BHP Iron Ore Pty Ltd
OB29/30/35 Mine Closure Plan

December 2024, Revision 7

Site code: S0001402

Tenements: ML244SA, ML266SA, G52/277, G52/279

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Document amendment record

Version	Change Effected	Date of Change
1.0	New document prepared for submission with the Orebody 29, 30 and 35 Referral to the EPA	2013
2.0	Internal Revision Updated to reflect the *Guidelines for Preparing Mine Closure Plans* (May 2015). Update to reflect minor changes is business process and approach to Closure Planning across WAIO.	24 August 2015
3.0	Internal Revision Updated to reflect changes in organisational structure, including roles and responsibilities. Updated technical guidance.	September 2016
4.0	Updated for submission to EPA in accordance with Ministerial Statement 963	May 2017
5.0	Amendment to May 2017 version based on government feedback	June 2018
6.0	Three yearly updates on 2018 version approved by government	November 2021
7.0	Three yearly updates on 2021 version to incorporate comments from regulator and support submission of a Significant Amendment Part IV.	December 2024

Submission details

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Executive Summary

The Orebody (OB) 29, OB 30 and OB 35 mining operations (OB29/30/35) are located within BHP's[1] Newman Mining Hub precinct immediately to the south of the Mt Whaleback mining operations and approximately 7 km west of the Newman Township in the eastern Pilbara region of Western Australia (WA) on the lands of the Nyiyaparli people.

The main features at OB29/30/35 requiring closure currently comprise:

- Three below water table pits (OB29, OB30 and OB35).
- An extension of the OB35 pit, named ES PB1.
- Four Overburden Storage Areas (OSAs); two located at OB29 (North and South) and two at OB35 (OSA 1 and OSA 2).
- Access tracks and haul roads.
- Two surface water diversions.
- Dewatering infrastructure.
- Offices.

Future developments which are considered by this Mine Closure Plan (MCP) include:

- Expansion of below water table mine pits at OB29 and OB30.
- Two additional ex-pit OSAs at OB29.
- Extended Development Envelope for installation of a surplus water pipeline between OB29/30/35 and Ophthalmia Dam.

Exclusions from the scope of this MCP include other operations / facilities within the Newman Hub Mining precinct, namely:

- Mt Whaleback mining operations.
- Newman Hub processing / support infrastructure (including the existing Whaleback Creek diversion around the processing stockyard); and
- Whaleback tailings storage facility.

This MCP has been developed to meet:

- Condition 6 of Ministerial Statement 963, which approves mining below the water table at OB29/30/35.

The purpose of this MCP is, therefore, to meet the requirements of:

- Ministerial Statement 963.
- Support the submission of a Significant Amendment Part IV for future developments listed above.
- Department of Energy, Mines, Industry Regulation and Safety (DEMIRS, previously Department of Mines, Industry Regulation and Safety (DMIRS) Statutory Guidelines for Preparing Mine Closure Plans 2020 (DMIRS, 2020a); and
- BHP corporate requirements.

BHP is committed to environmental stewardship. The BHP Charter is the overarching document that articulates the corporate vision and values and what BHP stands for. The first value in the Company Charter is:

> *Do what's right (A sustainable future starts with safety and integrity, building trust with those around us).*

The WAIO closure and rehabilitation objective is to:

> *Develop a safe, stable, non-polluting and sustainable landscape that is consistent with key stakeholder agreed social and environmental values and aligned with creating optimal business value.*

To guide the development and implementation of mine closure and rehabilitation for the Pilbara operations, BHP has established a set of guiding closure principles which are applied to the OB29/30/35 mining operations. The guiding closure principles address post-closure land use, land management, safety, landforms, mine planning, ecosystem sustainability, water, decommissioning, contaminated sites, human resources and community assets.

Table E 1 discusses the key risks and issues by technical area and provides a summary of the activities and actions that would be undertaken prior to closure and post-closure to achieve the closure outcomes described. A forward work program, as identified by the knowledge gaps in the analysis of data, is also provided in Table E 1. Full descriptions and context are provided in the relevant sections of this MCP.

[1] A number of terms have been used to refer to the company in this document:
- BHP refers to the BHP group of companies under parent entities BHP Group Limited and BHP Group Plc
- BHP Western Australian Iron Ore (WAIO) refers to the local Western Australian operation
- BHP Iron Ore Pty Ltd (BHPIO) is the legal company name for licences and approvals

Table E 1 Summary of key risks and management approaches

Technical area	Key risks and issues	Management response	Tools (Processes, plans and guidelines)	Forward work plan
Terrestrial environmental quality Acid Metalliferous Drainage (AMD) Contaminated sites	AMD release from Potentially Acid Forming (PAF) material within OSAs / In-pit Storage Areas (ISAs) or low-grade stockpiles remaining at closure that impacts groundwater and or surface water quality.	The AMD source hazard (including acid, neutral and saline drainage) associated with the OB29/30/35 operations is low. There is predicted to be only minor volumes of AMD 1, 2 and 3. There are predicted to be negligible pit wall exposures of PAF material. The hazards will be managed as follows: • Placement of AMD 1 / 2 / 3 wastes within OSAs so that there is a 10 m layer of Non-Acid Forming (NAF) waste between these materials and the surface of the OSA. • Given the negligible exposures of PAF on pit walls, and the likelihood that any remaining pit lakes will form groundwater sinks, no specific management measures are considered necessary.	• Materials characterisation information is incorporated into mining models. • Geochemical testing and AMD risk assessments. • WAIO standards and procedures: - AMD Management Technical Process Instruction (TPI) (WAIO, 2022a). - BHP Global Mined Material Management Standard (BHP, 2021e). - Reactive Ground and AMD Potential: Mining Design and Dumping Procedure (WAIO, 2022c). - Mines Closure Design Guidance Procedure (WAIO, 2022f) outlines the framework for reactive waste management. - Preliminary AMD Risk Assessment Procedure 0132980 (WAIO, 2022b). - Rehabilitation Planning and Execution Procedure (WAIO, 2023d). • Assessment of compliance to plan. • Pre-closure monitoring including monitoring of surface water and groundwater.	• Undertake gap analysis of existing knowledge of waste characteristics and ongoing characterisation of waste to address gaps and inform final landforms designs, with a focus on confirming competent waste balance. • Further geochemical characterisation as required, including: - Geochemical testing of Tertiary Detritals. - Leach testing of key stratigraphies. - Assessment of the geotechnical hazard of high sulphur Non-Acid Forming (NAF) waste to gain a better understanding of the potential for neutral metalliferous drainage.
	Impact to pit lake quality from AMD			
	Identified areas of contamination are not remediated during operations.	• Remediation of known contamination in accordance with the *Contaminated Sites Act 2003*, as required.	• BHP Contaminated Sites Register and risk-based schedule for investigation.	Investigation of suspected contaminated sites and remediation of known contamination, as required, during operations.
		• Waste disposed to landfills in accordance with the conditions of Environmental Licence L4503/1975/14.	• Conditions of environmental licence L4503/1975/14. • WAIO Waste Management Strategy.	Landfill disposal of anthropogenic asbestos material currently assumes a cover thickness of 2 m. Review the cover thickness based on risk and confirm whether the specification needs to be changed.
Surface water	Surface water flow off-site does not meet acceptable limits.	• The OB30 creek diversion will be upgraded to accommodate closure conditions (10,000-year ARI) to prevent uncontrolled release of surface water to mine voids. • Stability controls for pit walls (such as buttressing or backfill) may be considered where there is the potential for pit wall stability to threaten the integrity of surface water control structures (creek diversions). • Stability modelling for the 'land bridge' section of the OB35 creek diversion shows that stability achieves a Factor of Safety (FoS) of >1.5.	• Surface water assessment and modelling to inform closure strategy, including sensitivity testing. • Internal Design Review Process to verify that closure design guidance has been incorporated. • Materials characterisation informs construction materials selection. • Stability assessments.	• Conduct studies to inform the requirements for closure upgrades to the creek diversions including: - Monitoring of rainfall and surface water flows. - Monitoring of diversion performance. • Review and revise surface water modelling as the site approaches closure to take account of changes due to the construction of creek diversions (and associated upgrades) and changes to drainage characteristics resulting from final landform designs and adjacent mining developments. • Upgrade permanent creek diversions to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments. • Conduct detailed mine void stability analysis to determine whether stability controls such as backfilling or buttressing need to be incorporated to prevent failure of creek diversions post-closure.
Groundwater	Change to groundwater levels from open voids at OB29/30/35 has unacceptable impacts at key receptors.	• The OB29/30/35 operations have been considered in the light of the potential cumulative impacts to groundwater from both OB29/30/35 and the adjacent Western Ridge mine. The current base case for closure is that below water table voids at Western Ridge are backfilled to 5 m above the water table and, at OB29/30/35, will remain open at OB30, will be partially backfilled in the south of OB29 and will be partially backfilled at OB35. This will result in pit lakes forming at OB29 and OB30 and a small pit lake forming in OB35 in the residual void below the water table. Backfill options are currently under review and are dependent on waste rock availability. • Ongoing monitoring of groundwater during dewatering and refinement of groundwater models will continue to inform the closure strategy for OB29/30/35 and mitigation measures will be developed if unacceptable impacts to environmental receptors are identified.	• Conceptual and numerical groundwater modelling inform pit closure strategy and assessment of impacts on ecohydrological receptors. • Eastern Pilbara Water Resource Management Plan. • Newman Potable Source Protection Plan. • Pre-closure monitoring including monitoring of groundwater enables groundwater modelling to be refined.	• Refinement of conceptual and numerical groundwater models based on monitoring of the drawdown pathway during operations. • Refinement of mine void closure strategies based on updated groundwater modelling and mine plans. • Refinement of groundwater monitoring network to improve inputs to Source-Pathway-Receptor assessments for closure.
	Impact to groundwater quality from pit that becomes a temporary through flow system.	• Creek diversions will be upgraded for closure conditions to prevent uncontrolled release of surface water to mine voids.	• Geochemical testing and AMD risk assessment conducted. • Pit wall and land bridge stability assessments inform closure designs. • Surface water assessment and modelling to inform closure strategy, including sensitivity testing.	• Upgrade the OB30 creek diversion to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments. • Conduct detailed mine void stability analysis to determine whether stability controls such as backfilling or buttressing need to be incorporated to prevent failure of creek diversions post-closure.

Technical area	Key risks and issues	Management response	Tools (Processes, plans and guidelines)	Forward work plan
Landforms	Erosion or weathering event exposes buried waste rock and releases waste rock and / or sediment onto downslope areas.	• Segregation of competent hard cap waste at OB29/30/35 and competent waste stratigraphies at Whaleback. • Landform design is based on materials characterisation and the outcomes of erosion modelling. • Surface water modelling and construction of controls to prevent impacts to the stability of OSAs during extreme flood events. This could include rock armouring of the toes of OSAs, relocation of portions of the OSAs out of flood plains (e.g., OSA 1), modification of diversions or the construction of additional surface water flow controls.	• Materials characterisation and erosion modelling (WEPP, SIBERIA). • Inert waste class coding is included within the mining model. • Surface water hydrology assessments. • The Mines Closure Design Guidance Procedure (WAIO, 2022f) informs OSA design. • Internal Design Review Process enables verification that closure design guidance has been incorporated into mine plans. • Assessment of compliance to plan. • Rehabilitation works include construction supervision and post-construction inspections.	• Ongoing review of competent waste balance taking into account Whaleback and OB29/30/35 deposits. • Review and revision of landform designs following changes to OB29/30/35 mine plans and adjacent mining developments. • Upgrade creek diversions to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments.
	Geotechnical instability causes global failure of OSA into pit or adjacent land area.	• Where landforms are located within the zone of instability of the pit, consideration will be given to buttressing pit walls, backfill of the pit or relocation of the landform. In the case of the OB29 West OSA, the OSA will be extended as backfill into the south end of the OB29 pit. • Where flood events could impact the stability of OSAs post-closure, measures for maintaining stability will be implemented which could include rehandling portions of the OSA out of the flood plain, rock armouring of the toes of OSAs, modification of diversions or the construction of additional surface water flow controls. • Material from the OSA 1 that lies within the 1 in 10,000-year flood plain will be relocated or the surface water diversion for closure modified. • Residual mine voids will be left in a geotechnically stable state and, where pit walls do not achieve stability completion criteria (static FoS ≥1.5), buttressing may be considered.	• Geological model (highlights fault zones). • Geotechnical pit model informs pit design. • Pit wall stability assessments. • The Internal Design Review Process identifies pit setbacks and enables verification that closure design guidance has been incorporated into mine plans. • Compliance to plans is assessed and rehabilitation works include construction supervision and post-construction inspections.	• As the site approaches closure: - Conduct detailed pit wall stability assessments and identify the need for controls such as buttressing. - Develop closure designs for creek diversions taking into account the disturbance footprint at closure.
Rehabilitation	Rehabilitation values do not achieve ecological criteria.	• Topsoil reconciliation and waste characterisation for use as growth media. • Use of local provenance seed. • Seed collection and rehabilitation conducted in accordance with procedures and informed by trials.	• Progressive rehabilitation and associated monitoring and feedback loops. • Growth media trials. • Rehabilitation Standard (WAIO, 2023f). • Rehabilitation Planning and Execution Procedure (WAIO, 2023d). • Management of Growth Media for Rehabilitation TPI (WAIO, 2024a). • Seed Management Procedure (WAIO, 2022d). • Weed Management Procedure (WAIO, 2020). • Research by the Botanic Gardens and Park Authority and the University of Western Australia on rehabilitation.	• Investigate locations which may be available for rehabilitation / landform trials. • Further assessment of the plant growth potential of alternate growth media. • Further refinement of the soil and growth media balance to verify sufficient material is available.
Visual amenity	Impact to visual amenity post-mining.	• Options for managing visual impacts post-closure will be incorporated into designs following consultation with stakeholders.	• WAIO Rehabilitation Standard (WAIO, 2023f).	• Consultation with stakeholders.
Site safety and security	Site safety measures fail or are inadequate at closed site or pit.	• Design and install reasonable duty of care control measures including abandonment bunds conforming to DEMIRS guidance (DoIR, 1997) and the outcomes of recent consultation with DEMIRS on abandonment bunds. • Residual mine voids will be left in a geotechnically stable state and, where pit walls do not achieve stability completion criteria (static FoS ≥1.5) or will not allow abandonment bunds to be located outside the zone of instability, buttressing may be considered. • Regular monitoring and maintenance of security measures during the post-closure monitoring and maintenance period. • Infrastructure not being transferred to a third-party post-closure will be removed. • Final landform design engineering to allow for sustainable safe access to places of agreed Traditional Owner significance and to accommodate the post-mining land use. • Fibrous material will be covered by 1 m of inert (non-fibrous) waste.	• Materials characterisation information is incorporated into mining models. • Pit wall stability assessments inform abandonment bund locations. • Geological model (highlights fault zones). • Geotechnical pit model informs pit design. • Mines Closure Design Guidance Procedure (WAIO, 2022f) includes guidance on abandonment bunds. • Internal Design Review Process. • Assessment of compliance to plan.	• Detailed slope stability analysis and assessment of potential interactions with surface water diversions to inform final abandonment bund locations for mine voids remaining at closure. • Consultation with stakeholders on post-closure land use requirements and safe access. • Development of detailed decommissioning and demolition plans. • Undertake a review of the 1 m thick cap over stored fibrous material to confirm the adequacy of the capping approach.

