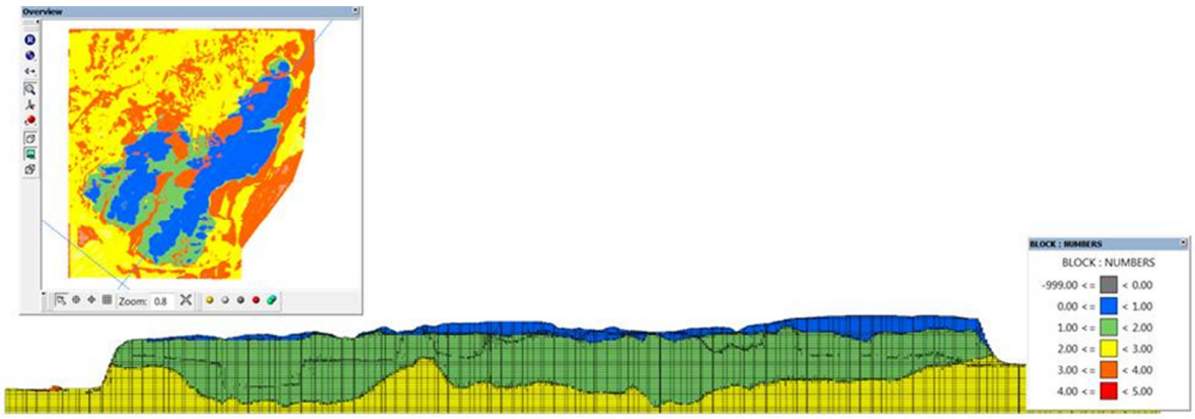


Figure 13: Mesa K stratigraphy, where blue represents weathered zone (HTP), green represents the main ore zone (TP) and yellow represents undifferentiated basement.

10.3 Mineral waste characteristics and inventory

Developing a comprehensive understanding of the types and volumes of materials that will remain at the completion of mining at Mesa J Hub is critical for the effective design, construction and rehabilitation of the mining landforms. Rio Tinto has well-developed processes for the collection and analysis of this data that are implemented from early exploration works and continues through the life of the mine. Long term material behaviour can also be predicted through characterisation of representative waste types and correlation to similar waste materials present at other sites.

Table 4 to Table 6 below provides a summary of the volumes of key material types at the Mesa J Hub. This information is used to inform the landform design and management strategies during operations and closure. Volumes are based on current mining models and will be subject to change. Further detail on these materials are provided in subsequent sections.

Table 4: Materials summary – Mesa H

Material	Volume (m^3)	Comments
Total waste material expected	123,330,000	
Material with potential AMD risk (PAF)	0	
Material with significant fibre risks	0	
Inert mineral waste - low erodibility		
Hydrated (HTP)	9,467,500	
Inert mineral waste- medium erodibility	0	
Inert mineral waste - high erodibility		
Alluvium	6,588,750	
TPB	1,754,922	
TPC	60,388,203	
TPD	2,075,000	Materials under review, may move to medium category
TPH	2,268,672	
TPM	27,752,734	
Rock	3,385,469	
Others	9,648,750	

Table 5: Materials summary – Mesa J

Material	Volume (m^3)	Comments
Total waste material expected	69,936,668	
Material with potential AMD risk (PAF)	0	
Material with significant fibre risks	0	
Inert mineral waste - low erodibility		
Hydrated (HTP)	41,639,543	
Inert mineral waste- medium erodibility	0	
Inert mineral waste - high erodibility		
Alluvium	3,328,296	
TPB	3,702,788	
TPC	14,441,944	Materials under review, may move to medium category
TPM	5,653,264	
TPH	1,170,833	

Table 6: Materials summary – Mesa K

Material	Volume (m^3)	Comments
Total waste material expected	5,386,250	
Material with potential AMD risk (PAF)	0	
Material with significant fibre risks	0	
Inert mineral waste - low erodibility		
Hydrated (HTP)	1,362,031	
Inert mineral waste- medium erodibility	0	
Inert mineral waste - high erodibility	0	
TPB	167,500	
TPC	560,000	
TPH	1,130,469	
TPM	2,121,250	
Rock	42,500	
Others	2,500.00	

10.3.1 Physical characteristics

The key physical property of the waste material that is applicable to the closure design is how susceptible the material is to erosion. Materials are assessed and classified in one of three levels of erodibility; low, medium or high. Materials which are classified as low erodibility, for example, are competent hard rock that is suitable for placement on the outer surface of waste landforms to provide long term protection against erosion. Potential waste types across the Mesa J Hub have been assessed using a combination of site-specific geophysical test work and extrapolation from equivalent material similar sites. Table 4 to Table 6 above lists the material types and volumes for the various erosion classifications. The erosion classification of individual landforms is included in Appendix F.

10.3.2 Geochemical characteristic

Rio Tinto has undertaken an extensive program of geochemical testing over several years to understand the potential for acidification and/or metalliferous drainage to occur as a result of exposing various waste rock types common to mining operations in the Pilbara. The geochemical characterisation process aims to assess sulfur content as an indicator of acid generation potential, and to undertake static (acid base accounting) and, if appropriate, kinetic testing of materials. This information is applied to the geological block model and subsequent mining model, to ensure materials posing potential geochemical risks are identified prior to mining and managed appropriately. This work is in accordance with the *Rio Tinto Iron Ore (WA) Mineral Waste Management Plan for Undeveloped Resources and Studies* and the *Spontaneous Combustion and Acid Rock Drainage (SCARD) Management Plan*.

The most significant geochemical risk posed by mining iron ore deposits in the Pilbara is associated with the sulfide mineral pyrite (FeS_2), which can form sulfuric acid when exposed to oxygen and water. The Mount McRae Shale (MCS), most commonly associated with pyrite and acid and metalliferous drainage in the Pilbara, is not expected to be exposed during mining at Mesa H, Mesa J and Mesa K based on the current proposed pit shells for each deposit; mining is confined to CID materials.

A review of the geochemical risk assessment for each deposit was undertaken in 2015/16 which assessed the sites to be a low risk for acid and/or metalliferous mine drainage (AMD). A further review of Mesa H in 2017 utilising new drilling data supported the Mesa H assessment as low risk. Based on the proposed final pit shells for each deposit it is not anticipated that any moderate or high risk material types will be exposed.

Table 7: Assessed Geochemical risk in the Mesa J Hub mining areas

Mining Area	Geochemical Risk
Mesa H	Low
Mesa J	Low
Mesa K	Low

In terms of potential for metalliferous drainage, minor and trace elements that were enriched compared to average crustal abundances were Fe, As, Sn, Co, Cr, Cu, Mn, Pb, Se, Te, V, Zr and Zn. However, whilst concentrations of some trace elements were elevated these elements are unlikely to mobilise into ground water.

10.3.3 Fibrous minerals

Fibrous minerals present a health hazard if fibres of a (defined) respirable size become airborne and are inhaled. The most common mineral associated with fibrous minerals encountered within the iron formations present in the Robe Valley area is riebeckite. Riebeckite is usually found in fresh (unweathered) BIF. The asbestiform variety of riebeckite is crocidolite, or blue asbestos. The presence of riebeckite does not necessarily pose a fibrous mineral risk but it is a precursor mineral to crocidolite, therefore, there exists a likelihood of encountering crocidolite.

If present, crocidolite seams would primarily occur within the unmineralised Marra Mamba Iron Formation that underlies the CID at Mesa H and Mesa J. In addition, crocidolite may also occur in BIF clasts found within overlying alluvium cover or within the tertiary basal pisolite horizon (i.e. TPB).

Crocidolite has not been intersected in any drillholes within the Mesa H, Mesa J and Mesa K mining or project areas (based on historical drillhole information up to October 2016). However, the underlying basement formation, which includes the Marra Mamba Iron Formation, as well as the TPB horizon in the Mesa H area, is considered to pose a potential fibre risk if exposed in the footwall. However the current mining sequence does not intersect this material.

The *Rio Tinto Iron Ore (WA) Fibrous Minerals Management Plan* describes guidelines for the management of fibrous minerals encountered during mine production, however, based on current drilling and mine planning information, which indicates that basal or basement lithologies can generally be avoided during operations, potentially hazardous or designated hazardous areas are not expected within the life of mine or upon closure in these areas.

10.4 Local soils

Topsoil is recognised as an important factor is achieving high quality rehabilitation results. Characterisation of soils provides an indication of soil properties and their potential impacts on vegetation establishment, growth and landform stability; although it is important to recognise that they are expected to be altered as a result of mining processes. Appropriate characterisation can also help ensure soils with adverse properties are avoided in landform design.

The physical and chemical properties of Robe Valley topsoil are provided in Table 8. Soil properties are within the range typical of that found elsewhere in the Pilbara. It is generally classified as sandy clay loam to medium clay with a coarse material fraction value of up to 81.7%. It is neutral pH, non-saline and non-sodic (below exchangeable sodium percentage of <6%). Both organic carbon and nutrient levels vary according to landscape position: they are typically very low in the higher portions of the landscape, but are present in slightly higher levels in low-lying areas and drainage lines. Robe Valley soils possess low hydraulic conductivity indicating that they could be naturally susceptible to increased surface run off, less water availability to plants and surface erosion. Overall Robe Valley topsoil is consistent with Pilbara soil parameters.

Subsoil has physical properties suitable for plant growth and generally has chemical properties amenable to plant growth, although it does lack the nutrient content, organic matter and soil seed bank of topsoil.

Table 8: Comparison between Robe Valley soils and typical Pilbara soil parameters[7]

Properties		Pilbara Soils	Robe Valley Topsoil
Physical Properties	Soil texture (<2mm soil fraction)	Sand – Clay Loam	Sandy clay loam – Medium heavy clay
	Coarse material content (%)	0 - 93	0.0 – 81.7
	Aggregate stability (Emerson Class[1])	2 - 6	2 – 5
	Soil Strength (Modules of Rupture (kPa))	0 - 267	13.9 – 112.4
	Plant available water holding capacity	-	Low
	Hydraulic conductivity (Ksat(mm/h))	-	0.5 – 1.6
Chemical Properties	Soil pH	5.3 – 9.5	6.0 – 8.6
	Salinity (dS/m)	0.007 – 0.233	0.012 – 0.080
	Organic Carbon (%)	0.07 – 3.74	0.14 – 1.69
	Macro-nutrient status	-	Low
	Micro-nutrient status	-	Low
	Effective Cation Exchange Capacity (meq/100g)	1.9 – 16.8	3.6 – 17.68
	Exchangeable Sodium Percentage (%)	0.21 – 6.39	1.39 – 5.90
	Total metal concentrations	Low	Low

10.5 Soil inventory

Topsoil is often a limited resource in the Pilbara with topsoil recovery often being restricted due to the nature and terrain of the landscape. The goal of soil management is to maximise the collection of topsoil and subsoil, and to store it to maximise its viability and productivity to ensure there is sufficient soil for subsequent use in rehabilitation.

Where practical, a minimum of 200mm of topsoil and 600mm of subsoil is collected when new areas are disturbed. Mesa K currently has a shortfall of material, as the existing stockpiles were moved to Mesa J. As a result, the soil balance for these sites should be considered collectively. It is anticipated that sufficient soil volumes will be available to meet rehabilitation requirements for the deposits.

Table 9 to Table 11 provide the current and projected soil inventory for the Mesa J Hub. Mesa H disturbance is limited to exploration activities, and although some areas have been disturbed the topsoil remains available for collection from the future pit areas.

Table 9: Predicted LOM soil balances for Mesa H

Material	Current volume (m^3)	Predicted total volume LOM (m^3)	Predicted volume required for rehabilitation (m^3)
Topsoil	0	1,764,720	1764,720
Subsoil	0		
Total	0	1,764,720	1,764,720

Table 10: Predicted LOM soil balances for Mesa J

Material	Current volume (m^3)	Predicted total volume LOM (m^3)	Predicted volume required for rehabilitation (m^3)
Topsoil	600,000	3,390,043	2,977,500
Subsoil	2,782,657		
Total	3,382,657	3,390,043	2,977,500

[7] Note that the typical ranges above apply to topsoil and may not be representative of subsoil properties.

Table 11: Predicted LOM soil balances for Mesa K

Material	Current volume (m^3)	Predicted total volume LOM (m^3)	Predicted volume required for rehabilitation (m^3)
Topsoil	0	5,060	254,060
Subsoil	0		
Total	0	5,060	254,060

Whilst it is predicted that Mesa J Hub will have sufficient soil resources to complete rehabilitation works, each project is assessed to determine the type and amount of soil used. This could include an assessment of:

- current soil inventory;
- landform and rehab type;
- potential for trials;
- distance to soil stockpiles; or
- potential upcoming rehabilitation.

10.6 Alternative growth media

Whilst rehabilitation areas have proven to generally perform better with topsoil application, absence of topsoil does not necessarily mean that rehabilitation will fail, or that completion criteria will not be achieved. Trials have been conducted on waste dump rehabilitation without topsoil application (e.g. S Dump and T Dump at Mesa J, see Section 13.1). The trials were performing strongly against most success indicators, however these waste dumps have been re-disturbed due to additional ore being located under the waste dumps.

In 2009, Rio Tinto commissioned a study into the use of waste fines storage facility material as an alternative rehabilitation growth medium, using Mesa J TSF1 materials. A more extensive study in 2010 investigated additional types of mine waste materials. The studies reviewed soil, waste fines and mineral waste characteristics from select Pilbara mining operations, to identify material combinations that may be suitable as a topsoil substitute or supplement in cases where topsoil volumes may be insufficient for rehabilitation requirements. In these cases, topsoil would be applied to high impact and visibility areas such as waste landforms first and lower impact areas such as laydown areas may receive alternative growth media.

The studies showed plant-available nutrients held within the waste materials, although variable and characteristically low, were comparable to natural soils in the region. The majority of the waste materials had macro and micro nutrient concentrations within the range or above the levels measured in benchmark Pilbara topsoil and rehabilitated soils. The pH and phosphorus buffering index of most waste materials were also comparable to that of the benchmark topsoil materials.

In general, Pilbara mineral wastes were non-saline and non-sodic, with no sample presenting above the 15% threshold for exchangeable sodium percentage (ESP), the indicator of high sodicity. The soil structure of waste materials were relatively stable, with only slight or no dispersion upon re-moulding, indicating a structure that is not easily degraded, and is not prone to hard setting. However, estimated plant available water content of the waste materials ranged from 3% to 25%.

Four material classes were analysed from Mesa J and Mesa K, including surficial waste, alluvial waste, weathered waste and waste fines storage material. All material classes were assessed as suitable waste materials for use as a surface growth medium, from both a physical and chemical perspective. A further study in 2015 tested additional waste fines storage material samples from Mesa J, finding them also suitable.

In summary, alternative growth media options are available for consideration in the Mesa J Hub rehabilitation, should a shortfall of available topsoil and subsoil be encountered. Options for utilising the alternative growth media will be considered as the site comes closer to closure. Opportunities to utilise the growth media in field trials will be considered as part of progressive rehabilitation planning.

11. Water

11.1 Surface water

The Mesa J and K mines are located immediately downstream of the confluence of Robe River and Jimmawurrada Creek (Figure 14).

The Robe River is the major river system in the region and covers a linear distance of approximately 260 km, with a catchment area of approximately 7,500 km^2. The Robe River catchment generally drains east to west through the high relief areas of the Hamersley Ranges onto the more gently sloping areas in the coastal plain before discharging into the Indian Ocean. Surface flows are intermittent, typically once per year after significant and intense rainfall. The river has significant underflow in its alluvial bed which maintains a number of permanent pools in the river channel.

Mesa K is located at the top of a local sub-catchment and there are no tributaries that originate in or cross the project area. Two historic waste dumps are situated close to the Robe River, which show limited impacts from past flood events. Existing regional 1 in 100 annual exceedance probability (AEP) – previously referred to as a 1 in 100 year average recurrence interval (ARI) – flood modelling for Mesa K suggests that these dumps are located outside 1 in 100 AEP floodplain of the Robe River (Figure 15), however this will be re-assessed as part of the planned hydrological modelling of the final landforms for Mesa J Hub.

Surface water management at Mesa J operations currently employs a “sump and pump” and “diversion” strategy. The southern cutback pits at Mesa J, including Pit 11, Pit 12, Pit 14, Pit 7 and Pit 6, are exposed to surface water flows from the surrounding catchment, with dumps protecting a majority of the southern cutback, and the remaining runoff flowing into Pit 11 South. Levees and waste dumps to the south and east protect Mesa J from local flooding of the Jimmawurrada Creek. A diversion drain also exists on the western side of Mesa J to direct flows from the adjacent small western catchment, as well as breakout flows from a larger southern catchment, around Pit 11 North and into the natural drainage line to the west of Mesa J.

Although Mesa H deposit is located outside the 1in 100 AEP floodplain of the Robe River, flood protection will be required during operations to manage the runoff from a 24 km^2 local catchment that currently discharges directly over the south-eastern extent of the Mesa H deposit and floods Pit 11 at Mesa J (Figure 15). Diversion drains have been designed, with the preferred design option to divert the local catchment westwards into the central watercourse that bisects Mesa H.

At closure it is expected that any diversion structures that were used to control surface water flows during operations at Mesa J Hub would undergo a slow and inevitable collapse, resulting in runoff from the local catchments draining into the backfilled pit voids. With the exception of the waste dump proposed to the south of Mesa J, all waste dumps at Mesa H and Mesa J are located outside of the current 1 in 100 AEP floodplain (Figure 15). The long-term, post-closure stability of the dump proposed to the south of Mesa J could potentially be compromised if water were to permanently pool against the dump, depending on the waste type. A large portion of these flows can be diverted and the requirement for these diversion structures to meet closure objectives will be further assessed as part of the planned hydrological modelling of the final landforms for Mesa J Hub.

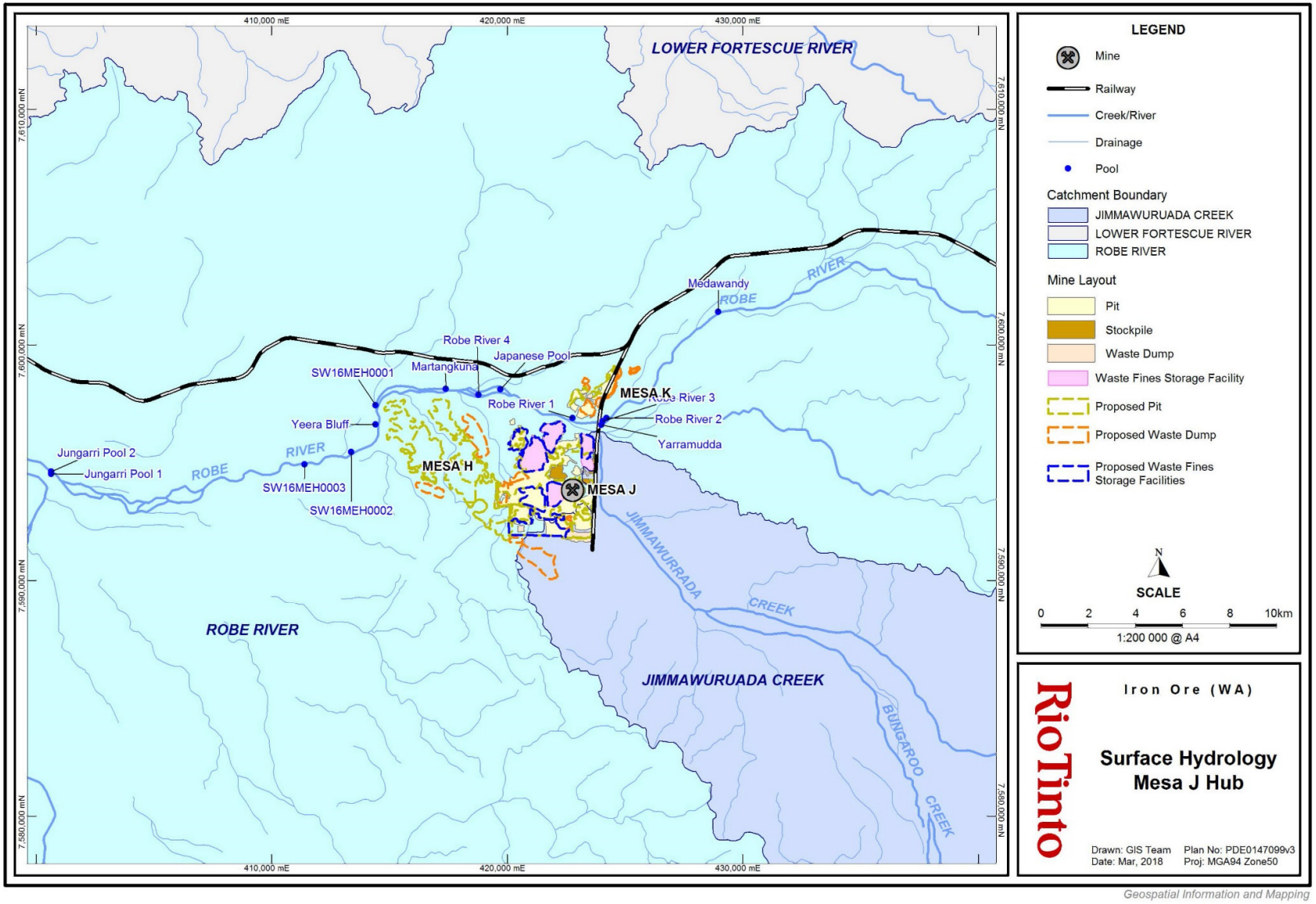


Figure 14: Surface hydrology surrounding Mesa J Hub

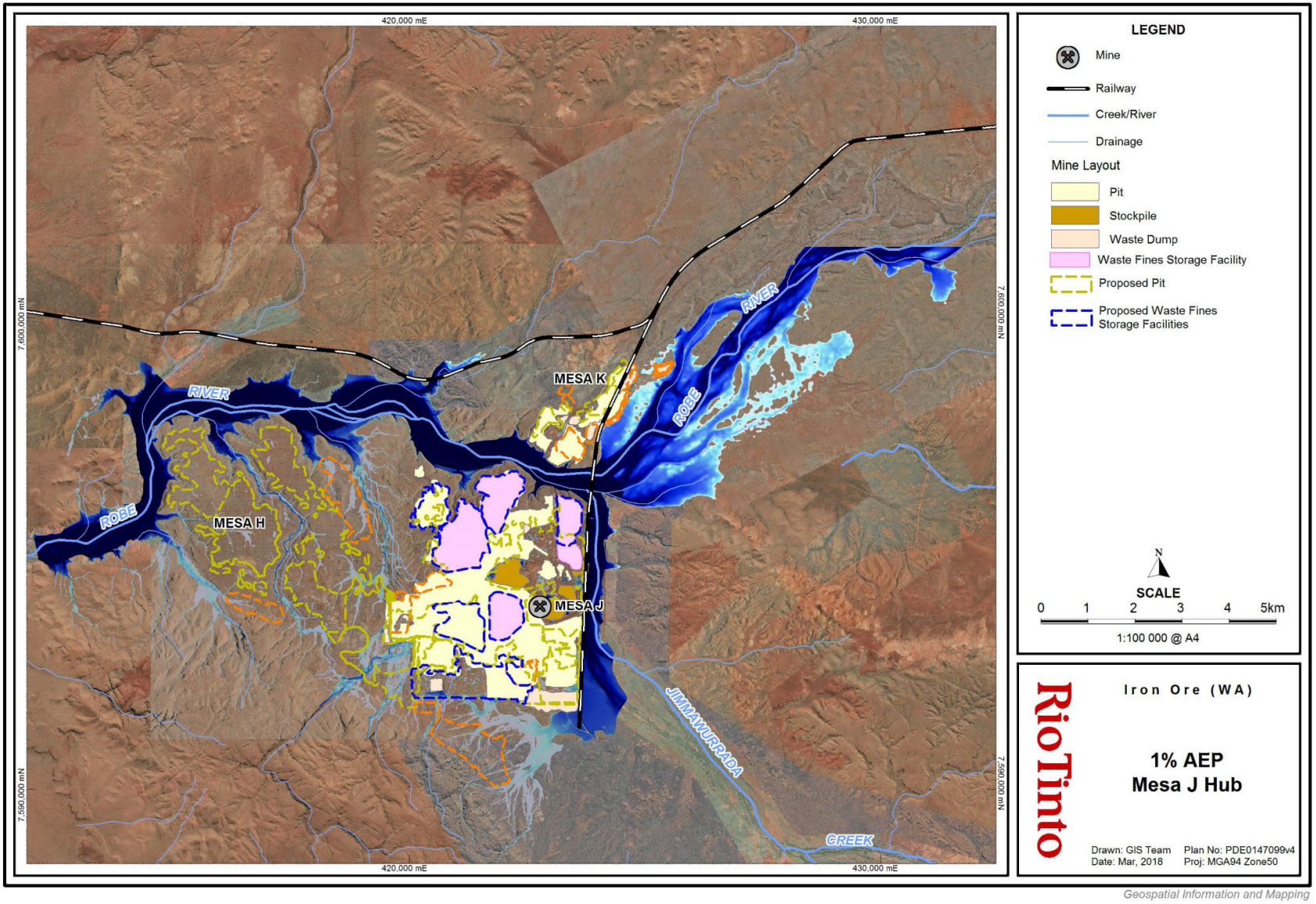


Figure 15: Mesa J Hub 1% AEP Flood Extent

11.2 Groundwater

Dewatering via in-pit sumping has occurred at Mesa J since 1995. Approximately 34% of the Mesa H scheduling inventory occurs below the pre-mining water table (water table prior to Mesa J's operation), however due to the passive dewatering of Mesa H caused by the dewatering of Mesa J, only ~13% of the scheduling inventory is below the present-day water table.

The existing Mesa J Hub borefield (Southern Cutback borefield) is situated in the southern part of Mesa J mine site and is used in conjunction with dewatering volume reuse to supply water for the wet plant. To enable the ongoing operation of a wet plant to process ore extracted at Mesa J and Mesa H, water demand is estimated to be between broadly 4 and 9 GL/year.

The Mesa J Hub is situated downstream from the confluence of the Robe River and Jimmawurrada Creek. The local catchment is defined by three major aquifers: the weathered basement aquifer, overlaid by the CID aquifer, and the alluvium aquifer which occurs along the Robe River.

A major alluvial aquifer underlies the lower Robe River. It consist of gravels beds with a saturated thickness of up to 20-25 m adjacent the river; gradually reducing in thickness laterally from the river and downstream, locally creating surface expressions of groundwater as pools. Based on available data and pumping test results, the highly permeable Robe River alluvium is conceptually in partial hydraulic connection with the underlying aquifers. The localised alluvium/colluvium overburden found on top of the mesas occurs above the water table and is unsaturated.

The mineralised section of the CID forms a semi-confined aquifer of variable permeability due to the juxtaposition of solution cavities and CID (highly permeable) and horizontal lenses of clay and clay alteration near fractures (low permeability). Groundwater in the ore body tends to flow from the southeast in the Bungaroo Valley aquifer under the Jimmawurrada Creek catchment (Figure 14), to the north and northwest towards the Robe River.

Beneath the Robe Pisolite is the confined basement aquifer consisting of the Wittenoom and Marra Mamba Iron Formations. The basement units are intruded by several dolerite dykes and bounded by fault structures formed during three major deformation events.

Long term water quality monitoring indicates that groundwater and surface water is predominantly fresh across the Mesa J Hub. The chemistry of the Robe River pools is primarily influenced by significant rainfall, stream flow events and evapotranspiration.

Salinity levels recorded in permanent pools are generally considered fresh (<2000 µS/cm) with some seasonal variation identified by short duration changes in chloride concentration associated with rainfall events and pool evaporation cycles. The pH values are within the typical range for Pilbara inland waters, slightly alkaline (7.4 - 8.2). The only proposed pit lake in the post closure landform will be located in the Mesa J Pit 15 area, which is planned to be used as a water storage dam. Further investigation is required to determine the risk, extent, quality and management of this pit lake. If required, mitigation actions will be implemented, potentially including backfilling.

Recharge to local aquifers currently occurs as a result of multiple inputs; rainfall and cyclonic event recharge, seepage leakage from the existing waste fines storage facilities and water reservoir, Robe River and Jimmawurrada Creek recharge through stream-flow events, and operational surplus discharge into the Jimmawurrada Creek and the west creek located between Mesa H and J.

Based on the water balance for the area, groundwater recovery is expected to begin after groundwater abstraction activities cease. Recovery will be to the pre-mining water table level and recovery timeframes are currently estimated in the order of ~60 years post mine closure within the pit areas. Recovery of Robe River pools and Jimmawurrada Creek is expected to predominantly happen within the first or second major rainfall events, historically between 5 and 10 years.

Predicted groundwater recovery levels and the modelled time to recovery are listed in Table 12[8].

Table 12: Predicted groundwater level and approximate time to recovery.

Deposit	Pre-mining level (mAHD)	Estimated maximum drawdown level (mAHD)	Recovery level (mAHD)	Time (years)
Mesa H	120-144	110 (34m drawdown)	120-144	60
Mesa J	142-155	110 (45m drawdown)	142-155	60
Mesa K	144-146	No change – AWT mining	N/A	N/A

11.3 Robe River Pools

Permanent and semi-permanent pools exist along the Robe River due to the significant subsurface flow in the alluvium. The number and permanency of pools are controlled by rainfall and groundwater levels. When a rainfall event occurs, the underlying aquifer is recharged causing the water table to rise and replenish the pools. During a dry period the water table will lower resulting in shallower pools or disconnection from groundwater. The Robe River pools remain as the only surface water source during dry periods, and therefore are an important refuge for aquatic ecosystems in the region. Permanent and deep pools are the most stable and consequently have the greatest diversity and stability of species. These pools also have significant value for the local Traditional Owners.

Environmental and hydrological monitoring occurs at various pools and stream locations along the Robe River in the vicinity of the Mesa J Hub, including Medawandy, Yarramudda, Martangkuna, Yeera Bluff, Japanese Pool, four stream locations near Mesa J and three stream locations near Mesa H (Figure 14). This long-term monitoring of the Robe River includes an integrated assessment of ecological parameters including freshwater fauna (i.e. macroinvertebrates and fish), channel/pool morphology, riparian/bank condition and water quality, utilising an upstream/downstream approach. Over 25 years of monitoring to date indicates any detectable changes to the ecology of the Robe River pools has been influenced by climate, and could not be attributed to mining operations. Work is ongoing to improve knowledge and predict groundwater level and quality changes that may occur in the future.

12. Biodiversity

12.1 Terrestrial fauna habitat

There are 16 terrestrial habitat types identified at the Mesa J Hub. These habitats are broadly grouped into six main habitat types, including breakaways & gullies, mesa plateaus, rocky ranges, plains, water-courses and ‘disturbed’ (Figure 16). Characteristics of these habitat types are provided in Table 13.

Breakaways & gullies have been recognised as high value habitat for species of conservation significance, such as Pilbara Olive Python, Northern Quoll, Pilbara Leaf-nosed Bat and Ghost Bat. The Water-courses habitat is recognised as high value habitat as it supports a greater diversity and abundance of fauna than other habitats, provide foraging habitat and provide potential dispersal routes for conservation significant fauna.

[8] Recovery levels are based on the continuation of current climate conditions.

Table 13: Description of pre-mining habitats identified at Mesa J Hub

Landform	Habitat	Basic description
Breakaways & Gullies	Breakaways	• Eucalyptus leucophloia over mixed Acacia tumida var. pilbarensis and Acacia bivenosa shrubland over Triodia wiseana hummock grassland. • Breakaway or ridge line, falling away to steep scree slope. Stony compact soils, low levels of leaf litter, sparse open vegetation; small caves and crevices.
Breakaways & Gullies	Gullies	• Scattered Eucalypts over Acacia shrubland over hummock or tussock grassland. • Deep often rocky gorges, sometimes with semi-permanent or permanent pools. Rocky structures providing large opportunities of refuge and foraging for a wide suite of vertebrate fauna species; numerous rock ledges, crevices and caves. Some semipermanent water pools.
Mesa Plateaus	Mesa Plateaus	• Scattered Eucalyptus leucophloia over mixed Acacia ancistrocarpa, Acacia bivenosa, Acacia maitlandii, shrubland over Triodia wiseana hummock grassland. • Elevated flat hill top on stony soils.
Plains	Grassland Plains	• Corymbia hamersleyana woodland over Acacia ancistrocarpa shrubland over Triodia wiseana grassland. • Broad flat low lying plains to undulating plain on soft loamy soils.
Plains	Loamy Plains	• Scattered to open Corymbia hamersleyana woodland over mixed Acacia ancistrocarpa, A. inaequilatera, A. bivenosa, A. colei var. ileocarpa, Grevillea pyramidalis subsp. leucadendron shrubland over Triodia wiseana or T. epactia hummock grassland or *Cenchrus ciliaris and *C. setiger grassland. • Low-lying undulating loamy to stony plain within Bungaroo valley floor.
Plains	Stony Plains	• Mixed Acacia shrubland over Triodia Hummock grassland. • Low-lying undulating Stony plain. Stony compact soils, low levels of leaf litter, sparse open vegetation.
Plains	Stony Shrubland Plain	• Trees (usually Corymbia hamersleyana) are few and shrubs are generally openly scattered. Dominant shrub species include Acacia inaequilatera, A. orthocarpa, A. ancistrocarpa and A. atkinsiana. • Relatively flat, stony plains covered by shrublands over spinifex hummock grasses with scattered emergent trees. The substrate comprises firm, red-brown fine clay-sand under loose pebbles and stones. Wood and leaf litter is sparse to moderate, and is generally concentrated under shrubs and trees.
Plains	Undulating Plains	• Corymbia spp. scattered low trees over Acacia spp. tall open shrubland to open shrubland over Triodia epactia, T. wiseana hummock grassland. • This landform comprised the stony undulating plains and wetter plains that were dominated by a clayey substrate.
Rocky Ranges	Hill Tops	• Scattered Eucalypts over sparse Acacia shrubland over hummock or tussock grassland. • Stony hills on high ranges with dissected valleys and gullies. Stony compact soils, low levels of leaf litter, sparse open vegetation, small overhangs.
Rocky Ranges	Low Hills	• Corymbia hamersleyana scattered low trees over mixed Acacia shrubland over Triodia hummock grassland. • Low rolling stony hills and valleys. Stony compact soils, low levels of leaf litter, sparse open vegetation.