Technical area	Key risks and issues	Management response	Tools (Processes, plans and guidelines)	Forward work plan
Heritage and post-closure land use	Heritage values not achieved post-mining.	• Consultation with Traditional Owners to develop closure strategies to address heritage and cultural values which could include, but not necessarily be limited to: - Closure landform designs. - Maintaining access to sites of significance. - Repatriation of artefacts.	• Archaeological and ethnographic surveys. • Closure execution activities to be approved through the BHP Project Environmental and Heritage Review (PEAHR) process. • Consultation program.	• Consultation with Traditional Owners.
	Land condition is not suited to the post-closure land use.	• Consultation with key stakeholders to inform post-mining land use performance objectives and completion criteria. • Assessment of infrastructure condition prior to transfer.	• Identification of land management requirements through post-closure monitoring and maintenance program. • Consultation program.	• Consultation with post-mining landowners / managers.

Contents

Maps

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Abbreviations

Abbreviation	Meaning
ABA	Acid Base Accounting
AEP	Annual Exceedance Probability
AER	Annual Environmental Report
Ag	Silver
Al	Aluminium
ALUM	Australian Land Use and Management Classification
AMD	Acid and Metalliferous Drainage
ANC	Acid Neutralising Capacity
ANZMEC	Australian and New Zealand Minerals and Energy Council
ARI	Average Recurrence Interval
As	Arsenic
AS/NZS ISO	Australian and New Zealand International Standards Organisation
AWT	Above Water Table
B	Boron
Ba	Barium
BAM Act	*Biosecurity and Agriculture Management Act 2007 (WA)*
BC Act	*Biodiversity Conservation Act 2016 (WA)*
BCM	Bank Cubic Metres
Be	Beryllium
bgl	below ground level
BHPIO	BHP Iron Ore Pty Ltd
BIF	Banded Iron Formation
BoM	Bureau of Meteorology
BWT	Below Water Table
Ca	Calcium
$CaCO_3$	Carbonate
CAP	Corporate Alignment Planning
Cd	Cadmium
CEC	Cation Exchange Capacity
CEO	Chief Executive Officer
Cl	Chloride
Co	Cobalt
COD	Chemical Oxygen Demand
Cr	Chromium
CS Act	*Contaminated Sites Act 2003 (WA)*
CSIRO	*Commonwealth Scientific and Industrial Research Organisation*
Cu	Copper
DBCA	Department of Biodiversity Conservation and Attractions
DEC	Department of Environment and Conservation (now the Department of Water and Environmental Regulation and the DBCA)
DEMIRS	Department of Energy, Mines, Industry Regulation and Safety
DER	Department of Environment Regulation (now Department of Water and Environmental Regulation)
DMIRS	Department of Mines, Industry Regulation and Safety (now Department of Energy, Mines, Industry Regulation and Safety)
DMP	Department of Mining and Petroleum (now Department of Energy, Mines, Industry Regulation and Safety)
DoIR	Department of Industry and Resources (now Department of Energy, Mines, Industry Regulation and Safety)
DoW	Department of Water
DPIRD	Department of Primary Industries and Regional Development
DPLH	Department of Planning, Lands and Heritage
DPS	Definition Phase Study

Abbreviation	Meaning
DSD	Department of State Development (now Department of Jobs, Tourism, Science and Innovation)
DSI	Detailed Site Investigation
DWER	Department of Water and Environmental Regulation
EC	Electrical Conductivity
EP Act	*Environmental Protection Act 1986 (WA)*
EPA	Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)*
ES PB1	*Eastern Syncline Pushback 1*
ESP	Exchangeable Sodium Percentage
F	Fluoride
Fe	Iron
FoS	Factor of Safety
GAI	Global Abundance Index
GDE	Groundwater Dependent Ecosystem
GL	Gigalitres
GLD	Group Level Document
GPS	Global Positioning System
ha	Hectare
HCO_3	Bicarbonate
Hg	Mercury
IBRA	Interim Biogeographic Regionalisation for Australia
IFD	Intensity Frequency Duration
IODP	Interest Only Deposited Plan
IPCC	Intergovernmental Panel on Climate Change
IPS	Identification Phase Study
ISA	In-pit Storage Area
IUCN	International Union for Conservation of Nature
JTSI	Department of Jobs Tourism Science and Innovation
K	Potassium
km	Kilometre
Ke	Effective hydraulic conductivity
Ki	Inter-rill erodibility
km	Kilometres
km^2	Kilometre squared
KNAC	Karlka Nyiyaparli Aboriginal Corporation
KR	Rill erodibility
LoA	Life of Asset
LCM	Loose Cubic Metres
LoM	Life of Mine
m	Metre
m^2	Metre squared
m^3/s	Cubic metre per second
m AHD	Metres above Australian Height Datum
MAR	Managed Aquifer Recharge
MAR	Mandatory Audit Report
MCA	Minerals Council of Australia
MCP	Regulatory Mine Closure Plan
Mg	Magnesium
mg/L	Milligrams per litre
ML	Megalitres
mm	Millimetres

Abbreviation	Meaning
Mn	Manganese
Mo	Molybdenum
MPA	Maximum Potential Acidity
MRF	Mining Rehabilitation Fund
mRL	Metres reduced level
MS	Ministerial Statement
N	Nitrogen
Na	Sodium
NAF	Non-Acid Forming
NAG	Net Acid Generation
NAPP	Net Acid Production Potential
NEMP	National Environmental Management Plan
Ni	Nickel
NO_3	Nitrate
NVCP	Native Vegetation Clearing Permit
OB	Orebody
OB 29/30/35	Orebody 29, 30 and 35
OEPA	Office of the Environmental Protection Authority (now Department of Water and Environmental Regulation)
OSA	Overburden Storage Area
P	Phosphorus
PAF	Potentially Acid Forming
Pb	Lead
PEAHR	Project Environmental and Heritage Review
PEC	Priority Ecological Community
PFAS	Per- and polyfluoroalkyl substances
PFOS	Perfluorooctane Sulfonic Acid
pH	Numeric scale used to specify acidity or basicity
PMF	Probable Maximum Flood
PSI	Preliminary Site Investigation
RAP	Remediation Action Plan
RCP	Representative Concentration Pathway
ROM	Run Of Mine
RORB	Runoff Routing (software)
RULSE	Revised Universal Soil Loss Equation
S	Sulphur
SAP	Sampling and Analysis Plan
Se	Selenium
SERA	National Standards for Ecological Restoration
SO_4	Sulphate
SPE	Selection Phase Study
SRE	Short Range Endemic
SS	Suspended Solids
SWIA	Surface Water Impact Assessment
TARP	Trigger Action Response Plan
tc	Critical Shear
TDS	Total Dissolved Solids
TEC	Threatened Ecological Community
TPI	Technical Process Instruction
TRH	Total Recoverable Hydrocarbons
TSF	Tailings Storage Facility
TSS	Total Suspended Solids

Abbreviation	Meaning
UC-NAF	Uncertain Non-Acid Forming
VAR	Voluntary Audit Report
WA	Western Australia
WABSI	Western Australian Biodiversity Science Institute
WAIO	BHP's Western Australian Iron Ore operations
WEPP	Water Erosion Prediction Project
WMAT	Waste Material
Zn	Zinc
ZOI	Zone of Instability

1 Introduction

BHP Iron Ore Pty Ltd (BHPIO) operates Orebody (OB) 29, OB30 and OB35 (OB29/30/35) mining operations as part of the larger Mount Whaleback (Mt Whaleback) mining operations in BHP's Newman Hub in the Eastern Pilbara region of Western Australia (WA), which also includes the existing Mt Whaleback mine and the approved Western Ridge mine. The site is situated approximately 7 kilometres (km) west-south-west of the Newman Township (Map 1-1).

Above water table (AWT) mining at OB29/30/35 commenced in 1974 at OB29, with approval for mining of OB30 and OB35 granted in 1999. Approval for below water table (BWT) mining at OB29/30/35 was granted in 2014. Mining of the orebodies is currently expected to continue until approximately 2065 under the current mine plan.

1.1 Purpose of the plan

This Mine Closure Plan (MCP) is being submitted:

- As an update to the 2021 OB29/30/35 MCP in accordance with Condition 6 of Ministerial Statement (MS) 963.
- To support the Orebody 29/30/35 Significant Amendment Part IV approval submission.

The MPC describes how the OB29/30/35 operation and associated infrastructure within the Closure Plan Area (see Map 1-2) will be rehabilitated and closed in a manner that is consistent with:

- Condition 6 of Ministerial Statement 963;
- Department of Energy, Mines, Industry Regulation and Safety (DEMIRS) Guidelines for Preparing Mine Closure Plans (DMIRS, 2020a; 2020b); and
- BHP[2] corporate requirements.

The MCP will be used by BHP Western Australia Iron Ore (WAIO) and its contractors in the implementation of appropriate rehabilitation and mine closure strategies at OB29/30/35.

The MCP will be revised at intervals of three years.

1.2 MCP Scope

The scope of this MCP addresses the Orebody 29/30/35 (herein referred to as OB29/30/35 Closure Plan Area, which includes the Eastern Syncline Pushback 1 (ES PB1) and supporting infrastructure (see Section 2.1 for further details).

A Part IV Significant Amendment is also being sought for expansion of activities to include:

- Expanded pits for OB29 and OB30 and a minor addition of a ramp on OB35
- Two new ex-pit Overburden Storage Areas (OSA) at OB29
- An increase in groundwater abstraction from the currently approved 8 gigalitres per annum (GL/a) to 24.5 GL/a.
- An increase in discharge of surplus water to Ophthalmia Dam[3] from the currently authorised extend of 8 GL/a to 20.8 GL/a.
- The construction of a new pipeline, largely within existing cleared and disturbed areas[4], with the capacity to distribute additional surplus water to Ophthalmia Dam. The pipeline corridor is largely outside of the OB29/30/35 Closure Plan Area (see Map 2-1).

1.3 Document history

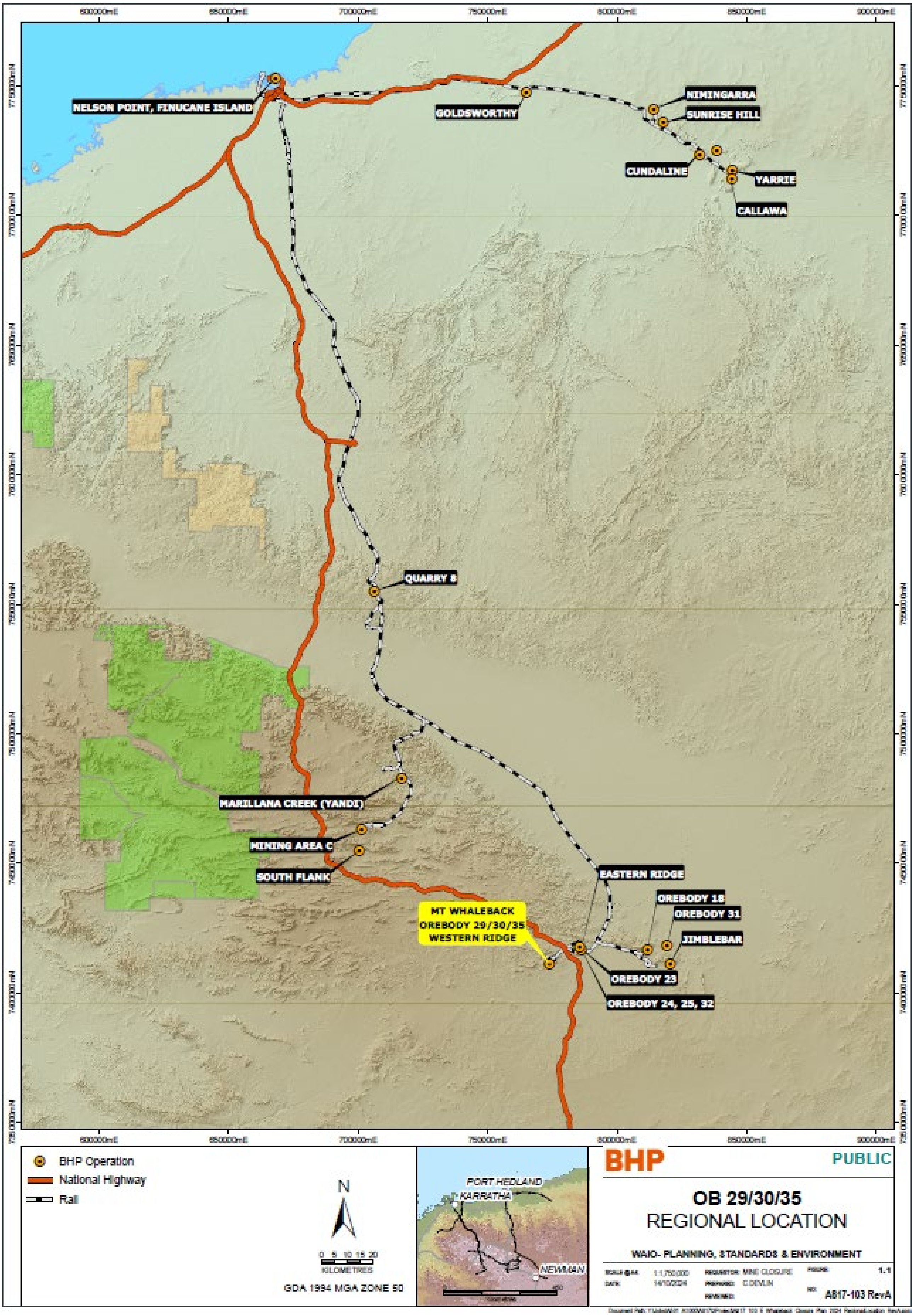
BHP submitted a draft MCP for OB29/30/35 with the submission of a referral to the Environmental Protection Authority (EPA) under the *Environmental Protection Act 1986* (EP Act) for proposed below water table mining operations in 2013. This was updated in 2017 for submission to the EPA in accordance with Ministerial Statement 963, and again in 2018 in response to feedback on the 2017 plan. Based on the revision interval of three years, the MCP was revised and submitted in 2021 as Revision 6.

This current iteration of the MCP is Revision 7.

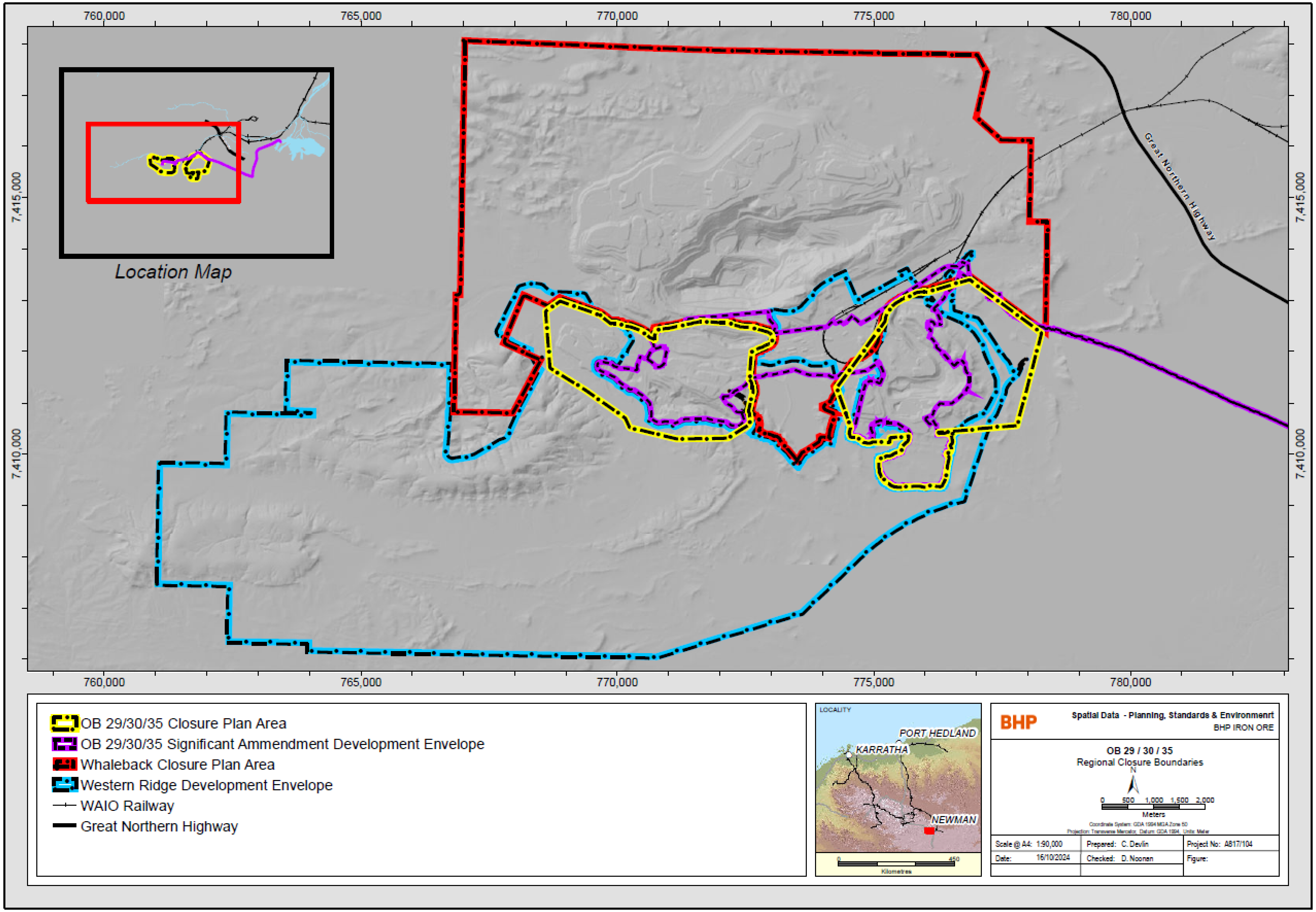
[2] A number of terms have been used to refer to the company in this document:
- BHP refers to the BHP group of companies under parent entities BHP Group Limited and BHP Group Plc
- BHP Western Australian Iron Ore (WAIO) refers to the local Western Australian operation
- BHP Iron Ore Pty Ltd (BHPIO) is the legal company name for licences and approvals

[3] Closure of the Ophthalmia Dam is included in a separate MCP (BHP, 2023n) and so is excluded from the scope of this MCP.

[4] The new pipeline follows the same path as the existing pipeline and discharges into the Ophthalmia Dam as along same corridor as the existing pipeline. Both the existing pipeline and the Ophthalmia Dam are included in a separate MCP (BHP, 2023n) and so are not included in this MCP.



Map 1-1 OB29/30/35 regional location



Map 1-2 **Relationship between the OB29/30/35 Closure Plan Area and Significant Amendment Development Envelope and Surrounds**

1.4 BHP business guidance

BHP is committed to environmental stewardship. The BHP Charter is the overarching document that articulates the corporate vision and values and what BHP stands for. The first value in the Company Charter is:

Do what's right (A sustainable future starts with safety and integrity, building trust with those around us).

This commitment provides the starting point from where the mine closure and rehabilitation policy and procedures begin. The remaining values are integrity, respect, performance, simplicity and accountability.

A series of Global Standards (previously *Our Requirements* documents) that underpin the Charter have been developed which describe the performance requirements and accountabilities for definitive business obligations, processes, functions and activities. Compliance with these documents ensures minimum standards are met for all BHP operations.

The *Global Standards* considered relevant to Mine Closure include:

- **Closure and Legacy Management** – as stewards of the land on which we operate and members of the communities which host us, we have a responsibility to leave a sustainable, positive legacy for host communities, the environment and future land users. In line with Our Purpose and Our Charter, delivering optimised closure outcomes and objectives supports our licence to operate, our commitment to social value and our aspiration to build a better world. BHP's closure management process manages closure risks throughout the entire lifecycle of a site by considering BHP's values, external expectations, safety and costs, while addressing legal obligations and public commitments (BHP, 2023c).
- **Environment and Climate Change Standards** – we acknowledge that the nature of our operations can have adverse or positive environmental impacts, and that climate change can amplify the sensitivities of our natural systems. We identify and assess environment and climate related risks and aim to minimise impacts through every stage of our operations and contribute to resilience of, and positive impact to, the natural environment. We also recognise that our environmental performance and management of our environmental impacts on our host communities is an important part of our contribution to social value (BHP, 2023k; 2023i).
- **Risk Management** – through the delivery of best-in-class risk management, we protect what BHP has today and grow value for tomorrow. The identification and management of risks is central to achieving our strategic objectives. An essential element of effective risk management is to have an enterprise view so that the full risk exposure can be prioritised, and the aggregate impact from cumulative risks can be understood. As such, BHP operates to one Risk Framework for all risks (BHP, 2023f).
- **Corporate Alignment Planning** – the Corporate Alignment Planning (CAP) process is fundamental to creating alignment across the organisation; it guides the development of plans, targets and budgets to help us decide where best to deploy capital and invest resources with the fundamental aim of delivering sector leading operational performance, financial returns and social value. The CAP process has two discrete phases: it starts with directional planning to understand the strategic options and growth plans to maximise long-term value of our assets; then moves into delivery planning, which focuses on short and medium-term plans to deliver against the agreed strategic objectives. We regularly review our strategy against the constantly changing external environment to capture the risks and opportunities presented and cascade any changes through our planning processes. The intent of the CAP process and deliverables is to facilitate robust discussion, informed decision-making and disciplined delivery of quality planning outcomes (BHP, 2023a).
- **Global Investment Process and Capital Projects** – our investments are governed by a single process which is structured in phases so that appropriate levels of work and associated reviews can be done to support the business case and a decision on whether an investment should progress. These requirements are designed to make sure that investments and capital projects have gone through the appropriate level of study, critical thinking and planning so that they are aligned with BHP's strategy and values, are technically achievable and maximise financial and social value (BHP, 2023d; 2023g).
- **Community and Indigenous Peoples and Social Value and Sustainability Standards** – working openly with the communities in which we operate, and with government, contributes to economic and social development and social licence to operate (BHP, 2023h; 2023o).

From the Charter and Global Standards flow various business level documents and procedures that provide a framework for the application of the corporate vision and values with respect to mine closure planning and rehabilitation. These include, for example:

- Closure and Rehabilitation Management Strategy (WAIO, 2016);
- Closure Planning Standard (BHP, 2021b);
- Rehabilitation Standard (WAIO, 2023f);
- Closure Provision and Life of Asset Cost Procedure (WAIO, 2017);
- Mined Materials Management Standard (BHP, 2021e);
- Acid and Metalliferous Drainage Management Standard (WAIO, 2022a);
- Biodiversity Strategy (WAIO, 2018c);
- Environment and Climate Change Management Procedure (WAIO, 2019a);
- Mines Closure Design Guidance Technical Process Instruction (WAIO, 2022f); and
- Water Management (WAIO, 2022g).

It should be noted that the procedures and standards referenced in this document are periodically updated and where there is a difference between the procedure referenced in this plan and the controlled version in BHP's document system, the version in the document system takes precedence.

1.5 Navigating this document

The pdf of this document has been saved with bookmarks that can be used to quickly navigate between sections and appendices. To access these bookmarks, the navigation pane will need to be opened. The location of this pane is dependent on the browser used, but typically can be identified from a bookmark icon.

2 Project summary

2.1 OB29/30/35 mining operations overview

The OB29/30/35 mining operations are located within the BHP Newman Mining Hub precinct immediately to the south of the Mt Whaleback mining operations (Map 1-1) and approximately 7 km west-south-west of the town of Newman. This MCP focuses specifically on the OB29/30/35 mining operations and associated infrastructure, referred to throughout this MCP as the OB29/30/35 Closure Plan Area. Exclusions from the scope include other operations / facilities within the Newman Hub Mining precinct, namely:

- Mt Whaleback mining operations;
- Newman Hub processing / support infrastructure (including the existing Whaleback Creek diversion around the processing stockyard, the rail loop and Ophthalmia Dam and associated infrastructure); and
- Whaleback tailings storage facility.

Whaleback Mine, Western Ridge and Eastern Ridge mining areas are addressed under separate MCPs and therefore are not discussed further in this document. The spatial relationship between the different closure planning areas is shown in Map 1-2.

2.1.1 History

The OB29/30/35 above the water table mining operations were approved under, and are subject to, the *Iron Ore (Mount Newman) Agreement Act 1964* and the *Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972* (McCamey's State Agreement).

Orebody 29 (OB29) above water table mining operation commenced in 1974 with further development of OB29 approved under a State Agreement Act Development Proposal in 1988 (Iron Ore BHP-Utah Minerals International 1988).