Landform	Habitat	Basic description
Rocky Ranges	Stony Hills and Rises	• Scattered Corymbia hamersleyana over mixed Acacia inaequilatera, Acacia pyrifolia var. pyrifolia shrubland over Triodia wiseana hummock grassland. • Low stony hills and slopes with dissected valleys and drainage on stony soils.
Water-courses	Drainage Line	• Scattered Eucalyptus camaldulensis and E. victrix over mixed Acacia shrubland over mixed herbs and grasses. • Broad valley or drainage line. Range from soft sandy soils with surface cobbles and pebbles, diversity of microhabitats leaves logs and twigs to rocky structures with ephemeral drainage lines sometimes containing small semipermanent water pools.
Water-courses	Minor Creekline	• Corymbia hamersleyana low open woodland over Acacia spp. tall shrubland to shrubland over Triodia wiseana, T. epactia hummock grassland. • Permanent or semi-permanent water is not expected to occur within the creeks or flowlines; they are only likely to flow during significant rainfall events and thus do not represent true riverine landforms.
Water-courses	Riverine	• Melaleuca argentea and Eucalyptus camaldulensis over mixed Acacia colei var. colei, Acacia trachycarpa, Acacia tumida var. pilbarensis shrubland over mixed herbs. • Part of the Robe River riparian zone containing a diverse vegetation and with semipermanent or permanent pools. Dense diverse vegetation with significant level of leaf litter providing large opportunities of refuge and foraging for a wide suite of vertebrate fauna species; permanent pools of water.
Disturbed	Disturbed	• Cleared - Disturbed habitat within mining area, mainly attributed to exploration activities. • Little value as fauna habitat.

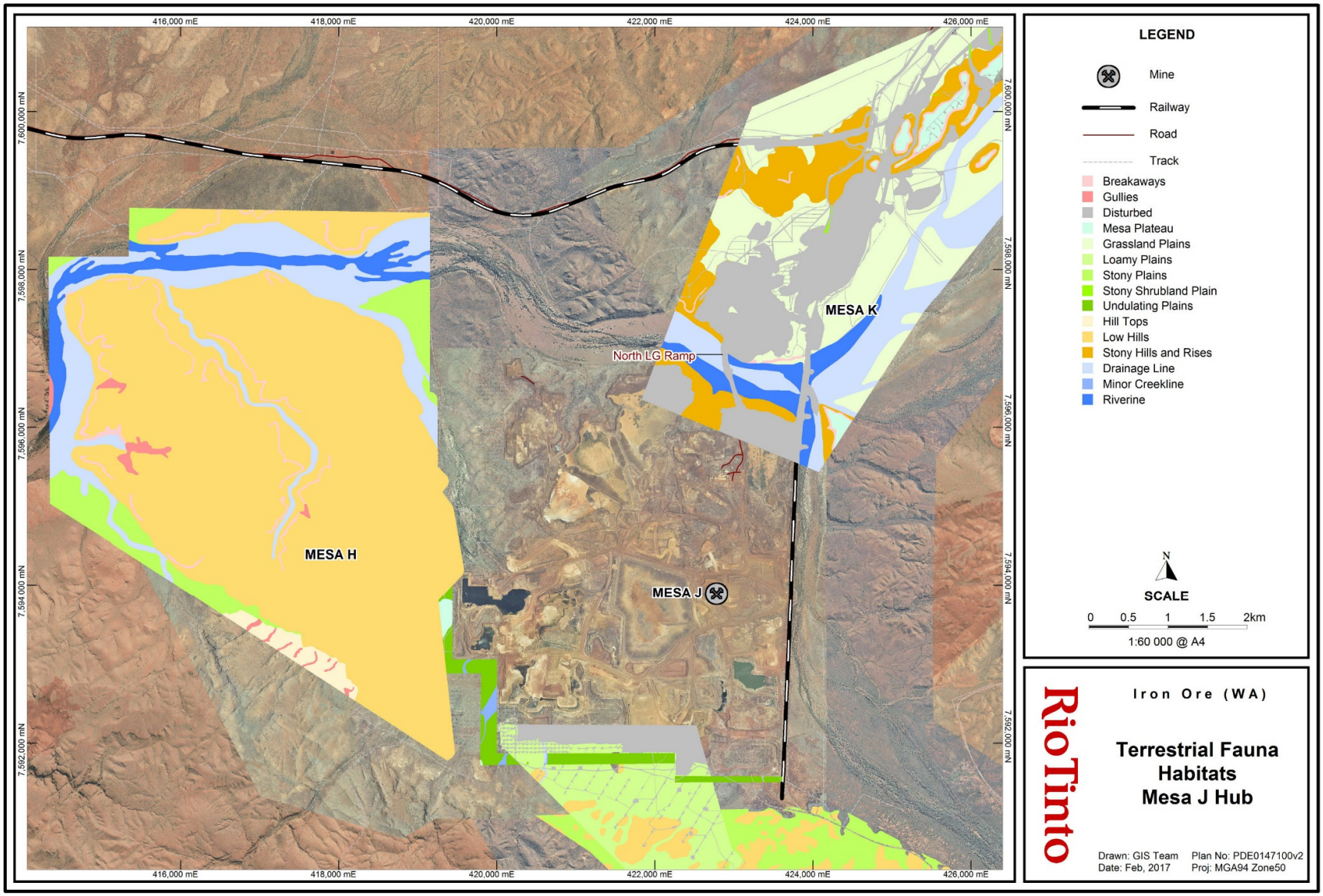


Figure 16: Terrestrial fauna habitats of Mesa J Hub

12.2 Fauna habitat

Re-introduction of fauna is not considered as part of this closure plan. Instead, natural migration of fauna species into rehabilitated land is encouraged by creating habitats with similar composition to pre-mining communities in appropriate locations and with consideration of the post-closure soil and landforms design.

Habitat elements that are considered as part of the closure landform design include:

- vegetation known to provide preferred food or shelter preference;
- retaining and replacing woody debris;
- rapid generation and retention of leaf litter using small-scale topography (e.g. furrows created from ripping);
- 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; and
- managing feral predators and herbivores across both reference and rehabilitated areas.

Species associated with plains, drainage line or disturbed habitats have the potential to benefit from the rehabilitation of mine, as a consequence of returned or expanded habitat post-closure.

12.3 Conservation significant fauna

Eight species of conservation significance have been recorded or evidence found of their presence within the Mesa J Hub mining area.

A summary of the species, conservation status and habitat is presented in Table 14.

Table 14: Species of conservation significance and associated habitats at Mesa J Hub

Fauna species	Conservation status WA	EPBC Act status	Habitat occurrence
Dasyurus hallucatus (Northern Quoll)	Schedule 2	Endangered	Breakaways & Gullies Rocky Ranges Water-courses
Liasis olivaceus barroni (Pilbara Olive Python)	Schedule 3	Vulnerable	Breakaways & Gullies
Macroderma gigas (Ghost Bat)	Schedule 3	Vulnerable	Breakaways & Gullies Water-courses
Rhinonicteris aurantia (Pilbara) (Pilbara Leaf-nosed Bat)	Schedule 3	Vulnerable	Breakaways & Gullies Water-courses
Merops ornatus (Rainbow Bee-Eater)	Schedule 5		Breakaways & Gullies Water-courses Plains
Ardea modesta (Eastern Great Egret)	Schedule 5		Water-courses
Pseudomys chapmani (Western pebble-mound mouse)	Priority 4		Rocky Ranges
Notoscincus butleri (Lined soil-crevice skink)	Priority 4		Plains

12.4 Feral animals

Feral carnivores (e.g. cats, dogs, foxes) can create locally increased predation pressure on native fauna as well as increase competition with native species for resources such as space (territory), water and food. Feral herbivores (e.g. cattle, camels, donkeys) can also have a significant impact in Rangeland areas, such as the Pilbara. In dry times, grazing pressure reduces the abundance of palatable native species, impacting biodiversity and can create conditions that encourage weeds to grow. Foot traffic impacts the soil conditions, and in combination with over grazing, can encourage erosion. Foot traffic has also been the cause of damage to cultural landmarks and Aboriginal sites. Overgrazing and damaged soils has a flow-on effect to native fauna species that rely on this vegetation for food and shelter. Should management of feral animals be required at closure, a management plan will be developed. Feral animal control is an operational requirement, however it is not expected to be required post closure.

12.5 Conservation significant flora

Table 15 describes the Priority flora that have been identified in or near the Mesa J Hub. No Declared Rare or Threatened flora have been recorded in or near the Mesa J Hub area, nor are any expected to occur.

Table 15: Conservation significant flora identified in or near the Mesa J Hub.

Flora taxon	Conservation status WA	Habitat comments
Triodia sp. Robe River (M.E. Trudgen et al. MET 12367)	Priority 3	Ironstone substrates, sometimes with a clay loam content, most commonly on the crests of mesas (particularly around the rocky margins) and sometimes in in flowlines dissecting these areas.
Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301)	Priority 3	Drainage lines, creeks in hills or plains. Brown silty loam.
Rhynchosia bungarensis	Priority 4	Pebbly coarse sand and amongst boulders on the banks of flowlines.

12.6 Invasive flora

Flora and vegetation surveys have recorded 24 introduced species (Table 16), with 20 species on the Department of Parks and Wildlife Impacts and Invasiveness Ratings list for the Pilbara.

Table 16: Weed species recorded at Mesa J Hub

Scientific Name	Common Name	Ecological Impact	Invasiveness
**Aerva javanica*	Kapok Bush	High	Rapid
**Argemone ochroleuca*	Mexican Poppy	Unknown	Rapid
**Bidens bipinnata*	Bipinnate Beggartick	Unknown	Rapid
**Cenchrus ciliaris*	Buffel grass	High	Rapid
**Cenchrus setiger*	Birdwood Grass	High	Rapid
**Chloris barbata*	Purpletop Chloris	High	Rapid
**Citrullus colocynthis*	Colocynth	Unknown	Moderate
**Cucumis melo*	Ulcardo Melon	Unknown	Moderate
**Cynodon dactylon*	Couch	High	Rapid
**Datura leichhardtii*	Native Thornapple	Unknown	Unknown
**Echinochloa colona*	Awnless Barnyard Grass	High	Rapid

Scientific Name	Common Name	Ecological Impact	Invasiveness
**Euphorbia hirta*	Asthma Plant	Low	Slow
**Flaveria trinervia*	Speedy Weed	-	-
**Lactuca serriola*	Prickly Lettuce	-	-
**Malvastrum americanum*	Spiked Malvastrum	High	Rapid
**Melochia pyramidata*		-	-
**Ocimum basilicum*	Basil	-	-
**Passiflora foetida*	Stinking Passion Flower	High	Rapid
**Phoenix dactylifera*	Date Palm	High	Rapid
**Rumex vesicarius*	Ruby Dock	High	Rapid
**Setaria verticillata*	Whorled Pigeon Grass	High	Rapid
**Solanum nigrum*	Black Berry Nightshade	Low	Rapid
**Sonchus oleraceus*	Common Sowthistle	Low	Rapid
**Tribulus terrestris*	Caltrop	Unknown	Moderate
**Vachellia farnesiana*	Mimosa Bush	High	Rapid

12.7 Priority and/or Threatened Ecological Communities

No Threatened Ecological Communities have been recorded in or near the Mesa J Hub area. Three Priority Ecological Communities (PEC) occur within the Mesa J Hub area as described in Table 17. However, vegetation which is considered analogous to the Priority 3 PEC '*Triodia sp. Robe River assemblages of mesas of the West Pilbara'* has been mapped at Mesa H.

Table 17: Priority and/or threatened ecological communities in or near the Mesa J Hub area

Community Name	Conservation status WA	Description	Location in respect to Mesa J Hub
Subterranean invertebrate communities of mesas in the Robe Valley region	Priority 1	A series of isolated mesas occur in the Robe Valley in the Pilbara Region. The mesas are remnants of old valley infill deposits of the palaeo Robe River. The troglobitic faunal communities occur in an extremely specialised habitat and appear to require the particular structure and hydrogeology associated with mesas to provide a suitable humid habitat. Short range endemism is common in the fauna. The habitat is the humidified pisolitic strata.	Central and northern sections of Mesa J and all of Mesa K
Subterranean invertebrate community of pisolitic hills in the Pilbara	Priority 1	A series of isolated low undulating hills occur in the Pilbara region. The troglofauna are being identified as having very short range distributions.	Southwestern potion of Mesa J and all of Mesa H
Stygofaunal community of the Bungaroo Aquifer	Priority 1	A unique assemblage of aquatic subterranean fauna including eels, snails and other stygofauna.	South-eastern corner of Mesa J, extending south

13. Progressive rehabilitation

Regular reviews of the mine plan are used to identify disturbed areas of the site where mining activity has been completed. These areas are then reviewed for potential to undertake progressive rehabilitation works. Lessons learnt during these activities and from subsequent monitoring campaigns are used to inform and update our standard management practices and provide input into suitability of final closure criteria for the site.

To date, approximately 310ha of rehabilitation has been completed at the Mesa J and Mesa K operations. Approximately 105ha of previously rehabilitated areas have been re-disturbed to facilitate ongoing mining activities, with 205ha remaining. Table 18 and Figure 17 provide an overview of the main areas of progressive rehabilitation undertaken at Mesa J and Mesa K to date.

Table 18: Progressive rehabilitation details

Site	Location	Category	Area rehabilitated (ha, approximate)	Year of Rehabilitation (estimated)
Mesa J	Calcium Dump	Waste Dump	6.57 Disturbed	1996
Mesa J	A Dump	Waste Dump	10.77 Disturbed	2004
Mesa J	North West Dump	Waste Dump	7.08 Partially disturbed 5.40 remaining	2002-2004
Mesa J	North East Dump	Waste Dump	4.86 Disturbed	2002
Mesa J	S Waste Dump	Waste Dump	31.10 Planned to be reclaimed	2004-2008
Mesa J	T Waste Dump	Waste Dump	28.70 Planned to be reclaimed	2004-2008
Mesa J	Pit 10	Pit Floor	13.26	2014
Mesa J	TSF1	Waste Fines Storage Facility	44.87	2014
Mesa J	CLBB	Rail (Construction)	1.62	2014
Mesa K	K Pit	Pit Floor	142.00 Partially disturbed 62.22 remaining	1994-1996
Mesa K	West WD	Waste Dump	3.87	1996
Mesa K	Haul Rd	Haul Road	11.23	1997
Mesa K	Gravel Pit	Pit Floor	4.48	2013

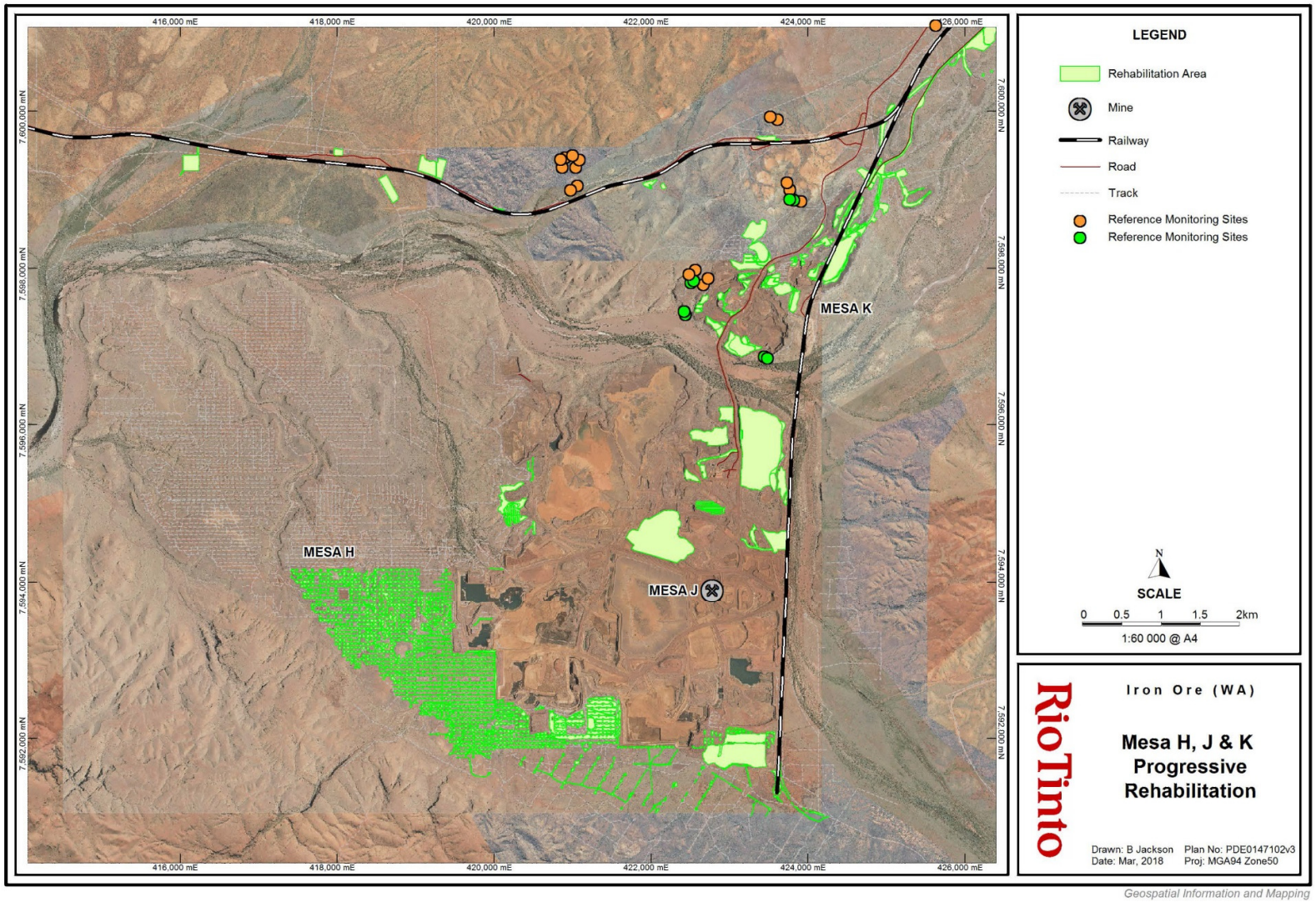


Figure 17: Progressive rehabilitation areas at Mesa J and Mesa K

13.1 Seed provenance and selection

Locally collected seed is needed to assist in revegetation and the creation of a self-sustaining ecosystem. Over time the viability of seeds in stockpiled topsoil decreases, and thus the quality of the topsoil deteriorates. In addition, the topsoil that was salvaged prior to disturbance may not contain seeds of all the target species of its new location / habitat.

Seed mixes for rehabilitation are of local provenance where possible. Specific seed mixes are selected to provide a range of species appropriate to the desired habitat, taking into consideration landscape position and slope. In areas where erosion risks are identified, seed mixes may be modified to include or increase the portion of species that provide rapid cover.

Rio Tinto purchases seeds from commercial seed suppliers, with emphasis on ensuring that there are appropriate local provenance seeds available for rehabilitation of each of its sites. Seeds are stored in purpose-built, climate controlled storage facilities to maximise long term viability.

The inclusion of rare and threatened species in rehabilitation programmes is limited by:

- habitat preference (preference for drainage lines, gullies, calcretes or other habitat not suitable or similar to those likely to be present in the rehabilitation landscapes);
- abundance – very few populations or small populations from which to source seed;
- difficult taxonomy / unresolved taxonomy issues and thus status of species highly uncertain;
- growth form – e.g. short lived annual species with preference for growth under woodland canopies;
- seed production – some species do not regularly produce seed;
- propagation methods – some species are not able to germinate from seed and cuttings are required which is not a suitable method for broad scale application in an arid environment;
- availability of seed at the time when rehabilitation occurs; and/or
- seed dormancy.

Given these issues, the main focus of rehabilitation programs is to restore vegetation complexes that include the more common species present in the particular habitat type, and to achieve a diverse range of strata. Seed mixes may include species of conservation significance if they are available, but presence of these species in rehabilitation areas is more likely to result from natural recruitment from surrounding areas.

13.2 Pits

The majority of Mesa K Pits were rehabilitated between 1994 and 1996. Some topsoil was spread on the area, followed by shallow ripping and seeding. Monitoring locations were installed in 1999, at 25 different locations around the pit. A suite of sites were monitored on six occasions, the most recent of which was in 2013. The rehabilitation was compared to local undisturbed reference sites. Vegetation is well established, reflecting the maturity of the rehabilitation.

Mesa J Pit 10 was rehabilitated in 2014. The pit was ripped and seeded, with topsoil only spread on the northern area of Pit 10. Monitoring locations were installed in 2014 on both the top-soiled and non-top-soiled areas of Pit 10. Development of the rehabilitation was monitored in 2014 and 2015 (Figure 18). The rehabilitation is compared to local undisturbed reference sites. Pit 10 North has good vegetation establishment with a range of native vegetation species. Pit 10 South has limited native perennial vegetation establishment, due to both the young age of the rehabilitation and the lack of topsoil. Over time, it is expected to perform similarly well to Mesa K Pit rehabilitation (Figure 19), with differences attributed to topsoil, particularly at Pit 10 South. Buffel Grass and Birdwood Grass are present at Pit 10 North and Ruby Dock at Pit 10 South. Weeds in rehabilitation are managed under the company's *Weed Management Strategy* which has control measures such as periodic spraying and equipment hygiene procedures.

The Gravel Pit at Mesa K was rehabilitated in 2013 by reshaping, ripping, and seeding. Good regrowth had occurred on the area prior to rehabilitation, so the soil and vegetation were collected and respread during rehabilitation. Monitoring locations were installed in 2014, one on the upper area and one on the lower area. These were monitored in 2014 and 2015. The rehabilitation was compared to local undisturbed reference sites. Vegetation is establishing well, with vegetation parameters comparable to the reference sites (Figure 20).

13.3 Waste dumps and waste fines storage facilities

Mesa K West waste dump and a haul road were rehabilitated in 1996 and 1997 respectively. Both locations had topsoil spread on the area. Monitoring locations were installed in 2013; two at the Waste Dump and one at the Haul Road. These were monitored in 2013. The rehabilitation was compared to local undisturbed reference sites. Vegetation is well established at both rehabilitation areas, reflecting the maturity of the rehabilitation; however density and cover are slightly lower than reference sites.

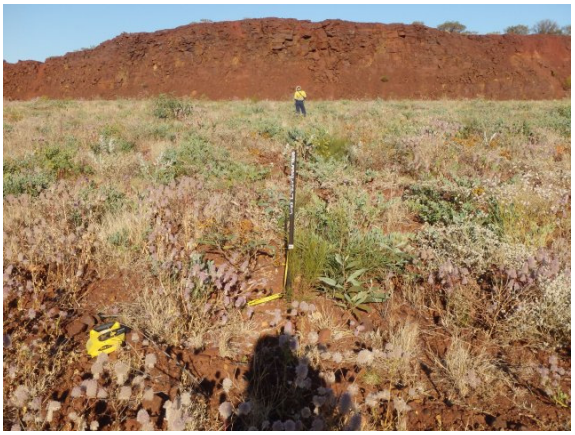
The S and T Waste Dumps at Mesa J were rehabilitated between 2004 and 2008 by reshaping, ripping, and seeding the dump slopes and tops. S Dump received topsoil, whilst T Dump received subsoil. Monitoring locations were installed in 2008, including both sloped and flat areas. Development of the rehabilitation was monitored on five occasions, the most recent of which was in 2015. The rehabilitation is compared to local undisturbed reference sites. At S Dump, vegetation cover and density had been increasing since completion, with an upper storey developing since 2010. The flat areas on top of the dump had plant density and cover plateauing in 2015, indicating the rehabilitation had completely established. T Dump also increased vegetation cover and density in the early stages, and plateaued around 2010. S Dump had higher cover and density than the compared reference sites, while T Dump had lower values (Figure 21). Minor erosion occurred on the sloped sides of both dumps; however monitoring data demonstrates it was not active and had stabilized. Buffel Grass was present at S Dump and Ruby Dock at T Dump; both are sparse and not outcompeting native vegetation. Weeds in rehabilitation are managed under the company's weed management strategy which has control measures such as periodic spraying and equipment hygiene procedures.

Mesa J Waste Fines Storage Facility 1 (TSF1) was rehabilitated in 2014 as a trial of WFSF closure without the use of a capping layer. TSF1 was ripped and seeded, taking care to avoid large trees established in the area. Topsoil was not spread on TSF1, as growth media studies supported the surface material being suitable for vegetation growth. Monitoring locations were installed in 2014 on the upper and low-lying (periodic inundation) areas of TSF1. Development of the rehabilitation was monitored in 2014 and 2015. The rehabilitation is compared to local undisturbed reference sites. Vegetation establishment has been variable across TSF1 (Figure 22); however vegetation metrics have mostly increased since 2014. Minor subsidence has been noted, although is expected to stabilize as vegetation establishes and waste fines settle. Birdwood Grass is present in the low-lying areas and Buffel Grass in the upper areas. Ruby Dock is present across TSF1; however in general, introduced species are declining in density. Weeds in rehabilitation are managed under the company's weed management strategy which has control measures such as periodic spraying and equipment hygiene procedures.

13.4 Low impact disturbance areas, roads and borrow pits

The construction areas along the rail line at Mesa J were rehabilitated in 2014. Topsoil was respread and the areas were shallow ripped; no seeding occurred due to the direct return of fresh topsoil. Three monitoring locations were installed and monitored in 2015; two next to the rail line and one along the access road. The rehabilitation was compared to local undisturbed reference sites. Vegetation establishment along the access road was comparable to reference sites, even at a young age, with no weeds present. Good results are attributed to the lack of disturbance and traffic surrounding the area. Vegetation establishment along the rail line is beginning to occur, however vegetation parameters are low, reflecting the young age of the rehabilitation. Buffel Grass, Birdwood Grass, Ruby Dock, Kapok and Pie Melon are present in these areas; Birdwood Grass, Spiked Malvastrum and Mimosa Bush were also present in nearby reference sites. Weeds in rehabilitation are managed under the company's *Weed Management Strategy* which has control measures such as periodic spraying and equipment hygiene procedures.

After rehabilitation (January 2014)



Monitoring (September 2015)

Figure 18: Progressive rehabilitation of Mesa J Pit 10 North

Mesa K Pit (2013 – 17 years)

Mesa J Pit 10 South (2015 – 1 year)

Figure 19: Recently completed rehabilitation of the pit floor at Pit 10 Mesa J is expected to reach similar successful rehabilitation outcomes as 17 year old rehabilitation at Mesa K.

After rehabilitation (March 2014)

Monitoring (September 2015)

Figure 20: Progressive rehabilitation of the Mesa K Gravel Pit without topsoil.

S Dump (2015 – 7 years)

T Dump (2015 – 7 years)

Figure 21: Mesa J Waste Dump rehabilitation – comparison of success utilising topsoil and subsoil

TSF1_T1 (2015 – 1 years)

TSF1_T4 (2015 – 1 years)

Figure 22: Mesa J TSF1 showing variability in vegetation establishment, although the area is still young.

14. Contaminated sites

Rio Tinto maintains registers for potentially contaminating activities and known or suspected contaminated sites which have been formally reported under s11 of the *Contaminated Sites Act 2003* (WA). The registers are informed by regular review of operations and where required preliminary site investigations to assess contaminants associated with such activities and assess their risk of harm to human health, the environment and environmental values. Potentially contaminating activities and land uses as described in the guideline '*Assessment and management of contaminated sites'* (DER, 2014), that may be associated with mining activities onsite include, but not limited to:

- Airport facilities;
- Automotive repair workshops (light and heavy machinery);
- Substations and transformers;
- Fertiliser and explosives storage;
- Landfill sites;
- Mineral processing, mining, screening and crushing facilities;
- Rail transport corridors;
- Hydrocarbon storage, handling and dispensing facilities;
- Sewage waste water treatment plants and irrigation areas; and
- Disturbance of potentially acid forming materials during the course of mining.

All potentially contaminating activities and land uses identified on the site register are managed as part of the ongoing mining operation. Prior to closure as part of the decommissioning process, a contaminated site assessment will be undertaken. Based on this assessment, specific plans will be developed to remediate or manage contaminants, where required, to support the final land use.

15. Cultural heritage

Rio Tinto recognises and respects the significance of Australia's cultural heritage, and in particular the cultural heritage of Aboriginal people who have traditional ownership of, and/or cultural connections to, the land on which it operates. Extensive archaeological and ethnographic surveys have been undertaken in the Mesa J Hub area, and these surveys help to inform the heritage values of the area. Rio Tinto takes all reasonable and practicable measures to prevent harm to cultural heritage sites, this includes during works associated with rehabilitation and closure. Where this is not possible, steps are taken to minimise or mitigate impacts and ensure required statutory approvals are obtained. Closure works consider issues such as post closure access requirements to culturally significant sites and appropriate return of any materials salvaged during mining operations.

15.1 Relevant Aboriginal groups

The Mesa J Hub lies within the traditional country of the Kuruma Marthudunera (K&M) people. The K&M currently have a large native title claim area over the Robe Valley, which includes the Mesa J Hub, and K&M also possess a native title determination (Part A) over a large area east of the claim into the western Hamersley ranges, which abuts the native title claim.

The extent of Kuruma Marthudunera country in relation to Mesa J Hub is shown on Figure 5. A Claim Wide Participation Agreement (CWPA) was signed by Rio Tinto and K&M in 2011, and an Indigenous Land Use Agreement (ILUA) registered in 2013. A Cultural Heritage Management Plan is scheduled to be completed in 2017, and is due for review every 5 years.

15.2 Ethnographic and archaeological values

Heritage surveys (in alignment with the Heritage Protocol within the CWPA) with nominated Kuruma Marthudunera representatives and external consultants have identified archaeological and ethnographic sites and made recommendations on the significance and management of each site. Sites of significance within the Mesa J Hub area include:

- 3 Law Grounds (Thalartna, Yarramarda and Buggumadda);
- Old Deepdale Homestead;
- 3 important ethnographic (thalu/increase) sites (Jirti Thalu, Parkunyji and Yunta);
- one large rockhole at Mesa J with high ethnographic significance (Mesa J Rockhole);
- one permanent waterhole in the Robe River with high ethnographic significance (Yeera Bluff);
- numerous named (ethnographic) waterholes spread along the Robe River. Some permanent, some semi-permanent;
- a burial site north of Mesa H on the terrace between the mesa escarpment and the Robe River;

- the Robe River is viewed by K&M as a whole system, which includes its general health and waterholes, vegetation and fauna;
- the existing Mesa Façades are used as navigational landmarks; and
- multiple archaeological sites (including several gender restricted sites).

In some cases where disturbance is unavoidable, artefacts and cultural material may be disturbed and removed under Section 18 consent of the *Aboriginal Heritage Act* 1972 and placed into storage to facilitate mining activity. A number of such sites at the Mesa J Hub have either been cleared or nominated to be cleared under these provisions, with material stored in the Mesa J Keeping Place located at the Mesa J minesite In some circumstances, when objects or artefacts have been salvaged from a site, the K&M people have expressed the desire to repatriate the artefacts to the land from which they were removed post closure and rehabilitation. The particular circumstances where this may be required is captured in the Cultural Heritage Management Plan (CHMP) for the Mesa J Hub area

16. Regional Community

The town of Pannawonica is 16 kilometres north-west of the mine. Pannawonica was established in 1970 specifically to support the adjacent mines, and is one of a limited few closed towns remaining in the Pilbara whereby all facilities are owned by a mining company, in this case Rio Tinto, and are maintained and operated on its behalf. It has a resident population of over 700 people.

Approximately 350 people work at the Mesa J and K operation. Employees either reside permanently in the town of Pannawonica or reside in the town on a fly-in, fly-out (FIFO) roster. The FIFO workforce utilise the Karratha airport and travel to Pannawonica via the North West Highway. The town falls within the Yarraloola pastoral lease.

There are no permanent Aboriginal communities in close proximity to the Mesa J Hub. The nearest Aboriginal community is a small settlement known as “The Block” which is located 3km north of Mesa H. The Block is seasonally occupied by some families from the K&M and contains limited permanent infrastructure. There is potential for the occupation of the community to increase over time.

IDENTIFICATION AND MANAGEMENT OF CLOSURE ISSUES

17. Risk evaluation process

A closure risk assessment was completed to identify and assess closure issues for Mesa H, J and K. The risk assessment is included in Appendix D. The assessment was completed by an internal panel of multi-disciplinary subject matter experts with the aim of:

- identifying hazards, aspects and opportunities that could influence the successful closure of the site;
- evaluating the resulting risks to people, property and the environment; and
- defining the actions required to reduce the risk to below the risk acceptance threshold.

Risk was evaluated on the basis of the maximum reasonable outcome consequence and the likelihood of that consequence occurring. Risks were evaluated inclusive of current management and commitments, and represent current residual risk.

Issues are assessed against the following consequence criteria:

- **Costs:** economic impacts if the risk were to eventuate ranging from low to very high, determined as a percentage of the projected closure cost for the operation;
- **Health:** reversible health effects of little concern (very low) to multiple fatalities (very high);
- **Personal safety:** inconvenient first aid treatments (very low) to multiple fatalities (very high);
- **Environment:** reversible impact (very low) to widespread, long-term impacts (very high). These risks are separated into two categories – during decommissioning/active closure implementation or post closure.
- **Community trust:** mistrust amongst a small section of the wider community (very low) to widespread mistrust with key stakeholders (very high). Also includes potential heritage impacts ranging from reparable damage to a site of low cultural significance (very low) through to irreparable damage to a site of international cultural significance (very high); and
- **Compliance:** non-conformance to internal requirements (very low) to prosecution for breach of regulatory licence(s) (very high).

Risks are classified as follows:

- **Class I:** Risks that are below the risk acceptance threshold and do not require further active management.
- **Class II:** Risks that lie on the risk acceptance threshold and require active monitoring to ensure management remains adequate and fit-for-purpose.
- **Class III:** Risks that, based on the current level of knowledge, could exceed the risk acceptance threshold and require proactive management and / or resolution of knowledge gaps.
- **Class IV:** Risks that, based on the current level of knowledge, will exceed the risk acceptance threshold and need urgent and immediate action.

Actions are assigned to risks that exceeded the risk acceptance threshold and therefore require additional control measures to reduce the risk to an acceptable level. Actions are also assigned to address knowledge gaps where it is assessed that further information is required to better understand and/or adequately assess the risk presented by an issue. This would typically be the case in the early stages of closure where the detailed knowledge of the issues may be low. These actions are captured in Appendix E.

18. Management of key issues

The DMP/EPA *Guidelines for Preparing Mine Closure Plans* lists a number of rehabilitation and closure issues that may be relevant for mine sites. An evaluation of the relevance of each of these issues to the Mesa J Hub is presented in Table 19. The information in this table is intended to compliment that contained in the risk assessment presented as Appendix D.