The Orebody 30 (OB30) and Orebody 35 (OB35) above water table mining operations were approved under a State Agreement Act Project Proposal in 1999 (BHPIO 1999). OB35 above water table mining operations were referred to the WA EPA in 2011, under s38 of the EP Act, with the EPA decision being "Not Assessed – Public Advice Given".

The Minister for the Environment issued Ministerial Statement 963 in 2014, approving mining below the water table at OB29/30/35, following an Assessment on Proponent Information by the EPA under the EP Act.

Approval for the ES PB1 mining operation was sought via State Agreement development proposals which were submitted in November 2020 and approved in February 2021.

A Part IV Significant Amendment is currently being sought.

2.1.2 Current operations

The OB29/30/35 and ES PB1 deposits are mined to supply Marra Mamba ore to blend with the Brockman ore from the Mt Whaleback operations.

BHP plans to use existing open pit mining techniques, ore processing methods, and supporting mine infrastructure (maintenance, fuel, administration) over the life of the OB29/30/35 operations. Major components of existing mining infrastructure and activities within the OB29/30/35 Closure Plan Area comprise:

- Three below water table pits (OB29, OB30 and OB35).
- An extension of the OB35 pit, named ES PB1.
- Four OSAs; two located at OB29 (OB29 OSA North and OB29 OSA South) and two at OB35 and OB30 (OSA 1 and OSA 2).
- Two creek diversions:
  - Diversion of Whaleback Creek to enable the expansion of the OB30 pit (OB30 creek diversion).
  - Downstream diversion of Southern Creek to enable the western end of the OB35 pit to be mined (OB35 creek diversion[5]).
- Access tracks and haul roads.
- Dewatering infrastructure. Surplus water is transported via current Mt Whaleback Hub water infrastructure, covered under a separate MCP (BHP, 2023n), and disposed at licensed discharge points into the Ophthalmia Dam artificial recharge system, located approximately 12 km east of the OB29/30/35 Closure Plan Area via existing pipeline infrastructure, covered under other MCPs.
- Offices.

[5] The OB35 creek diversion was previously known as the Phase 2 diversion because it was part of a two-phase diversion of Southern Creek. Phase 1 of the diversion is covered by a separate MCP (BHP, 2023m).

2.1.3 Future developments

BHP is seeking approval for expansion of existing mine pits (OB30 and OB29), minor additional disturbance at OB35 to install a ramp, construction of an additional OSA (OB29 OSA East) and expansion of an existing OSA (OB29 OSA South) to form a new OSA (OB29 OSA West).

In addition, approval is being sought to increase the rate of groundwater abstraction for mine dewatering at OB29/30/35 and to increase the allowable volume for surplice discharge to Ophthalmia Dam[6]. This will require the construction of a new pipeline with the capacity to distribute additional surplus water. The proposed pipeline will be largely located on previously cleared or disturbed areas that are included under a separate MCP (BHP, 2023n). However, aspects of the new pipeline that are relevant to closure are briefly discussed in this MCP for completeness.

This plan considers the implications of these future developments for closure.

2.2 Closure features and domains

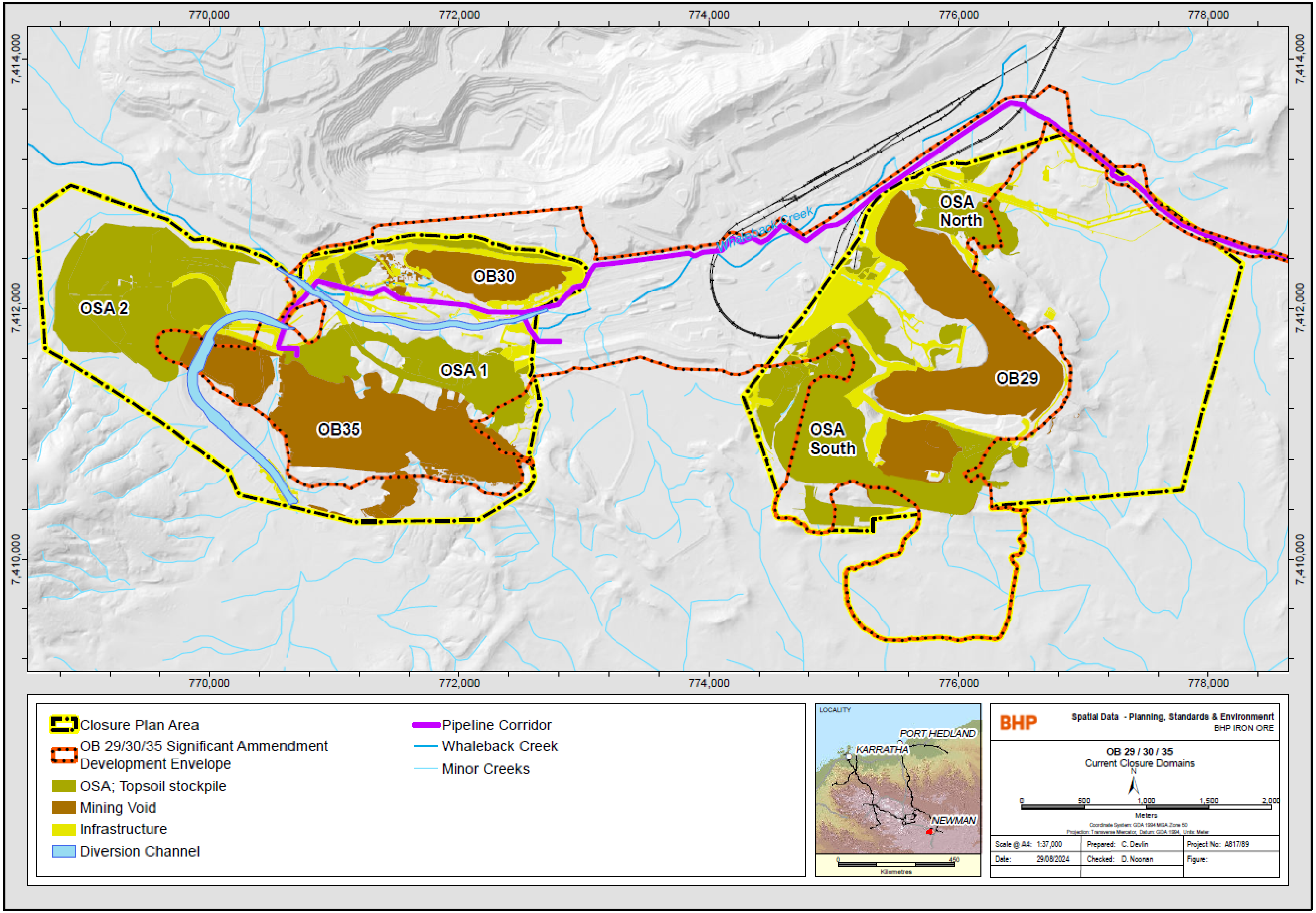
To facilitate effective mine closure planning, the OB29/30/35 mining operations have been divided into several physically distinct domains and features (Table 2-1). The domains are comprised of features that have similar rehabilitation and closure requirements and are shown on Map 2-1 and Map 2-2. Map 2-1 shows areas that have been disturbed as of June 2024, and Map 2-2 shows indicative footprints of total predicted disturbance including areas yet to be disturbed (see Table 2-1 for breakdown by Mining Rehabilitation Fund (MRF) category).

Table 2-1 Domains and features of the operations

Domain	MRF Class	Current Footprint (ha)	Future Footprint (ha)	Feature
OSAs / ISAs/ stockpiles / Run of Mine (ROM) pads	Overburden Class 1	688.91	802.39	**Current** OB29 (OB29 OSA North and OB29 OSA South), OB35 and OB30 (OSA 1 and OSA 2). **Future** One additional OSA (OB29 OSA East) and the expansion of the existing OB29 OSA South to form a newly named OSA called OB29 OSA West.
	Overburden Class 2			
	Topsoil			Topsoil stockpiles.
	Low Grade Ore Class 1			Low grade ore stockpiles.
	Low Grade Ore Class 2			
	Mine Void In-pit Storage Area (ISA)[3]	Within mine void footprint		**Current** OB35 ISA OB29 ISAs
Sub-total		**688.91**	**802.39**	
Mine Voids	Below Water Table	517.90	687.24	**Current** OB29, OB30, OB35 and ES PB1 – below water table mining. **Future** OB35 ramp
Sub-total		**517.9**	**687.2**	
Infrastructure *Note the rail loop is included in the Whaleback MCP* (BHP, 2023n)	Borefield	0.96	0.96	Dewatering bores.
	Building other than workshop or camp	1.32	1.32	OB29 crib room; emergency services training facility; water tank and standpipe.
	Plant site	1.53	1.53	
	Evaporation pond	0.81	0.81	Evaporation pond.

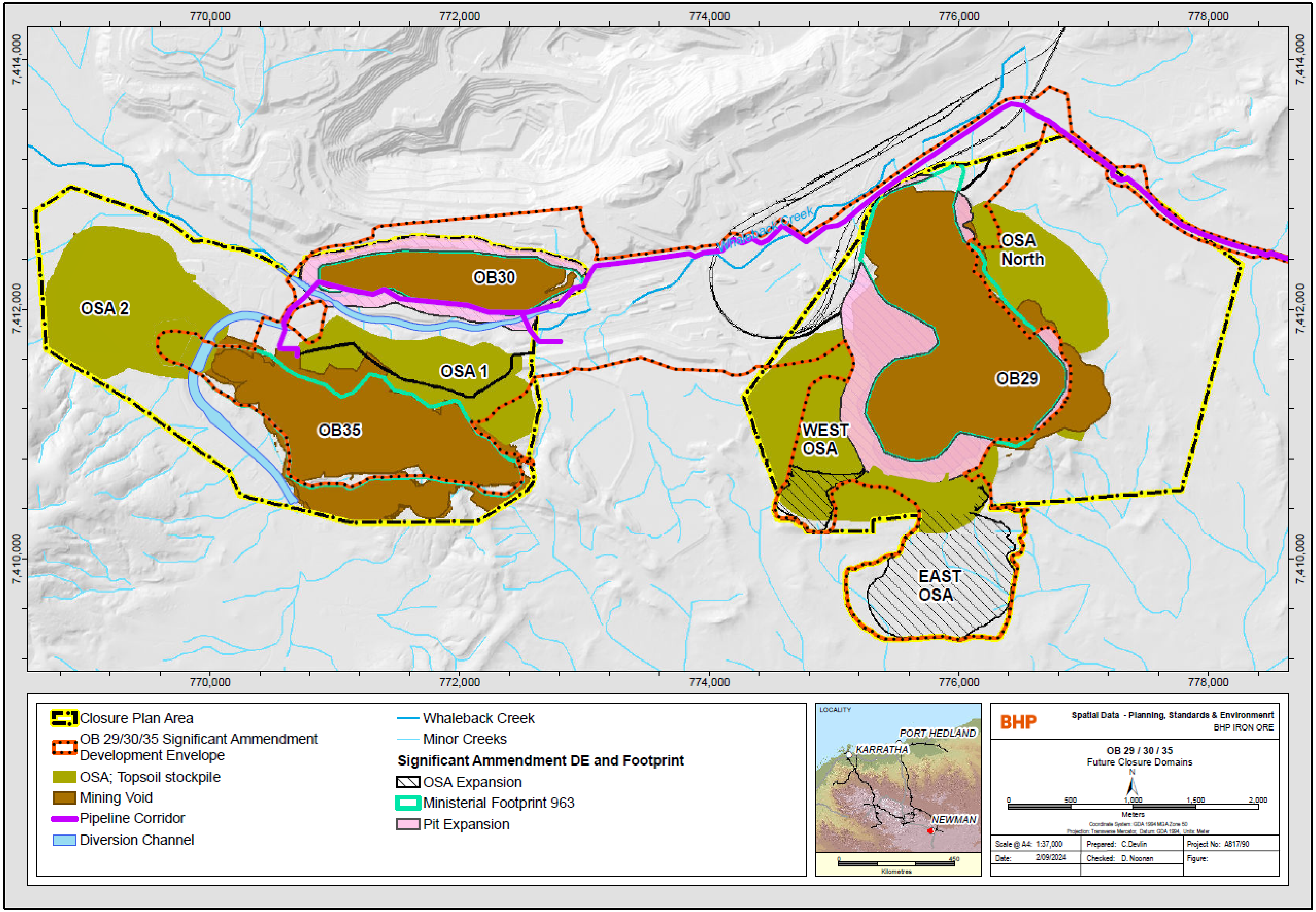
[6] Closure activities associated with Ophthalmia Dam are outside of the scope of this MCP.

Domain	MRF Class	Current Footprint (ha)	Future Footprint (ha)	Feature
	Laydown / hard stand	6.11	6.11	Laydown area.
	Other disturbed areas	113.83	113.83	OB29 putrescible landfill and asbestos waste disposal area, borrow pits.
	Transport or infrastructure corridor	119.61	119.61	Main access road; haul roads; access tracks; railway.
	Pipeline	-	23.64	Surplus water pipeline from OB29/30/35 to Ophthalmia Dam.
Sub-total		**244.17**	**267.81**	
TOTAL		**1,450.98**	**1,757.40**	
Creek diversions & flood protection works	Diversion channel or drain	89.57	89.57	**Current** OB30 flood protection bund and rock armoured creek bank OB30 Creek Diversion OB35 Creek Diversion
Rehabilitated land	Rehabilitation	75.08	Dependent on post-closure land use[4]	Various



Refer to Appendix N for a pdf version

Map 2-1 Closure domains – current disturbance



Refer to Appendix N for a pdf version

Map 2-2 **Closure domains – future predicted disturbance**

2.3 Estimated completion date

The FY24 life-of-mine (LoM) planning indicates the projected date for OB29/30/35 mining completion is 2065. BHP undertakes regular reviews of the LoM planning based on business priorities, resource availability and market demand.

2.4 Tenure & ownership

The OB29/30/35 mining operations are managed and operated by BHPIO on behalf of the owners, being BHP Iron Ore (Jimblebar) Pty Ltd and the Mount Newman Joint Venture which comprises:

- BHP Minerals Pty Ltd (85%).
- Mitsui-Itochu Iron Pty Ltd (10%).
- ITOCHU Minerals & Energy of Australia Pty Ltd (5%).

The tenure of the OB29/30/35 mining operation and the ownership of each tenement is shown on Map 2-3 and detailed in Table 2-2 along with the legislation under which tenure has been granted.

Table 2-2 Whaleback and OB29/30/35 mining operations tenements summary

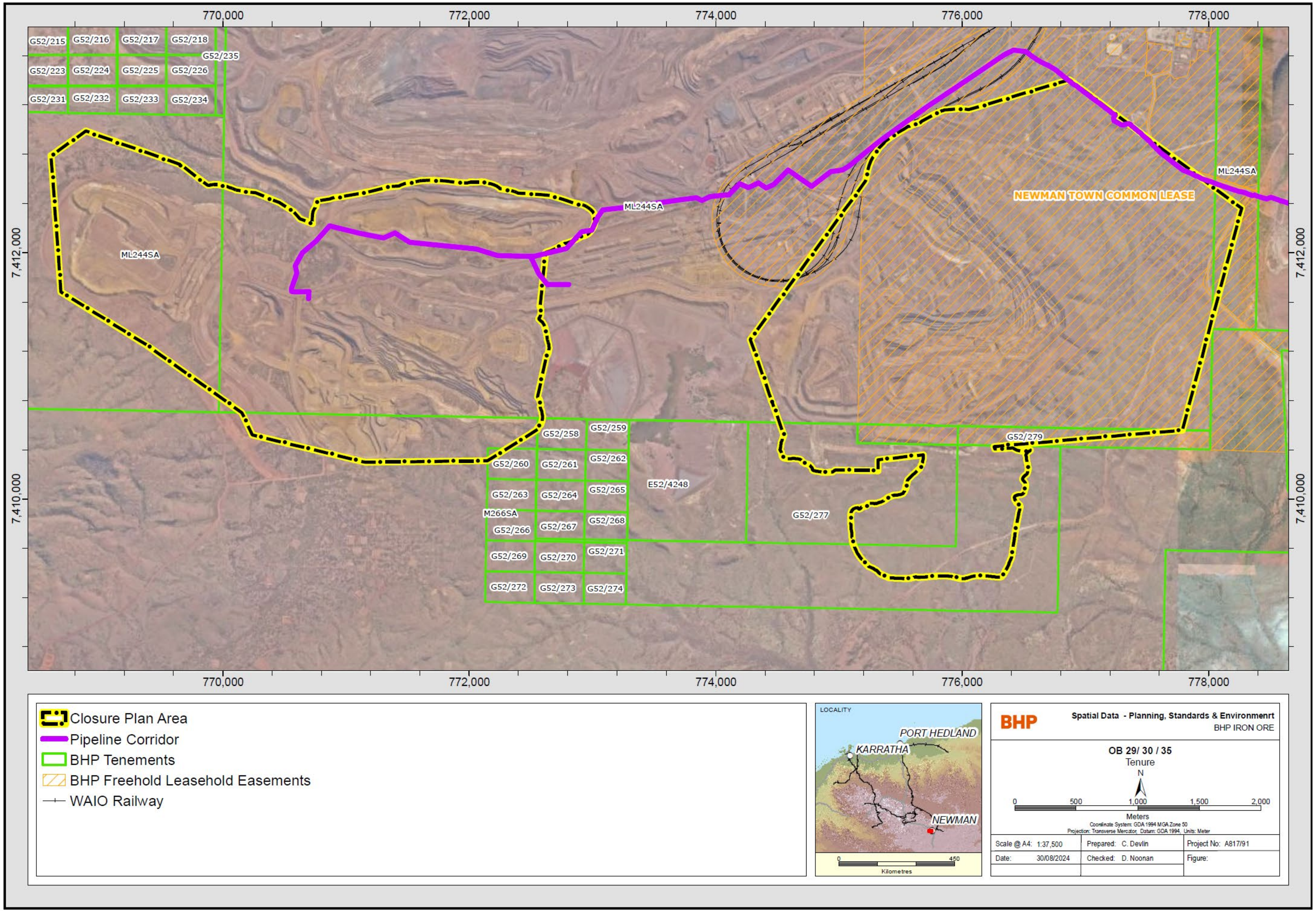
Lease	Purpose	Legislation	Ownership
Mineral Lease 244SA	Mt Whaleback Mine and Orebody 29/30/35 Mine	*Iron Ore (Mount Newman) Agreement Act 1964 (WA)*	BHP Minerals Pty Ltd (85%), Mitsui-Itochu Iron Pty Ltd (10%), ITOCHU Minerals and Energy of Australia Pty Ltd (5%)
Mining Lease 266SA	Orebody 35 Mine	*Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972 (WA)*	BHP Iron Ore (Jimblebar) Pty Ltd (100%)
General Purpose Lease 52/277	For all purposes incidental to mining and related operations under the State Agreement. Used for topsoil storage adjacent to OB29.	*Iron Ore (Mount Newman) Agreement Act 1964 (WA)* *Mining Act 1978 (WA)*	BHP Minerals Pty Ltd (85%), Mitsui-Itochu Iron Pty Ltd (10%), ITOCHU Minerals and Energy of Australia Pty Ltd (5%)
General Purpose Lease 52/279	For all purposes incidental to mining and related operations under the State Agreement. Used for topsoil storage adjacent to OB29.	*Iron Ore (Mount Newman) Agreement Act 1964 (WA)* *Mining Act 1978 (WA)*	BHP Minerals Pty Ltd (85%), Mitsui-Itochu Iron Pty Ltd (10%), ITOCHU Minerals and Energy of Australia Pty Ltd (5%)
Crown Lease K858923	Construction or development of the demised premises of a greenbelt and roads and ancillary facilities and amenities for the mine townsite and the town common surround the mine townsite	*Iron Ore (Mount Newman) Agreement Act 1964 (WA)* *Land Administration Act 1997 (WA)*	BHP Minerals Pty Ltd (85%), Mitsui-Itochu Iron Pty Ltd (10%), ITOCHU Minerals and Energy of Australia Pty Ltd (5%)
Crown Lease I150289	Crown Least (Newman Dust Suppression Pipeline)	*Iron Ore (Mount Newman) Agreement Act 1964 (WA)* *Land Administration Act 1997 (WA)*	BHP Minerals Pty Ltd (85%), Mitsui-Itochu Iron Pty Ltd (10%), ITOCHU Minerals and Energy of Australia Pty Ltd (5%)
Crown Lease N088235	Crown Lease (Newman Water Supply)	*Iron Ore (Mount Newman) Agreement Act 1964 (WA)* *Land Administration Act 1997 (WA)*	BHP Minerals Pty Ltd (85%), Mitsui-Itochu Iron Pty Ltd (10%), ITOCHU Minerals and Energy of Australia Pty Ltd (5%)

The contact details for BHP Iron Ore Pty Ltd are:

BHP Iron Ore Pty Ltd
City Square
125 St Georges Terrace
PERTH WA 6000
Phone: +618 6321 0000

The mine is located on the land of the Nyiyaparli people (Native Title Determination [WCD2018/008]), with their connection to the land stretching back over 40,000 years.

The underlying tenure for OB29/30/35 comprises unallocated crown land (Map 2-3).



Refer to Appendix N for a pdf version

Map 2-3 OB29/30/35 tenure overview

3 Closure obligations and commitments

The management measures contained within this MCP have been developed with reference to State government rehabilitation requirements, policies and guidance statements. A legal obligations register is provided in Appendix A.

3.1 Part IV EP Act 1986 Approvals

The EP Act provides for the establishment of the EPA, which has the objective of overseeing the prevention, control and abatement of pollution and environmental harm, and the conservation, preservation, protection, enhancement and management of the environment. The EPA has developed policies to assist with achieving its objective. These include policies on the use of the precautionary principle, the principle of intergenerational equity, the principle of the conservation of biological diversity and ecological integrity, principles relating to improved valuation, pricing and incentive mechanisms and the principle of waste minimisation.

Part IV of the EP Act establishes provisions for the EPA to carry out formal Environmental Impact Assessments of proposals which may have a significant impact on the environment and the setting of statutory conditions by the Minister for the Environment. The development of OB35 above the water table was formally referred to the EPA in 2011; the EPA assigned a level of assessment for this application as ‘Not Assessed – Public Advice Given’. Above water table mining has, therefore, been undertaken under a Native Vegetation Clearing Permit (NVCP) (Section 3.2.1). Approval to mine below the water table was sought via the below water table mining referral submitted in 2013 (BHP Billiton, 2013a). Ministerial Statement No. 963 was issued in 2014 under Part IV of the EP Act following the assessment of this proposal.

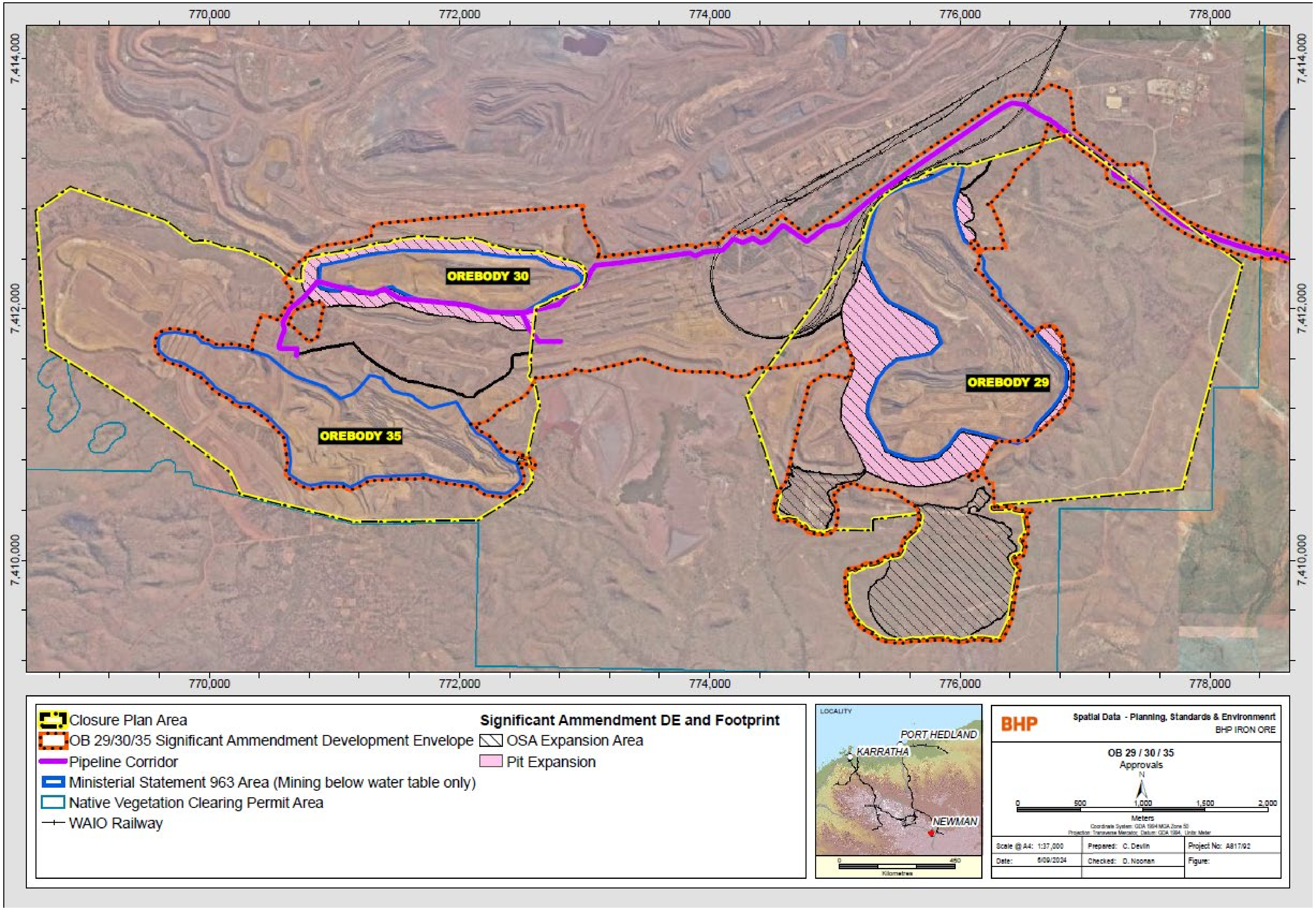
The approved disturbance boundaries for OB29/30/35 under Ministerial Statement No. 963 and the NVCP (CP 5617/6) are shown on Map 3-1 along with the Development Envelope boundary for the proposed Part IV Significant Amendment.