Table 19: Relevance of potential closure and rehabilitation issues to Mesa J Hub

Issue	Evaluation of relevance to Mesa J Hub	Further discussion
Acid and metalliferous drainage	The geochemical evaluation has determined that the sites are a low AMD risk.	Not addressed further in this chapter.
Challenges associated with rehabilitation and revegetation	The Mesa J and K areas have had areas of successful rehabilitation undertaken in both waste dumps and pits. Progressive backfill of pits to meet closure commitments and other opportunistic rehabilitation will be undertaken during operations, however the majority of rehabilitation will be completed at closure. A significant proportion of Mesa J will be covered by in-pit waste fines storage facilities. Management of waste fines rehabilitation is discussed in Section 18.2.	Section 18.1 and 18.2
Dispersive, sodic and erosive materials	The sites have a proportion of material which is of high erodibility.	Section 18.3.
Radioactivity	Not a significant issue for this site	Not addressed further in this chapter.
Mine pit lakes	A small pit lake is proposed at the Mesa J reservoir, (pit 15) a small water storage area during operations.	Section 18.4
Geotechnical instability	The waste dumps planned to remain at closure are not within the zone of instability of any pit voids. To ensure long term stability of the Mesa façades, the pit design incorporates pit wall design parameters and minimum façade width based on geotechnical assessment	Section 18.5
Inadvertent public access	There is potential for public access to the area post closure. Options are being considered for each mining area to address the risk of inadvertent public access.	Section 18.6
Hazardous materials	Hazardous materials (e.g. hydrocarbons, ammonium nitrate) will be removed prior to or during decommissioning.	Not addressed further in this chapter.
Hazardous and unsafe facilities	All infrastructure will either be demolished during decommissioning, or handed to the State in accordance with State Agreement requirements.	Not addressed further in this chapter.
Contaminated sites	There are no reportable contaminated sites.	Not addressed further in this chapter.
Fibrous materials	The geological evaluation has determined that the sites are a low fibrous materials risk.	Not addressed further in this chapter.
Non-target metals and target metal residues in mine wastes	No chemical processing occurs at the site.	Not addressed further in this chapter.

Issue	Evaluation of relevance to Mesa J Hub	Further discussion
Adverse impacts on surface and groundwater quality	Surface and groundwater quality are not expected to be significantly impacted as a result of the closure strategy. Monitoring of the Robe River Pools occurs regularly to assess water quality.	Section 18.7
Design and management of surface water structures	Surface water diversions and flood protection features will be present. No major creek diversion is required.	Section 18.8.
Dust emissions	This is not considered to be a significant closure issue for the site due to its remote location and no specific sensitive receptors identified.	Not addressed further in this chapter.
Flora and fauna diversity/threatened species	Subterranean Fauna Priority Ecological Communities (PECs) intersect the mining footprint. Mining exclusion zones have been established to ensure sufficient troglofauna habitat will remain at closure. The Bungaroo community does not require management at this stage.	Section 18.9
Visual amenity	The results of a visual impact assessment have been considered during planning of waste dump locations and height.	Section 0
Heritage issues	Management of cultural heritage values is conducted through processes established under the Indigenous Land Use Agreement, and strategies incorporated into Cultural Heritage Management Plans (CHMP). The CHMP for the Mesa J Hub will be drafted in 2017 and reviewed annually.	Not addressed further in this chapter.
Alteration of the direction of groundwater flow	Alteration of groundwater flow direction is not expected in the long term.	Not addressed further in this chapter.
Alteration of the depth to water table of the local aquifer	Dewatering will suppress groundwater levels at the operation. Ongoing and adaptive management will occur in response to modelling and monitoring indicating an impact to the Robe River pools.	Section 18.7
Alteration of the hydrology and flow of surface waters	No major creek diversion are required. Landform design takes into account surface water impacts and changes to hydrology.	Section 18.8.

18.1 Challenges with progressive rehabilitation

Rio Tinto has formal processes for identifying areas which are no longer required for operational activity and are therefore available for rehabilitation. However, mine plans are dynamic and subject to continuous revision, and rehabilitation may need to be re-disturbed for mining or operational use. Progressive rehabilitation opportunities are reassessed regularly as part of the planning process.

A legacy area review workshops was conducted at Mesa J and K in early 2017. The workshops focus on all areas of the mine, particularly the older lesser known areas. The current mine plan for Mesa J incorporates progressive backfill of pits where practical as required by Ministerial Statement 208, and proposed mining for Mesa H also incorporates progressive backfill of pits. The majority of backfill is undertaken during operations, however some backfill may not be possible until the end of mine life due to mine sequencing. Some backfill areas require additional landform design which has been included as an action in the closure task list.

Rehabilitation is conducted in accordance with 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 to adopt learnings from ongoing rehabilitation projects. The Handbook addresses:

- soil resource management;
- rehabilitation techniques;
- local provenance species seeding practices;
- records and data management; and
- on-going monitoring.

Rehabilitation typically involves:

- removal of rubbish, redundant equipment and infrastructure, ensuring the area is not contaminated;
- reshaping and contouring land to blend with natural relief to manage drainage to ensure stability;
- ensuring that appropriate controls are in place to manage hazardous mineral wastes, including encapsulation of PAF and fibrous wastes (not applicable in the Mesa J Hub), and installation of store and release covers where required;
- installation of abandonment and drainage management bunds where required;
- application of soil to a depth of 200mm where practical to promote vegetation growth;
- deep rip to an appropriate depth prior to seeding;
- seeding to ensure a suitable vegetation cover and composition, generally using a mechanical seeder;
- recording rehabilitated areas on internal GIS databases; and
- inclusion within the rehabilitation monitoring program where appropriate.

Topsoil and subsoil is managed in accordance with the *Rio Tinto Iron Ore Soil Resource Management Work Practice* in order to ensure appropriate material is available for rehabilitation activities. Where practical, a minimum of 200mm of topsoil and up to 600mm of subsoil is collected whenever new ground is disturbed. Reconciliations of topsoil volumes are undertaken to confirm that sufficient material is available to spread across the rehabilitated area, assuming a spreading depth of 200mm. Locations for soil stockpiles have been identified and incorporated into the mine plan. Topsoil stockpiles are planned to be up to 2m tall to maintain viability, and will be used to rehabilitate areas cleared for mining and infrastructure, including pit voids.

18.1.1 Revegetation challenges

The use of topsoil in rehabilitation is generally linked to improved revegetation outcomes. The soil seed bank quality within the stockpiled soil is known to reduce over time. Given the long mine schedules in Iron Ore operations it is anticipated that the soil quality may be reduced. Field trials been undertaken in the business to gauge results of using reduced soil quality, no soil or alternative growth media. It is likely that the reduced viability of the seed bank is a key concern in achieving the range of key species desired in the rehabilitation in a cost effective process.

Supplementary seeding is commonly undertaken in rehabilitation of medium and high disturbance areas. The ability to meet seed requirement volumes for closure is captured as a risk in achieving successful revegetation. A long term seed procurement strategy requires development to ensure sufficient volumes of seed are available for use when required. Seed used in rehabilitation is local provenance where possible, and availability can be limited by seasonal variation and a lack of suitable collectors. Currently seed procurement is focused on meeting the requirements of progressive rehabilitation targets.

Actions have been included in the sites closure task register relating to improving rehabilitation and revegetation success.

18.2 Management of waste fines storage facilities

The Mesa J Hub will utilise the existing Mesa J wet plants for processing. All waste fines are proposed to be contained in in-pit Waste Fines Storage Facilities (WFSF). Waste fines are scheduled to be contained entirely within the Mesa J in-pit facilities. As WFSF's reach capacity they will be capped with a layer of waste rock, when safe to access with heavy equipment.

The final landform design of these areas assumes a minimum 2m capping layer of inert material will be placed over the facilities. The capping layer thickness may be increased to facilitate disposal of waste rock, and enable utilisation of the surface of the WFSF for operational purposes. Given the designs for the future WFSF are still conceptual, further work will be required to review the interaction between pit walls and the WFSF's. Updates to the landform will be included in closure plan updates.

A closure task has also been identified to assess the potential for seepage from WFSF into the aquifer and potential impact to groundwater quality and subterranean habitats.

Rehabilitation of the existing TSF1 has been completed. This area was rehabilitated without capping as a trial. It is anticipated that all other waste fines storage facilities may be capped to reduce the heights and expanse of waste dumps and meet the project commitment to backfill as much waste rock within the pit limits as possible.

18.3 Management of erodible mineral waste

18.3.1 Principles of waste dump design

Mineral waste dumps located on mine sites that are operated by Rio Tinto are designed and rehabilitated in accordance with internal Landform Design Guidelines, which provides guidance on:

- the objectives of waste dump design, which is to achieve dumps that are:
  - safe;
  - stable;
  - aesthetically compatible with the surrounding landscape;
  - vegetated;
  - non-polluting;
  - compatible with the agreed post-mining land use; and
  - progressively rehabilitated;
- appropriate locations for the siting of waste dumps;
- appropriate shapes and designs of waste dumps;
- appropriate surface treatments; and
- links to other relevant internal and external guidance material.

These Guidelines are updated on a regular basis to incorporate learnings from research, studies and rehabilitation implementation projects. The most significant update occurred in 2012 to provide design criteria for waste dumps based on the specific waste types present. This was the result of several years of materials testing and landform evolution modelling studies of wastes typically found in the Pilbara including those at the Mesa J Hub, with design recommendations based on the assumption that an average erosion rate of 5/ha/year (with a maximum of 10/ha/year) will be acceptable. Further studies have since been undertaken on additional waste types, and this resulted in further minor updates in 2014 and 2016.

It should be noted that erosion modelling is conducted on the conservative assumption that slopes are not vegetated. However, vegetation is expected to establish on all slopes, thereby further reducing the erosion potential.

18.3.2 Erosion risk

The Mesa H and Mesa J deposits have a proportion of higher erodibility waste materials, include Tertiary Pisolite Clay (TPC) and Alluvials. Waste disposal via in-pit backfill, and location of several waste dumps in-pit, reduces the erosion risk associated with these materials, as sedimentation would be contained in-pit. The main erosion risk is associated with ex-pit dumps. Erodibility testing and landform modelling of the alluvial materials has been completed and testing is currently underway for the TPC material. To ensure long term stability of waste dumps, design parameters are based on erodibility testing of specific material types, as documented in the *Rio Tinto Iron Ore Batter Selector Tool*. Waste dumps in the project area are generally limited to 40m height, to ensure long-term stability and to reduce visual impact.

The Mesa H external waste dumps have been designed to incorporate a capping layer of competent material on the external surface, to enable 20 degree batter angle and 20m lift height, and a reduction in dump footprint. A competent waste stockpile area has been included in the mine plan, separate to the waste dumps. The Hardcap or HTP geo zone as illustrated in Figure 12 comprises suitable low erodibility waste that will be utilised for capping.

The Mesa K waste dumps contain a large proportion of low erodibility hydrated waste, that present a low erosion risk. Generally the waste dumps have maximum 20 meter lift heights, 20 degree slopes and 10 meter wide berm, based on recommended parameters within the batter selector tool.

A portion of waste at Mesa J and H will be utilised to cap the waste fines facilities to a minimum thickness of 2m. The capping layer thickness may be increased to facilitate disposal of waste rock, and to enable utilisation of the surface of the WFSF for operational purposes. Mine planning to support this closure plan has assumed waste fines will receive a minimum 2m capping depth, if this increases there would be an associated reduction in the final waste dump configurations.

18.4 Management of pit lakes

The water management strategy for Mesa J requires a water reservoir to store water from various sources (including pit dewatering, and WFSF decant), that is used for operational purposes, primarily in the wet processing plants. A small pit lake is currently proposed at the Mesa J Pit 15 reservoir, which is planned as a water storage area from 2020. This may be subject to change over time dependant on changes to the waste and waste fines deposition strategy and designs. Water quality modelling is required to confirm an acceptable environmental outcome. The water quality is anticipated to remain acceptable in the long term with seasonal flushing events contributing to this. Should water modelling outcomes be unfavourable, mitigation actions to address the impact would be implemented, including potential backfilling.

Consideration will need to be given on the accessibility of this area in terms of cattle and other livestock. Further detailed design will be provided in future updates to the closure plan.

18.5 Management of pit void stability

As the Mesa landforms have landscape, visual, heritage and ecological value, it is important to ensure they remain stable in the long term. To ensure long term stability of the Mesa façades, the pit design incorporates pit wall design parameters and minimum required façade width based on geotechnical assessment. A mining exclusion zone (MEZ) protects the façade (Figure 26).

The predicted zones of instability from the pit floors are illustrated in Figure 23, Figure 24 and Figure 25. All permanent landforms such as external waste dumps will be located outside these zones. Abandonment bund locations are conceptual only at this stage, and require further refinement however they will be located outside the zones of instability. Actions to address void stability are included in the sites closure task register.

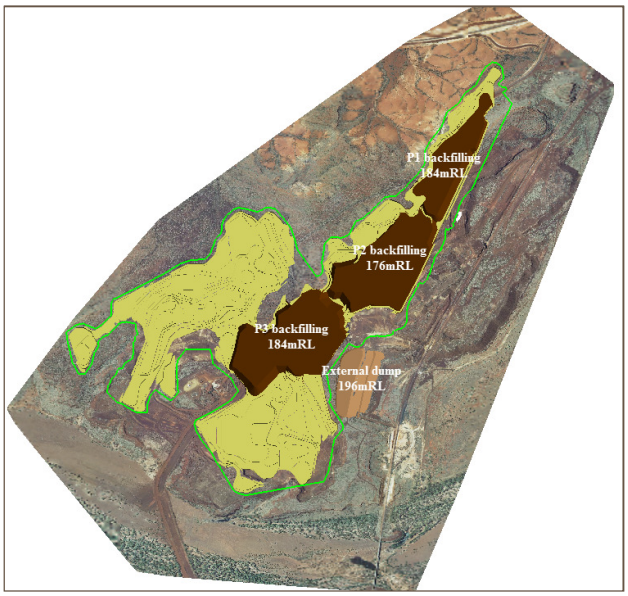


Figure 23: The Mesa K predicted zones of instability

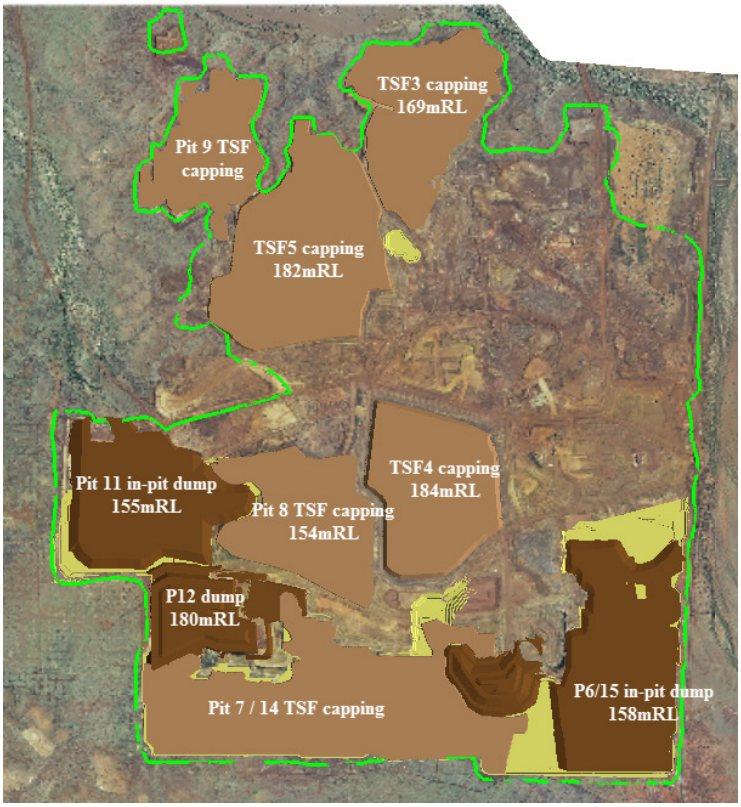


Figure 24: The Mesa J predicted zones of instability

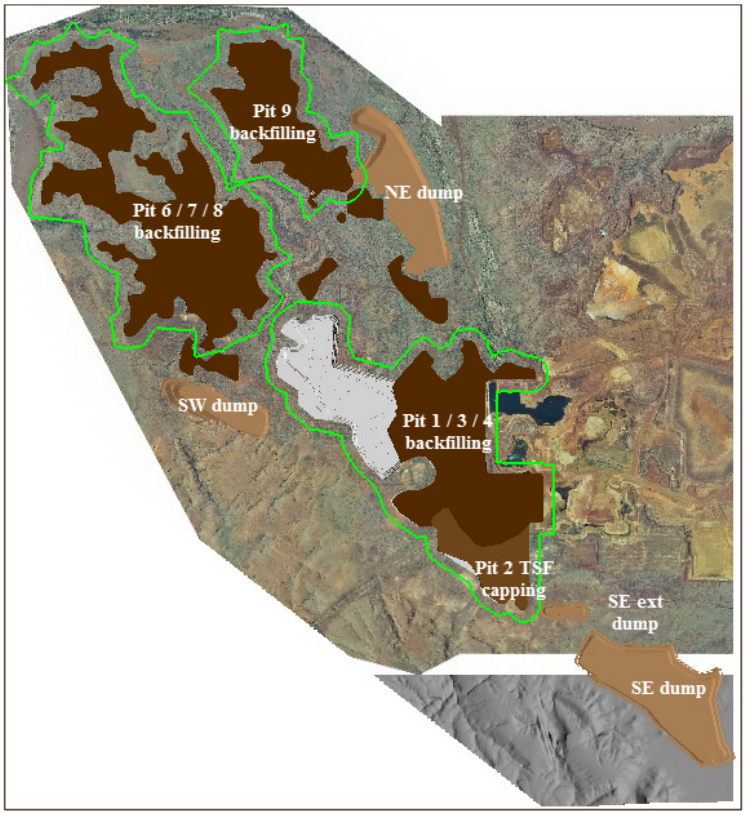


Figure 25: The Mesa H predicted zones of instability

18.6 Management of inadvertent public access

Inadvertent access to the site footprint post closure poses a safety risk due to the following circumstances:

- parts of the area are likely to be suitable to return to pastoral activities post closure;
- there will be pit voids not backfilled to the surface topography;
- there will be a pit lake at Mesa J; and
- access by Traditional Owners to significant heritage and ethnographic sites in the area.

This risk is considered to be reduced to an acceptable level and appropriately managed by the following:

- the area is remote from population centres;
- infrastructure will be decommissioned prior to relinquishment;
- the pits will be predominantly surrounded by the steep mesa façades, providing an effective barrier to inadvertent vehicle access;
- abandonment bunds will be established in areas where the mesa façade does not provide a barrier to inadvertent vehicle access to pits;
- tracks not required for post closure monitoring will be rehabilitated during closure implementation and prior to relinquishment all remaining tracks will be rehabilitated; and
- potential handover of ownership and maintenance requirements for post closure access by stakeholders such as pastoralists and Traditional owners.

18.6.1 Abandonment bunds

The Department of Mines and Petroleum (DMP) Abandonment Bund Guidelines require a 5 meter wide by 2 meter high abandonment bund be placed around a completed pit outside the zone of instability. The purpose of the guidelines is to reduce the likelihood of inadvertent access to the pit. Abandonment bund scenarios will be discussed for each mining area.

The mesa landform and mining method for Robe Valley deposits presents a relatively unique circumstance in regards to requirements for abandonments bunds. The retention of the breakaway landform around the edge of the mesa as a façade up to 20m in height, after mining out the central portion of the mesa, provides an effective barrier to inadvertent access to the pit. Where the façade does not provide an effective barrier to pit access, an abandonment bund is warranted. Consultation with the DMP has commenced on this, including members of the Environment and Safety Divisions.

The nearby Mesa A deposit at the Mesa A Hub provides a precedent of a pragmatic approach to abandonment bunds that is proposed to be adopted at the Mesa J Hub. Mesa A has a steep mesa face to the east, that gradually reduces in elevation to the west to the same height as the surrounding plain. An abandonment bund design for Mesa A was approved under an *Environmental Protection Act* Section 45C approval, and by the District Inspector DMP. Vehicle access to the pit was considered unlikely where the façade was retained at the western end of the mesa, due to the steep terrain. Therefore no abandonment bund is required where the mesa façade is retained. An abandonment bund was required around the flat eastern extent of the deposit, joining to the mesa façade to the west. The abandonment bund has been constructed and the majority of it is already in place. A bund to block vehicular access points onto the mesa is also required.

The majority of the Mesa H pit perimeter will be contained within a steep mesa façade, and no abandonment bund is currently proposed where this façade provides an effective barrier to vehicular access. The south east of the deposit is not bordered by a mesa landform, and will require an abandonment bund. The project will have a conceptual abandonment bund design completed at feasibility stage. During the approvals process for this area, mining exclusion zones may be amended, therefore a bund location design cannot be completed at this time.

Following initial consultation of the project with DMP officers, the company has a project proposed during 2017 to incorporate abandonment bund requirements for new pits and deposits into the required project outputs. Mesa H is likely to be one of the first sites to complete this process during 2017 and should enable a bund design that can be implemented during construction.

The Mesa J and K mining areas do not currently have abandonment bunds in place. An action in the closure task register for the site is to develop these designs with a view to include them in the next update to the closure plan. Specifics of Abandonment bund locations will be discussed with the DMP Environment and Safety Divisions as appropriate.

18.7 Management of dewatering impacts

Dewatering of below water table pits and abstraction at borefields creates a cone of depression in the water table which, depending on geological and hydraulic boundaries, can extend up to several kilometres beyond the area dewatered. This can reduce the amount of groundwater available for any groundwater dependent vegetation and local permanent pools, and therefore efforts are made to reduce the zone of this impact as much as practical.

At Jimmawurrada Creek, the cumulative drawdown along the creek during operations as a result of the Mesa J dewatering, abstraction from the Southern Cutback borefield and the adjacent Coastal Water Project is proposed to be reduced by the implementation of a thickener plant, which will reduce the water demand by approximately 35% and therefore reduce the overall time for the groundwater to recover.

Although poorer water quality may affect the riparian vegetation, terrestrial, subterranean and aquatic fauna around the permanent pools in the Robe River, groundwater abstraction from the CID and basement aquifers has been consistently of fresh quality with chloride concentrations lower than concentrations recorded in the down gradient pools; surplus water discharge monthly quality monitoring data also support this finding.

Semi-permanent and permanent pools exist along the Robe River and have high biodiversity and heritage value. As detailed in Section 11.2, Mesa H and Mesa J aquifers are a continuity of the same system, discharging to the Robe River alluvium aquifer to the north. Annual monitoring of Robe River pools and vegetation since 1993 has reported no measurable impact on the ecology of pools north of Mesa J due to mine-related dewatering. Supplemental discharge may potentially need to continue for a period of time after cessation of active mining at Mesa J Hub to support maintaining environmental and heritage values, this period is largerly dependent on climate. Once mining starts, the aquifer is further stressed and more data becomes avalibale the existing groundwater model will be continuously revised to assess the impacts of dewatering and determine appropriate mitigation requirements.

Groundwater is expected to recover to pre-mining water table levels once dewatering has ceased in the area. Modelling of ground water draw down and recovery timeframes will continue to be updated during the life of the project. Should any potential significant impact to the environmental or heritage values associated with the pools be predicted, mitigation strategies such as direct / optimised discharge to key pools, and avoiding mine pit dewatering below a 120m RL in pit 7 will be considered in consultation with stakeholders.

18.8 Management of surface water

Landforms need to consider the surrounding hydrology of the area, as landforms can have an impact in catchments both upstream and downstream of their location. Both situations need to be considered when conducting a hydrological study. Waste dumps and other landforms can act as a diversion or dam for upstream surface water, reducing flow to the downstream catchment. Likewise, these landforms can erode with surface water flow, destabilising the landform and impacting the downstream environment with sediment.

At the Mesa J Hub, waste dumps and other landforms are generally built outside the 1 in 100 AEP flood plain, consider material characterisation and often include surface water management structures such as diversions, bunds and surface water retention cells. There are, however, two historic waste dumps associated with Mesa K that are potentially constructed within the 1 in 100 AEP flood plain of the Robe River. Preliminary investigation shows that the waste dumps have survived a 1 in 20 to 1 in 50 AEP event in 2009 with minimal disturbance. Further hydrologic/hydraulic modelling and investigation will inform an appropriate closure strategy for these dumps.

Surface water diversions to the south of Mesa H and J pits are not intended to continue to function post-closure. Post-closure drainage will report to backfilled pits, which is likely to intercept 0.5% of the Robe River catchment area. Diversions may be deliberately breached at closure so that surface flows enhance recovery of the groundwater table; alternatively the diversions will likely be breached by large events post-closure that exceeds design criteria. Further assessment will be required to determine the optimal closure strategy for these diversions.

The impacts of the final landform design on surface drainage flows at a site level will require assessment prior to final closure planning

18.9 Management of threatened flora and fauna

As detailed in Section 12.7, there are two PEC's associated with troglofauna communities in mesa landforms of the Robe Valley. Impacts to troglofauna communities during mining of the Mesa J Hub are primarily managed via establishment of avoidance areas or mining exclusion zones. At Mesa K, several avoidance areas to preserve troglofauna habitat have been agreed with regulators as part of environmental assessment and approval. At Mesa J, MS 208 requires protection of the mesa façade adjacent to the Robe River north of the mine to protect heritage values, which will also protect significant fauna and troglofauna habitat. Mesa H pit designs have incorporated mining exclusion zones to protect heritage and biological values including retention of troglofauna habitat. The retention of the Mesa facades during operations will ensure that significant fauna and troglofauna habitat is retained in the final landform upon closure. Proposed mining exclusion zones are shown in Figure 26.

The Bungaroo stygofauna PEC community lies outside the scope of proposed mining operations, and any management of stygofauna will largely be completed during the operational phase.

18.10 Management of social surroundings

The mesa landforms have high cultural value to the K&M, particularly when viewed from within or near the Robe River. The facades also support important Matters of National Environmental Significance (MNES) species habitat and also serve to preserve intact troglofauna habitat. At Mesa J, MS 208 requires retention of the mesa façade adjacent to the Robe River north of the mine to protect environmental and heritage values. At Mesa H, the façades adjacent to the Robe River will also be retained to protect heritage values. Visual impact is a key consideration during waste dump design, generally waste dumps are similar height to the surrounding topography, with a focus on minimising the visual impact of any waste landforms when viewed from the Robe River.

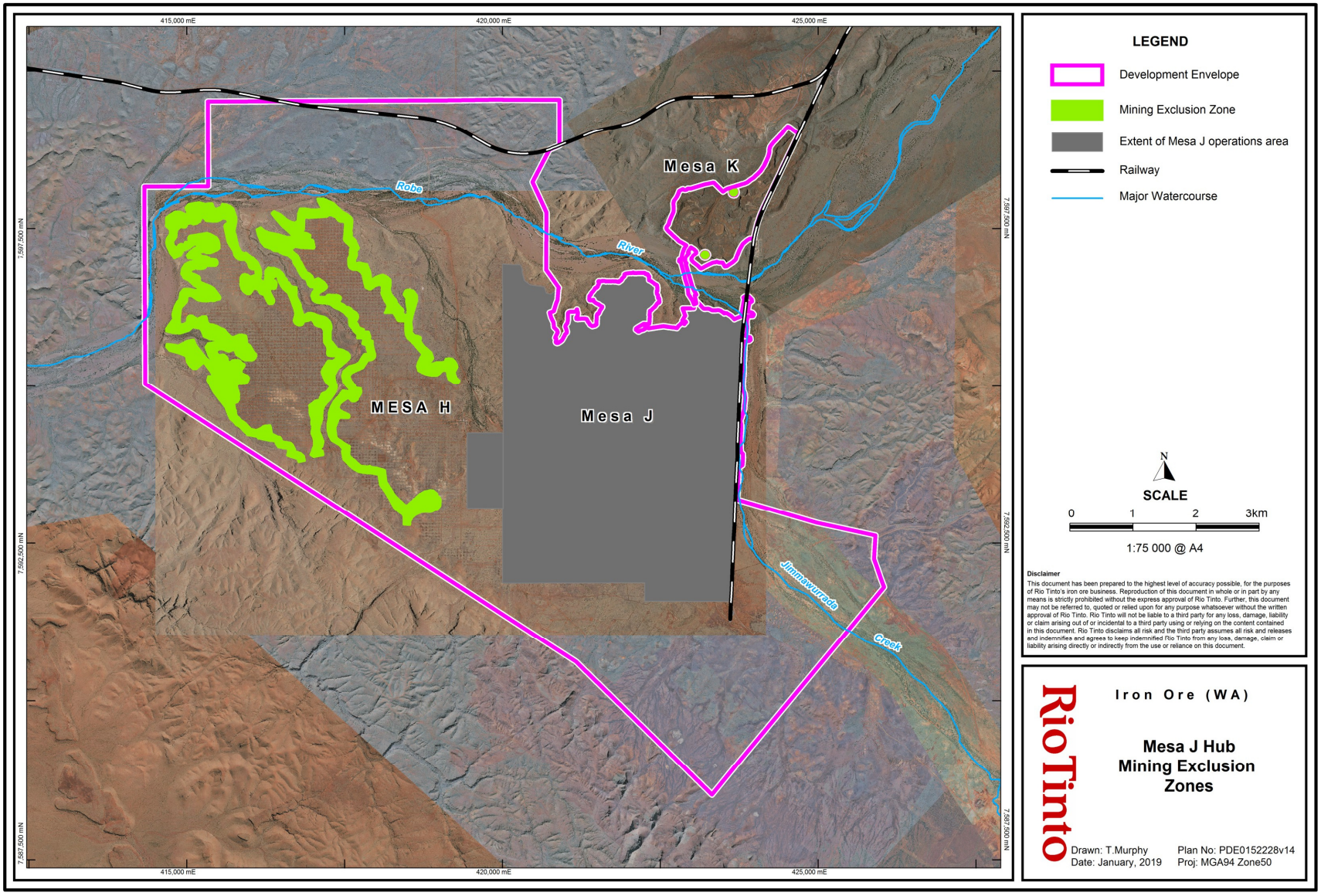


Figure 26: Mesa J Hub Mining Exclusion Zones

CLOSURE IMPLEMENTATION

Rio Tinto uses closure domains to group areas with common features, rehabilitation and decommissioning requirements at closure. Detailed closure strategies for the rehabilitation and decommissioning of individual closure domains, beyond those of current standard management practices, will be documented in the Mine Closure Plan to be prepared as the site approaches closure. The closure measures identified below consider the methods used to manage key risks as discussed in the previous section.

19. Closure Measures

Proposed closure measures for each of the closure domains are included in Table 20. The distribution of closure domains are illustrated in Figure 27. Designs and key criteria for all major landforms are included in Appendix F.

Table 20: Mesa J Hub general area implementation strategies by closure domain.

Domain class	Domains	Closure measures
Pits		
Above water table (AWT) pits	Mesa H Pit 9 Mesa J Pit 1 Mesa J Pit 2 Mesa J Pit 3 Mesa J Pit 4 Mesa J Pit 5 Mesa K Pit 1 Mesa K Pit 2 Mesa K Pit 3 Mesa K Pit 4 Mesa K Pit 5 Mesa K Pit 6	• Pits may be partially backfilled where possible to minimise the volume of waste in out of pit waste landforms. • Prior to final closure, appropriate evaluation and implementation of measures to restrict public access will be undertaken. • Rehabilitate final surface of pit floors in accordance with standard procedures (as per infrastructure areas) (Note. pit walls will remain).
Below water table pits (geochemical risk: low)	Mesa H Pit 1 Mesa H Pit 2 Mesa H Pit 3 Mesa H Pit 4 Mesa H Pit 5 Mesa H Pit 6 Mesa H Pit 7 Mesa H Pit 8 Mesa J Pit 6 Mesa J Pit 7 Mesa J Pit 8	• Undertake opportunistic backfill during operations and if required post-closure to prevent the formation of pit lakes in the final landform (excluding pit 15)[9]. • Rehabilitate final surface of pit floors in accordance with standard procedures (as per infrastructure areas) (Note. pit walls will remain). • Mesa J pit 15 will have an area partially left as a pit lake.

[9] Below water table pits (not differentiated in Figure 27 as each Pit is a section of the wider mining area) may not be backfilled uniformly across the entire surface. Sections of the pit may remain above water table during mining, and therefore not require backfill. All areas with a recovering water table at risk of forming a pit lake are backfilled (as indicated in orange)

Domain class	Domains	Closure measures
	Mesa J Pit 9	
	Mesa J Pit 10	
	Mesa J Pit 11	
	Mesa J Pit 12	
	Mesa J Pit 14	
	Mesa J Pit 15	
Waste dumps and stockpiles		
In-pit waste dumps (inert)	Mesa H Pit1 backfill Mesa H Pit2 backfill Mesa H Pit3 backfill Mesa H Pit4 backfill Mesa H Pit6/8 backfill Mesa H Pit9 backfill Mesa J Pit 11 inpit WD Mesa J P12 WD Mesa J P6 WD Mesa J P7/15 WD Mesa K Pit 1 backfill Mesa K Pit 2 backfill Mesa K Pit 3 backfill Mesa K Gravel Pit WD	• Reshaping outer slopes to appropriate angles/profiles based on design criteria suitable for waste type. • Rehabilitate final surface in accordance with standard procedures (as per infrastructure areas).
Free standing inert waste dumps	Mesa H NE Dump Mesa H SW Dump Mesa H SE Dump Mesa J Boondock WD Mesa K North WD Mesa K WD	• Where practicable, construct dumps in accordance with criteria outlined in Appendix F. • Reshaping outer slopes to appropriate angles/profiles based on design criteria suitable for waste type. • Application of subsoil/topsoil. • Rip and seed using appropriate native species.
Other domains		
Haul roads		• Push slopes at either side of the haul road to a maximum gradient of 20 degrees with berms at 10 metre intervals. • Install cross bunds where appropriate (at approximately 50m to intervals if the gradient of the reshaped road corridor is <10 degrees). • Rehabilitate final surface in accordance with standard procedures (as per inert waste dumps).
ROM pad	ROM pad	• Remove infrastructure. • Utilise earthen mound for pit backfill OR rehabilitate as a free standing inert waste dump.
Landfill	Landfill	• Cap landfill with a layer of inert material to a minimum thickness of 2 metres. • Rehabilitate final surface in accordance with standard procedures (as per infrastructure areas).

Domain class	Domains	Closure measures
Waste fines storage facility	Mesa J TSF 1 Mesa J TSF 3 Mesa J TSF 4 Mesa J TSF 5 Mesa J Pit7/14 TSF Mesa J Pit 8 TSF Mesa J Pit 9 TSF	• Cap waste fines storage facility with a layer of inert material to a minimum thickness of 2 metres. • Rehabilitate final surface in accordance with standard procedures (as per infrastructure areas). • TSF1 will remain uncapped.