3.1.1 Ministerial Statement

Legally binding closure commitments for the OB29/30/35 mine that are of particular importance to this MCP are Condition 6 of Ministerial Statement 963, as shown in Table 3-1.

Table 3-1 Ministerial Statement 963 - conditions related to closure and rehabilitation

Condition Number	Closure Condition
6-1	The proponent shall ensure that the mines are closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed post-mining outcomes and land uses for a Priority 1 Public Drinking Water Source Area, and without unacceptable liability to the State of Western Australia.
6-2	The proponent shall prepare a Mine Closure Plan for the proposal.
6-3	The Mine Closure Plan required by condition 6-2 shall: (1) when implemented, manage the implementation of the proposal to meet the requirements of condition 6-1; (2) be prepared in accordance with the Guidelines for Preparing Mine Closure Plans, June 2011 (Department of Mines and Petroleum and Environmental Protection Authority) or its revisions; and (3) be to the requirements of the CEO on advice of the Department of Mines and Petroleum and the Department of Water.
6-4	Within 12 months of commissioning of the first below water table mine pit or as otherwise agreed by the CEO the proponent shall implement the approved Mine Closure Plan and continue implementation until otherwise agreed by the CEO.
6-5	Revisions to the Mine Closure Plan may be approved by the CEO on the advice of the Department of Mines and Petroleum and the Department of Water.
6-6	The proponent shall implement revisions of the Mine Closure Plan required by condition 6-5.



Refer to Appendix N for a pdf version

Map 3-1 OB29/30/35 approval boundaries

3.2 Permits and licences

3.2.1 Native Vegetation Clearing Permits

There is one NVCP relevant to the OB29/30/35 operations and associated infrastructure; CPS 5617/6 (expiry 2033) which permits land clearing for mining and associated infrastructure and activities for the OB29/30/35 operations. The legally binding obligations relating to closure or rehabilitation in this NVCP is shown in Table 3-2.

Table 3-2 Closure and rehabilitation commitments in NVCPs

Licence/Permit Number	Relevant Closure Condition
Weeds	
CPS 5617/6 Condition 7	**Weed Control** When undertaking any clearing or other activity authorised under this Permit, the Permit Holder must take the following steps to minimise the risk of the introduction and spread of weeds: (i) clean earth-moving machinery of soil and vegetation prior to entering and leaving the area to be cleared; (ii) ensure that no weed-affected soil, mulch, fill or other material is brought into the area to be cleared; and (iii) restrict the movement of machines and other vehicles to the limits of the areas to be cleared.
Watercourse management	
CPS 5617/6 Condition 8	**Watercourse Management** Where the area shaded blue in Figure 1 of Schedule 1 [of Plan 5617/6] (refer to Appendix A-2) is to be impacted by clearing, the Permit Holder shall maintain the existing surface flow of Whaleback Creek.
Clearing	
CPS 5617/6 Condition 9	**Retain and spread vegetative material and topsoil** 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.
CPS 5617/6 Condition 9	b) Within 12 months following completion of clearing authorised under this Permit, revegetate and rehabilitate areas that are no longer required for the purpose for which they were cleared under this Permit by: (i) ripping the ground on the contour to remove soil compaction; and (ii) laying the vegetative material and topsoil retained under Condition 9(a) on the cleared area.
CPS 5617/6 Condition 9	c) Within 4 years of undertaking revegetation and rehabilitation in accordance with Condition 9(b) of this Permit: (i) engage an environmental specialist to determine the species composition, structure and density of the area revegetated and rehabilitated; and (ii) where, in the opinion of an environmental specialist, the composition structure and density determined under Condition 9(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.
CPS 5617/6 Condition 9	d) Where additional planting or direct seeding of native vegetation is undertaken in accordance with Condition 9(c)(ii) of this permit, the Permit Holder shall repeat condition 9(c)(i) and 9(c)(ii) within 24 months of undertaking the additional planting or direct seeding of native vegetation. e) Where a determination by an environmental specialist that the composition, structure and density within areas revegetated and rehabilitated will result in a similar species composition, structure and density to that of pre-clearing vegetation types in that area, as determined in Condition 9(c)(i) and (ii) of this permit, that determination shall be submitted for the CEO's consideration. If the CEO does not agree with the determination made under Condition 9(c)(ii), the CEO may require the Permit Holder to undertake additional planting and direct seeding in accordance with the requirements under Condition 9(c)(ii).

<table>
<tr><th>Licence/Permit Number</th><th>Relevant Closure Condition</th></tr>
<tr><td>CPS 5617/6 Condition 10</td><td>Retain vegetative material and topsoil, revegetation and rehabilitation
The Permit Holder shall:
a) Prior to 5 October 2023, revegetate and rehabilitate 10 hectares of temporary disturbance previously cleared within the area crossed-hatched yellow on attached Plan 5617/6 [Appendix A-2] by:
(i) laying vegetative material and topsoil previously retained within the area cross-hatched yellow on attached Plan 5617/6 on the cleared areas; and
(ii) ripping the ground on the contour to remove soil compaction.
b) Within 4 years of undertaking revegetation and rehabilitation in accordance with Condition 10(a) of this Permit:
(i) engage an environmental specialist to determine the species composition, structure and density of the area revegetated and rehabilitated; and
(ii) where, in the opinion of an environmental specialist, the composition structure and density determined under Condition 10(b)(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.
c) Where additional planting or direct seeding of native vegetation is undertaken in accordance with Condition 10(b)(ii) of this permit, the Permit Holder shall repeat Condition 10(b)(i) and 10(b)(ii) within 24 months of undertaking the additional planting or direct seeding of native vegetation.
d) Where a determination by an environmental specialist that the composition, structure and density within areas revegetated and rehabilitated will result in a similar species composition, structure and density to that of pre-clearing vegetation types in that area, as determined in Condition 10(b)(i) and (ii) of this permit, that determination shall be submitted for the CEO's consideration. If the CEO does not agree with the determination made under Condition 10(b)(ii), the CEO may require the Permit Holder to undertake additional planting and direct seeding in accordance with the requirements under condition 10(b)(ii).</td></tr>
<tr><td colspan="2">Record keeping</td></tr>
<tr><td>CPS 5617/56 Condition 11</td><td>Records to be kept
The Permit Holder must maintain the following records relating to the listed relevant matters in accordance with the specifications detailed in Table 1

Table 1: Records that must be kept
<table>
<tr><th>No.</th><th>Relevant matter</th><th>Specifications</th></tr>
<tr><td>1</td><td>In relation to the authorised clearing activities generally.</td><td>(a) the location where the clearing occurred, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;
(b) the date that the area was cleared;
(c) the size of the area cleared (in hectares);
(d) actions taken to avoid, minimise, and reduce the impacts and extent of clearing in accordance with Condition 6;
(e) actions taken to minimise the risk of the introduction and spread of weeds in accordance with Condition 7; and
(f) actions taken in accordance with Condition 8.</td></tr>
<tr><td>2</td><td>In relation to the revegetation and rehabilitation management pursuant to Condition 9.</td><td>(a) The location of any areas revegetated and rehabilitated, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;
(b) a description of the revegetation and rehabilitation activities undertaken; and
(c) the size of the area revegetated and rehabilitated (in hectares)</td></tr>
<tr><td>3</td><td>In relation to the revegetation and rehabilitation management pursuant to Condition 10.</td><td>(a) The location of any areas revegetated and rehabilitated, recorded using a Global Positioning System (GPS) unit set to Geocentric Datum Australia 1994 (GDA94), expressing the geographical coordinates in Eastings and Northings;
(b) a description of the revegetation and rehabilitation activities undertaken; and
(c) the size of the area revegetated and rehabilitated (in hectares).</td></tr>
</table></td></tr>
</table>

Licence/Permit Number	Relevant Closure Condition
Reporting	
CPS 5617/6 Condition 12	**Reporting** a) The Permit Holder shall provide a report to the CEO by 1 October each year for the life of this Permit, demonstrating adherence to all conditions of this Permit, and setting out the records required under Condition 11 of this Permit in relation to clearing carried out between 1 July and 30 June of the previous financial year.
CPS 5617/6 Condition 12	(b) If no clearing authorised under this Permit was undertaken between 1 July and 30 June of the previous financial year, a written report confirming that no clearing under this permit has been carried out, must be provided to the CEO by 1 October of each year.
CPS 5617/6 Condition 12	(c) Prior to 30 November 2035, the Permit Holder must provide to the CEO a written report of records required under Condition 11 of this Permit where these records have not already been provided under Condition 12(a) or 12(b) of this Permit.

3.2.2 Part V EP Act Licence

Operations at OB29/30/35 are governed by environmental licence (L4503/1975/14). The conditions of this licence are predominantly aimed at operational activities, however, there are several conditions that may have implications for execution of closure (e.g., water discharge and ambient air quality limits) and planning for the closure of waste facilities (Table 3-3).

Table 3-3 Environmental licence conditions with implications for closure

<table>
<tr><th>Condition No.</th><th colspan="4">Condition</th></tr>
<tr><td>22</td><td colspan="4">The licence holder shall manage the landfilling activities to ensure:
(a) waste is placed and compacted to ensure all faces are stable and capable of retaining rehabilitation material; and
(b) rehabilitation of a cell or phase takes place within 6 months after disposal in that cell or phase has been completed.</td></tr>
<tr><td rowspan="11">23</td><td colspan="4">The licence holder shall ensure that cover is applied and maintained on landfilled wastes in accordance with Table 6 and that sufficient stockpiles of cover are maintained on site at all times.</td></tr>
<tr><td colspan="4">Table 6: Cover Requirements</td></tr>
<tr><td>Waste type</td><td>Cover material</td><td>Depth</td><td>Timescale</td></tr>
<tr><td>Inert Waste type 1</td><td>N/A</td><td>N/A</td><td>No cover required</td></tr>
<tr><td>Inert waste type 2 (excluding tyres)</td><td rowspan="6">Type 1 inert waste, clean fill or Uncontaminated fill</td><td>100 mm</td><td>As soon as practical following the achievement of final process limits</td></tr>
<tr><td>Inert waste type 2 (tyres)</td><td>500 mm</td><td>As soon as practicable following the achievement of final process limits</td></tr>
<tr><td rowspan="2">Putrescible waste</td><td>150 mm</td><td>As soon as practicable and not later than weekly</td></tr>
<tr><td>1,000 mm</td><td>Within 3 months of achieving final waste contours</td></tr>
<tr><td rowspan="2">Special waste type 1</td><td>300 mm</td><td>As soon as practicable after deposit and prior to compaction</td></tr>
<tr><td>1,000 mm</td><td>By the end of the working day in which the asbestos waste was deposited</td></tr>
<tr><td colspan="4"></td></tr>
<tr><td>7</td><td colspan="4">The licence holder is authorised to install and undertake the works for the infrastructure and equipment specified in Table 2, to the requirements specified in that table.
Table 2: Authorised landfill infrastructure to be constructed
<table>
<tr><th>Infrastructure</th><th>Specifications (design and construction)</th></tr>
<tr><td>New inert landfill</td><td>(a) Inert waste disposal;
(b) Hydrocarbon contaminated wastes will not be disposed of at the facility; and
(c) Waste disposal in designated areas depicted in Figure 1 of Schedule 1.</td></tr>
<tr><td>New putrescible landfill</td><td>(a) Facility designed to prevent runoff leaving the facility;
(b) Hydrocarbon contaminated wastes will not be disposed of at the facility;
(c) Windrows implemented to direct clean stormwater around the landfill; and
(d) Waste disposal in designed areas depicted in Figure 1 of Schedule 1.</td></tr>
<tr><td>Two new asbestos disposal areas</td><td>(a) Asbestos waste is managed in accordance with the Environmental Protection (Controlled Waste) Regulations 2004, the Code of Practice for the Management and Control of Asbestos in Workplaces, Code of Practice for the Safe Removal of Asbestos, Australian Standard 2601 – The Demolition of Structure;
(b) Disposed in accordance with Table 5 and Table 6 of this licence; and
(c) Waste disposal in designated areas depicted in Figure 1 of Schedule 1.</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>Condition No.</th><th colspan="4">Condition</th></tr>
<tr><td rowspan="3">29</td><td colspan="4">The licence holder must monitor emissions:
(a) at the corresponding monitoring point location;
(b) for the corresponding parameter;
(c) in the corresponding unit;
(d) for the corresponding averaging period; and
(e) at the corresponding frequency,
as set out in Table 7.
Table 7: Monitoring of point source emissions to surface water, including limits</td></tr>
<tr><td>Emission point reference</td><td>Parameter</td><td>Limit</td><td>Averaging period</td></tr>
<tr><td>Ophthalmia Dam discharge point: W1</td><td>Total recoverable hydrocarbons (TRH)</td><td>15 mg/L</td><td>Quarterly when discharging</td></tr>
</table>

3.2.3 Groundwater licence

Abstraction of water at OB29/30/35 is conducted in accordance with Groundwater Licence 160418(8). There are no specific conditions relevant to closure within the licence, but the licence specifies that operations must comply with the Groundwater Licence Operating Strategy for operations at Mt Whaleback, Orebody 29, Orebody 30 and Orebody 35 (WAIO, 2019b)[7]. The Groundwater Operating Strategy outlines the current groundwater monitoring program (Section 10.1.8). The results from this pre-closure monitoring program will help to refine the groundwater model, completion criteria and post-closure monitoring program for the OB29/30/35 operations. There are no other closure-related commitments.

3.3 Other regulatory mechanisms

3.3.1 State Agreement Act

The OB29/30/35 operations take place pursuant to approved proposals under the *Iron Ore (Mount Newman) Agreement Act 1964* (Newman State Agreement) and *Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972* (McCamey's State Agreement) (see Appendix A-1). Key requirements of these Acts with regard closure are as follows:

- **Newman State Agreement** - Section 9A(3)(k) of the Newman State Agreement requires "additional areas to be mined to have an environmental programme for rehabilitation, protection and management of the environment". Once additional areas are approved for mining, a continuous programme must be carried out to ascertain the effectiveness of the measures being taken to rehabilitate, protect and manage the environment. Under Section 9A(12)(a), reporting is required to be submitted to the Environment Minister from time to time as reliable information becomes available (but not more frequently than once every twelve months). Environmental compliance (including closure and rehabilitation) is governed by the applicable environmental legislation.
- **McCamey's State Agreement** - Section 9C(2) of the McCamey's State Agreement requires "the Joint Venturers in respect of the measure for the protection and management of the environment and matters referred to in paragraphs (j), (k), (l) of subclause (2) of clause 7 and which are the subject of approved proposals under this Agreement, carry out a continuous programme of investigation and research including monitoring and the study of sample areas to ascertain the effectiveness of the measures they are taking pursuant to such approved proposals for rehabilitation and the protection and management of the environment." Under Section 9(C)2, reporting is required to be submitted to the Environment Minister concerning investigations and research at 3 yearly intervals. Environmental compliance (including closure and rehabilitation) is governed by the applicable environmental legislation.

3.3.2 Tenement conditions

OB29/30/35 is situated on tenure granted under the Newman State Agreement, McCamey's State Agreement, *Mining Act 1978* and *Land Administration Act 1997* (WA). Closure-related conditions of tenure are summarised in Table 3-4.

7 Note the date of Version 3 of the Groundwater Operating Strategy approved in the licence is 2018. The Version 3 strategy was updated to in January 2019 to address regulator comments.

Table 3-4 Closure related tenement conditions

Tenement No.	Condition Number	Closure Condition
M266SA	2	Mining being carried out in accordance with proposals submitted under Clauses 7, 9 or 9A and approved under Clause 8 of the *Iron Ore (McCamey's Monster) Agreement Authorisation Act* as amended and in accordance with other terms, covenants and conditions of the above Agreement Act or leases or licences issued pursuant to that Agreement
	5	The lessee shall remove, stockpile and use topsoil from the process site in the rehabilitation of the lease area to the satisfaction of the State Mining Engineer
G52/277 & [G52/279]	7 [or 15]	Measures such as effective sediment traps and stormwater retention facilities being implemented to preserve the natural values of receiving catchments and those of adjacent areas of native vegetation.
	8 [or 16]	Groundwater quality monitoring bores being installed, maintained and utilised for water quality monitoring on and near the mine-site and downstream where aquifers are present.
	14 [or 22]	All hydrocarbon or other pollutant spillage being reported to Water and Rivers Commission. Remediation being carried out to the satisfaction of Water and Rivers Commission.

3.3.3 Native Title and cultural heritage

The OB29/30/35 tenure falls within the boundary of the Nyiyaparli Native Title Determination [WCD2018/008]. BHPIO has a comprehensive native title agreement with the Nyiyaparli people and is committed to consulting with the Nyiyaparli people regarding the operation of the Project and, therefore, its eventual closure. The agreement includes the following commitments:

- The Nyiyaparli people will be engaged to inform the rehabilitation programme based on their holistic understanding of 'healthy country'.
- The integrity of, and access to, places of cultural significance will be maintained in the closure design.
- Salvaged artefacts will be returned to Country post closure as per the wishes of the Nyiyaparli people.

Cultural Heritage Management at BHP is driven by the Sustainable Cultural Heritage Framework. The framework is underpinned by four initiatives – legal compliance, scientific research, Indigenous engagement and cultural heritage education – with three key objectives:

- Comply with the *WA Aboriginal Heritage Act 1972* and other relevant legislation;
- Guide the heritage approvals process by addressing key gaps in the knowledge base; and
- Create a positive heritage legacy for future generations.

Consultation with the Nyiyaparli people, via registered Native Title body corporation Karlka Nyiyaparli Aboriginal Corporation (KNAC), on closure and post-closure land-use is undertaken through the ongoing stakeholder engagement process.

3.3.4 Commonwealth EPBC Strategic Approval

BHP has a strategic approval (the Commonwealth Strategic Approval) under the *Environment Protection and Biodiversity Conservation* Act 1999 (EPBC Act). The BHP Billiton Iron Ore Pilbara Strategic Assessment Program (BHP Billiton, 2017) was endorsed by the Minister for the Environment and Energy on 11 May 2017 and an Approval Decision (with conditions) for taking actions in accordance with the Program was issued on 19 June 2017. Relevant Program Matters are Matters of National Environmental Significance and all activities within the scope of the strategic approval must be taken in accordance with the endorsed Program.

3.3.5 Contaminated Sites Act 2003

The Contaminated Sites Act 2003 (CS Act), regulates the reporting, management and remediation of contaminated sites. Under the Act, remediation of contaminated sites is the responsibility of the polluter or current site owner. Reporting and management of contaminated sites occurs throughout the operations and BHP has reported knowledge and suspected contaminated sites at OB29/30/35 to the Department of Water and Environmental Regulation (DWER) in general accordance with the Act (see Section 5.10).

BHP also provides regular updates to DWER as sites are investigated and remediated.

3.4 Closure guidelines and industry standards

BHP governs closure planning, on a corporate level, by the Corporate Alignment Planning Global Standard (BHP, 2023a) and the Closure and Legacy Management Global Standard (BHP, 2023c). The purpose of these documents is to ensure that closure planning is included in business planning processes throughout the lifecycle of a project.

This MCP has been prepared to satisfy the relevant components of BHP's Corporate Alignment Planning and closure planning processes and has been finalised for external review in line with the DEMIRS Statutory Guideline (2020a). In addition, this MCP incorporates relevant aspects from other closure guidelines and industry standards including:

- *Mine Closure Plan Guidance – How to Prepare in Accordance with Part 1 of the Statutory Guidelines for Mine Closure Plans* (DMIRS, 2020b);

- *Integrated Mine Closure: Good Practice Guide* (ICMM, 2019);
- *Australian and New Zealand Minerals and Energy Council (ANZMEC) and the Minerals Council of Australia (MCA) Strategic Framework for Mine Closure* (ANZMEC & MCA, 2000);
- *Mine Closure and Completion* (DISER, 2016a);
- *Preventing Acid and Metalliferous Drainage* (DISER, 2016c);
- *Mine Rehabilitation* (DISER, 2016b);
- *Evaluating Performance Monitoring and Auditing* (DISER, 2016d)*;* and
- *Technical Guidance - A framework for developing mine-site completion criteria in Western Australia* (Young, et al., 2019).

4 Stakeholder consultation

4.1 Objectives

BHP recognises the importance of engaging with relevant stakeholders. The ability to build relationships and work collaboratively and transparently with our host communities is critical to the Company's long-term success. BHP has established a comprehensive consultation program to support ongoing, effective dialogue with stakeholders potentially impacted by, or interested in, the implications of the Company's operations. This approach is consistent with BHP's Purpose, which is to bring people and resources together to build a better world, and the company's Values which include a commitment to supporting communities.

> *"We believe we are successful when we work in partnership with communities to achieve long-term social, environmental and economic outcomes. We seek to create and contribute to social value in the communities in which we operate. We seek meaningful long-term relationships that respect local cultures. We aim to support the development of diversified and resilient local economies, contributing to quality-of-life improvements that continue beyond the life of our operated assets."* (BHP, 2020d).

BHP has an ongoing consultation program relating to its OB29/30/35 mining operations with government agencies (both state and local), non-government organisations and land-users that have expressed interest in, or are directly impacted by, a proposed project. The objectives of the program are to:

- Provide information and the opportunity to comment to government agencies and other stakeholders who may potentially be interested in activities (including closure and rehabilitation) at OB29/30/35;
- Identify the key issues and concerns of government agencies and other stakeholders regarding the design and management of activities (including closure and rehabilitation) at OB29/30/35;
- Discuss objectives for the development of OB29/30/35 and its ultimate rehabilitation and closure;
- Periodically provide updated information and results of the development and closure planning process to government agencies and other stakeholders as more information comes to hand; and
- Allow for adjustments to the design and / or management of any proposed activities to accommodate concerns or issues raised by government agencies and other stakeholders, where relevant.

4.2 Consultation program

BHP's locally based Community and Indigenous Affairs team are active members of the Newman community and through continued community engagement they have established:

- Supportive working relationships between BHP and the Newman community;
- An environment conducive to productive dialogue;
- An understanding of key issues and concerns of the community in relation to developments in the area; and
- An avenue to share key project information as it becomes available.

As part of the broad consultation program for OB29/30/35, BHP consults with identified stakeholders on closure related issues during each project phase (pre-approval, operations, rehabilitation and post closure) to enable legal requirements, risks and internal and external stakeholder expectations for the closure of OB29/30/35 to be considered at an appropriate time and as far as practicable.

In line with DEMIRS (2020a), BHP considers the key stakeholders for closure to be post-mining owners or managers, including Traditional Owners, and relevant regulators. The current closure consultation focus of OB29/30/35 is primarily with the key stakeholders Traditional Owners, DWER, EPA and DEMIRS. However, as individual deposits approach cessation of mining (nominally within 5 years of this time), closure specific consultation will increase with broader stakeholder groups such as those listed below.

Government agencies:

- DWER;
- DEMIRS;
- Department of Planning Lands and Heritage (DPLH);
- Department of Biodiversity Conservation and Attractions (DBCA);
- Department of Jobs Tourism Science and Innovation (JTSI);
- Shire of East Pilbara;
- Main Roads Western Australia;
- EPA;
- Department of Health;
- Heritage Council of WA;

- Department of Primary Industries and Regional Development (DPIRD);
- Pilbara Development Commission; and
- Department of Agriculture Water and the Environment.

Landowners and managers

- Traditional landowners - the Nyiyaparli people.

Communities/local and regional groups:

- Wildflower Society of WA;
- Conservation Council of WA;
- Greening Australia;
- Newman Community Consultative Group;
- Project employees; and
- Project contractors.

BHP has undertaken social surroundings engagement with Nyiyaparli representatives (through KNAC) to understand the aspects of the environment that are important to the Nyiyaparli Traditional Owners. The most recent engagement was undertaken in May 2024 to discuss aspects related to the Significant Amendment (Stevens Heritage Services, 2024) (see Section 5.12).

Given the stage of the OB29/30/35 mining operations life, the current consultation program focuses on progressive rehabilitation and technical study updates. An indicative program for consultation to be conducted in advance of the next closure plan update (three-yearly cycle) is shown in Table 4-1.

Table 4-1 Stakeholder consultation program

Stakeholders	Timing	Communications
Nyiyaparli Traditional Owners, through Karlka Nyiyaparli Aboriginal Corporation (KNAC).	Ongoing as part of regular stakeholder consultation (nominally associated with any new development proposals, at a minimum with each major MCP update).	Progressive rehabilitation and technical studies update. Post-closure land use and access considerations. Mine Closure Plan update communications and feedback.
DWER	Annual	Update on contaminated sites management (WAIO-wide)
EPA, DEMIRS, DWER, DPLH	Ongoing as part of regular stakeholder consultation (nominally associated with any new development proposals, at a minimum with each major MCP update).	MCP update briefing including: • Post-closure land use studies; • Completion criteria; • Progressive rehabilitation; and • Technical studies update.

4.3 Consultation undertaken to date

Table 4-2 describes the key issues discussed with stakeholders and comments received relating to mine site rehabilitation and closure[8].

BHP will continue ongoing dialogue with selected stakeholders over the lifetime of the mine in line with the BHP Stakeholder Engagement Management Plan, with closure remaining an ongoing point of discussion.