Infrastructure areas	Plant
	Maintenance
	Buildings
	Roads
	Laydown
	Conveyors
	(etc.)
		• Retain or remove infrastructure in accordance with State Agreement requirements.
		• Undertake contaminated sites evaluation and clean up if required.
		• Where infrastructure requires removal, remove all structures and footings that is above surface or within 1m of the final land surface.
		• Drain pipelines and remove hazardous materials (from pipelines and elsewhere across the site) in accordance with Controlled Waste Regulations.
		• Actively seek reuse and recycling opportunities for decommissioned infrastructure.
		• Dispose of inert materials are not retained, reused or recycled in an inert landfill area (may be a used pit area) and then cap with at least 2 metres of inert material.
		• Where linear infrastructure is removed, reinstate drainage lines where appropriate.
		• Rehabilitate final surface in accordance with standard procedures, which includes:
		  ○ add a layer of topsoil where available and appropriate;
		  ○ deep rip the surface where required to address compaction;
		  ○ revegetate with an appropriate mix of native species.

20. Post-mining and post-closure landforms

The post mining landform is the landform that would be generated as a result of implementation of the mine plan assuming no progressive rehabilitation activities are conducted. A conceptual image of the post mining landform is shown in Figure 28 and Figure 30.

The post closure landform is the final expected landform at the completion of the closure measures outlined in Table 20 above. A conceptual image of this landform is shown in Figure 29, Figure 31 and Figure 32.

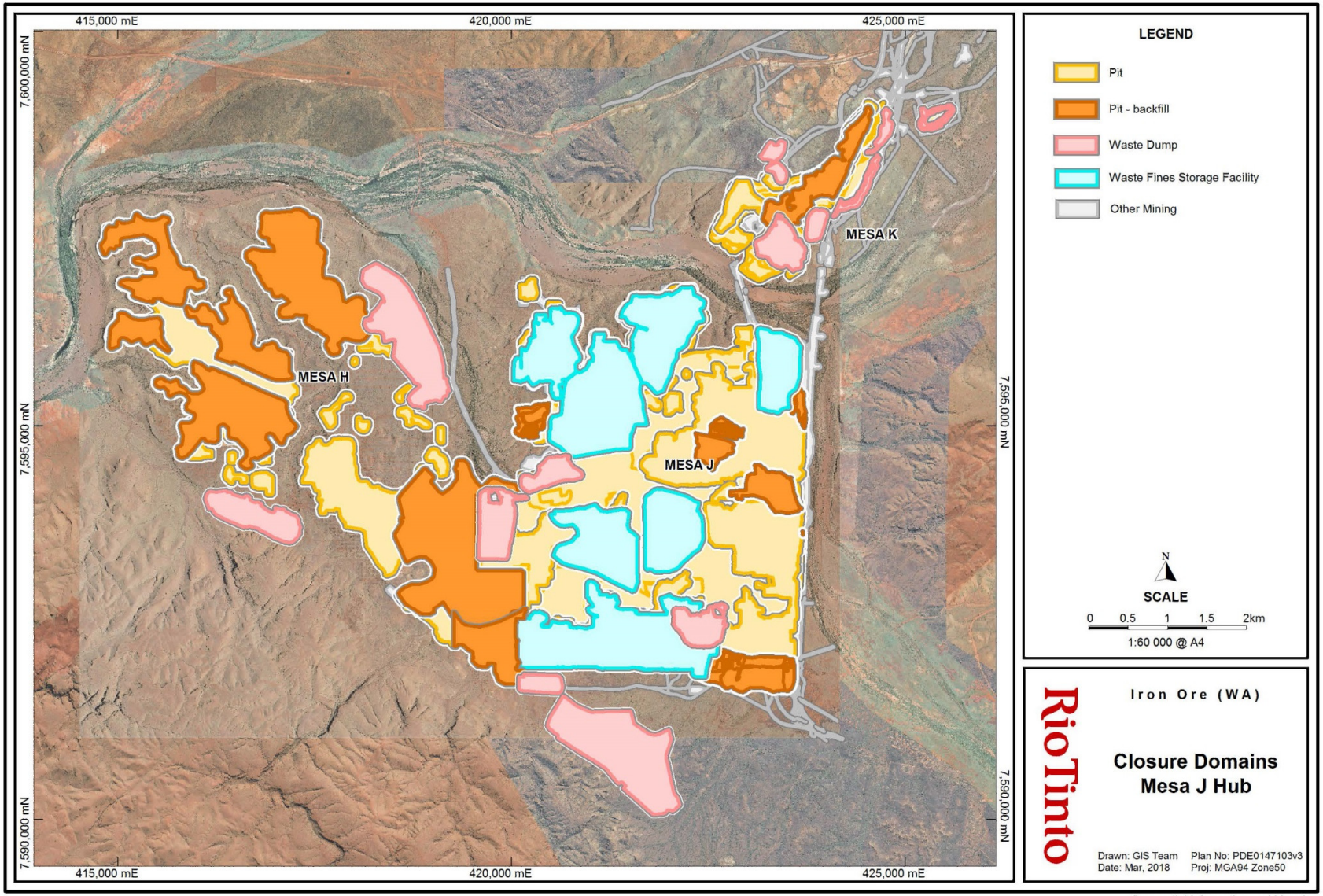


Figure 27: Closure Domains

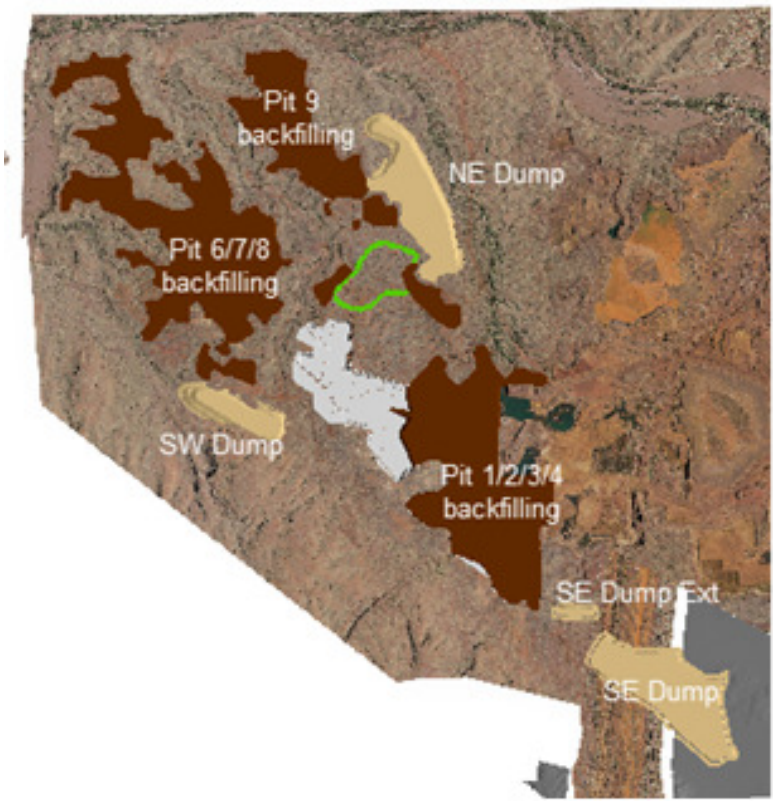


Figure 28: Mesa H post mining landform

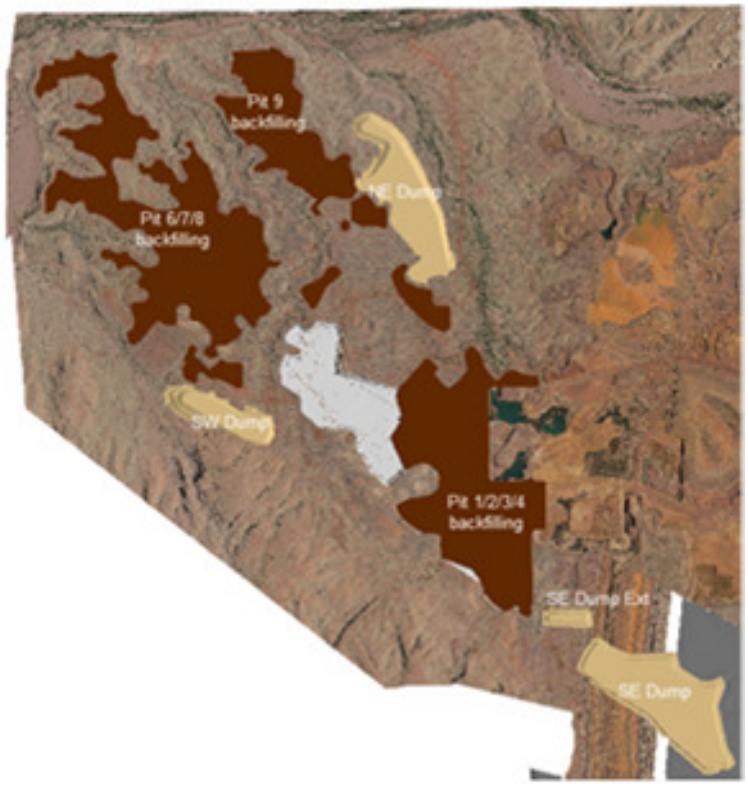


Figure 29: Mesa H post closure landform

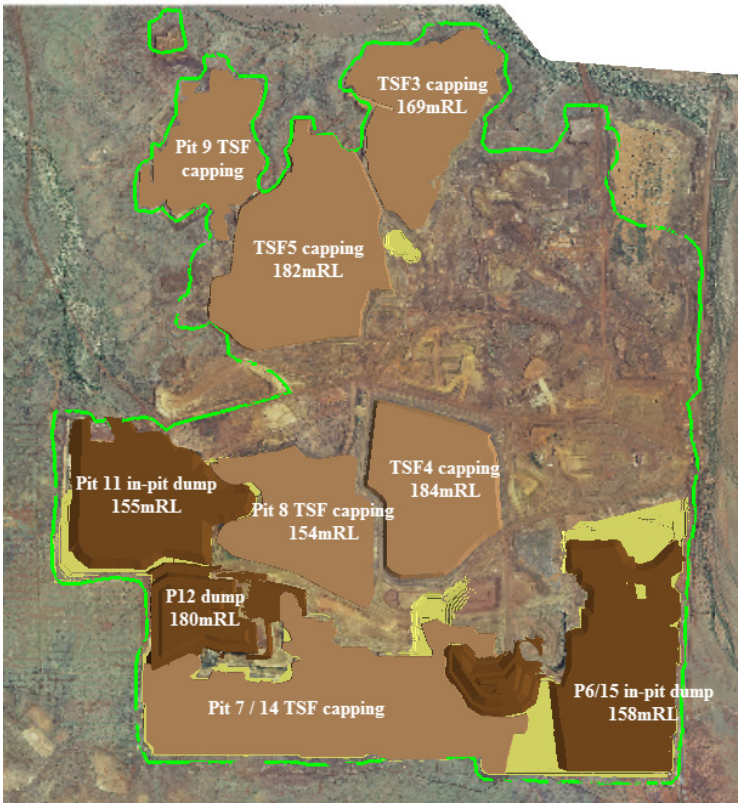


Figure 30: Mesa J post mining landform

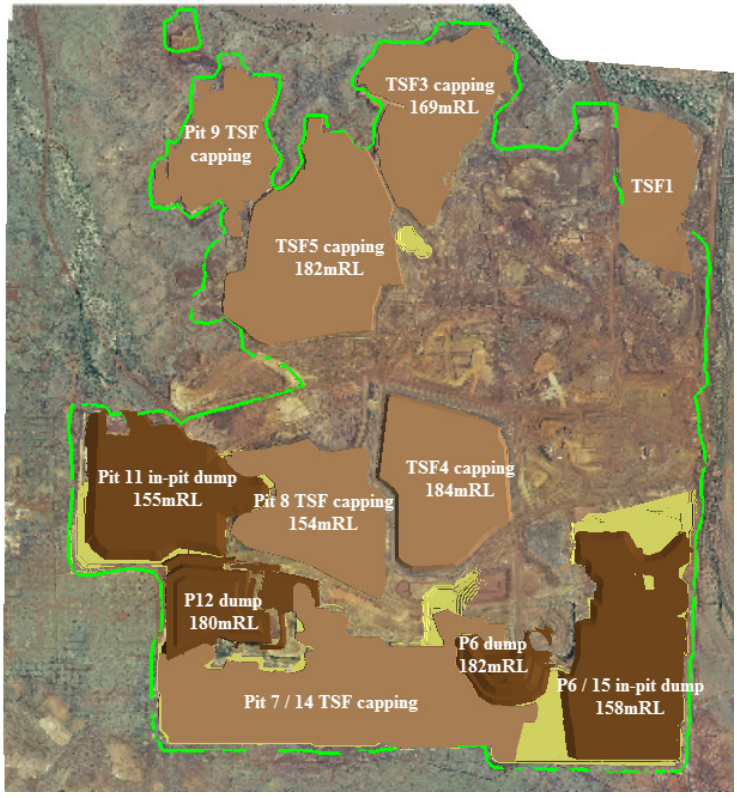


Figure 31: Mesa J post closure landform

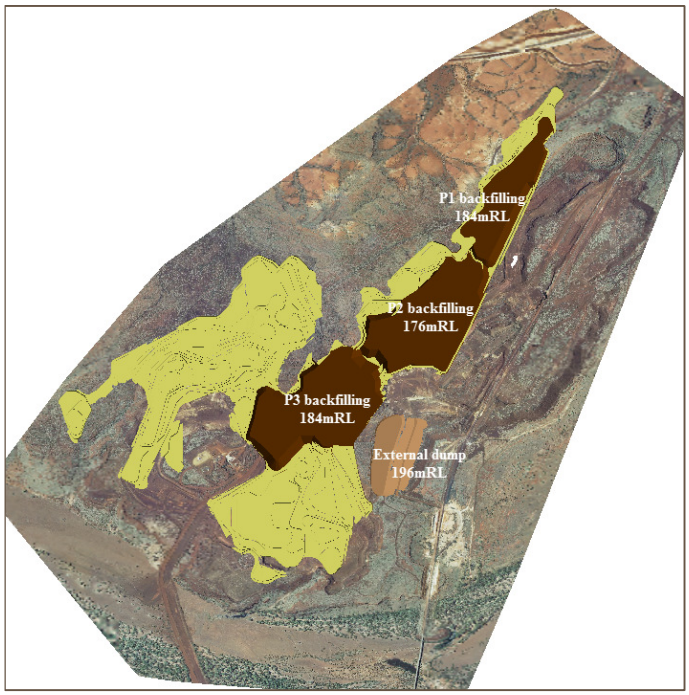


Figure 32: Mesa K post closure landform

21. Premature closure and other factors

The closure implementation schedule may be influenced by factors outside of the current mine plan. These factors include:

- suspension of operations under care and maintenance: this could occur if production costs exceed product value e.g. due to commodity price changes;
- unexpected closure: this could occur if there was major change in global demand for iron ore; and
- future proposals: there are multiple deposits in proximity to Mesa J that are likely to be developed in the future.

21.1 Care and maintenance

In the event of temporary closure, measures will be undertaken to transfer the site from operations into a care and maintenance regime and relevant authorities notified. A Care and Maintenance Plan would be developed prior to the care and maintenance period which demonstrates how on-going environmental obligations associated with the site will continue to be met during the period of care and maintenance. Social obligations and responsibilities will also be addressed in this plan.

21.2 Unexpected closure

Whilst the Company considers the risk of unexpected closure to be minimal, there are numerous factors that could force early closure of one or several sites. Even if some level of contraction were to occur, it is reasonable to assume that the Robe JV would continue to operate in the Pilbara and that it could continue to manage closure of its sites. It should be noted that the Company is one group within the global Rio Tinto group of companies, which further mitigates this risk.

In the event of unplanned or sudden closure, the Company will notify all relevant authorities including the DMP. The existing closure plan for the site would then be revised and a Decommissioning Plan prepared and submitted to the DMP and other relevant authorities within three months of notification of closure. The Decommissioning Plan will include undertaking detailed consultation with stakeholders. Once the plan is approved by the relevant authorities, work will commence on closure implementation activities.

21.3 Future proposals

The Robe JV hold mineral leases pursuant to the Agreement Act over multiple undeveloped deposits in the Robe Valley. Development of several of these deposits will potentially require continued utilisation of the Mesa J Hub infrastructure after completion of mining at the Mesa J, K and H deposits. These future developments are excluded from the scope of this current Mesa J Hub closure plan, but will be included in future closure plan updates with improved certainty of the specifics of these developments.

CLOSURE MONITORING AND MAINTENANCE

22. Closure monitoring program

The primary purpose of closure monitoring is to assess whether closure criteria have been met for the Mesa J Hub. A specific monitoring program will be finalised as the site approaches closure, and this current plan outlines the principles that will be employed rather than specific details.

22.1 Phases of monitoring

For the purposes of this plan, monitoring is assumed to be conducted in several phases including:

- Baseline monitoring, which is conducted as operations expand into new mining areas. Results that are relevant to closure are summarised in the environment knowledge base;
- Operational monitoring, which occurs throughout the life of the mine, in line with regulatory requirements and the Rio Tinto operational standards. Results that are relevant to closure are incorporated in the environment knowledge base when it is reviewed;
- Pre-closure monitoring, which occurs as the site approaches closure to underpin assessment of post-closure performance;
- Closure monitoring, which is conducted during the period of active site closure (approximately two years following the cessation of mining); and
- Post-closure monitoring, which is conducted on a regular basis until either:
  - There is a demonstration that closure objectives have been met and that the site is able to be relinquished; or
  - Parameters being monitored reach a steady state.

This plan considers pre-closure, closure and post-closure monitoring.

22.2 Indicative monitoring program

The monitoring program will be finalised during development of a Final Closure Plan as the site approaches closure. Specific and appropriate monitoring will be conducted to ensure data is obtained to allow assessment of performance against completion criteria (Section 8). The monitoring programme is likely to contain specific monitoring of the following key areas, as a minimum.

22.2.1 Rehabilitation monitoring

The purpose of the rehabilitation monitoring program is to evaluate successional development of rehabilitation areas and thereby provide useful feedback for the improvement of rehabilitation techniques, and to help assess progress towards long term rehabilitation objectives.

Rehabilitation monitoring also provides vital information which can be used to set realistic and achievable completion criteria. This can be achieved by examining changes in key parameters over time, and by comparing results from the rehabilitation with those from corresponding reference sites. Reference sites, also known as Controls or Analogues, are positioned within local areas of uncleared native vegetation.

Rehabilitation monitoring occurs on a scheduled basis, aimed at establishing trends for the locations return to self-sustaining status. The rehabilitation development is compared to the reference site values. Data analysis is undertaken to assess progress towards an acceptable outcome and a report produced to document findings.

22.2.2 Water monitoring

Water monitoring during closure will focus on confirming groundwater recovery and quality, and pit lake modelling predictions. A specific program of monitoring will be developed prior to decommissioning.

22.3 Heritage surveys

Heritage assessments are undertaken prior to closure to ascertain potential cultural heritage impacts of closure implementation, and inform the development of alternative strategies if required. Assessments are also undertaken post-closure to confirm that implementation has been undertaken in an appropriate manner.

23. Post-closure maintenance

Post closure, maintenance will continue as required until it is determined that the closure objectives have been met or it is otherwise agreed with Government to allow relinquishment of the site.

FINANCIAL PROVISION FOR CLOSURE

Rio Tinto considers specifics of the closure cost estimate to be commercially sensitive information. This section outlines the general process used to develop the closure cost estimate.

24. Principles of Rio Tinto closure cost estimation

Closure cost estimates are determined based on methods outlined in the Rio Tinto Closure Standard and the Rio Tinto Accounting Policy. Closure costs are considered in two formats:

- a Present Closure Obligation (PCO) which is indicative of costs associated with closure of the mine given its current footprint, this accounts for the progressive development of a site over time; and
- a Total Projected Closure (TPC) cost which predicts the cost (in current terms) associated with closure at the end of the life of the mine. The TPC includes areas that are not currently approved, but that feature within the life of mine plan and that are considered likely to be developed in the future.

The cost estimates consider the following components[10]:

- decommissioning (i.e. removal of infrastructure)[11];
- final landform construction;
- rehabilitation and biodiversity management;
- heritage management;
- workforce management (i.e. training costs and redundancy payments)[12];
- monitoring costs;
- costs associated with the development of a final closure plan;
- costs associated with undertaking a final shutdown of operations;
- allowance for failed rehabilitation or pollution that may necessitate rework of rehabilitation areas;
- assignment of indirect costs in accordance with Rio Tinto Accounting Policy; and
- a contingency factor.

25. Closure cost estimation methods

The closure cost estimation methodology is based on methods outlined in the Rio Tinto Closure Standard and Rio Tinto Accounting Policy, with the level of accuracy increasing as the site approaches closure[13]. The closure cost estimates are conducted based on the most recent information of mine plans and infrastructure. Closure costs estimate are generally undertaken by specialist external consultants. The PCO estimate for each site is revised on an annual basis to account for incremental mine development during the year. The TPC estimate is revised whenever a formal closure plan review is conducted to capture any changes to life of mine design. As part of Rio Tinto assurance processes these costs are audited by external financial auditors annually to ensure adequate closure provisions are maintained.

Note that for commercial reasons the actual estimate is not documented in this closure plan.

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[10] Costs associated with decontamination are assessed during closure plan development but are costed separately as they are classified as operating costs, not closure costs.

[11] The decommissioning cost estimate assumes that infrastructure will be demolished and buried on site. The site is sufficiently remote that deconstruction for the purposes of materials salvage and recycling is likely to be cost prohibitive. However; opportunities for salvage and recycling will be sought as the site approaches closure.

[12] Workforce management costs have only been included in the TPC.

[13] The level of accuracy applied to Rio Tinto estimates is as follows:

- greater than 10 years from closure: ±30%;
- between 10 years and 5 years from closure: ±20%; and
- less than 5 years from closure: ±15%.

MANAGEMENT OF INFORMATION AND DATA

26. Data and information management

26.1 Iron Ore Document Management System (IODMS)

The Company operates a comprehensive document management system, with electronic records of all key information and data. The document system, known as Iron Ore Document Management System (IODMS) is linked to other business units within the Rio Tinto group of companies, and processes are in place to ensure that the data contained within this system is appropriately backed up and protected. Each document stored within this system is given a unique document number which identifies the document and enables it to be accessed. This system will continue to operate following site closure, and all relevant data will be retained according to appropriate data retention requirements.

An audit will be conducted prior to closure to ascertain whether there is any additional information stored in hard copy form at the site. Such data will be scanned and entered into IODMS to ensure that it is appropriately retained post-closure.

26.2 Closure knowledge base

The closure knowledge database is a knowledge management process designed to bring closure related research and monitoring outcomes together into one searchable location. It uses a single entry form to capture where the report is stored, and how and where the research can be applied for all new ongoing and completed closure related studies. This information is then managed by the Closure team within a secure database.

26.3 EnviroSys

EnviroSys is an environmental database that is used by Rio Tinto to manage environmental and hydrogeological data. The tool is used to store, monitor and analyse those parameters and report trends on data collections.

Data collected currently includes:

- groundwater – biological, chemical, field, levels, production;
- marine water – biological, chemical, field;
- soil chemistry;
- surface water – biological, chemical, field, levels, production;
- tonnes and moisture;
- rehabilitation;
- water meters; and
- weather (rainfall, temperatures etc.).

EnviroSys is used to support the building of closure knowledge bases, as well as ensure compliance with operating licenses pertaining to data management. At closure this data would be appropriately stored to allow for review of post closure completion criteria.

26.4 Legal and other requirements system

The Legal and Other Requirements System (LAORS) is used by the Company to manage the following:

- Approval and Legislation Reports which provide a high level snapshot of approvals and legislation and is used to check the status and expiry dates of approvals.
- Approval and Legislative Requirements Reports which lists
  - accountabilities for specific conditions within approvals and clauses within legislation;
  - required actions to comply with approvals and or legislation; and
  - due dates for specific requirements.
- Statutory Position Appointed Persons reports which list individuals appointed to a statutory position.
- Statutory Position Accountabilities Reports which identify clauses of legislation that the statutory position is accountable for.

This information is used to track legal requirements associated with closure and will be maintained during closure activities to ensure all requirements and obligations are met.

Appendix A – Register of key closure obligations

Ministerial Statement 208 (Mesa J Iron Ore Development)	
Condition No.	**Closure conditions**
4-1	Prior to construction at the site, the proponent shall prepare a Drainage Management Programme, to protect the Robe River - Jimmawurrada Creek system from the deleterious impacts of sedimentation and pollution from the project, to the satisfaction of the Minister for the Environment on advice of the Environmental Protection Authority, the Department of Conservation and Land Management and the Water Authority of Western Australia. The plan is to include but is not necessarily limited to: 1. a monitoring programme to detect impacts; 2. procedures for protecting the ecology of the system; 3. procedures for reporting on the programme; and 4. a commitment to ameliorate environmental impacts to the satisfaction of the Environmental Protection Authority if impacts are detected which are deemed unacceptable by the Environmental Protection Authority.
4-2	Subsequent to condition 4-1, the proponent shall implement the approved Drainage Management Programme to the satisfaction of the Environmental Projection Authority on advice of the Water Authority of Western Australia and the Department of Conservation and Land Management.
5-1	Prior to the commencement of dewatering, the proponent shall prepare a Dewatering Management Programme, to protect the Robe River - Jimmawurrada Creek system, to the satisfaction of the Environmental Protection Authority on advice of the Department of Conservation and Land Management and the Water Authority of Western Australia. The plan is to include but is not necessarily limited to: 1. a monitoring programme to detect impacts; 2. procedures for protecting the ecology and water quality of the permanent pools and associated vegetation; 3. procedures for reporting on the programme; and 4. a commitment to ameliorate environmental impacts to the satisfaction of the Environmental Protection Authority if impacts are detected which are deemed unacceptable by the Environmental Protection Authority.
5-2	Subsequent to condition 5-1, the proponent shall implement the approved Environmental Management Programme to the satisfaction of the Environmental Protection Authority on advice of the Water Authority of Western Australia and the Department of Conservation and: Land Management.
6-1	Within 12 months of the date of this statement, the proponent shall prepare a Rehabilitation Management Programme to the satisfaction of the Environmental Protection Authority on advice of the Department of Mines and the Department of Conservation and Land Management. The programme shall include but not necessarily be limited to: 1. proposals for rehabilitation of the project area; and 2. a monitoring programme to determine success of the rehabilitation. **CLOSED COMPLETE: Rehabilitation Management Plan satisfies this condition**
6-2	The initial programme shall be submitted to the Environmental Protection Authority, with subsequent programmes for the project to be updated annualy in conjunction with reporting requirements under the Iron Ore (Robe River) Agreement Act.
6-3	At least twelve months prior to the decommissioning, the proponent shall prepare a plan for decommissioning and rehabilitating the site, to the satisfaction of the Environmental Protection Authority on advice of the Department of Mines and the Department of Conservation and Land Management.

Ministerial Statement 208 (Mesa J Iron Ore Development)	
6-4	Subsequent to conditions 6-1 and 6-3, the proponent shall implement the approved programmes for rehabilitating and decommissioning the site, to the satisfaction of the Environmental Protection Authority on advice of the Department of Mines and the Department of Conservation and Land Management.
Commitment No.	**Closure commitments**
Commitment 6	The proponent will implement landform stabilization and revegetation programs in the project area for the duration.
Commitment 11	At the completion of the project, the proponent will prepare the site for abandonment in accordance with the requirements of the Mines Department and in recognition of the requirements of the Iron Ore (Robe River) Agreement Act, 1964, including, as applicable: 1. Re-establishment of pre-existing drainage patterns as far as practicably achieved; 2. The initiation of stabilisation and revegetation activities to stabilise structures and communities; and, 3. The mining plan will be modified to incorporate the return of as much waste rock to the mined out pit as can be practically achieved during the life of the project.

Ministerial Statement 776 (Mesa K Remnant Mining Project)	
Condition No.	**Closure conditions**
7-1	The proponent shall implement the proposal to achieve stable, self-sustaining and functioning ecosystem(s) that is/are consistent with the surrounding landscape and maintain(s) key environmental values over the long-term and to the satisfaction of the CEO of the Department of Environment and Conservation.
Commitment No.	**Closure commitments**
Schedule 1 - Mine and Mining	Waste Rock Disposal: Initially directed to surface waste dumps and, thereafter, used in progressive backfilling of mine pits as far as practicable

Iron Ore (Robe River) Agreement Act 1964	
Clause No.	**Closure obligations**
Schedule 1 10 e)	on the cessation or determination of any lease license or easement granted hereunder by the State to the Company or (except as otherwise agreed by the Minister) to an associated company or other assignee of the Company under clause 13 hereof of land for the plant site or the Company's wharf for any installation within the harbour for the Company's railway or for housing at the port or port townsite the improvements and things erected on the relevant land and provided for in connection therewith other than plant and equipment shall remain or become the absolute property of the State without compensation and freed and discharged from all mortgages and encumbrances and the Company will do and execute such documents and things (including surrenders) as the State may reasonably require to give effect to this provision. In the event of the Company immediately prior to such expiration or determination or subsequent thereto deciding to remove its locomotives rolling stock plant and equipment or any of them from any land it shall not do so without first notifying the State in writing of its decision and thereby granting to the State the right or option exercisable within three months thereafter to purchase at valuation in situ the said plant and equipment or any of them. Such valuation shall be mutually agreed or in default of agreement shall be made by such competent valuer as the parties may appoint or failing agreement as to such appointment then by two competent valuers one to be appointed by each party or by an umpire appointed by such valuers should they fail to agree;

Mining Act 1978	
Tenement No. AML70/00248 (ML248SA)	
Condition No.	**Closure conditions**
n/a	No conditions relevant to closure

Permit No. CPS4397	
Condition No.	**Closure conditions**
13	Retain vegetative material and topsoil, revegetation and rehabilitation The Permit Holder shall: (a) retain the vegetative material and topsoil removed by clearing authorised under this Permit and stockpile the vegetative material and topsoil in an area that has already been cleared; (b) within 12 months following clearing authorised under this Permit, revegetate and rehabilitate the area(s) that are no longer required for the purpose for which they were cleared under this Permit by: i) re-shaping the surface of the land so that it is consistent with the surrounding 5 metres of uncleared land; ii) ripping the ground on the contour to remove soil compaction; and iii) laying the vegetative material and topsoil retained under Condition 13(a) on the cleared area; (c) within 4 years of laying vegetative material and topsoil on the cleared area in accordance with Condition 13(b) of this Permit: i) engage an enviromnental specialist to determine the species composition, structure and density of the area revegetated and rehabilitated; and ii) where, in the opinion of an enviromnental specialist, the composition structure and density determined under Condition 13(c) (i) of this Permit will not result in a similar species composition, structure and density to that of pre-clearing vegetation types in that area, revegetate the area by deliberately planting and/or direct seeding native vegetation that will result in a similar species composition, structure and density of native vegetation to pre-clearing vegetation types in that area and ensuring only local provenance seeds and propagating material are used.

Permit No. CPS4442	
Condition No.	**Closure conditions**
12	Retain vegetative material and topsoil, revegetation and rehabilitation The Permit Holder shall: (a) retain the vegetative material and topsoil removed by clearing authorised under this Permit and stockpile the vegetative material and topsoil in an area that has already been cleared; (b) at an optimal time within 12 months following completion of works authorised under this Permit, revegetate and rehabilitate the area(s) that are no longer required for the purpose for which they were cleared under this Permit by: i) re-shaping the surface of the land so that it is consistent with the surrounding 5 metres of uncleared land; ii) ripping the ground on the contour to remove soil compaction; and iii) laying the vegetative material and topsoil retained under Condition 12(a) on the cleared area; (c) within 24 months of laying vegetative material and topsoil on the cleared area in accordance with Condition 12(b) of this Permit: i) engage an enviromnental specialist to determine the species composition, structure and density of the area revegetated and rehabilitated; and ii) where, in the opinion of an enviromnental specialist, the composition structure and density determined under Condition 12(c) (i) of this Permit will not result in a similar species composition, structure and density to that of pre-clearing vegetation types in that area, revegetate the area by deliberately planting and/or direct seeding native vegetation that will result in a similar species composition, structure and density of native vegetation to pre-clearing vegetation types in that area and ensuring only local provenance seeds and propagating material are used.

Permit No. CPS4598

Condition No.	Closure conditions
7	Retain vegetative material and topsoil, revegetation and rehabilitation The Permit Holder shall: (a) retain the vegetative material and topsoil removed by clearing authorised under this Permit and stockpile the vegetative material and topsoil in an area that has already been cleared; (b) within 12 months following completion of works authorised under this Permit, revegetate and rehabilitate the area(s) that are no longer required for the purpose for which they were cleared under this Permit by: i) re-shaping the surface of the land so that it is consistent with the surrounding 5 metres of uncleared land; ii) ripping the ground on the contour to remove soil compaction; and iii) laying the vegetative material and topsoil retained under Condition 7(a) on the cleared area; (c) within 4 years of laying vegetative material and topsoil on the cleared area in accordance with Condition 7(b) of this Permit: i) engage an enviromnental specialist to determine the species composition, structure and density of the area revegetated and rehabilitated; and ii) where, in the opinion of an enviromnental specialist, the composition structure and density determined under Condition 7(c) (i) of this Permit will not result in a similar species composition, structure and density to that of pre-clearing vegetation types in that area, revegetate the area by deliberately planting and/or direct seeding native vegetation that will result in a similar species composition, structure and density of native vegetation to pre-clearing vegetation types in that area and ensuring only local provenance seeds and propagating material are used.

Relevant Legislation

Closure planning and implementation requires consideration of general legislative requirements beyond those that apply to a specific site. A list of potentially relevant legislation is provided below, but is not necessarily exhaustive. A comprehensive legal review will be required as closure approaches to ensure that all relevant legislative requirements are identified.

Australian Commonwealth Legislation	**Western Australian State Legislation**
Environmental Protection and Biodiversity Conservation Act 1999	*Environmental Protection Act 1986*
Native Title Act 1993	*Environmental Protection Regulations 1987*
Aboriginal and Torres Strait Islander Heritage Protection Act 1984	*Environmental Protection (Controlled Waste) Regulations 2004*
Workplace Relations Act 1996	*Environmental Protection (Unauthorised Discharges) Regulations 2004*
	Contaminated Sites Act 2003
	Contaminated Sites Regulations 2006
	Conservation and Land Management Act 1984
	Mining Act 1978
	Mining Regulations 1981
	Parks and Reserves Act 1895
	Rights in Water and Irrigation Act 1914
	Wildlife Conservation Act 1950
	Aboriginal Heritage Act 1972
	Aboriginal Affairs Planning Authority Act 1972
	Mines Safety and Inspection Act 1994
	Mines Safety and Inspection Regulations 1995
	Occupiers Liability Act 1985
	Criminal Code Compilation Act 1913

Relevant Guidelines and Standards

Closure planning and implementation requires consideration of relevant guidelines and standards, some of which may have regulatory consequence through being referenced in regulatory documents. A list of key guidelines and standards that are routinely considered is provided below, but is not exhaustive due to the breadth of the closure planning discipline. This closure plan has been prepared so as to be considered with relevant content of these guidelines and standards.

Guideline or Standard	**Author**
Guidelines for the Preparation of Mine Closure Plans (2015)	Western Australian Department of Mines and Petroleum and Environmental Protection Authority
Mine Closure: Leading Practice Sustainable Development Program for the Mining Industry (2016)	Commonwealth Department of Industry, Innovation and Science
Mine Rehabilitation Handbook (1998)	Minerals Council of Australia
Guideline for the Assessment of Environmental Factors: Rehabilitation of Terrestrial Ecosystems (2006)	Western Australian Environmental Protection Authority
Australian and New Zealand Guidelines for Fresh and Marine Water Quality (2000)	Agriculture and Resource Management Council of Australia and New Zealand and the Australian and New Zealand Environment and Conservation Council
Mine Void Water Resource Issues in Western Australia (2003)	Western Australian Water and Rivers Commission
Contaminated Sites guideline series	Western Australian Department of Environment Regulation
Environmental Notes on Mining: Acid Mine Drainage (2009)	Western Australian Department of Mines and Petroleum
Environmental Notes on Mining: Waste Rock Dumps (2009)	Western Australian Department of Mines and Petroleum
Safety Bund Walls Around Abandoned Open Pit Mines (1997)	Western Australian Department of Industry and Resources
Global Acid Rock Drainage Guide (2014)	International Network for Acid Prevention
Australian Standard 2601: The Demolition of Structures (2001)	Standards Australia
Australian Standard 4976: The Removal of Underground Petroleum Storage Tanks (2008)	Standards Australia
Demolition Work Code of Practice (2015)	Safe Work Australia

Appendix B – Communications Register

Consultation Stage	Stakeholder	Date	Subject	Summary of discussion relevant to closure	Response
Referral	Environmental Protection Authority Service Unit	1991	Robe referral to EPA	Formal referral of the Mesa J Iron Ore development, Pannawonica under Clause 7A of the Iron Ore (Robe River) Agreement	
Ministerial Statement	Environmental Protection Authority Service Unit	1992	Acceptance of MS208	Formal acceptance of all conditions on Ministerial Statement 208.	
Operations	Environmental Protection Authority Service Unit	2005	Extension of Mesa J Pit Area-Section 45C	CALM: The proposal to retain the pit extension area as a deep water pit and not backfill it to groundwater level is no longer acceptable to CALM. The Ministerial approval for the original Mesa J mine was over 13 years ago, and is no longer consistent with current best practice environmental management, which is to ensure that mine pits are backfilled to the water table in order to mitigate any adverse water quality issues. Given that this is a new development, Pilbara Iron should improve its standards for environmental management and mine closure and decommissioning in order to comply with what is acceptable best practice today.	The material from the pit extension area will be used to backfill other parts of the pit. As stated in the original approvals documents for Mesa J, there will be insufficient material available to backfill all pits to above water table level. Robe is currently preparing a closure plan for the Mesa J mine site, with the aim to backfill as many pits as practicable at Mesa J to above water table level. Calculations to determine the amount of material which will be available for backfilling pits are currently underway and a study will be commissioned to model impacts of the proposed final landform on water quality. Under Conditions 6-3 and 6-4 of Ministerial Statement 208, Robe is required to prepare and implement a decommissioning and rehabilitation plan to the satisfaction of the Environmental Protection Authority on advice of DolR and CALM.
Ministerial Statement	Office of the Environmental Protection Authority	2005	Change to MS208	Pit extension and boundary update	Section 45C
Ministerial Statement	Office of the Environmental Protection Authority	2006	Change to MS208	New rail siding at Green Pool	Section 45C
Ministerial Statement	Office of the Environmental Protection Authority	2007	Change to MS208	Installation of fibre optic cable for railway communications system from the Cape Lambert administration offices to the 5km peg and from the 71km peg to the Mesa J mine operations at Pannawonica	Section 45C
Referral	Environmental Protection Authority Service Unit	2007	Robe referral to EPA	Formal referral of the Mesa K Remnant Mining Projecton Ore Mine under Section 38 of the EP Act.	
PER	Environmental Protection Authority Service Unit	2008	Bulletin 1283 - Initial EPA assessment of Environmental Impact Assessment	The EPA acknowledges that the proponent has committed to finalising the PRP included with the EPS and implementing the PRP prior to commencement of productive mining. Mesa K and the PRP will be incorporated into the Greater Pannawonica Closure Study prior to completion of mining at Mesa K. The EPA notes the relatively short project life of the Mesa K Remnant Mining proposal of 2 – 3 years. The PRP includes rehabilitation strategies designed to contribute to maintenance free closure over the long term. The EPA supports the objective of the PRP to ensure mine rehabilitation and closure planning commences in the early stages of project planning and is integrated with mine development planning and operations. The PRP includes a schedule for timing of closure, rehabilitation and monitoring. The PRP will be regularly reviewed during site operations to ensure it remains accurate and relevant.	
Ministerial Statement	Office of the Environmental Protection Authority	2009	Acceptance of the PRP to satisfy Condition 7-1 of MS776	As per our discussion, there is no formal requirement in Ministerial Statement 000776 for the EPA to sign off on the management plans prepared for the Mesa K proposal. The EPA Board were provided with copies of the draft management plans in its consideration of the Mesa K proposal and acknowledged in Bulletin 1283 that Robe were committed to finalising the management plans prior to commencement of productive mining, and specifically that the PRP will be incorporated into the Greater Pannawonica Closure Study prior to completion of mining at Mesa K.	
Operations	Department of Mines & Petroleum	2009	Mesa J Inspection 2008	Several erosion qullies were observed on the north face of T Dump and they should be monitored and mitigation measures implemented if they are observed to grow over time or effect the stability of the dump. The eastern end of the dump had yet to be rehabilitated and this area should be closed out as soon as possible to prevent erosion and/or weeds on the eastern end spreading to the rehabilitated areas. The south side of T dump has limited revegetation and significant erosion problems. It is likely that this side of the dump will have to be reworked to meet closure criteria.	Rehabilitation monitoring on the T dump is scheduled for June 2009 and will include an erosion assessment. Mitigation measures will be implemented if the monitoring demonstrates unacceptable stability of the landform. The eastern end of the T dump was not included in the original rehabilitation design due to the proximity of the dump to the rail line. An assessment of rehabilitation design which can be completed whilst the rail is operational will be assessed prior to the end of 2009. Regular weed inspections will be carried out and management programs implemented if an outbreak is recorded.

Consultation Stage	Stakeholder	Date	Subject	Summary of discussion relevant to closure	Response
Operations	Department of State Development	2010	Response to State Agreement reports 2009	No significant comments. DMP Comments: Areas displaying Improvements: • The establishment of reference sites to be used for the development of conceptual completion criteria at operating sites • The commencement of a 5 year seed science programme • Corrective actions requested as part of the 2008 DMP inspection have been completed or progressed Areas deficient in information I area of concern at several sites: • Limited progressive rehabilitation was noted • Although there was an improvement from the previous AER, for most sites there was limited information on rehabilitation monitoring results • Limited detail of erosion monitoring results	Positive aspects noted. • For concerns regarding limited progressive rehabilitation, a rehabilitation and closure team has been formed and is working to improve our planning and implementation of progressive rehabilitation projects. • Whilst there may not of been earthworks conducted at an individual site, a large proportion of works are involved in the planning stage for rehabilitation, including making improvements to historic designs, haulage of clean inert waste fill to enable future rehabilitation projects and a range of research and development activities to inform and guide future rehabilitation programs. • RTIO operations will not be able to demonstrate rehabilitation works being conducted at every site every year, due to the large and long time frames in which our operational areas remain active. • Identification and scheduling of areas available for rehabilitation across our operations are conducted over a 5 year time frame. This 5 year plan is updated through the 5 year mine planning and quarterly mine planning processes.
Operations	Department of State Development	2011	Response to State Agreement reports 2010	No significant comments. DMP Comments: A number of areas of improvement were noted across the RTIO sites. These include: • The Land Data Improvement Project continued during 2010, aiming to improve assessment and monitoring of disturbance footprints and rehabilitation areas; • Investigation of pit lake bioremediation options in conjunction with Edith Cowan University. • The commencement of investigations into alternative growth mediums. The concerns include: • RTIO are not planning to develop completion criteria for the closure of sites during the early stages of project development. The DMP encourages completion criteria to be developed during the early stages of the project because it sets a goal for the rehabilitation of the site and ensures closure is considered during the construction and operational phases of the project. It is acknowledged however, that during the early stages of project development the criteria can be quite conceptual and be further developed and refined as the project progresses. • Progressive rehabilitation is being carried out at some sites, with plans for future rehabilitation works noted. However a greater commitment to progressive rehabilitation should be achievable across most sites. It should be noted that progressive rehabilitation not only involves achieving actual rehabilitation on the ground but also includes researching knowledge gaps which may include setting up rehabilitation trials, gaining a better understanding of material characterisation etc.	RTIO agrees that completion criteria need to be developed and agreed prior to closure implementation (including progressive rehabilitation undertaken during the course of operations), but considers that any criteria drafted early in the development of a long-life mine need to be considered indicative only. RTIO is currently undergoing a project to develop criteria to measure the success of progressive rehabilitation, the status of which was included in the overview section of the report. RTIO has included indicative completion criteria in closure plans submitted to Government since publication of the new closure plan reporting guidelines, and will continue to do so. Over the past 3 years RTIO has increased the amount of rehabilitation planning, earthworks and research and development projects considerably. Areas available for progressive rehabilitation are identified for the RTIO business and scheduled as part of mine planning and business planning processes. The RTIO approach for sign off on rehabilitation areas ensures a reduction in the areas of rehabilitation being re-disturbed. This planned approach means that only areas that are scheduled for closure will undergo rehabilitation, thus not all sites will have rehabilitation occurring every year. RTIO is also planning on the achievement of quality hectares of rehabilitation rather than achieving hectares which may require rework in future. The RTIO closure planning and rehabilitation efforts and procedures are being informed by the learning's from our rehabilitation.
Operations	Department of State Development	2011	Response to State Agreement reports 2010	DMP Comments: The closure plan for the site dates back to 2005, with the next review not scheduled until 2012. As a guide, the DMP's new guidelines for Mine Closure Plans require a review every 3 years.	A decision was taken in 2010 to review the remaining reserves to inform the next closure plan. This work is in progress, and thus the timing for the closure plan has been delayed to ensure the correct data is utilised. The mine Mesa J/K operations do not have a requirement for a 3 year update schedule in their approvals.
Operations	Office of the Environmental Protection Authority	2012	Annual Audit Compliance Report 2011		Condition 6-1: Review of the Mesa J Environmental Management Programme including the rehabilitation management plan was conducted in 2011. At this time the Mesa J and Mesa K Environmental Management Programmes have been integrated. The Mesa JK integrated environmental management plan [RTIO-HSE-0013059] was submitted to the OEPA on the 29 October 2011 [RTIO-HSE-0127414].
Operations	Office of the Environmental Protection Authority	2012	Annual Audit Compliance Report 2011		Condition 7-1: Mesa K Preliminary Rehabilitation Plan [RTIO-HSE-0044852] was submitted to EPA on 14 January 2009 for formal sign-off following acceptance by DEC Environmental Management Branch [RTIO-HSE-0058967].

Consultation Stage	Stakeholder	Date	Subject	Summary of discussion relevant to closure	Response
Operations	Department of Mines & Petroleum	2012	Robe Valley Inspection 2012	Much of the rehabilitation on these dumps is progressing well. Investigation of some sections where vegetation has not established may be required. In the event that these dumps are removed to allow for mining, make sure that the topsoil and vegetation is pre-stripped from the rehabilitated areas. Rehabilitation of the Pit 7 Dump has been largely unsuccessful. Remedial work will be required. Despite the failings of this dump, any knowledge gained from this trial would assist in future waste dump designs.	
Ministerial Statement	Office of the Environmental Protection Authority	2013	Acceptance of the OEMP to satisfy Condition 6-1 of MS208 and 7-1 of MS776	The revised Plan has been reviewed by the OEPA and is considered to address the relevant implementation conditions above, relating to the Environmental Management Plan (MS 208) and the protection of troglofauna (MS776).	
Ministerial Statement	Office of the Environmental Protection Authority	2013	Change to MS776	Increase in disturbance footprint and removal of mine life	Section 45C
Operations	Office of the Environmental Protection Authority	2013	Annual Audit Compliance Report 2012		Condition 6-1: The Rehabilitation Management Plan for Mesa J and Nearby Mesas, Deepdale Area was submitted in November 1993 [RTIO-HSE-0043199]. This completed this preconstruction requirement. Refer below for on-going requirements.
Operations	Office of the Environmental Protection Authority	2013	Annual Audit Compliance Report 2012		Condition 7-1: Mesa K Preliminary Rehabilitation Plan [RTIO-HSE-0044852] was submitted to EPA on 14 January 2009 for formal sign-off following acceptance by DEC Environmental Management Branch [RTIO-HSE-0058967]. No rehabilitation was conducted at the Mesa K mine site during 2012. However work toward progressive rehabilitation and closure continued with the backfill of waste rock into Gravel Pit.
Operations	Department of State Development	2014	Response to State Agreement reports 2012	No significant comments. DMP Comments: DMP is very supportive of the proposed and existing research projects, including the seed provenance study, and request that updates and results relating to these projects are included in future TERs.	Noted
Closure Management	Office of the Environmental Protection Authority	2014	General correspondence from the OEPA regarding a joint BHP Billiton and Rio Tinto rehabilitation presentation	Correspondence from OEPA commending BHP Billiton and Rio Tinto on their joint presentation on rehabilitation success in the Pilbara. In its letter OEPA recognised that mine closure and rehabilitation is an important strategic issue and recognised the significant challenges remaining in this area. The OEPA referred to the Department of Mines and Petroleum/EAP Joint Mine Closure Guidelines as the primary document guiding mine closure and rehabilitation across all land tenures and sought written confirmation from both companies that they would abide by any contemporary version of the guidelines, irrespective of what the current Ministerial Statement conditions required in regard to closure and rehabilitation, or similarly what State Agreement Act conditions require on the same matter. OEPA indicated its desire to discuss the updating of existing Ministerial Statements to ensure they are contemporary with respect to mine closure and rehabilitation with both parties in future.	Rio Tinto acknowledged the feedback form OEPA and indicated it looked forward to continued involvement with government and industry partners in developing sustainable, long term improvements for rehabilitation and closure in Western Australia. In response to the request for mine closure plans to conform to the contemporary version of the Department of Mines and Petroleum/EAP Joint Mine Closure Guidelines, it is noted that Rio Tinto iron ore closure plans drafted to support new proposals are prepared in accordance with the Guidelines. These plans are prepared in consultation with the Department of Mines and Petroleum and other key stakeholders. To date eight closure plans have been prepared in accordance with the Guidelines and submitted to Government. Rio Tinto iron ore will continue with this process going forward. For existing Ministerial Statements, closure planning is undertaken in accordance with approval conditions and Rio Tinto standards. Of particular note, compliance to the Rio Tinto standard is required irrespective of what the current Ministerial Statement conditions and State Agreement requirements are on this matter. Rio Tinto's standards require the preparation of closure plans for each aspect of an iron ore operation, and plans are revised at a frequency that is appropriate to the life and scale of the operations, and take into consideration the objectives and intended outcomes of the contemporary Guideline. We will continue our closure planning in accordance with our approval conditions, and Rio Tinto standards. This process will ensure that our plans are progressively updated to align with contemporary Guidelines. Rio Tinto iron ore considers this a practical approach which is consistent with requirements for closure planning in Western Australia. (Our reference: RTIO-HSE-0229340).

Consultation Stage	Stakeholder	Date	Subject	Summary of discussion relevant to closure	Response
Operations	Office of the Environmental Protection Authority	2014	Annual Audit Compliance Report 2013		Condition 6-1: The Rehabilitation Management Plan for Mesa J and Nearby Mesas, Deepdale Area was submitted in November 1993 (Our ref: RTIO-HSE-0043199).
Operations	Office of the Environmental Protection Authority	2014	Annual Audit Compliance Report 2013		Condition 7-1: Mesa K Preliminary Rehabilitation Plan [Our ref: RTIO-HSE-0044852] was submitted to EPA 14 January 2009 for formal sign-off following acceptance by DEC Environmental Management Branch [Our ref: RTIO-HSE-0058967]. Note that a subsequent change to the Project approved by the OEPA through a section 45C application 25 February 2013 [Your ref: A579133: OEPA 2012/000541][Our ref: RTIO-HSE-0178454] changed the project life element. This change renders rehabilitation timeframes proposed in the Mesa K Preliminary Rehabilitation Plan [Our ref: RTIO-HSE-0044852] no longer applicable. Rehabilitation of 4.48ha occurred at Mesa K Gravel Pit during the reporting period.
Operations	Department of State Development	2014	Response to State Agreement reports 2013	No significant comments. DMP Comments: It should be mentioned that the information provided relating to rehabilitation monitoring offers a good overview of the progression of historical rehabilitation.	Noted
Operations	Office of the Environmental Protection Authority	2015	Annual Audit Compliance Report 2014		Condition 6-1: The following documents were submitted and approved: The Rehabilitation Management Plan for Mesa J and Nearby Mesas, Deepdale Area, November 1993 (Our ref: RTIO-HSE-0043199). The Rehabilitation Management Plan for Mesa J and nearby Mesas, Deepdale Area Addendum, June 1994 (Our ref: RTIO-HSE-0115345), The Rehabilitation Management Plan Addendum Report, November 1994 (Our ref: RTIO-HSE-0043199).
Operations	Office of the Environmental Protection Authority	2015	Annual Audit Compliance Report 2014	Proponent stated in correspondence dated 19 January 2015 that no mining or associated activities occurred at this site during the 2014 calendar year and that no rehabilitation occurred at Mesa K during this time (2015-0001039637). The OEPA strongly encourages the proponent to commence rehabilitation in areas of the mine site where operational activities are unlikely to recommence.	Condition 7-1: Mesa K Preliminary Rehabilitation Plan [Our ref: RTIO-HSE-0044852] was submitted to OEPA 14 January 2009 for formal sign-off following acceptance by DEC Environmental Management Branch [Our ref: RTIO-HSE-0058967]. Note that a subsequent change to the Project approved by the OEPA through a section 45C application 25 February 2013 [OEPA ref: A579133: OEPA 2012/000541] [Our ref: RTIO-HSE-0178454] changed the project life element. This change renders rehabilitation timeframes proposed in the Mesa K Preliminary Rehabilitation Plan [Our ref: RTIO-HSE-0044852] no longer applicable. No rehabilitation was undertaken at Mesa K during the reporting period.
Operations	Department of State Development	2015	Response to State Agreement reports 2014	No significant comments. DMP Comments: It is positive to note that all the AER's provide information on rehabilitation monitoring and offer a good overview of the progress of rehabilitation towards analogue sites. It is also positive to note the continuation of research and trials, including (but not limited to): • The Seed Provenance Study in collaboration with the Department of Parks and Wildlife for collection of material occurred in 2014 and it is noted that support from a second Pilbara mining company was secured for the project. DMP supports a collaborative and targeted research approach; • Final Landform Project; • Priority Flora Species establishment; • Native Pivot Trial; and • Pit Void Guidance.	

Consultation Stage	Stakeholder	Date	Subject	Summary of discussion relevant to closure	Response
Operations	Department of Mines & Petroleum	2015	Mesa J Inspection 2015	1) Check the due date for the closure plan and advise DMP of when it will be provided for comment. 2) RTIO to consult with RSD regarding closure options for pit areas (for example, the steep pit face on the northern end of Pit 10) and provide written evidence to DMP that: a) consultation has taken place; and, b) what action will be undertaken at closure. 3) RTIO to provide a plan to DMP of areas that will be rehabilitated at Mesa J and Mesa K and evidence that commitment has been sought from the LOM planners to designate and sign off areas for rehabilitation.	1) The closure plan is currently under review as part of a potential referral. Submissions of the closure plan will comply with the relevant Ministerial Conditions. 2) Initial conversations have been held with the Resources Safety Division generally. One issue discussed is the use of natural features to aid in access restrictions as an alternative to construction of bunds. A directed engagement on abandonment bunds is planned for 2016. 3) Identification of areas for progressive rehabilitation informs all RTIO Closure Plans, and will be part of the closure plan review currently being undertaken. The need to better integrate closure planning into site mine planning is noted. RTIO has recently made organisation changes that see the closure function now co-located with the mine planning function to improve integration.
Operations	Kuruma Marthudunera Working Group	2016	Robe River pool impacts	Key concerns relate to Robe Pools at Mesa H Details of pumping rates from CWP and sites requested.	RTIO will continue to provide updates on study progress, including details of the proposals, hydrogeological outputs and visual impact assessment input. Heritage surveys and support will continue to be requested through the normal channels. The GWOS set strategies for maintaining and running the borefield, with the final level of control being closure of the borefield.
Operations	Office of the Environmental Protection Authority	2016	Annual Audit Compliance Report 2015		Condition 6-1: The following documents were submitted and approved: The Rehabilitation Management Plan for Mesa J and Nearby Mesas, Deepdale Area, November 1993 (our ref: RTIO-HSE-0043199). The Rehabilitation Management Plan for Mesa J and nearby Mesas, Deepdale Area Addendum, June 1994 (our ref: RTIO-HSE-0115345), The Rehabilitation Management Plan Addendum Report, November 1994 (our ref: RTIO-HSE-0043199).
Operations	Office of the Environmental Protection Authority	2016	Annual Audit Compliance Report 2015		Condition 7-1: Mesa K Preliminary Rehabilitation Plan (our ref: RTIO-HSE-0044852) was submitted to OEPA 14 January 2009 for formal sign-off following acceptance by DEC Environmental Management Branch (our ref: RTIO-HSE-0058967). Note that a subsequent change to the Project approved by the OEPA through a section 45C application 25 February 2013 (OEPA ref: A579133: OEPA 2012/000541, our ref: RTIO-HSE-0178454), changed the project life element. This change renders rehabilitation timeframes proposed in the Mesa K Preliminary Rehabilitation Plan (our ref: RTIO-HSE-0044852) no longer applicable. No rehabilitation was undertaken at Mesa K during the reporting period as future mining is planned for Mesa K.
Operations	Kuruma Marthudunera Working Group	2016	Mesa Facades	Retention of mesa facades along Robe River key requirement. Preference facades are 50m width rather than 30m. Preference to retain facades along central watercourse.	Mesa facades along Robe River will be retained. Will further assess geotech stability and resource impact of 50m vs 30m facades. Central watercourse: will assess impacts to resource and discuss options further with K&M.
Closure Management	Department of State Development	2016	General mine closure plan discussions held with DSD. (Formal written communication from Rio Tinto to DSD dated 11th July 2016).	DSD held discussions and sent various correspondence to Rio Tinto requesting that all State Agreement proponents: • Prepare and submit mine closure plans in accordance with the Guidelines for Preparing Mine Closure Plans (compliant mine closure plans) for all mine operations, including those where there is no current legal obligation to do so; and • Report land disturbance data consistent with Mining Rehabilitation Fund (MRF) categories in our State Agreement Annual Environmental Reports (AER).	In relation to mine closure plans Rio Tinto indicated that it was willing to voluntarily provide the State with the material requested on the following basis: • A timeframe of at least three years to progressively prepare and lodge compliant mine closure plans for operations where modern closure conditions do not currently apply; • Assurance that Mine Closure Plans will only be reviewed on a triennial basis by the Department of Mines and Petroleum (DMP) in accordance with the Guidelines; and • Confirmation that mine closure plans will not be connected in any formal way with the operation of our State Agreement mining approvals, such that changes to our mine plan will not mandate the need for revision of our mine closure plans, except at the regular triennial review period. As part of this Rio Tinto provided a suggested submission schedule which was subsequently agreed to by the DSD. Mesa A was nominally planned for submission in 2017.
Closure Management	Department of Mines & Petroleum	2016	Robe referral to EPA	Clarification sought whether the diversion controls being considered will apply for operation only or will they remain post closure, and would pooling/damming of surface flow occur.	Further modelling and consideration being undertaken for closure requirements, but the current design is intended for the diversion structures to allow for surface flows coming off the hills to be diverted into existing drainage into Robe River. Low risk of pools being created and structures not designed for damming flows.

Consultation Stage	Stakeholder	Date	Subject	Summary of discussion relevant to closure	Response
Closure Management	Department of Mines & Petroleum	2016	Abandonment bund placement prior to disturbance	Comment that abandonment bund placement and actual installation need to be considered early in mine planning and mine development to ensure they are not precluded from being installed at closure	RTIO acknowledged closure plans would reflect current requirements.
Closure Management	Department of Mines & Petroleum	2016	PMP/PMF modelling for closure planning	DMP acknowledged that achieving stability of large waste landforms is challenging, even under current 'reasonable climatic conditions'. DMP has observed many cases across the Pilbara and the State more broadly where rehabilitation areas have performed poorly or failed, often over a reasonably short time frame. Guidance is expected to be risk based and not a 'one size fits all' approach. It was suggested that high risk dumps (e.g. those containing designated fibrous or PAF waste) may need to be designed to withstand larger or more intense rainfall events than small, inert, low risk waste dumps.	RTIO will wait for the landform design document which will include guidance on the PMP/PMF issue.
Operations	Department of State Development	2016	Response to State Agreement reports 2015	DMP supports the inclusion of rehabilitation monitoring data and photographs. Rehabilitation appears to be progressing well with only a small number of sites yielding poor results. Rework should be monitored for success and an update provided in future AERs and TERs.	
Operations	Kuruma Marthudunera Working Group	2016	Jirti Thalu access	The importance of Jirti Thalu to the K&M people was highlighted, and that they had concerns about the safety of certain community members if the place was impacted.	Mine planning will run options to test the impact with Jirti Thalu removed form the mine schedule.
Closure Management	Department of Mines & Petroleum	2016	Public safety risk mitigation requirements for closed mine sites	Environmental inspectors regulate safety through Mining Regulations 1981 Regulation 28 "…all holes, pits, trenches and other disturbances to the surface of the land made whilst mining which in the opinion of an environmental officer are likely to endanger the safety of any person or animal will be filled in or otherwise made safe to the satisfaction of the environmental officer". The DMP intends to revise its abandonment bund guidance to become less prescriptive and more outcomes focused. There would not be an expectation to batter down and rehabilitate large faces – abandonment bunds to prevent inadvertent access would be more appropriate. Vegetation on a slope would help prevent access, but should not be relied upon as a primary control as it could be lost to fire etc. Similarly, fences should not be considered a permanent control.	RTIO is considering options.
Operations	Department of Mines & Petroleum	2017	2017 Robe Valley closure plan overview	RTIO presented an overview of the Mesa A Hub and Mesa J Hub closure plans, including scope, risks, gaps and actions. The DMP feedback was positive and they look forward to receiving the plans. Their interest was in the waste dump designs and management of erodible material and abandonment bunds. They were happy to hear that the business has a project planned for this year to incorporate the inclusion of abandonment bund considerations into study outputs (likely at FS level).	The closure plans will likely contain some discussion on abandonment bund options but not detailed designs for all areas at this stage. Completion of this is included in the closure task list.
Closure Management	Department of Environmental Regulation	2017	Contaminated Sites		Contaminated sites are managed as an operational issue, using a risk based approach. Closure is considered in the risk rating based on estimated closure dtae. Focus is currently on the higher risk areas, with 19 locations to be investigated and managed in the next five years.
Operations	Kuruma Marthudunera Working Group	2017	Water monitoring Site Visit	Traditional owners attended a monitoring run with the hydrology team to download dataloggers in pools along the Robe River. A summary of the locations visited and photos of the monitoring work were provided to KMAC for awareness.	

Consultation Stage	Stakeholder	Date	Subject	Summary of discussion relevant to closure	Response
Closure Management	Department of Water and Environmental Regulation	2017	General Closure Plan schedule	Overview provided of closure plans that Rio Tinto (iron ore) is currently working on in 2017 and planning for 2018 to either support approvals in process, for compliance purposes or to meet commitments made to the Department of State Development in 2016 to submit closure plans for all operations over a three year period. These include: - Silvergrass East - Hope Downs 1 - Mesa A hub - Mesa J hub - Paraburdoo - Tom Price - Brockman 4 - Hope Downs 4 - Eastern Range - Channar	

Appendix C – Closure knowledge database (Confidential)

Rio Tinto Mesa J hub closure knowledge database

The closure knowledge database is a summary of the technical reports that directly or indirectly contribute to the development of the closure plan. These documents do not form part of the report and are for indicative purposes only.

The knowledge and understanding of closure issues and management strategies evolve and improve over time, coincident with the development of the mining operation. As a result, some components of some reports and studies may be superseded by new research or studies. While the closure plan addresses the current state of understanding and strategy for closure, the closure knowledge database captures the historical development of closure knowledge, and demonstrates how experience and knowledge developed at other Rio Tinto sites has been considered during the development of the closure plan and across the life of the operation. Accordingly, some information presented in the closure knowledge database may be obsolete.

Technical reports supporting the closure of the operation will be presented as part of the last plan produced prior to the implementation of closure (also known as the Decommissioning Plan).

CONFIDENTIAL

Geochemical characterisation

Review of Waste Rock Geochemistry a) General Overview of Acid Base Accounting — **2006**

This report contains a general overview of acid base accounting and a summary of the geochemical test work that has been previously completed for various sites and lithologies.

Internal reference: RTIO-PDE-0021130

There are large discrepancies in the total sulfur concentration measured using XRF and LECO machines. The XRF machine underestimates the sulfur concentration at values greater than 2%. Materials with total sulfur concentrations less than 0.1% can contain low capacity PAF material, however, it is considered only to be low additional acid and metalliferous risk if the boundary for inert material and potentially acid forming material is shifted from 0.02%S to 0.1%S. A paste pH result of less than 7 should be sent to the black shale dump and a paste pH result of greater than 7 can be sent to an inert material waste dump.

Mineralogical Analysis of Potentially Acid Forming Materials — **2008**

Quantitative mineralogy (QEM-Scan) for samples of rock collected from Tom Price, Channar, West Angelas, Brockman, Paraburdoo, East Extension, Western Turner Syncline and Hope Downs 1 North was undertaken. Comparisons were made between two methodologies use to characterise potentially acid forming materials; acid base accounting and mineralogical analysis.

Internal reference: RTIO-PDE-0053725

All samples contained elevated total sulfur concentrations and the lithologies were either shale, banded iron formation or dolomite. Pyrite was the dominant mineral contributing to acidity and the dominant sulfate secondary mineralisation consisted of alunite and jarosite.

Determination of ARD potential of Rio Tinto Iron Ore (WA) Waste Rock Samples — **2008**

This report investigates the use of mineralogy to predict acid and metalliferous drainage potential. Analysis of numerous rocks was undertaken using QEM-SCAN.

Internal reference: RTIO-PDE-0051613

Areas of waste rock which have underdone oxidation can be identified where sulfur-bearing minerals vary between samples in the form of pyrite, alunite and jarosite. The variability of gangue mineral phases suggest that some areas of composite waste rock pile may provide some neutralising potential while other areas will have no neutralising potential. Variable textural and mineralogical controls on sulfide mineral occurrence result in decreased accessibility of pyrite to oxidising fluids.

Environmental Status of Selenium (Se) in the Pilbara Region of Western Australia – Potential Risk from Iron Ore Mining — **2011**

This report includes information about Selenium geochemistry, distribution in the environment, occurrence in rocks in the Pilbara and potential risks to the environment.

Internal reference: RTIO-PDE-0103857

The Selenium (Se) content of shales containing significant pyrite should be recorded as part of the overall risk assessment for acid and metalliferous mine drainage. However, it should also be noted Se solubility is far less constrained by pH than in the case of metals and near neutral drainage may contain significant Se concentrations in solution. It would be most useful to study the Selenium budget of the wetlands in the Pilbara as, apart from the chance poisoning of livestock from the consumption of plants that have taken up high concentrations of Selenium, impacts are most likely to be felt in wetlands receiving mine site drainage.

Contaminant Leaching from Non-Sulfidic Waste Material — **2011**

The available leach extract data and information pertaining to the distribution of metals and metalloids in non sulfur materials at neutral pH was reviewed. Based on this review conceptual models for controls on their leaching and mobility were developed.

Internal reference: RTIO-HSE-0145041

The review found that contaminant leaching from non-sulfidic materials was generally very limited. Usually the pH in leach tests was near-neutral (pH 6 to 8), and dissolved contaminant concentration were at or below detection limits. It is believed that a primary leachable contaminant source is the oxidation of sulfide minerals. Release from oxidising sulfides leads to release of soluble reaction products. Under neutral pH conditions, there is the potential for release of these contaminants when those products dissolve.

Contaminant Leaching from Low-Sulphur Waste Minerals (Summary) **2011**

Internal reference: RTIO-PDE-0090689

RTIO's Geochemical Database was reviewed and based upon this data, conceptual models for controls on the leaching and mobility of a range of metals and metalloids were developed. This summary also describes potential controls on the amount of dissolved element that may be released. This is a summary of a comprehensive report RTIO-PDE-0100104.

For most contaminants, dissolved concentrations at circum neutral pH (pH 6 to 8) were very low, typically at or below detection limit. Geochemical modelling indicates that water-rock interactions are controlled by equilibrium, for salt, carbonates and sulphates this equilibrium is often source term limited whilst hydroxyl-sulphates and hydroxides are solubility controlled. Results also indicate that sorption plays an important role in solute concentration; weak (but detectable) sorption occurred for selenium and zinc whilst the strongest sorption was evident for cobalt. The review suggested that storage waste facilities containing low-sulfur materials pose a low level of environmental risk however, there is a small risk of increased in mobility of some contaminants if acidic conditions arise. Acidic conditions can sometimes arise from the interactions between iron and aluminium hydroxyl-sulphates and hydroxides.

Geochemical Assessment of Tailings from Yandi, Paraburdoo, Tom Price, Brockman 4 and Mesa J **2014**

Internal reference: RTIO-PDE-0123030

This report presents the results from geochemical testing and saline solution extraction of tailings samples from Yandi, Paraburdoo, Tom Price, Brockman 4 and Mesa J deposits.

Overall the tailings from these operations are unlikely to generate acid and are not expected to leach significant levels of metals under oxidising or saline conditions.

Oxidation and solute accumulation in dewatered pit wall rocks **2014**

Internal reference: RTIO-PDE-0109045

Dewatering and removing the water table may result in de-saturation of sulphide-bearing lithologies. This study was undertaken to review how oxygen ingress and consequent sulphide oxidation of Mount McRae Shales could impact water quality when the groundwater table rebounds after mining.

Large Scale Column Construction Procedure and Initial Chemistry **2014**

Internal reference: RTIO-PDE-0123894

Large scale column experiments have been constructed to examine the reactivity of hot and cold black shale material in an operational environment. The memo describes the construction of the columns and the first geochemistry data collected after small rainfall events at Rhodes Ridge.

Initial results suggest that effluent water retains the chemistry of the incident rainfall. Constituents to note in the initial chemistry include nitrate and ammonia detected in the hot black shale effluent. This study provides an important comparison between laboratory characterisation studies and field reactivity of waste rock. Data from the large scale column tests can be applied to reactivity of in pit waste/talus as well as waste rock dumps. It can be used as an intermediate to predict long term reactivity of waste rock.

Robe Valley AMD Risk Assessment **2015**

Internal reference: RTIO-PDE-0061933

This report presents an updated (from 2000) risk assessment associated with acid and metalliferous drainage in past, current and possible future deposits at the Robe Valley. Note, conservative assessment values have been assigned where drilling information is sparse and subsequent material characterisation understanding is limited. These risks will be reviewed as more information becomes available.

Sites with a low to no risk for acid and metalliferous drainage (AMD) are Warramboo, Highway, Tod Bore, Dinner Camp Bore, Mesa A, Mesa B, Mesa C, Mesa F, Mesa G, Mesa H, Mesa I, Mesa J, Mesa K, Mesa L, Mesa M, Mesa N, Middle Robe and Omega. Sites with moderate AMD risk are Bungaroo and Jimmawurrada Creek.

Robe Valley Geochemical Assessment **2016**

Internal reference: RTIO-PDE-0142883

The overall objective of the geochemical assessment was to geochemically characterise reverse circulation drill samples selected and collected by RTIO from their Robe Valley operations. Samples from seven deposits across RTIO's Robe Valley operations were selected by RTIO and delivered to OKC's laboratory in Osborne Park for a range of geochemical analyses. The laboratory analyses were completed over two stages with results from the first stage influencing the second stage of testing. This report includes results and interpretations of the geochemical characterisation program.

All samples showed low AMD risk.

Updated AMD Risk Assessment Summary for Inclusion into 2016 Robe Valley Closure Plan (Mesa H, Mesa J and Mesa K) **2016**

Internal reference: RTIO-PDE-0147826

A review of the AMD risk assessment has been completed to support the development of a Robe Valley closure plan focusing on the Mesa H, Mesa J and Mesa K mining and project areas. This update is based the latest (2015/2016) available drillhole data and proposed final pit shells.

The overall AMD risk for these areas remains low following an update to the assessment. However, it is recommended that the AMD risk assessment be reviewed for the Mesa H project area once 2015/2016 drillhole interpretation is finalised, and also upon completion of the Mesa J/K drillhole re-interpretation being undertaken to support Mesa H pre-feasibility studies.

Mesa H 2017 AMD Risk Assessment Update Summary (memorandum) **2017**

Internal reference: RTIO-PDE-0154172

A review of the acid and metalliferous drainage (AMD) risk associated with mining in the Mesa H project area has been completed to support the referral of the Mesa H Iron Ore Project Feasibility study. This review considers recently available (July 2017) drillhole data and mine planning data.

The overall AMD risk for the Mesa H area remains low following an update to the initial assessment.

Physical characterisation

Characterisation of Mesa J TSF1 Tailings and Vegetation **2009**

Internal reference: RTIO-HSE-0083225

The purpose of this study is to provide an understanding of the chemical, physical and biological properties present at the Mesa J Tailings Storage Facility (TSF1). The study investigates the spatial distribution of the coarse, transition and fine zone surface tails, as well as characterising the material properties for comparison with surrounding analogue soils.

Despite some differences in physical characteristics between the different tailings zones, in general, the tailings are considered suitable for plant growth. The fine tailings zone supports water dependent vegetation, the transition zone supports mixed low closed shrubland and also most alien species. The coarse tailings zone supports scattered tall Acacia shrubs and low trees. Root penetration into the TSF1 is expected to enhance cracking and the development of soil structure and also further drying of the soil beneath. Top soil stockpiles have been identified as a source of native seed.

Net solute load response to the installation of infiltration limiting dry cover systems over acid forming waste piles **2014**

Internal reference: RTIO-PDE-0128431

This work was conducted to verify the central design concept of store-and-release covers over sulfidic above water table waste dumps that is, whether limiting net percolation volume through the cover results in a lesser sulfate and acidity load being realised generated and passing through the dump.

The results from this thesis project confirm that the central aim of store-and-release covers to reduce net percolation volume is a valid measure for reducing the net loading of sulfate and acidity. The mechanism through which decreasing net percolation (applied water volume) results in a lesser sulfate and acidity load was identified, however further work in a site context is needed to assess how this relationship between percolation volume and loading persists in the real-world environment.

Mesa H Geological Modelling and Resource Estimation Report **2014**

Internal reference: GDSR 6103

Document information collected about local geology and extent of resource.

Mesa H is one of a group of oolitic to pisolitic goethite-hematite deposits of Tertiary age which have formed in ancestral drainage channels of the Robe River, in the western Pilbara region of WA. This group is known as the Lower Robe (or Deepdale) group and comprises fourteen mesas or cuestas (which are identified by the letters A to N, commencing from the mouth of the Robe River).

Modelling and Resource Report - Mesa J South **2016**

Internal reference: GDSR 6360

Document information collected about local geology and extent of resource.

Mesa J is one of a group of oolitic to pisolitic goethite-hematite deposits of Tertiary age which have formed in ancestral drainage channels of the Robe River, in the western Pilbara region of WA. This group is known as the Lower Robe (or Deepdale) group and comprises fourteen mesas or cuestas (which are identified by the letters A to N, commencing from the mouth of the Robe River).

Waste characterisation and erodibility assessment for landform design : Tertiary Pisolite Clay **2017**

Internal reference: RTIO-HSE-0304816

The objective of this report is to define appropriate landform batter characteristics for the Tertiary Pisolite Clay materials supplied from the Mesa H deposit.

The results indicate that for the TPC materials at Mesa H (using a climate sequence developed for Mesa J), a lift height of 10m is achievable. Minimum berm widths vary with lift height (and slope length). A 20 degree lift at Mesa J sheeted with TPC material would require a 15m wide, 5% backsloping berm in order to store runoff from a rain event with a 200 year return period, and sediment generated from the slope for a period of 200 years. Lift options other than a 20 degree linear slope are also provided. This includes a concave option that indicates that a single lift (without a berm) that is 35m high could be constructed.

Growth Media Characterisation **2018**

Internal reference: RTIO-HSE-0324326

This report provides an interpretation of material characterisation data for a total of 53 potential growth media samples made up of 34 samples for which data has been previously collected by Outback Ecology Services on behalf of Rio Tinto, 11 samples for which data has been previously collected by Landloch on behalf of Rio Tinto as part of previous erosion studies and 8 additional samples collected and analysed as part of this project. Based on this characterisation, each material was classified as either suitable or not suitable for use as a growth medium.

Properties tested for included pH1:5 (water), salinity (EC1:5, EC1:2), exchangeable cations (K+, Ca2+, Mg2+, Na+, Al3+), effective cation exchange capacity (ECEC), exchangeable sodium percentage (ESP), particle size distribution (fine fraction<2mm), coarse fraction (> 2mm), particle size distribution (all material), texture, emerson class, dispersion potential rating, rock particle density, rock water absorption and rock cover of rain-armoured surface. A classification scheme for key parameters was then developed to classify a material as suitable or unsuitable. Several materials have properties that were invariably suitable. In some cases, materials have some properties that are suitable and others unsuitable. In others, several of the properties are problematic. Suitable materials represent those that have base properties that are not likely to impede vegetation. Marginal materials are those that are likely to support vegetation but that have some properties that may limit establishment and growth. Unsuitable materials are those that have properties that are likely to significantly impact on vegetation growth either through being saline, prone to dispersion, and having pH values quite different to those typically observed. Of the 53 samples, 21 were recommended as suitable growth media, 25 were assessed as marginal growth media and 8 were not recommended as growth media. Samples which were recommended were sourced from Yandicoogina, Channar, Mesa J, Mesa K, Eastern Range, Paraburdoo and Parker Point. Marginal samples were sourced from Brockman 4, Brockman 2/Nammuldi, Mesa A, Mesa J, Channar, Eastern Range, Paraburdoo, Yandicoogina and Hope Downs 4. Samples which were not recommended were sourced from areas at Greater Paraburdoo (Paraburdoo and Eastern Range), West Angelas, Western Turner Syncline and Parker Point.

Groundwater

Mesa J Water Management Study - Groundwater Modelling **2007**

Internal reference: RTIO-PDE-0033605

This report details the modelling work undertaken during this study, but summarises also any relevant previous hydrogeological and modelling work done for the Mesa J site.

There are three major aquifer units in the Jimmawurrada – Bungaroo Creek valley: • Alluvial overburden: is a major unconfined aquifer, if saturated. In the Mesa J area, the alluvial overburden is relatively thin and rises above the water table such that it is largely unsaturated, except in the Robe River and along the Jimmawurrada Creek. • Robe Pisolite: forms the main regional aquifer. In the Mesa J area, the pisolite is unconfined. The Robe Pisolite is bounded to the east and west of Mesa J by basement highs. To the north, the aquifer is dissected by the Robe River and is in hydraulic continuity with the Robe River valley. • Yarraloola Conglomerate and weathered/fractured dolomite of the Wittenoom Formation: Aquifer potential in the Yarraloola Conglomerate is consistent with the findings of other recent work in the area (such as the water supply investigations undertaken at Warramboo). This aquifer is the target of the recently drilled water supply bores DWB11 to 20.

Pannawonica and Mesa J Groundwater Operating Strategy **2014**

Internal reference: RTIO-HSE-0017341

This document forms the Groundwater Operating Strategy for Pannawonica Town and Mesa J Borefields.

The Mesa J mine is situated in the Jimmawarruda-Bungaroo Creek Valley. There are several major aquifer units in region. The highly permeable alluvial is found in the river beds and flood plains of the local watercourses. The ore body itself forms an unconfined aquifer of highly variable permeability. Beneath the Robe Pisolite is the Yaraloola Conglomerate. In the mining area the basement units are from the Wittenoom and Marra Mamba Formation.

Mesa H 2016 Pre-Feasibility Study: Hydrogeological Drilling Program Completion Report **2016**

Internal reference: RTIO-PDE-0142386

This report presents drilling and construction details for works completed as part of the Mesa H Pre-Feasibility Study (PFS).

Drilling results helped define the extent of the Robe Pisolite (CID) underneath the Robe River alluvium, identify the Paraburdoo Member and the Bee Gorge Member of the Wittenoom Formation as local aquifers and at the same time classify the unmineralised BIF (whenever underlying the CID) as an aquitard.

Mesa H Conceptual Hydrogeology **2016**

Internal reference: RTIO-PDE-0147732

Dewatering is required with a max drawdown of ~20m (current water table). Permanent pools, riparian vegetation and 2 x Rights Reserve sites have to be protected during mining operations.

Permanent pools and riparian vegetation are sustained by the Robe River aquifer. Storage of the Rove River aquifer likely to be very high. Lowering the water table in the CID could cause localised drain of the Robe River aquifer. Lowering of the water table in the Wittenoom Aquifer unlikely to affect the Robe River Aquifer.

Mesa H Surface and Groundwater Chemistry Interpretation **2016**

Internal reference: RTIO-PDE-0144245

An interpretation of chemistry and isotope data has been conducted for Mesa H in an attempt to establish whether Robe River pools are groundwater fed and hydraulically connected to the CID and/or Wittenoom aquifers. This Technical Memorandum summarises the methodology and results of this assessment.

Available chemistry and isotope data indicate that the Robe River pools are likely connected to the alluvial aquifer, and that the CID and Wittenoom aquifers are mainly comprised of fresh recharge. However, the latter aquifers appear to be receiving unusually high saline recharge at different locations particularly along the topographically low part of the mesa located to the west of Mesa H and down-gradient of the tailings pond. It is unclear whether the high salinity recharge observed in outlier CID/Wittenoom bores results from diffuse recharge due to local topography or geology, seepage from the tailing pond or an unknown recharge mechanism.

Mesa H Conceptual Hydrogeology **2016**

Internal reference: RTIO-PDE-0147733

The main objectives of this conceptual hydrogeological study are to define aquifer types and hydraulic characteristics, define groundwater boundaries, define recharge and discharge systems and volumes, assess the Robe River permanent pools hydraulics and groundwater dependency, and identify the risk of groundwater abstraction to impact sensitive ecological and heritage receptors.

The main findings observed in this study were: • Three regional aquifers: Wittenoom Aquifer, CID Aquifer and Robe River Aquifer; • Three no-flow boundaries: Marra Mamba Iron Formation, Brockman Iron Formation and Boolgeeda Iron Formation; • One partially confining layer: Tertiary Basal Pisolite; • Robe River pools chemical signature are associated mostly with the Robe River Aquifer with lesser correlation to the other regional aquifers; • Dewatering of the CID has the potential to locally lower the water level in the Robe River Aquifer draining the alluvium depending on the duration and extent of the groundwater abstraction; • Impact to the Rights Reserve pool to the west of Mesa H (KM-RR16) is unlikely; and • Impact to the Rights Reserve to the northeast of Mesa H (KM-RR21) is possible.

Robe River catchment water strategy **2016**

Internal reference: RTIO-PDE-0147734

The Iron Ore Water Strategy 2016 aims to support business value by reducing water-related constraint in current operations and future developments, and strengthen our licence to operate through responsible water management.

The environmental and cultural values of the Robe River are considered to be of high significance to the Kuruma Marthudunera (K&M) people, government regulators and the broader community. Water-related activities required to enable the 5-year plan are achievable. The water-related challenges facing the development of the Bungaroo and Jimmawurrada deposits remain significant.

Review of Depth to Groundwater at Mesa K **2016**

Internal reference: RTIO-PDE-0023804

Geological Support hydrogeologists were asked to assess the depth to groundwater and to determine if mining would intersect the water table.

Indications are that the maximum extent of potential mining would intersect the water table at Mesa K.

Robe Valley Mesa H Pre-Feasibility Study – Dewatering, Water Supply and Impact Assessments **2017**

Internal reference: RTIO-PDE-0149724

RTIO is undertaking a PFS study to expand into Mesa H. As part of the PFS, dewatering estimation, assessment of potential drawdown impacts on the Robe River, assess potential water supply for the mine and groundwater recovery are required to support the Environmental Review.

During closure, the drawdown front is predicted to have moved further to the north, reaching Robe River and surface water polls along its path. The model predicts peak drawdown of ~0.5m in the Robe River area, north of the Mesa H – Pit 8 and Pit 9 in 2042. Full system/aquifer recovery associated with the groundwater levels is predicted to occur within 50 years after the end of dewatering.

Independent peer review of the Environmental Risk Assessment for "Mesa J Tailings Storage Facilities (TSF)" **2018**

Internal reference: RTIO-PDE-0161266

This report provides a simple, screening-level assessment of the potential for Contaminants of Potential Concern (COPC) to be transported from Mesa J TSFs to receptors along Robe River and associated tributaries. The overall approach was to use an existing numerical groundwater model to predict chloride transport as conservative proxy for all COPC, which include chloride, copper and nitrate. Predictions were made at the end of the model calibration period (Dec. 2016), at the end of Mesa H operations (Dec. 2037), and at 190 years after mine closure (Dec. 2227). Based on the model results, dilution factors were calculated and applied to TSF monitoring bore concentrations in order to estimate exposure concentrations.

Whilst this review finds the overall approach to be appropriate, it is recommended that further modelling and statistical treatment of the monitoring data is warranted to provide a range of possible exposure concentrations and thus a more defensible risk characterisation. Model structural uncertainty and parameter uncertainty should also be discussed and investigated if either/both are deemed to have a significant influence on results.

Surface water

Mesa K surface water management **2007**

Internal reference: RTIO-PDE-0032034

This memo outlines the catchment hydrology of the Mesa K deposit, and the current surface water management practices.

Prior to historical mining activities, this area would have originally drained directly into the Robe River. The Mesa proper has been heavily disturbed and as a result is now largely internally draining, intercepting 0.03% of the flow contribution to the Robe River.

Long Term Ecological Research on a Pilbara River System **2009**

Internal reference: RTIO-PDE-0147723

The Robe River alluvial aquifer has been identified as a potential water source in the Pilbara regional water plan and previous regional hydrogeological assessments. This document summarises the groundwater dependent values associated with the Robe River alluvial aquifer and describes the links between these ecosystems and the aquifer.

The Robe River, like most Pilbara rivers is ephemeral, with a highly variable flow regime reliant on summer cyclones and autumn thunderstorms. The alluvial aquifer is recharged from direct infiltration through the riverbed during these unpredictable river flow events. River pools, riparian vegetation and aquifer ecosystems are identified as being sustained, at least in part, by water from the alluvial aquifer, particularly during periods of no river flow. The river and riparian ecosystems are of conservation significance at the local scale and provide valuable habitat for several priority fauna species, two federally protected migratory birds and a potentially new fish species. The aquifer ecosystem with its distinct stygofauna species is expected to be of high conservation value.

Mesa J & K Surface Water Management **2011**

Internal reference: RTIO-PDE-0068650

This report describes the interaction between natural surface water runoff, the local environment and the Mesa J and Mesa K mine sites.

Mining operations in Mesa J have intercepted the local Western Creek. The termination of this ephemeral creek into Pit 11 South results in a catchment area reduction of over 60% for the local Western Creek. The Mesa J mine is protected by the railway embankment in addition to the Southern Levee which affords the Mesa J mine flood protection against a 50 year flood event. The Mesa J to K causeway crosses the Robe River immediately north of Mesa J mine operation. The causeway consists of a number of culverts and a spillway that will be overtopped during a 1 in 2 year ARI flood event. A section of the causeway, known as the Plug, will preferentially erode away once the causeway is overtopped.

Mesa J and K Mine Site Flood Risk Assessment **2014**

Internal reference: RTIO-HSE-0235234

The objectives of this assessment are to define the hydrological characteristics of the area and assess current flood risks in order to facilitate management of surface water runoff and minimise resulting production loss at the Mesa J. Mesa K remains inactive over this wet season.

The Mesa J causeway causes minor impoundment and ponding of surface water by intercepting surface water runoff from the upper Robe River catchment. A “plug” has been incorporated into the causeway bridge that should preferentially erode when windrows have been breached and the causeway is being overtopped. Two levee banks are in place to protect the south eastern portion of the Mesa J mine and borefield from local runoff and Jimmawurrada Creek flood waters.

Five Year Surface Water Management Strategy: Mesa J and K 2014 to 2019 **2014**

Internal reference: RTIO-PDE-0147726

This report summarises the known surface water management strategy, risks to plan and opportunities to the mine site and co-commitments required to implement the strategy for the next five years of mining (2014-2019)

At Mesa J and K, four key risks have been identified relating to surface water. The first risk focuses on pit inundation, particularly Pit 11. This pit is sacrificial and has storage for a ARI 50 year event. The second risk is around landform erosion, and is managed using landform design. The third is operational, when the river floods and removes access to the mine. The fourth is also operational, in how to manage discharge to the creek during floods. All risks have been assessed and the residual risk is Low or Moderate.

Aquatic Ecosystems Study: September 2015 **2015**

Internal reference: RTIO-HSE-0290103

The current program outlined in this report assesses impacts, if any, from mining activities on Robe River pools. This on- ground program incorporates an annual aquatic ecosystem survey of Robe River pools as part of an on-going commitment to assess any environmental impacts of mine development on the adjacent and downstream aquatic ecosystem.

In September 2015, there were no significant changes to the river pools from the long-term mean position. The long term database that exists from these Robe surveys allows informed analysis and interpretation of these changes. The current survey supports previous findings that difference in environmental characteristics of pools are primarily a result of overriding climatic influences determining pool permanence and local morphology. To date, there have been no detectable changes in the aquatic ecology of the Robe River that could be attributed to mining operations.

Mesa H Order of Magnitude Design Flood Estimation and Floodplain Mapping **2016**

Internal reference: RTIO-PDE-0139440

The objective of this investigation is to provide design flood estimates and floodplain mapping for the Mesa H deposit. The results of this investigation will inform the development of surface water management options for the proposed mine.

The results from the hydraulic modelling indicate that, for the most part, Mesa H lies beyond the 1% AEP floodplain and is not vulnerable to riverine flooding (Figure 12). The 1% AEP flood depths are predominantly shallower than 1 m and the corresponding velocities are generally lower than 2 m/s.

Mesa J Life of Mine Pit UF14.18 Design Hydrology Review **2016**

Internal reference: RTIO-PDE-0147721

This memo details the current understanding flood management practices and risks at Mesa J in preparation for the update to the mine plan.

The existing southern levee and the levee southeast of the mine prevent rising floodwater from Jimmawurrada Creek entering the mine. Local runoff is trapped behind the levees and left to dissipate naturally via infiltration and evaporation. The southern cutback pits, including Pit 11, Pit 12, Pit 14, Pit 7 and Pit 6, are exposed to surface water flows from the southern catchments and moderate to high surface water risks have been identified. The flood water is either managed in pit by sump pump measure or defended by the local dumps and flood protection bunds. At Pit 11, two options for flood protection bunds have been assessed to divert the southern creek into the existing diversion drain (an upgrade of the drain has also been investigated) which flows into a natural creek at its northwest extent.

Flora

Baseline Flora and Vegetation Assessment of Robe Valley Mesas (Mesas B, C, D, E, F, H and I) **2011**

Internal reference: RTIO-HSE-0111431

This report documents the methods, results and key findings of the baseline flora and vegetation survey within the study area. It provides an assessment of the vegetation communities and flora species recorded.

Biota Environmental Sciences (Biota) was commissioned in August 2010 to conduct a biological survey of various mesas in the vicinity of Pannawonica. Fifty vegetation units, including three mosaic units, were identified and mapped within the study area. None of the vegetation units within the study area comprise TECs. A total of 221 species were recorded within the study area. Three species of Priority flora (Triodia sp. Robe River (M.E. Trudgen et al. MET 12367), Ptilotus mollis and Rhynchosia bungarensis) were recorded from the study area. Fifteen species of introduced flora were recorded in the study area.

Statement Addressing the 10 Clearing Principles: Mesa J Southern Cutback Flood Protection Bund **2013**

Internal reference: RTIO-HSE-0187908

This desktop report has been prepared from a review of existing biological information, including available databases and various studies in the Mesa J locality. It is intended that this report will be used as supporting documentation for Rio Tinto's NVCP application.

The landforms, vegetation, flora and fauna habitats are well represented within the Mesa J locality and the broader Pilbara region. The study area does not contain any TECs pursuant to the EPBC Act 1999, ESAs pursuant to the EP Act 1986, or PECs listed by the DEC.

Mesa J Road Reconstruction Flora and Fauna Assessment **2013**

Internal reference: RTIO-HSE-0192503

The study area extends from Pannawonica to Mesa J (Figure 1.1) and comprises approximately 12 km of established road covering a total area of 69 ha. The purpose of this assessment was to undertake adequate surveys to provide the necessary information required to support a NVCP Application, and undertake a rare flora assessment of area prior to ground disturbance works commence.

Rio Tinto Iron Ore commissioned ecologia Environment to undertake a single-phase Level 1 flora and vegetation and a Level 1 vertebrate fauna survey prior to the reconstruction of the Mesa J Access Road. A total of 154 plant taxa were recorded and fully identified. No plant taxa listed under the EPBC Act or the WC Act have been recorded in the study area. Twelve weed species were recorded within the study area, seven of which have been assessed within the DEC (now DPaW) environmental threat assessment of weeds for the Pilbara bioregion. Thirty-one fauna species (three mammals, 29 birds and two reptile species) were opportunistically recorded during the survey, including the conservation significant Rainbow Bee-eater (EPBC Act Migratory, WC Act S3).

Mesa K Gravel Pit South Rehabilitation Record **2013**

Internal reference: RTIO-HSE-0246225

This report summarises the rehabilitation of the gravel pit south area at Mesa K Operations, completed in 2013 by the RTIO Rehabilitation team, with the assistance of Mesa J/K Operations team.

The 4.5ha gravel pit south rehabilitation area consisted of two separate elevations joined together via a gentle slope (batter). A track along the bottom edge of the higher elevation was left in situ to service the area. Windrows were installed around the outer edges of all rehabilitated areas to stop water flowing off the top berms and down the outer slopes. No topsoil was imported as the area had very good natural regrowth prior to commencement of rehabilitation; the land was scalped and re-spread as part of the rehabilitation process.

Mesa J, Pit 10 Rehabilitation Record 2014 **2014**

Internal reference: RTIO-HSE-0300385

This report summarises the rehabilitation of part of the Pit 10 area at Mesa J Operations that was completed in 2014 by the RTIO Rehabilitation team, with the assistance of Mesa J Operations team. Threshed and non threshed spinifex seeds were trialled.

Two sections of Pit 10, totalling ~11.5 hectares, were rehabilitated. Rehabilitation earthworks involved areas with unconsolidated waste, such as minor ramps and small piles of dirt near pit walls, to be re-profiled and blended in with the surrounding terrain to ensure appropriate drainage. The area was re-profiled to level out material on the pit floor, and topsoil was applied and spread to ~2.86 ha in the northern section of the pit. The northern section of the pit had been fallow for 8 years and little vegetation growth had occurred during that time. Both areas were ripped along the contours and seeded with native seed of local provenance. The pit walls were not treated. On two 1 hectare blocks, threshed *Triodia wiseana* seeds were spread to measure germination success against non threshed (control) seeds. No topsoil was applied to these areas to ensure seeds stored in the seed bank did not impact the germination results.

Flora, Vegetation and Fauna Habitat Assessment at Jimmawurrada **2014**

Internal reference: RTIO-HSE-0220213

This report is intended as a supporting document for an NVCP application by Rio Tinto, as required by Section 51A of the Environmental Protection Act 1986 (EP Act). The report has been prepared on the basis of a review of existing information for the project area, combined with two site visits. This report describes the methodology employed for the flora, vegetation and fauna habitat assessment of the study area, and documents the results of the survey. In particular, this report identifies vegetation, flora and fauna habitats of conservation significance relevant to the study area.

Six broad fauna habitats were recorded within the study area; low hills and hill slopes, plains, floodplain, mosaic, major drainage lines, and soak. A total of 284 native taxa from 135 genera belonging to 51 families were recorded by Biota. An additional 18 taxa were recorded during the current study. Five conservation significant species were recorded within the study area.

Desktop Flora, Vegetation and Fauna Habitat Assessment at Robe Valley **2015**

Internal reference: RTIO-HSE-0257758

Approval for clearing of native vegetation associated with the proposal is required via a Native Vegetation Clearing Permit (NVCP) under Section 51A of the Environmental Protection Act 1986 (EP Act). Vegetation, flora and fauna assessments at Robe Valley (the study area) were required to address the 10 Clearing Principles as part of the NVCP application process.

One Priority 3 flora taxon has been previously recorded in the study area, Triodia sp. Robe River (M.E. Trudgen et al. MET 12367). Four weed species were previously recorded within the study area. Six vegetation associations were described from Hills and Slopes, eight units from Plains and one unit from Flowlines. Four conservation listed terrestrial fauna species have been previously recorded from the study area.

Mesa H Project – Level 2 Vegetation, Flora and Fauna Assessment – Phase 1 Summary **2015**

Internal reference: RTIO-HSE-0243872

The objective of the assessment was to complete Phase 1 of a two-phase biological survey of vegetation, flora and fauna of the Mesa H survey area and provide a brief summary presenting the key findings of the survey.

Astron was engaged to undertake a Level 2 vegetation, flora and fauna assessment for the Mesa H Project. Siz broad fauna habitat types were recorded in the survey area: Riverine, Gorge, Drainage, Breakaway, Rocky Hills, Low Hills/Slopes, Loamy/Stony Plain. One hundred and forty-three vertebrate fauna species were recorded within the survey area during the survey, of which eight were conservation significant. Two hundred and thirty-seven vascular flora species from 48 families and 125 genera were recorded in the survey area.

Mesa J Mine Extension – Level 2 Vegetation and Flora Assessment **2015**

Internal reference: RTIO-HSE-0280041

The objective of the assessment was to provide a single season Level 2 assessment of vegetation and flora values through a desktop assessment and field survey. The resultant data will be utilised to produce a report to support and inform the environmental assessment process for the Mesa J Mine Extension project.

Astron was engaged to undertake a Level 2 flora and vegetation assessment for the Mesa J Mine Extension. One hundred and thirty-six flora species, Representing 78 genera from 35 families were recorded in the survey area. No Threatened flora was recorded during the survey. Two State-listed Priority flora were identified in the survey area. Seven introduced flora species (weeds) were recorded in the survey area, none of which are listed as a declared pest.

Middle Robe and Eastern Deepdale Level 2 Vegetation and Flora Assessment **2015**

Internal reference: RTIO-HSE-0279582

Astron was engaged to undertake a Level 2 flora and vegetation assessment for the Middle Robe and East Deepdale Iron Ore Mine and Infrastructure Project the results of the assessment are presented in this report.

Vegetation condition ranged from ‘very poor’ to ‘excellent’. Fourteen of the 23 mesas within the survey area have been at least partially mined previously. Areas with clay soils typical of the Robe River floodplains were generally degraded from cattle grazing and weed proliferation, while vegetation associated with undisturbed mesas, hilltops and slopes was generally intact with very low weed abundance and little to no other signs of disturbance. Many of the permanent and semi-permanent pools and drainage channels of the Robe River area are relatively undisturbed. Six state-listed Priority flora were identified in the survey area. Twenty-five introduced flora species (weeds) were recorded in the survey area, none of which are listed as a declared pest for the Shire of Ashburton nor are they Weeds of National Significance. *Cenchrus ciliaris (Buffel Grass) and *C. setiger (Birdwood Grass) were the dominant weed species recorded, often characterising the understory of alluvial plains and drainage lines.

Desktop Flora, Vegetation and Fauna Habitat Assessment at Robe Valley **2016**

Internal reference: RTIO-HSE-0282048

Approval for clearing of native vegetation associated with the proposal is required via a Native Vegetation Clearing Permit (NVCP) under Section 51A of the Environmental Protection Act 1986 (EP Act). Vegetation, flora and fauna assessments at Robe Valley (the study area) were required to address the 10 Clearing Principles as part of the NVCP application process.

None of the three Threatened flora species known from the Pilbara region have been recorded from the study area. No conservation listed flora species have been previously recorded within the study area. One broad habitat type was described from the study area Plains. This broad habitat has been split into two categories; Stony Plain and Acacia on Stony Plain. Evidence of one conservation listed fauna species has been recorded in the study area, inactive mounds of the Western Pebble-mound Mouse.

Mesa H Level 2 Vegetation and Flora Assessment **2016**

Internal reference: RTIO-HSE-0300719

The objective of the assessment was to undertake a two-phase Level 2 assessment of vegetation and flora values through a desktop assessment and field survey. The resultant data will be utilised to produce a report to support and inform the environmental assessment process for the Mesa H project.

Astron Environmental Services has been commissioned to undertake a two-phase Level 2 vegetation and flora assessment in the Mesa H survey area which is approximately 4,930 hectares in size. There were 310 vascular flora species from 53 families and 150 genera recorded in the survey area. Three State-listed Priority flora were identified: Indigofera sp. Bungaroo Creek (S. van Leeuwen 4301) P3, Triodia sp. Robe River (M.E. Trudgen et al. MET 12367) P3 and Rhynchosia bungarensis P4.

Mesa H Riparian Vegetation – Baseline Monitoring **2016**

Internal reference: RTIO-HSE-0298821

Rio Tinto engaged Astron to establish and survey permanent transects downstream and upstream of proposed discharge locations within the Robe River and relevant tributaries, to record baseline riparian vegetation data. This data will provide a baseline with which ongoing monitoring data can be compared in subsequent years to identify any potential impacts to riparian vegetation from discharge.

In anticipation of potential impact to riparian vegetation due to increased stream flow, Rio Tinto has engaged Astron to establish a monitoring program to compile baseline data on the existing riparian vegetation and its condition. Data were also compiled for riparian vegetation upstream of the discharge point which acts as a reference area. There were 118 plant species from 36 families and 82 genera recorded from the 126 quadrats. No Threatened or Priority taxa were recorded within the transects, however one Priority flora species, Rhynchosia bungarensis P4, was recorded opportunistically within adjacent areas of the Robe River. Sixteen weed species were recorded within the transects.

Fauna

Middle Robe and East Deepdale - Mesa Façade Assessment **2015**

Internal reference: RTIO-HSE-0275944

Astron was engaged to undertake a mesa façade ecological value assessment for the Middle Robe East Deepdale Iron Ore Mine and Infrastructure Project. The purpose of the mesa facade assessment was to assist in determining which mesa facades should be retained if the Proposal proceeds.

The assessment concluded that 7% of the total length of the mesa facade within the survey were rated as high priority for retention. Mesa facades on four mesas were rated as high priority for retention; 37% of Mesa L, 10% of Mesa M, and 100% of Mesas 2400A and 2400C (both Mesas 2400A and 2400C are undisturbed by mining). Mesa that have impacted/disturbed facades were found to have low priority for retention and low ecological value based on the assessment parameters.
Mesa L and Mesa M are previously impacted mesas, however, they still retained breakaway habitat with ecological features important to fauna species of conservation significance. In addition the Priority 3 Ecological Community 'Triodia sp. Robe River assemblages of mesas of the West Pilbara' potentially occurs over the mesa and Triodia sp. Robe River (Priority 3) was present.
Mesa 2400A was rated as a high priority for retention due to the presence of a confirmed Pilbara Olive Python den and high suitability of habitat for the Northern Quoll. Mesa 2400C was rated as a high priority for retention due to multiple records of Northern Quolls indicating denning and shelter habitat. Both mesas were intact and provide important refuge and shelter opportunities for Matters of National Environmental Significance fauna species.

Middle Robe and East Deepdale Level 2 Fauna Assessment, August 2015 **2015**

Internal reference: RTIO-HSE-0280204

Astron was engaged to undertake a two-phase Level 2 vertebrate and short range endemic invertebrate fauna assessment for the Middle Robe and East Deepdale Iron Ore Mine and Infrastructure Project.

Six broad fauna habitat types were recorded in the survey area: Riverine, Drainage, Mesa, Breakaway, Stony Hills and Slopes, and Grassland Plains. Areas of disturbed habitat were also present within the survey area, particularly previously mined mesas. The Riverine and Breakaway habitats in the survey area are considered significant for fauna due to the microhabitats they provide such as caves and water pools. The Breakaway in particular contains a high diversity of microhabitats; it is an important site of refuge due to its location within isolated mesas and as habitat for conservation listed fauna. Nine conservation listed fauna species were recorded. The three targeted Matters of National Environmental Significance species, Pilbara Olive Python, Northern Quoll and Pilbara Leaf-nosed Bat were recorded frequently within the survey area. The two most prospective habitat types for short range endemic fauna, Breakaway and Stony Hills and Slopes, supported a moderately diverse short range endemic community of both specialist and relict short range endemic fauna species. The six potential short range endemic species were recorded.

Mesa J Mine Extension – Level 2 Fauna Assessment **2015**

Internal reference: RTIO-HSE-0279183

The objective of the assessment was to provide a single phase biological survey of vertebrate and SRE invertebrate fauna values through a desktop assessment and field survey. The resultant data will be utilised to produce a report to support and inform the environmental assessment process for the the Mesa J Mine Extension Proposal.

Rio Tinto engaged Astron to undertake a Level 2 vertebrate fauna and Short Range Endemic (SRE) invertebrate fauna assessment for a proposed extension to the Mesa J Mine. Three broad fauna habitat types were recorded in the survey area: Low Hills and Slopes, Loamy/Stony Plain and Drainage Line. Seventy-eight vertebrate fauna species comprising 20 reptiles, 48 birds and 10 mammals were recorded during the survey. Three conservation significant species were recorded during the survey.

Mesa H Level 2 Fauna Assessment **2016**

Internal reference: RTIO-HSE-0300720

The objective of the assessment was to undertake a two-phase Level 2 vertebrate fauna assessment and targeted SRE invertebrate fauna assessment, and to incorporate data from previous biological surveys to provide a report that meets Environmental Protection Authority (EPA) requirements.

Astron Environmental Services has been commissioned to undertake a two-phase Level 2 vertebrate and Short Range Endemic invertebrate fauna assessment in the Mesa H survey area.Seven broad fauna habitat types were recorded in the survey area: Riverine, Drainage Line, Gorge, Breakaway, Rocky Hills, Low Hills and Slopes, and Loamy/Stony Plain. There were 169 vertebrate fauna species recorded within the survey area. Seven conservation listed fauna species were recorded.

Mesa H – Riparian Community Assessment **2016**

Internal reference: RTIO-HSE-0298820

In anticipation of potential impact due to increased stream flow, Astron Environmental Services has been commissioned to undertake a Level 2 flora and vegetation assessment and Level 1 vertebrate fauna and aquatic fauna assessment in the Riparian Community survey area which is 2,105 hectares in size.

In anticipation of potential impact due to increased stream flow, Astron Environmental Services has been commissioned to undertake a Level 2 flora and vegetation assessment and Level 1 vertebrate fauna and aquatic fauna assessment in the Riparian Community survey area which is 2,105 hectares in size. There were 124 plant species from 37 families and 82 genera recorded from sampling sites and opportunistically throughout the survey area. No Threatened taxa were recorded, however three Priority flora species were recorded within the Robe River and its tributaries.

Biodiversity improvement studies

Evaluation of mine waste materials as alternative rehabilitation growth medium **2010**

Internal reference: RTIO-HSE-0109961

This study reviewed the physical and chemical properties of soil, tailing and mineral waste from select Pilbara mining operations, to identify waste material and material combinations for use as a topsoil substitute or supplement.

The study showed plant-available nutrients held within the waste materials, although variable, was characteristically low and comparable to natural soils in the region. The majority of the waste materials had macro and micro nutrient concentrations within the range or above the levels measured in benchmark Pilbara topsoil and rehabilitated soils. The pH and phosphorus buffering index of most waste materials were also comparable to that of the benchmark topsoil materials. However, some of the waste types and tailings may need to be mixed with rocky material due to poor physical / erodibility characteristics.

Genetic diversity in Eucalyptus leucophloia across the Pilbara: Provenance zone implications **2011**

Internal reference: RTIO-HSE-0108843

This study was undertaken to define the provenance seed collection zones for a common species of the Pilbara, Eucalyptus leucophloia (Snappy Gum). This report details information on genetic analysis conducted on E. leucophloia. Collections of E. leucophloia were made from 20 populations across the Pilbara bioregion and genetic analysis was conducted using microsatellite markers.

Genetic diversity in E. leucophloia was high and was typical of that found in other eucalypt species with wide spread distributions. Across the species the level of population differentiation was low and the majority of the diversity was maintained within populations with only 6% of variation partitioned between populations. Genetic variation in E. leucophloia showed little structure across the Pilbara with no clustering of populations based on any geographical proximity or in association with obvious topographical, physiogeographical or geological features such as the Hamersley or Chichester Ranges. Populations towards the edges of the species distribution within the Pilbara showed greater levels of differentiation from populations within the species main range. The high levels of genetic diversity and low levels of differentiation within E. leucophloia implies that seed resources for rehabilitation can be selected from a wide range within the Pilbara.

Genetic diversity in Acacia ancistrocarpa across the Pilbara: Provenance zone implications **2011**

Internal reference: RTIO-HSE-0119260

This study was undertaken to define the provenance seed collection zones for Acacia ancistrocarpa (Fitzroy Wattle). This report details information on genetic analysis conducted on Acacia ancistrocarpa. Collections were made from 24 populations across the Pilbara bioregion and genetic analysis was conducted on 16 populations using microsatellite markers.

Genetic diversity in A. ancistrocarpa was high but lower than that in E. leucophloia, another widespread species in the Pilbara. Across the species Pilbara range the level of population differentiation was low and the majority of the diversity was maintained within populations with only 3% of variation partitioned between populations. Genetic variation in A. ancistrocarpa showed little structure across the Pilbara with no clustering of populations based on geographical proximity or in association with obvious topographical, physiogeographical or geological features. Populations towards the edges of the species distribution within the Pilbara showed greater levels of differentiation from populations within the species main range. The high levels of genetic diversity and low levels of differentiation within A. ancistrocarpa implies that seed resources for land rehabilitation and mine-site revegetation programs can be selected from a wide range within the Pilbara

Root hydraulic conductance and aquaporin abundance respond rapidly to partial root-zone drying events in a riparian Melaleuca species **2011**

Internal reference: RTIO-HSE-0252171

This study examined partial root zone drying (PRD) responses of Melaleuca argentea.

The results demonstrate that PRD can induce rapid changes in root hydraulic conductance and aquaporin expression in roots, which may play a role in short-term water uptake adjustments, particularly in species adapted to heterogeneous water availability.

Baseline Terrestrial Fauna Assessment of Pilbara Rehabilitation Areas **2012**

Internal reference: RTIO-HSE-0134168

In 2011 a fauna survey was conducted within established rehabilitation areas at Brockman 2 and Tom Price mine sites, with the aim of identifying whether fauna is recolonising rehabilitation sites in assemblages comparable to reference sites.

The study found that at least 85 species of native vertebrate fauna, as well as representatives from each of six major groups of invertebrate fauna, are using rehabilitation areas at Brockman 2 and Tom Price, with species compositions that were broadly similar to reference sites. Ant collections were typical of the Pilbara bioregion, with an absence of invasive ant species. The study found greater data correlation between monitoring sites at a particular mine site (Tom Price or Brockman 2) than between rehabilitation and reference sites, indicating the importance of selecting local reference sites. The study concluded that the best candidates for bio-indicators are ants and reptiles.

Hay Project – Native Seed Orchard **2012**

Internal reference: RTIO-HSE-0141263

Commencing in 2011 (and still ongoing), a trial irrigated seed orchard was established at the Hamersley Agriculture Project (Marandoo). The purpose of the trial was to identify an alternate method of addressing seed deficits. If successful, the project may be implemented at other Rio Tinto operations, such as the Nammuldi agriculture project.

Genetic diversity in Aluta quadrata:Implication for management and provenance zone **2012**

Internal reference: RTIO-HSE-0156732

This study was undertaken to define the provenance seed collection zones for Aluta quadrata. This report details information on genetic analysis conducted on Aluta quadrata. Collections were made from 8 populations across the Pilbara bioregion and genetic analysis was conducted using microsatellite markers.

Genetic diversity in A. quadrata was moderate and lower than in the other two more widespread Pilbara species, E. leucophloia and A. ancistrocarpa. The findings suggest that its populations may have fluctuated significantly in size over time with genetic drift and possibly inbreeding resulting in a reduction in genetic variability, particularly in rare alleles. Despite the narrow geographic range, the level of population differentiation in A.quadrata was relatively high with 25% of the genetic variation maintained between populations and 19% due to differences between the three different locations. This significant genetic structure indicates that A. quadrata consists of three conservation or management units, Western Ranges, Pirraburdoo and Howie's Hole.

Genetic diversity in Acacia atkinsiana across the Pilbara: Provenance zone implications **2012**

Internal reference: RTIO-HSE-0187256

This study was undertaken to define the provenance seed collection zones for Acacia atkinsiana (Atkins wattle). This report details information on genetic analysis conducted on Aluta quadrata. Collections were made from 16 populations across the Pilbara bioregion and genetic analysis was conducted using microsatellite markers.

Genetic diversity in A. atkinsiana was low and lower than that observed in its congener Acacia ancistrocarpa, a widespread species across northern Australia. The level of population differentiation was high and 30% of the diversity was partitioned between populations across the range of A. atkinsiana. Genetic variation in A. atkinsiana showed some structure across the Pilbara with clustering of populations in the western part of the distribution and from the Hamersley Range, along with other populations that were divergent from these groups. The low levels of genetic diversity and high levels of differentiation within A. atkinsiana implies that seed for land rehabilitation and mine-site revegetation programs should be restricted to specific zones. For rehabilitation of sites within the Hamersley Range we recommend seed collections be restricted to that region. Similarly, for rehabilitation in the part of the distribution west of Pannawonica, seed collections should be restricted to that area.

Rehabilitation Quality Metric (RQM) Project **2012**

Internal reference: RTIO-HSE-0164020

Western Australia has no formal process to measure habitat quality and as such RTIO has needed to design its own customised metrics. Vegetation condition scoring has previously been developed by RTIO through a Biodiversity Net Positive Impact Assessment, but a more precise metric was needed. The Rehabilitation Quality Metric (RQM) project was developed to provide a repeatable method to assess rehabilitation quality against pre-determined reference sites, on a site by site basis, to predict rehabilitation ecosystem quality at the time of relinquishment.

The RQM methodology employs seventeen parameters to characterise the landscape, including vegetation, fauna habitat, fauna presence, erosion, and ecosystem function. Parameters are tailored to be an applicable measure for both rehabilitation and native vegetation (reference sites). Parameters are scored, based on measured or observed characteristics, with a value between 0 and 1, with 1 being functional (terrestrial ecosystem is functioning for the maintenance of biodiversity values at a local or property scale) and 0 being dysfunctional (terrestrial ecosystem is failing; indicators of ecosystem function have scored below acceptable levels). Both rehabilitation areas and reference sites are scored. Scores are subsequently determined for the entire mine lease, based on the condition of the land before mining (extrapolated from the reference sites, area weighted) and the likely post-mining conditions (extrapolated from the rehabilitation areas and expected closure domain distribution, area weighted, ie pits with no rehabilitation score 0). The difference between the pre-mining and post-mining scores represents the residual impact of mining.

Propagation of Pilbara spinifex (Triodia sp.) **2012**

Internal reference: RTIO-HSE-0169744

Triodia has often been observed to have very poor establishment from broadcast seed. This project investigated alternatives to growing Triodia (spinifex) from seed, focussing on ways to propagate seedlings from wild harvested material.

The project found the most successful propagating material was stolons. Greatest propagation success was achieved when Triodia were collected when semi to fully dormant (mid Winter-Spring). The 'Moist Root Induction Method' recommended by previous researchers was less successful than the standard propagation techniques employed in this project. Success varied notably between populations. Consequently, any future collections of propagating material should target multiple populations to maximise potential for success.

Pilbara Seed Science Project, Part 2 Final Report Jan 2012 **2013**

Internal reference: RTIO-HSE-0174944

Undertaken between 2009-2012, this seed research investigated germination, biology, dormancy classification and treatments for dormancy alleviation for a range of species from the Pilbara.

The *Acacia atkinsiana, Indigofera monophylla and Sida echinocarpa* seed lots have physical dormancy. Heat treatments and mechanical scarification improved germination on dormant seeds, however, heat treatments killed non-dormant seeds. The treatments used for *Goodenia stobbsiana* seeds failed to overcome dormancy, suggesting deep physiological dormancy. The *Hakea lorea/ chordophylla* seed lots were found to be non-dormant, with very high germination results in the controls. As such, they will not require any pre-treatments prior to direct seeding. The florets surrounding the *Triodia pungens* and *T. wiseana* seeds were found to restrict germination, however, many of the freshly extracted seeds out of the florets were found to be physiologically dormant. Treatments for dormancy include mechanical scarifier to rupture seed coat, hot water (noting potential damage to immature or non-dormant seeds) and increases to germination through wet / dry cycling and / or temperature cycling.

Morphological variation in the western rainbowfish (Melanotaenia australis) among habitats of the Pilbara region of northwest Australia. **2013**

Internal reference: RTIO-HSE-0252169

The aim of this honours thesis was to determine and quantify the extent of morphological variation present in M. australis and relate this to environmental variables, which will provide the first step to understanding how the species copes with environmental change.

This results of this thesis found that there was limited evidence that fish morphology correlated with environmental variables

Patterns of water use by the riparian tree Melaleuca argentea in semi-arid northwest Australia **2013**

Internal reference: RTIO-HSE-0249538

This thesis examines the water use physiology of the riparian tree Melaleuca argentea, and the ways in which this species may respond to anthropogenic disturbances to hydrologic processes.

M. argentea displays highly plastic root-level responses to heterogeneous water availability and to waterlogging, facilitating high rates of water use and growth in the riparian wetland habitats of the Pilbara. Mature M.argentea trees appear to tolerate groundwater drawdown of at least several metres, most likely by employing the same plastic root strategies to access deeper water. M.argentea can also withstand short periods of severe drought, by adopting a 'waiting' strategy of ceasing growth and shedding leaves to avoid moisture loss, a state from which they can then recover. M. argentea populations are unlikely to thrive under large and prolonged reductions in water availability.

Priority Species Seed Quality and Germination Final Report **2013**

Internal reference: RTIO-HSE-0207487

This study investigated the quality and germination biology of a range of priority and keystone (Triodia) plant species from the Pilbara.

Eremophila magnifica subsp. Magnifica has physical & physiological dormancy. Propagation methods other than seed may be more successful. Geijera salicifolia and Olearia mucronata has physiological dormancy. Temperature cycling may be required to stimulate germination. Indigofera ixiocarpa and Indigofera sp. Bungaroo Creek has physical dormancy or is non-dormant. Mechanical scarification may be required. Ptilotus subspinescens is non-dormant and will germinate easily without removal from the perianth sheath. However, seed is likely to lose viability with a few years. Sida echinocarpa and Sida sp. Barlee Range has physical dormancy. Seeds should be removed from the mericarp and then scarified in order to germinate. Triodia pungens has T. wiseana non-deeep or deep physiological dormancy. Germination of de-husked seeds can be improved by applying gibberellic acid or 1% smoke water and wet/dry cycling.

Early physiological flood-tolerance and extensive morphological changes are followed by slow post-flooding root recovery in the dryland tree Eucalyptus camaldulensis subsp. Refulgens **2014**

Internal reference: RTIO-HSE-0252170

This study investigated physiological and morphological response to flooding and recovery in Eucalyptus camaldulensis subsp. Refulgens, a riparian tree species from a dryland region prone to intense episodic flood events.

E. camaldulensis subsp. Refulgens underwent considerable morphological changes during flooding, including extensive adventitious root production, increased root porosity and stem hypertrophy. Physiologically, net photosynthesis and stomatal conductance were maintained for at least 2 weeks of flooding before declining gradually. Despite moderate flood-tolerance during flooding and presumably high environmental selection pressure, recovery of reduced root mass after flooding was poor.

Priority Species Project Progress Report 2013 **2014**

Internal reference: RTIO-HSE-0207486

The Priority Species Project, initiated in 2012, aims to improve knowledge of priority plant species and develop methods to successfully germinate and establish priority species, to enable priority plant species to be integrated into Rio Tinto rehabilitation programmes. This work is being undertaken in conjunction with the Department of Parks and Wildlife.

13 plant species were selected as being potentially suitable for establishment in rehabilitation: Eremophila magnifica subsp. magnifica, Indigofera sp. Bungaroo Creek, Indigofera sp. gilesii, Acacia bromilowiana, Sida sp. Barlee Range, Ptilotus subspinescens, Ptilotus mollis, Acacia subtiliformis, Isotropis parviflora, Grevillea sp. Turee, Hibiscus sp. Canga, Themeda sp. Hamersley Station, and Aluta quadrata. Indigofera sp. Bungaroo Creek and Ptilotus subspinescens were found to readily germinate in laboratory conditions, and a field trial was established at Brockman 4 late in 2013.

Regional Variation in Metal Concentrations of Pilbara Fish in Relation to Concentrations in Water and Sediments **2014**

Internal reference: RTIO-HSE-0216967

This study aimed to characterise and document natural, background metal concentrations in freshwater fishes from different locations across the Pilbara in order to understand how local geology may affect baseline metal levels in fish tissues and surface waters. Metal concentrations were analysed from water, sediment and muscle and liver tissues from fish collected from up to 13 sites as yet unimpacted by mining across the Pilbara during October (dry season) of 2012.

Levels of dissolved metals from water samples were generally low. However, some elevated concentrations of Boron, Copper and Zinc were recorded. Concentrations of heavy metals in sediments were variable across the Pilbara. Generally, sediment concentrations were well below the Interim Sediment Quality Guidelines (ISQG). However, metal concentrations in excess of ISQG TVs were recorded for Chromium and Copper at some sites. There was no relationship between metal concentrations in sediment and those in water. Metal concentrations in fish tissue (muscle and liver) varied between species with some significantly higher in some particular species. The study concluded that variation in metal concentrations in water, sediment and fish across pools in the Pilbara was likely to be mainly dictated by the local geological setting in which the pool occurs.

Progress Report 2014, Ecological responses of native fishes to dynamic water flows in northwest arid Australia **2014**

Internal reference: RTIO-HSE-0246021

This three year Australian Research Council linkage Project commenced in 2013 and aims to increase understanding of the effects of altered stream flows on the Pilbara freshwater aquatic environment. Project aims: 1. Quantifying fish biodiversity and population structure in relation to hydrological and environmental parameters to identify thresholds of ecological concern for water management; 2. Determine the fundamental physiological, morphological and behavioural adaptations of fishes to variations in water quality using experimental manipulations; and 3. Examine spatial scales of gene flow to determine if increased flows increase genetic connectivity relative to natural-flow sites.

To date work has focuses on characterisation of baseline physicochemical parameters across aquatic habitats within the Fortescue River catchment (Aim 1), analysis of variation in rainbow fish morphometrics and mechanosensory lateral line systems in response to geographic region and water management regime (Aim 2), and extraction of DNA samples from 17 populations across the Fortescue River catchment (Aim 3). The project will culminate in the development of a predictive model for stream restoration relevant to future closure scenarios for above and below-groundwater mines. Results from an honours thesis indicate that rainbow fish body shape varies according to geographic region but fish from a dewatered site (WW Ck) were more streamlined than other populations from the upper Fortescue catchment. This statement of results has been superseded by the results of the actual thesis report RTIO-HSE-0252169.

Progressive rehabilitation

Ecosystem Function Analysis of Robe Valley rehabilitated areas **2014**

Internal reference: RTIO-HSE-0280240

Five rehabilitation areas were monitored in 2013 - S Dump and T dump at Mesa J, and the Pit Floor, West Waste Dump and Haul Road at Mesa K. Six reference transects were monitored for comparison to the rehabilitation. Mesa J Hub uses the EFA monitoring technique.

S and T dump have established well, with increasing cover and density since rehabilitation. T Dump has stopped increasing in 2010, indicating full establishment. T Dump has lower density than S Dump, potentially due to the topsoil differences. All areas at Mesa K are well established, reflecting the maturity of the rehabilitation.

Mesa J Tailings Storage Facility 1 (TSF1) Rehabilitation Record **2014**

Internal reference: RTIO-HSE-0246219

This report summarises the rehabilitation of 45Ha of TSF1 at the Mesa J Operations, completed in 2014 by the RTIO Rehabilitation team, with the assistance of a rehabilitation contractor and the Mesa J/K Operations team.

The project totalling 45 hectares (Ha) involved the removal and stockpiling of 15kt (6,000m3) of high grade ore, the removal and stockpiling of 160kt (64,000m3) of course material to be used as stemming and the import of 85kt (38,500m3) of capping material, prior to shaping, ripping and seeding of the entire rehabilitated surface.

2014 Robe Valley EFA Monitoring **2014**

Internal reference: RTIO-HSE-0266718

Three rehabilitation areas were monitored in 2014 - Pit 10 and TSF1 at Mesa J, and the Gravel Pit at Mesa K. Five reference transects were monitored for comparison to the rehabilitation. Mesa J Hub uses the EFA monitoring technique.

The vegetation communities on all rehabilitation sites were in the initial stages of ecosystem development. Cover and density was lower than reference sites, as would be expected from newer rehabilitation.

2015 Robe Valley EFA Monitoring **2015**

Internal reference: RTIO-HSE-0273809

Six rehabilitation areas were monitored in 2015 - S Dump, T dump, Pit 10, TSF1 and the Rail Upgrade construction areas at Mesa J, and the Gravel Pit at Mesa K. Five reference transects were monitored for comparison to the rehabilitation. Mesa J Hub uses the EFA monitoring technique.

S and T dump have established well, with increasing cover and density since rehabilitation until 2010 and 2015, when T Dump and S dump stopped increasing respectively, indicating full establishment. T Dump has lower density than S Dump, potentially due to the topsoil differences. Pit 10 North has good vegetation establishment with a range of native vegetation species. Pit 10 South has limited native perennial vegetation establishment, due to both the young age of the rehabilitation and the lack of topsoil. Vegetation establishment has been variable across TSF1, with the better establishement occurring on coarser tailings or rocky edges. Vegetation establishment along in the construction areas is beginning to occur, however vegetation parameters are low, reflecting the young age of the rehabilitation. Better establishment is shown where the surrounding area is not disturbed or used regularly. Vegetation atthe Gravel Pit is establishing well, with vegetation parameters comparable to the reference sites.

Landform design

Results of flume investigations of the stability of rock mulches **1998**

Internal reference: RTIO-HSE-0109221

This study assessed the potential for rock mulches to be stripped from the soil surface by overland flows.

Although 150-300mm diameter BIF was not removed by simulated overland flows, even for 100mm/hr simulated runoff on 55% gradients, considerable scour of the spoil between the rocks was observed, indicating potential for long-term development of rills or gullies if the level of rock cover was less than 100%. Large reductions in sediment concentrations were observed when finer rocks were mixed with BIF. The data indicate that it is crucial for any rock mulch to cover a wide range of particle diameters, including a component of finer rocks. The resulting mixed rock created a framework of large rocks that resist movement by flows, while the smaller rocks reduce erosion being anchored within the larger (framework) rock. For rock mulches with a mixture of rock diameters, 80% cover produced acceptable erosion rates. Sediment loads were slightly higher for 40% cover by rock of mixed diameters, and it was speculated that this may also achieve acceptable erosion rates with the addition of vegetation.

Final Landform Design Criteria for Use During Mine Planning **2012**

Internal reference: RTIO-PDE-0159989

Rio Tinto Iron Ore WA have historically designed closure landforms for waste materials with berms ~10 m, lifts ~20 m and ad hoc alterations to batter gradients where erosion rates have been perceived to be unacceptably high. This report integrates recent advances in characterisation and modelling of materials, climate and erosion processes to provide appropriate final landform batter characteristics for key Pilbara mineral wastes and soils.

Material properties of mineral wastes were assessed and classified for the range of mineral wastes found across Rio Tinto Pilbara sites. Climate sequences were used to model and test potential erosion rates for a range of batter configurations (shapes (linear, concave), heights, gradients, berm capacity) and validated against existing slopes for which material and climate data were available. This information was used to develop a searchable waste dump batter database for all major mineral wastes and soils, intended for use during mine planning design.

Mesa J TSF Concept Closure Study **2016**

Internal reference: RTIO-HSE-0300384

The purpose of this report was to develop a concept design for the future closure of the TSF's at Mesa J based upon the Robe Valley 2014 Life of Mine plan. The report considers which pits will be used for waste backfill and which for future Tailings dams. Designs for future facilities are conceptual and will be updated over time.

The report considers which pits will be used for waste backfill and which for future Tailings dams. Designs for future facilities are conceptual and will be updated over time. The information is incorporated into the Life of Mine plan and utilised by the closure plan. Generic requiremenrts for 2m of capping has been used.

Contamination

Pannawonica Preliminary Site Investigation & Sampling & Analysis Plan **2007**

Internal reference: RTIO-HSE-0057556

This preliminary site investigation was undertaken to determine areas of potential contamination associated with current and historical activities at the site.

Analysis of the site concluded that the highest ranked activities in terms of risk are: fuel storage/handling at Pannawonica Service Station, fire training activities, storage and handling of fuels and oils at the Mine Services Building and the Eastern Deepdale fuel storage/transfer area. Many sites have not undergone environmental investigation for their potential negative impacts. In all cases visual and/or anecdotal evidence suggest that potential adverse impacts exist to soil, groundwater or surface water, be it fuel spills, leaking tanks, ongoing run-off/infiltration or burning, had historically occurred at these locations. For each issue of concern, a soil and groundwater sampling and analysis plan has been developed.

Phase 2 Environmental Site Assessment Pannawonica Service Station **2007**

Internal reference: RTIO-HSE-0042275

The objective of this investigation was to identify the location of the underground storage tanks and associated fuel lines and assess whether the reported loss of integrity in the underground storage tanks system has resulted in any sub-surface impacts to soil or groundwater.

The results of the Environmental Site Assessment indicate that no impacts to the environment have resulted from the observed loss of integrity in the fuel storage system. Of the twelve (12) soil samples submitted, no samples reported detectable concentrations of total petroleum hydrocarbons, benzene, toluene, ethylbenzene or xylenes or polycyclic aromatic hydrocarbons above the laboratory limits of detection. Detectable concentrations of lead were reported in all samples however none exceeded guideline values. No visual or olfactory evidence of hydrocarbon contamination was noted in the samples.

Impact of Nitrogen from Explosives on Mine Site Water Quality **2008**

Internal reference: RTIO-PDE-0054638

The likely issues associated with the use of nitrogen based explosives on mineral waste and any leachate water are explored in this report. The amounts of explosives used on site are described, along with nitrogen chemistry and toxicity. Nitrogen concentrations for various mine sites and specific lithologies are presented which includes concentration in rock assays and liquid extracts.

It was concluded that the largest risk of nitrogen contamination is likely to arise from the discharge of surface waters that have been in contact with blasted materials and are discharged off site into creeks or waterways. This becomes a more significant issue if the water is also acidic. Algae (ie cyanobacteria) plumes have been identified in acidic water at Tom Price

Control Measures for Potentially Acid Forming Pit Wall Rocks **2010**

Internal reference: RTIO-PDE-0079541

Desktop study of potential strategies to manage exposed sulfidic materials and find viable options for management was conducted with a focus on the Hope Downs 1 and Tom Price sites.

Chemical treatments have the potential to be effective only in the short-term and only for minor water quality issues. Grouting of the pit walls is expected to have limited applicability, although grout curtains behind the wall may have success (untested). Cover technologies have the greatest potential to be effective over the long term, but would need to be resistant to puncture by underlying rocks, resistant to weathering and UV damage ie shotcrete, geomembranes. For long term performance the exposed surface need to be as stable and free of loose material as possible. Treatment effectiveness will also depend on the site conditions, eg chemical less effective at Tom Price.

Workshop Summary and Desktop Review: Dewatering and Sulfate Accumulation **2012**

Internal reference: RTIO-PDE-0101903

This is a summary of a workshop held to determine the risks of dewatering sulphides within the pit wall. The outcomes from this workshop will be used to develop models to estimate the mass of sulfate produced as a consequence of dewatering activities.

There are many processes that contribute to poor pit water quality. Most of these processes are known and accounted for in existing models. However, the science of fluid flow in fractured rock is not well developed and this lack of knowledge restricts the outcomes of studies on pit water quality. There is a general lack of empirical data for estimating parameters used in models, creating a large degree of uncertainty in predictive models. Sensitivity analysis can be used to overcome some of these challenges.

Updated Preliminary Site Investigation and Sampling Analysis Plan for Mesa J Final **2012**

Internal reference:
RTIO-HSE-0148155

The objectives of the project were to update existing information relating to known or suspected contamination at Mesa J and surround areas and to subsequently develop a Sampling Analysis Plan in order to present an approach for future intrusive investigations designed to further characterise identified areas of interest.

The review of the Preliminary Site Investigation found that, in general, the existing findings are accurate and have been carried out and presented consistent with the Department of Conservation's Contaminated Sites Management Series. Results of the Sampling Analysis Plan conclude that potential areas of interest are: 1) Pannawonica Town - Substation, sewage treatment plant, service station, former minor and main landfill, Pannawonica MSB; 2) Middle Robe - Former power station, load out and laydown/park up areas, decommissioned 2E workshops, decommissioned vehicle refuelling areas, former ammonium nitrate shed, former Yaleen homestead, 2E former landfill; 3) Eastern Deepdale - Former workshops and refuelling areas, former sewage treatment plant, former landfill; 4) Mesa J - Workshop area, Mesa J tank farm, bulk lube storage area, light vehicle refuelling area; and 5) Mesa K - Groundwater.

Development of a conceptual model: Sulfate accumulation as a consequence of pit dewatering activities, memo **2012**

Internal reference:
RTIO-PDE-0101903

Mine dewatering and the consequent lowering of the water table may result in desaturation of sulfide bearing lithologies. The objective of this work was to develop a conceptual model of the associated processes: where sulphide bearing rock intersects the pit walls, and where the sulphide bearing rock is located behind the pit walls but not directly exposed on the pit wall face.

The conceptual model developed estimates the mass of sulfate produced as a consequence of dewatering activities, considering processes during operations and after operations cease, and using sensitivity analysis where parameter inputs are uncertain. The model output provides the basis for an assessment of potential impacts on water quality for general risk assessment applications. Further work was identified to improve parameterisation of the model, including the collection of additional empirical data for pit wall fracturing, saturation of pit wall fractures and sulfide oxidation rates in talus and on pit walls.

Ethnographic or archaeological values

Water and Indigenous People in the Pilbara: A Preliminary Study, CSIRO: Water for a Healthy Country **2011**

Internal reference:
RTIO-HSE-0218222

Water resources are vital to Indigenous identities, beliefs, environmental philosophies and livelihoods. This report provides a broad-scale scoping study of Indigenous relationships to water in the Pilbara and considers the potential impacts of Indigenous water values.

Indigenous belief systems perceive water as an elemental part of the broader cultural landscape, held and managed under customary systems of law. Water sources were derived during the Dreaming and are the most important features in the Pilbara cultural landscape. Interviews raised issues of long term drying, obstruction of water flow, over-extraction, inappropriate discharge from de-watering and access restrictions.

Ethnobotanical Survey for the RV region **2011**

Internal reference:
RTIO-HSE-0122187

This survey outlines provenance species which Traditional Owners identified as important to include in rehabilitation work for the Robe Valley.

22 species were considered to have ethnobotanical significance, including species of Acacia, Aristida, Cleome, Corymbia, Cymbopogon, Enchylaena, Eucalyptus, Petalostylis, Ptilotus, Rhynchosia, Senna, Solanum, Trichodesma, Triodia and Typha. Traditional owner use these plant species for specific purposes, such as bush tucker, ornamental, medical or as a tool.

Appendix D – Closure risk assessment

Ref.				Risk Description					Risk Management C	
Risk Type (T=Th	Category	Subcategory	Item	Evaluated 20 of 20 risks (0 Remaining) Threat Title	Potential causes (Triggers / Indicators)	Impacts (Consequences)	Existing Controls and Commitments	Evaluation Rationale (Maximum reasonable consequence)		Detailed Action Descriptions
T	**A**			**Planning and knowledge**						
T	**A**	**01**		**Contaminated sites**						
T	A	01	1	Contaminated sites (Non AMD) lead to an ongoing environmental or financial impact	• Use of chemicals and hydrocarbons during operations • Housekeeping practice and maintenance of work areas and equipment	CAPEX / OPEX Environment	• Regular maintenance / inspection / audit of work place procedures • Spill management kits readily available • Contaminated sites register maintained across life of operation	Contamination is missed during closure phase and identified post-closure. Teams are required to mobilise to clean up the contamination.	II	
T	A	01	02	Under-estimated acid and / or metalliferous drainage management requirements during operations (pre-closure) & decommissioning phase	• Potential for acid / alkaline / metalliferous / neutral / saline drainage generation during operation of mine • Water management, storage and monitoring practices • Water quality prior to return to environment e.g. via infiltration or discharge Elevated salts observed around the tailings facilities	CAPEX Environment OPEX	• Geochemical characterisation of mineral waste material routinely undertaken during drill programs. • Mine does not intend to excavate any PAF materials • Discharge water quality monitored. Includes sampling and trigger / response requirements • Wet season management plans used to control run off. • Groundwater operating management plan to monitor groundwater quality	Highly saline water generated as part of waste fines management results in neutral mine drainage i/ groundwater salination ssues during operations and continues throughout closure (including impacts to permanent Robe River pools).	II	
T	A	01	03	Acid and / or metalliferous drainage generation (after closure) creates a contaminated site	• Interaction of water and mineral waste or tailings could generate acid / alkaline levels that leach metals / salts from the mineral waste or local environment • Presence of temporary or permanent open water bodies, enabling evapoconcentration to occur with creation of alkaline / hypersaline water quality • Ability of metals / salts to move through environment to impact a sensitive receptor, to meet definitions in Contaminated Sites Act 2003	CAPEX Environment OPEX	• Mine does not intend to excavate any PAF materials	Pit wall erodes and collapses post-mining revealing PAF materials that impact water quality (including impacts to permanent Robe River pools).	II	
T	A	01	04	Human health impacts from in situ fibrous material exposures	• Hazardous fibres exposed in situ by mining, mined and moved to encapsulated areas or naturally present in soils disturbed by mining / rehabilitation activities • Erosion of materials containing hazardous fibres post-closure	Health	• Physical materials characterisation for fibres routinely undertaken as part of drilling campaign (part of Fibrous materials management program) • Physical materials characterisation complete, no fibres present in mineral waste or mineralised materials.	Pit wall erodes and collapses post-mining revealing fibrous materials.	II	
T	**A**	**02**		**Void management**						
T	A	02	01	Pit lakes or Tailings have undesirable impacts on local ecosystem function	• Open water bodies in Pilbara naturally attract fauna (feral and native species) for food/ water/ refuge, safe access to water required • Concentration of natural groundwater or mineral waste derived salts through evapoconcentration in open water bodies • Release of metals from natural geology or mineral waste into water (infiltration or groundwater flow) • Water provides opportunity for plant /weed growth, good and bad (toxic algal blooms, noxious weeds) • Certain plant / animal species bio-accumulate / magnify toxic metals • Instability associated with saturated, unconsolidated ground, can be increased by high traffcability	Safety Environment Community Reputation Compliance CAPEX OPEX	• Void closure management guidance • Geochemical waste characterisation, good understanding of water chemistry / reaction chemistry • Physical waste characterisation • Rehabilitation handbook • Landform design guidance • Aquatic fauna research underway to understand natural levels of toxic metal accumulation / impact on native species	Cattle regularly access pit lakes for water. The lake fringe suffers severe erosion, becoming boggy, such that cattle regularly become stuck in pit area, die and contaminate water source.	II	RV03: Confirm the assumption that pit lakes will not be formed above WFSF at closure by conducting a water balance analysis for Mesa J waste fines storage facilities. RV04: Undertake a review of predicted water quality for the Mesa J reservoir to assess viability of leaving this areas as pit lakes. RV64: Develop detailed closure designs for existing WFSF's at Mesa J
T	A	02	03	Pit lakes or tailings have undesirable impacts on downstream ecosystem function	• Concentration of natural groundwater or mineral waste derived salts through evapoconcentration in open water bodies • Groundwater flow through pit lake / Tailings or mineral waste with connection to regional aquifer • Density driven saline groundwater flow from groundwater sink-style pit lakes • Downstream groundwater users (people, plants or animals) Alternate ecosystem may develop at discharge points leading to stakeholder concern when discharge ceases, However changes may not have been explained at commencement of project	Health Environment Community Reputation Compliance	• Any proposed pit lakes would be assessed in accordance with Void closure management guidance • Environmental surveys include regional groundwater dependent ecosystem • Geochemical waste characterisation, no PAF excavation planned	Higher saline groundwater from the former mining areas seeps into the Robe River pools, impacts local pool water quality / flora / fauna	III	RV10:Review environmental reports on potential impacts of mining activities on Robe River permanent pools and compare waters level and water quality. Determine key environmental receptors and potential ecological impacts. Determine if effects / impacts are masked by other impacts, such as discharge to Jimmawurrada Creek. RV15: Document and distribute conceptual understanding of pool supplement water supply post closure to mitigate drawdown impacts on Robe River pools.

Ref.				Risk Description					Risk Management C	
Risk Type (T=Th	Category	Subcategory	Item	Evaluated 20 of 20 risks (0 Remaining) Threat Title	Potential causes (Triggers / Indicators)	Impacts (Consequences)	Existing Controls and Commitments	Evaluation Rationale (Maximum reasonable consequence)		Detailed Action Descriptions
T	A	02	06	Pit wall stability compromises closure outcomes	• Influence of erosion, subsidence, seismicity, wall slip • Influence of groundwater recovery and surface water flow on stability. • Creek system neighbouring or within zone of instability, potential stream capture • Ecosystem downstream of void dependent on surface water flows • Poor communication of zone of instability to facilitate identification of important features • Clay zones not previously identified in the footwall compromise pit wall stability	Safety Environment Community Reputation Compliance CAPEX OPEX	• Geotechnical assessments for wall stability and zone of collapse part of mine design reviews • Mesa A façade / MEZ preservation required.	An area of the pit wall facade collapses, and some troglofauna habitat, heritage sites and caves are lost.	II	RV67: Incorporate any Troglofauna pit boundary changes into closure plan at Mesa K.
T	**A**	**03**		**Heritage**						
T	A	03	01	Heritage site condition / cultural value is degraded as a result of implementing the closure plan	• New (previously unidentified) heritage sites, not considered in existing assessment, discussions, agreements or with authority to disturb • Changes to landforms on closure have potential to alter conditions at downstream sites, e.g. consider drainage, landform footprint, erosion implications • Cessation of maintenance of / to heritage site Cultural values not considered in rehabilitation strategies Presence of heritage sites in close proximity to mining areas Downstream area of significant value to traditional owners	Community Reputation Compliance	• Internal ground disturbance approval request system • GIS system includes results from heritage surveys • Heritage sites within mine area, S18 application etc. prior to disturbance • Ongoing consultation with Traditional Owners • Geotechnical assessments • Exclusion area for homestead outstation Heritage management plan Environmental groundwater and pools monitoring regime in place during operations	Failure to stabilise the Homestead outstation landform leads to significant erosion of the remaining in situ topography and eventual loss of the site.	III	
T	A	3		**Closure Landforms**						
T	A	3	01	Built landforms (excluding mine void areas) erode and / or collapse	• Physical material properties considered in design • Drainage and erosion management • Construction of landforms / waste dumps to design requirements • Sensitive receptors identified downstreamadily modelled Design does not consider PMP/PMF events Wbo surface water model not completed	Environment OPEX	• RTIO Rehabilitation handbook used for general rehabilitation activities Landform design guidelines Rehabilitation designs approved by multiple disciplines including geology, geo-tech and hydrology Rehabilitation designed to be stable without vegetation	Waste dump erodes due to poor surface water management practice, causing rehabilitation to fail and necessitating post-closure repair.	III	RV24: Identification, segregation and stockpiling of competent materials to allow for armouring of erosive final landform surfaces to be encountered at Mesa H. RV61: Confirm material types contained in the Mesa K waste dumps. Closure plan assumes all hydrated waste RV63: Complete a rehabilitation design incorporating hydrological considerations for the Mesa K Northern waste dump, including the River and landform location RV66: Complete a surface water closure design for Mesa H, J and K
T	A	3	02	Vegetation does not meet completion criteria	• Vegetation established, but does not re-seed in same abundance • Weed competition • Species selection / insufficient species diversity • Animal interference i.e. feral animals eating new growth • Changes to soil water conditions e.g. salinity, water logging etc. Potential shortfall of topsoil and subsoil for use in rehabilitation Potential shortfall in seed procurement to meet closure schedule	Environment Community OPEX	• Rehabilitation handbook provides guidance on seed selection for appropriate diversity • Top soil stockpiles provide seed bank • Wetland rehabilitation trial established to assist in appropriate species selection for post-closure soil water conditions • Invasive species management plan will be developed as part of decommissioning activities • Geochemical materials characterisation complete. Material is inert and general expected to be acceptable growth media. • Rehabilitation handbook provides direction on surface treatment options • Annual stockpile reconciliation of top soil and sub soil stockpiles, return of 200mm to create quality surface growth media • Wetland rehabilitation trial established at Yandi will provide feedback on general waste erosion performance, will look at value of adding mulch	Vegetation establishment is below expectations leading to rework and additional seeding or more intensive and costly revegetation techniques	III	

Ref.				Risk Description					Risk Management C	
Risk Type (T=Th	Category	Subcategory	Item	Evaluated 20 of 20 risks (0 Remaining) Threat Title	Potential causes (Triggers / Indicators)	Impacts (Consequences)	Existing Controls and Commitments	Evaluation Rationale (Maximum reasonable consequence)		Detailed Action Descriptions
T	**A**	**04**		**Other regional considerations**						
T	A	04	01	Environmental outcomes outside of disturbance areas do not align with approved environmental impacts	• New (previously unidentified) environmental sites, not considered in existing environmental impact assessment • Changes to environmental conditions due to cessation of artificial support / mitigation activities, e.g. water supplementation • Change to drainage patterns on closure e.g. removal of temporary diversions, drains etc.	Environment Community Reputation Compliance	• Internal ground disturbance approval request system to prevent inadvertent disturbance • Baseline biological / ecosystem health surveys and existing monitoring to define post-mining status • GIS system includes results from all flora, fauna, vegetation surveys • Operational management plan for discharge includes actions relating to water quality and discharge extent targets, to ensure environmental issues are managed during operations • Significant species management plan implemented during operation to minimise impact to select species • Vegetation management plan implemented during operations to monitor and manage impacts to vegetation (riparian, understorey and weeds)	Waste dump failure causes downstream silting of water cause and impacts riparian ecosystem health	**II**	
T	A	04	02	Adverse impact to flora or fauna with conservation status or wider regional impact to high value environment	• Scheduled, listed or declared rare and / or threatened species of flora or fauna present in/adjacent to site • Downstream regional area of high value • Environmental conditions post-closure differ significantly from pre-mining conditions • Post-mining land use differs from pre-mining land use	Environment Community Reputation Compliance CAPEX	• Internal ground disturbance approval request system to prevent inadvertent disturbance • Baseline biological / ecosystem health surveys and existing monitoring to define post-mining status • GIS system includes results from all flora, fauna, vegetation surveys e.g. Mesa A MEZ exclusion zone • Operational management plan for discharge includes actions relating to water quality and discharge extent targets (proximity to Fortescue Marsh), to ensure environmental issues are managed during operations • Significant species management plan implemented during operation to minimise impact to select species • Vegetation management plan implemented during operations to monitor and manage impacts to vegetation (riparian, understorey and weeds)	Weeds florish in the rehabilitation areas and spread, increasing the weed growth in the surrounding undisturbed landscape.	**II**	
T	**B**			**Stakeholders**						
T	**B**	**01**		**Consultation**						
T	B	01	01	Consultation fails to identify stakeholder concerns	• Large number of stakeholders in the project • Clarity of explanation / prediction of closure outcomes, communication styles, long term engagement of agreed outcomes through generational change. • Stakeholder expectations change over time, due to changing global benchmarks for mine rehabilitation success, intergenerational change, regulatory changes etc. • Stakeholders do not endorse site closure as their issues / concerns were not addressed	CAPEX OPEX Reputation	• RTIO stakeholder engagement practice with key stakeholders i.e. Traditional Owner M&L, etc. • Ad hoc consultation with key stakeholders • Detailed engagement planned during decommissioning study • Stakeholder engagement register	A stakeholder comes forward during the decomissioning phase and requires different closure outcomes than planned.	I	
T	**B**	**02**		**Key stakeholder expectations**						
T	B	02	01	Closure outcomes do not meet stakeholder(s) / community expectations	• Absence of rehabilitation trial or data to support predicted outcomes, closure activities fail to achieve completion criteria • Communication of anticipated closure outcomes and post-closure land use needs i.e. wrong plant species established • Unrealistic expectations for economic potential opportunities / post-closure land use capability i.e. aquiculture in pit lakes Visual ammenity not considered in landform design	CAPEX OPEX Reputation Community	• RTIO stakeholder engagement practice with key stakeholders • Monitoring established for water, rehabilitation trials started • Numerical completion criteria established for some aspects	Historic rehabilitation outcomes are no longer acceptable to key stakeholder and re-work is required.	**III**	RV36: Review Mesa J proposed waste dumps to ensure in-pit backfill is maximised where practical and impacts to visual amenity are minimised. This may mean an increase to waste fines storage facility capping thickness
T	B	02	02	A stakeholder's expectations conflict with that of another stakeholder, causing delays to plan approval and / or closure	• Conflicting stakeholder expectations or areas of authority e.g. different regulators for environment, heritage, health, economic, tourism • Conflicting legal obligations e.g. State Agreement and EPA • Interactions between catchment land uses, including mining developments, at different points in time	Community Reputation	• RTIO stakeholder engagement practice with key stakeholders	Stakeholder disagree on decommissioning strategy, requiring extensive re-negotiation and delaying closure.	**II**	
T	B	2	3	Inability to achieve closure objectives and criteria due to cumulative impacts from third parties	Regional approach not taken No forum currently available for sharing information with other mining companies	Cost Reputation Compliance	Development of a business policy is underway to allow Rio Tinto to discuss rehabilitation and closure with third parties	This is not currently viewed as a serious credible threat for the Robe Valley		

Mesa J Hub Closure Risk Assessment

Ref.				Risk Description					Risk Management C	
Risk Type (T=Th	Category	Subcategory	Item	Evaluated 20 of 20 risks (0 Remaining) Threat Title	Potential causes (Triggers / Indicators)	Impacts (Consequences)	Existing Controls and Commitments	Evaluation Rationale (Maximum reasonable consequence)		Detailed Action Descriptions
T	B	2	04	Closure strategy prevents or limits future exploitation of resources	• Backfill sterilises ore reserves • Lakes or habitat restoration prevent / limit future access to adjacent resources	Community	• RTIO stakeholder engagement practice with key stakeholders • Integration of potential Billiards North expansion deposits into current closure plan options	Closure of the Mesa J site is compromised by future approvals to mine adjacenrt deposits	I	
T	**B**	**03**		**Other expectations**						
T	B	03	01	Mine closure has a significant, long-term detrimental impact on local communities	• Local communities receive direct support from operation for basic community services e.g. doctor • Significant proportion of community are directly or indirectly employed by operation	Reputation	• Pannawonica township is owned by Rio Tinto, houses Mesa J personel • Mesa A is FIFO site, with independent workers camp	Closure of the Robe Valley mines result in loss of tourism	I	
T	**C**			**Obligations**						
T	**C**	**01**		**Agreements and commitments**						
T	C	01	01	Closure is not implemented in accordance with the approved closure plan	• Mine development changes prevent closure plan from being implemented as planned • Implementation results in a different outcome than anticipated	CAPEX OPEX Community	• Integration of closure plan with LoM plan • Mesa A Troglofauna Management Plan Ministerial statement Stakeholder input and review of closure plans	Closure commitment to re-establish troglofauna habitat is mis-interpreted and does not meet approved closure plan requirements	**III**	

Appendix E – Task, Research and Trial Activities Schedule

Ref	Task	Indicative timeframe
RV03	Confirm the assumption that pit lakes will not be formed above WFSF at closure by conducting a water balance analysis for Mesa J waste fines storage facilities.	Next Closure Plan
RV04	Undertake a review of predicted water quality for the Mesa J reservoir to assess viability of leaving this areas as pit lakes.	Next Closure Plan
RV10	Review environmental reports on potential impacts of mining activities on Robe River permanent pools and compare waters level and water quality. Determine key environmental receptors and potential ecological impacts. Determine if effects / impacts are masked by other impacts, such as discharge to Jimmawurrada Creek.	Next Closure Plan
RV15	Document and distribute conceptual understanding of pool supplement water supply post closure to mitigate drawdown impacts on Robe River pools.	Before OoM
RV24	Identification, segregation and stockpiling of competent materials to allow for armouring of erosive final landform surfaces to be encountered at Mesa H.	During operations
RV36	Review Mesa J proposed waste dumps to ensure in-pit backfill is maximised where practical and impacts to visual amenity are minimised. This may mean an increase to waste fines storage facility capping thickness	Next LOM Plan
RV50	Review post-closure access road and road designs with key stakeholders to establish long-term liability and ownership for road maintenance at Mesa J hub	OoM
RV51	Review access to open faces, placement of abandonment bunds or reshape landform as appropriate (Mesa J hub)	Next LOM Plan
RV61	Confirm material types contained in the Mesa K waste dumps. Closure plan assumes all hydrated waste.	Next Closure Plan
RV62	Complete landform designs for any backfilled waste materials in the Mesa J pits to meet Landform Design Guidelines.	Next Closure Plan
RV63	Complete a rehabilitation design incorporating hydrological considerations for the Mesa K Northern waste dump, including the River and landform location	Next Closure Plan
RV64	Develop detailed closure designs for existing WFSF's at Mesa J	Next Closure Plan
RV66	Complete a surface water closure design for Mesa H, J and K	Before OoM
RV67	Incorporate any Troglofauna pit boundary changes into closure plan at Mesa K.	Next Closure Plan
RV68	Pit 11 backfill – refine location where the backfill volume is likely to come from and the respective rehabilitation design for this area	Next LOM Plan

Appendix F – Landform design criteria

The following tables provide summaries of the key design criteria (where available) of the waste landforms associated with Mesa J Hub.

Please note that these are interim rehabilitation designs and will be refined as the dump approaches rehabilitation.

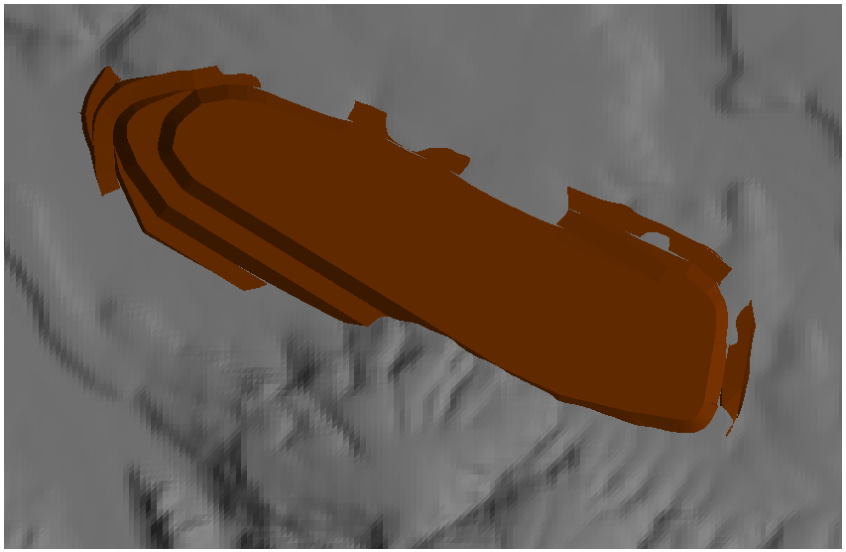
Mesa H SW Dump (Dump 2)

Waste volume		
Erodibility ranking	Moderate - High	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	30	
Topsoil required (Mm^3)	95,074 m^3	

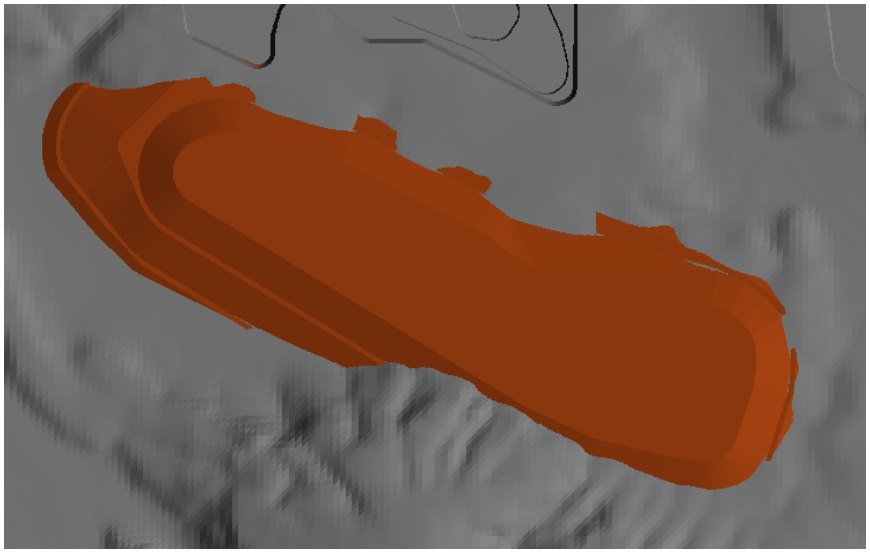
	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	37°	20°
Lift height (m)	20, 10	20, 10
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)		39.2

Comments:
Capped with hydrated waste for erosion mitigation

Construction Design



Rehabilitation Design



Mesa H SE Dump (Dump 3)

Waste volume		
Erodibility ranking	Moderate - High	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	20	
Topsoil required (Mm^3)	362,663 m^3	

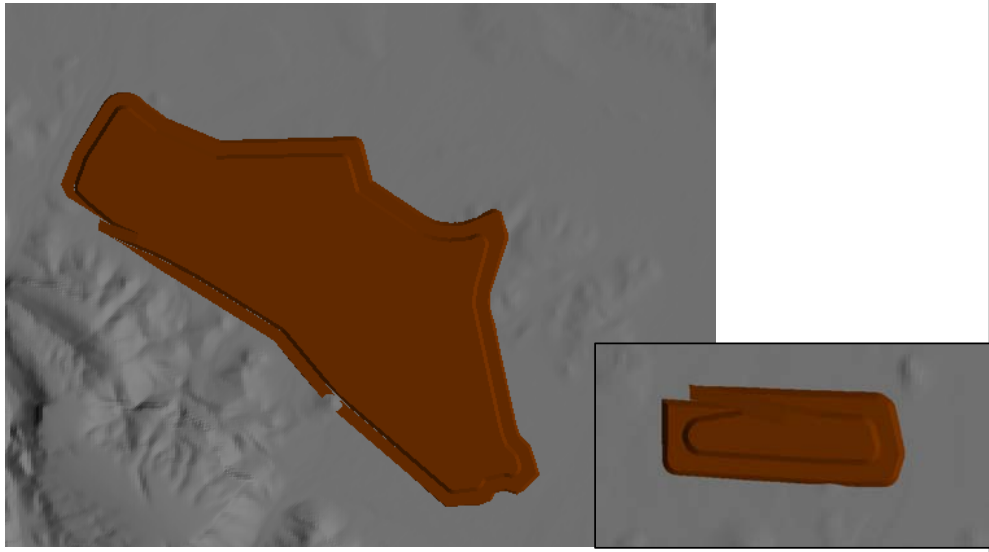
	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	37°	20°
Lift height (m)	10	10
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)		124

Comments:

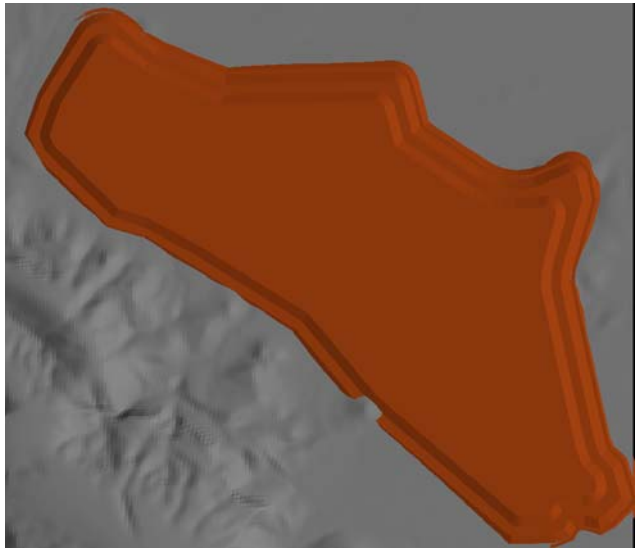
Capped with hydrated waste for erosion mitigation

Rehabilitation design for the extension (inset image) will be completed prior to the next closure plan submission

Construction Design



Rehabilitation Design



Mesa H NE Dump (Dump 4)

Waste volume		
Erodibility ranking	Moderate - High	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	30	
Topsoil required (Mm^3)	185,169 m^3	

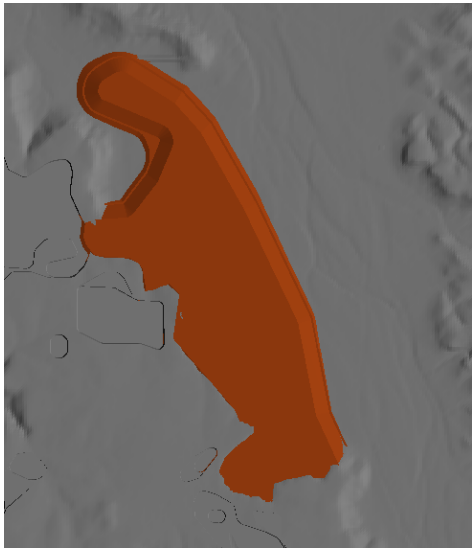
	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	37°	20°
Lift height (m)	20, 10	20, 10
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)		90.81

Comments:

Capped with hydrated waste for erosion mitigation

Construction Design

Rehabilitation Design



Mesa H Pit 1/3/4 backfill

Waste volume		
Erodibility ranking	NA	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	NA	
Topsoil required (Mm^3)	TBC m^3	

	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	NA	NA
Lift height (m)	NA	NA
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)	TBC	TBC

Comments:

No rehabilitation design required as surface is flat

Construction Design

Rehabilitation Design

Mesa H Pit 6/8 backfill

Waste volume		
Erodibility ranking	NA	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	NA	
Topsoil required (Mm^3)	TBC m^3	

	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	NA	NA
Lift height (m)	NA	NA
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)	TBC	TBC

Comments:

No rehabilitation design required as surface is flat

Construction Design

Rehabilitation Design

Mesa H Pit 9 backfill

Waste volume		
Erodibility ranking	NA	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	NA	
Topsoil required (Mm^3)	TBC m^3	

	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	NA	NA
Lift height (m)	NA	NA
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)	TBC	TBC

Comments:

No rehabilitation design required as surface is flat

Construction Design

Rehabilitation Design

Mesa J Boondock

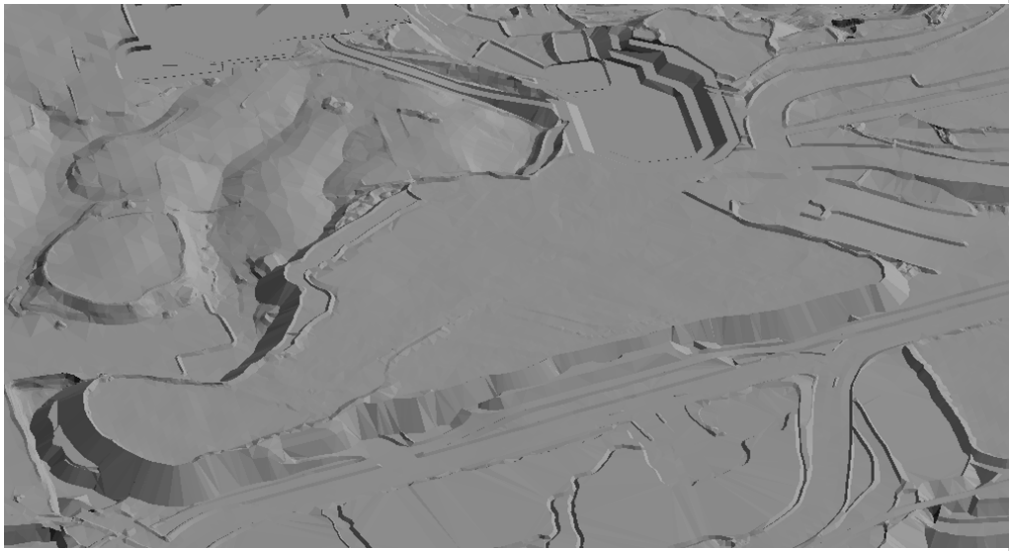
Waste volume		
Erodibility ranking	Low - Moderate	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	20	
Topsoil required (Mm^3)	190, 000 m^3	

	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	37°	20°
Lift height (m)	20	20
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)	51.6	54.8

Comments:

Rehab design pending a construction design extension, based on sterilisation drilling of the area.

Construction Design



Rehabilitation Design

Mesa J Pit 11 in-pit dump

Waste volume		
Erodibility ranking	Low - Moderate	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	25	
Topsoil required (Mm^3)	382, 000 m^3	

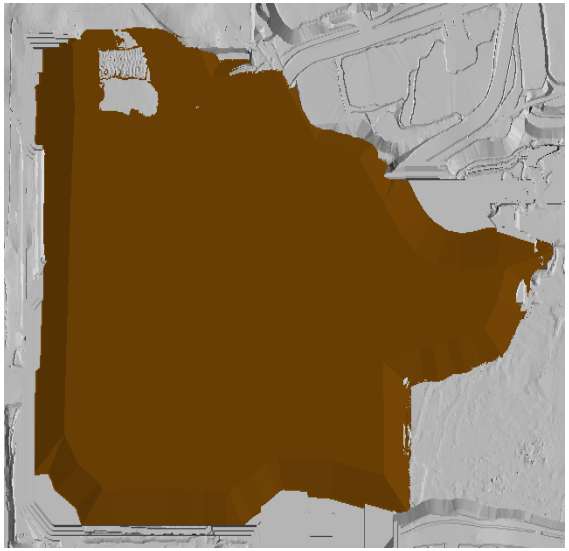
	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	37°	20°
Lift height (m)	25	25
Berm width (m)	NA	NA
Berm slope (deg)	NA	NA
Footprint (ha)	201.8	190.9

Comments:

Design will require review as adjacent WFSF designs are developed

A berm may need to be added if lift height does not meet erodibility requirements

Construction Design



Rehabilitation Design

Mesa J Pit 6 in-pit dump

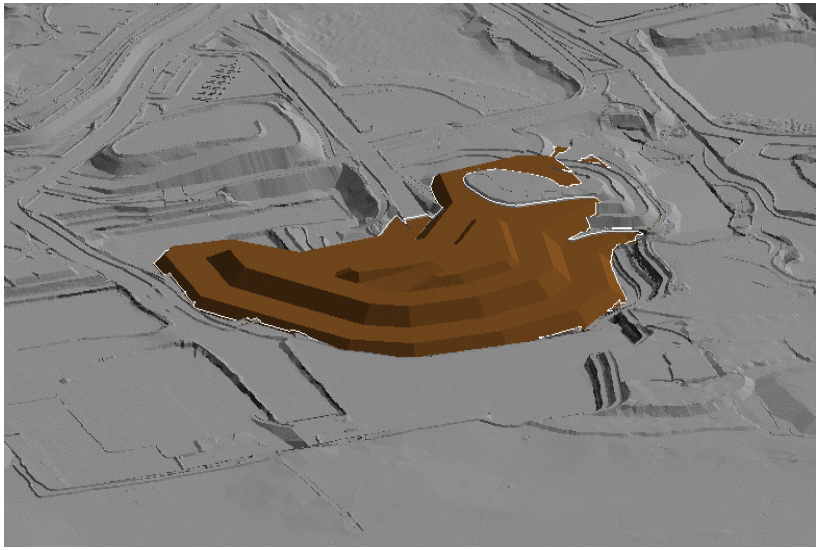
Waste volume		
Erodibility ranking	Low - Moderate	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	54	
Topsoil required (Mm^3)	78, 000 m^3	

	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	37°	20°
Lift height (m)	20, 10	20,10
Berm width (m)	50	25
Berm slope (deg)	0	0
Footprint (ha)	24.3	24.3

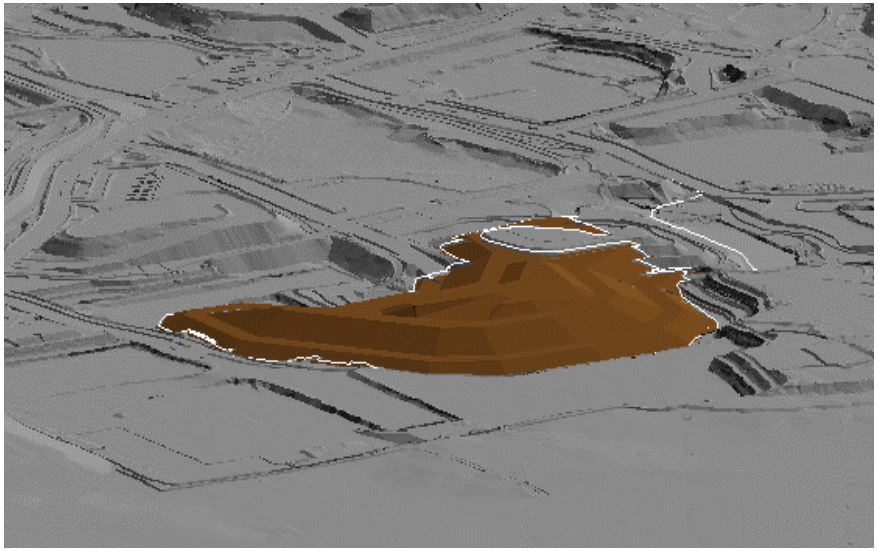
Comments:

Design will require review as adjacent WFSF designs are developed

Construction Design



Rehabilitation Design



Mesa K Northern Dump

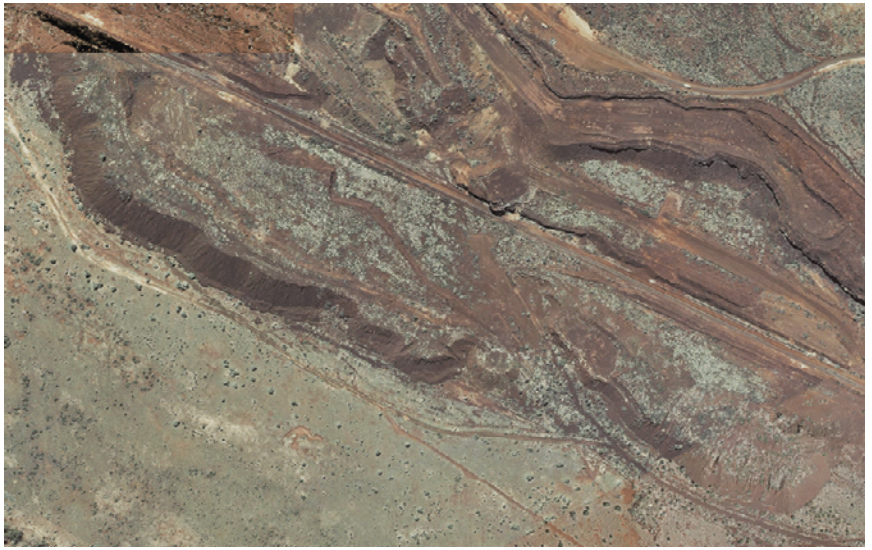
Waste volume		
Erodibility ranking	Low	
Classification	Inert ☒	Capping required at closure:
	PAF ☐	-
	Fibrous minerals ☐	-
	WFSF ☐	-
Overall height (m)	< 35	
Topsoil required (Mm³)	27, 600 m³	

	Construction Specifications	**Rehabilitation Specifications**
Slope angle (deg)	37°	15-20° (North), 20° (South)
Lift height (m)	35	10 (North), 20 (South)
Berm width (m)	NA	Concave (North), 25 (South)
Berm slope (deg)	NA	NA (North), 3° (South)
Footprint (ha)		21.1

Comments:

Design under review due to significant constraints

Construction Design



Rehabilitation Design