[8] Where Nyiyaparli people are referenced as stakeholders within Table 4-2 (and within MCP) it is noted that KNAC are the registered native title body corporation through which engagement with the Nyiyaparli people is facilitated. Comments and feedback on this MCP are done so through formal channels via KNAC

Table 4-2 Summary of stakeholder consultation for OB29/30/35 mining operations

Date	Description of Engagement	Stakeholders	Stakeholder comments / issue	Proponent response and / or resolution
December 2012	Meeting to discuss dewatering for OB29/30/35 below water table mining, licence amendments and closure expectations.	Department of Water (DoW; now DWER)	No concerns were raised.	No response required.
24 February and 22 August 2013	BHP provided an overview of the preliminary key environmental impacts of below water table mining and the conclusion of the impact assessment. There was also a discussion regarding rehabilitation and closure mechanisms.	Office of the Environmental Protection Authority (OEPA; now DWER)	OEPA (now DWER) requested further clarification of: • The potential long-term impacts of mine closure on the Newman Water Reserve Public Drinking Water Source Area, in particular the impacts on Ophthalmia Borefield (including increased salinity of water discharging from Ophthalmia Dam into the borefield); • The future status of Bore V18.	Clarification sent 4 October 2013 (letter titled BHP Billiton Iron Ore – Orebody 20/30/35 Mining Below Water Table – Provision of Further Information). Relevant information from this submission has been incorporated into this closure plan.
21 March 2013	Dust, noise, pollution and short and long-term management of dewatering. Licence amendment for the Hydrodynamic Trial and future operational phase were discussed.	Department of Environment and Conservation (DEC; now DWER)	Newman State Agreement obligations, Project Proposal requirements and commitments to closure and rehabilitation under the State Agreement Act.	Subsequent meeting with Department of State Development (DSD; now JTSI) – see below.
25 March 2103	Development of ecological completion criteria including Rehabilitation Strategy, seed management, growth media, rehabilitation monitoring, timeline to developing completion criteria and planned milestones.	DMP (now DEMIRS)	Supportive of strategy. Interested in changes to monitoring program especially in relation to defining progress and use towards developing completion criteria. Keen to be kept up to date as work progresses.	Progress to be reported annually
18 July 2013	Meeting to discuss Newman State Agreement obligations, Project Proposal requirements and commitments to closure and rehabilitation under the State Agreement Act.	Department of State Development (DSD) (now JTSI)	DSD representatives advised they would discuss potential closure mechanisms with the OEPA (now DWER).	BHP provided a commitment to submit a MCP every three years in the Environmental Referral Document for OB29/30/35 Below Water Table Mining. A draft closure plan was submitted with the Environmental Referral Document.
11 December 2013	Strategic Environmental Assessment update meeting. Introduced the Closure and Rehabilitation Management Strategy.	DMP (now DEMIRS)	Interested to know if the Closure and Rehabilitation Management Strategy included a mechanism to address the issue of works on the ground not progressing consistent with mine / closure planning.	The Closure and Rehabilitation Management Strategy is strategic with the supporting business procedures managing compliance to plans. The adaptive management approach on which the strategy is founded ensures corrective action can be taken. A detailed presentation of the strategy was scheduled for Monday 16/12/13.
16 December 2013	Closure and Rehabilitation Regional Management Strategy. BHP engagement with DMP regarding MCP submissions.	DMP (now DEMIRS)	DMP was supportive of the strategy and could not see any gaps. DMP advised that they are keen to be provided with an update on the MCPs prior to submission through a brief update presentation (not a full draft MCP). A schedule of when the updates are due would help manage DMP resources.	BHP will provide a list of the scheduled MCP updates and coordinate update sessions in advance of the MCP submissions.
17 March 2014	Provided Hard copy (pdf soft copy by email) of the Draft Closure and Rehabilitation Management Strategy for DMP consultation. Provided look ahead for next 12 month of closure plans that are anticipated to be submitted to EPA / DMP.	DMP (now DEMIRS)	Agreed to provide feedback to Rebecca Wright by about the end March 14. Noted upcoming items. DMP advised the July 14 revision to the guidelines will not be significant. The main changes will be more detailed guidance in Table 1 and guidance on how to submit a revised closure plan to make processing more efficient for DMP.	No response required. Likely Closure Guidelines changes noted.
8 April 2014	BHP Contaminated sites briefing which included: • Discussion of the risk-based management approach adopted by BHP for its suspected and known contaminated sites at its Pilbara operations. • Presentations showing the current status of contaminated sites management at the three hubs (i.e., Eastern, Infrastructure and Central).	Department of Environment Regulation (DER; now DWER)	Agreed that presentations on the progress of BHP's contaminated sites should happen on a regular basis detailing what works have been undertaken and what is proposed for the annual program.	Regular discussions on progress of contaminated sites investigations and remediation activities.
14 April 2014	Provided an overview of the Closure and Rehabilitation Regional Management Strategy	DoW (now DWER)	Supportive of the regional strategic approach and the alignment with the Pilbara Water Resource Management Strategy.	No response required.
7th to 9th July 2014	BHP coordinated a site visit to a number of its Pilbara operations. Discussions were held on: • BHP's proposed Eastern Pilbara Water Resources Management Plan (BHP Billiton Iron Ore, 2015c) • Operation and management of Ophthalmia Dam • Future plans for potable water management across the region.	DoW (now DWER)	The DoW was supportive of BHP's approach towards water management	No response required.
3 December 2014	Discussion held over potential for misalignment on targets defined in 2014 Annual Environmental Report (AER) where hectares planned for rehabilitation could be interpreted as being completed during FY2015. Review of Ecological Completion Criteria development meeting summary (from 26 March 2013). Discussion of progress to date on achievements and challenges in the development of Ecological Completion Criteria and alignment on new target date for defining agreed draft criteria now 2020.	DMP (now DEMIRS)	Concern was raised over BHP's ability to complete earthworks to an acceptable standard when using production fleet to execute bulk earthworks (regrade); concern alleviated by BHP engaging rehabilitation contractor to complete the works. DMP expressed interest in development of execution tolerances for rehabilitation earthworks; were supportive that growth media requirements are embedded in planning process for rehabilitation projects; acknowledged that delays in executing project works had resulted in push back in the delivery date for agreed draft completion criteria; and were interested in development of an alternative rehabilitation monitoring approach using remote sensing / photogrammetry. Overall DMP were supportive of proposed approach and keen to be kept up to date as work progresses.	Progress to be reported in Annual Environment Report (AER).
27 August 2015	Overview of the Strategic Environmental Assessment approach.	DMP (now DEMIRS)	Appreciated the update and can see the value of the regional approach. Expressed an interest in deep dive sessions on: • Eco-hydrological change assessment • Acid Metalliferous Drainage (AMD) assessment • Visual Impact Assessment Offered to have joint deep dives with other agencies if this avoids duplication on BHP's side.	Arrange deep dive session on AMD assessment, visual impact and eco-hydrological change.

Date	Description of Engagement	Stakeholders	Stakeholder comments / issue	Proponent response and / or resolution
12 October 2015	Pilbara Expansion Strategic Proposal - Hydrological Assessment and Management including AMD.	DMP (now DEMIRS)	Noted the strategic approach to be very useful context, particularly when assessing site by site closure plans	No response required.
17 November 2015	Overview of the Strategic Environmental Assessment using Eastern Ridge as a case study.	Nyiyaparli people	Strong interest in rehabilitation including: • Water; • Plant species used in rehabilitation and in particular whether there are bush tucker and medicine plants included; and • Environmental land management (particularly post-closure). Opportunities to view the site and be involved in rehabilitation activities would be welcomed.	Rehabilitation species list including photos to be provided to enable Traditional Owners to review in relation to bush tucker and medicine plants. Nyiyaparli Environment Sub-committee to further investigate how they might work with BHP in rehabilitation and land management activities.
1 May 2017	OB293035 Closure Plan update briefing prior to OEPA (now DWER) submission including: • Scope and Background - Orebody 29/30/35 mining operations are located within the BHP Newman Mining Hub precinct. - The plan excludes the whaleback mining operation, tailings dam, hub processing / supporting infrastructure. • Closure timing 2030 – 2040. • Closure risk assessment to understand studies required and inform our technical assessment works program. • Key risks and management. • Key studies including: - Pit development and overburden management strategy updates, including OB29, OB30 and OB35 pit backfill extents during operations. - OSA closure landform designs integrating all domains. - Pit void hydrogeology updated assessment. - Surface water hydrology updated assessment, including closure engineering requirements for Whaleback Creek diversion around OB30 and Southern Creek re-instatement across backfill OB35 pit. - AMD updated assessment.	DMP (now DEMIRS), DoW (now DWER)	Strong interest in surface water management including the OB30 Whaleback Creek permanent diversion and Southern Creek re-instatement across backfill OB35 pit void and what assessment criteria would be used. Questioned whether the planned updated AMD assessment due to new criteria was due to internal review or external guidance.	BHP creek flood assessments default to using 10,000-year Average Recurrence Interval (ARI) rather than Probable Maximum Floods (PMF). Clarified the planned update to AMD assessment is based on revised coding derived from improved geochemical knowledge of waste rock outlined in detail in Section 7.2.3 (AMD Geochemistry).
7 June 2017	Presented "Draft Vegetation Completion Criteria for rehabilitation of general conservation land use areas within the Pilbara"	DEMIRS	Consider working with other landholders to manage regionally important weeds.	Make document available for the Western Australian Biodiversity Science Institute (WABSI) project.
14 June 2017	Presented "Draft Vegetation Completion Criteria for rehabilitation of general conservation land use areas within the Pilbara"	DBCA	DBCA and Commonwealth Scientific and Industrial Research Organisation (CSIRO) are working on weed priority listing for Pilbara. No new weeds species – management should be related back to a risk approach. For pastoral – consider a risk-based approach and alternatives to controlling low risk weeds.	Make document available for the WABSI project.
4 August 2017	Presented "Draft Vegetation Completion Criteria for rehabilitation of general conservation land use areas within the Pilbara"	DBCA EPA Strategy and Guidance	Concerns regarding species richness – ensure similar species are present in analogue and rehabilitated sites – not exclusive species. Discussion on weed criteria and that it will be a subject to discuss as part of the WABSI project.	Make document available for the WABSI project.
6 March 2019	BHP presented and discussed the draft WAIO rehabilitation completion criteria, sustainability section only	DEMIRS DBCA	Meeting attendees generally happy with the approach proposed and the detail. During the meeting, it was noted that weeds will require addressing.	BHP has incorporated weeds into criteria.
30 July 2019	BHP presented and discussed progress against commitments to mine planning for Whaleback, but the comments are relevant to other sites.	DEMIRS JTSI	DEMIRS expects that results of testing and modelling of field trials be provided in AER and MCP. Landscape modelling should cover a range of climatic scenarios and be validated with field trials and ongoing monitoring.	This monitoring and modelling is being undertaken with results provided in AER and MCP.
6 February 2020	BHP discussed abandonment bunds with DEMIRS.	DEMIRS BHP	OSAs may be considered to form part of abandonment bunds on a case-by-case basis, but OSAs with slopes of 20° are not sufficient to be a deterrent to the public and will not control void access. Staggered large boulders have been used in creek beds.	BHP will incorporate the principles of the abandonment bund discussion into abandonment bund planning for all sites.
30 June 2021	Implementation committee meeting KNAC. Per- and polyfluoroalkyl substances (PFAS) Management Introduction BHP provided information on how PFAS information is tested, recorded and monitored. Discussed the interim PFAS Site Management Plan Discussion on environmental monitoring activities and new proposed study - dietary study for bush foods	Nyiyaparli people	No specific comments from Nyiyaparli or responses from BHP in relation to closure.	N/A

Date	Description of Engagement	Stakeholders	Stakeholder comments / issue	Proponent response and / or resolution
28 July to 1 August 2021	Social surrounds engagement	Nyiyaparli people	The engagement was focused on the proposed Western Ridge and Jimblebar developments, but a number of the points raised have relevance for OB29/30/35, particularly in relation to ES PB1 and OB29/30/35 infrastructure to be shared with Western Ridge. The engagement included a field visit on country and workshop. Key matters of interest to the Nyiyaparli communicated to BHP, related to water, dust, fire, access to country and heritage. Specific points discussed with potential relevance to closure included: • The Nyiyaparli expressed interest in being involved in: - Water quality monitoring; and - Rehabilitation. • Recording pre-mining conditions via aerial footage captured by drones. • The Nyiyaparli would like surveys of traditional hunting animals to be undertaken. • Nyiyaparli women showed the group some bush medicine and bush tucker species. They would like a full survey of the area for these values. • Nyiyaparli would like to better understand the landscape evolution at each stage pre-mining to mid-mining and then post mining. Is 3D modelling available to demonstrate?	BHP committed to: • Investigating opportunities for Nyiyaparli involvement in water quality monitoring and rehabilitation. BHP advised that there are Traditional Owner only business tenders. BHP Indigenous Affairs offered to assist and communicate directly with Nyiyaparli to advise on how to submit tenders. • BHP to initiate steps to capture aerial footage of project areas covering the general development area and close up footage along creek lines and areas of cultural significance including pools. There may be the potential to include one of the Nyiyaparli social surrounds team in the capture of the footage. • Investigating scopes for survey of fauna species used for traditional hunting. Survey to include Nyiyaparli representatives. • Exploring resources available / accessible to better portray the landscape pre-mining, during mining and at closure outcomes.
August 2021	Discussion on PFAS triggers BHP provided general briefings on the status of PFAS in BHP's Newman hub and BHP's proposed monitoring and mitigation approach (including triggers, actions and responses, and reporting). Discussions included PFAS sources (BHP and third party), PFAS sampling results (including ambient PFAS levels in the environment) and PFAS CRC Care stygofauna ecotoxicology study.	DWER - Contaminated Sites Water Corporation Shire of East Pilbara DWER - Source Protection Department of Health BHP	N/A	N/A
14 September 2021	BHP KNAC workshop on environment and closure engagements.	Nyiyaparli people	Request to hold formal workshop in Q4 2021 to plan out ongoing engagements around closure plan review and inputs to closure and rehabilitation processes.	BHP to organise: • Workshop as per request. • Site summary mine closure plan to be provided supporting full MCP documents, to improve Nyiyaparli comprehension of closure plans.
21 September 2021	BHP shared available PFAS groundwater data from the Newman area, including Ophthalmia Dam. BHP provided a brief overview of the results of CRC Care PFAS ecotoxicology study on Ethel Gorge Threatened Ecological Community (TEC) stygofauna.	DBCA	N/A	As requested, BHP agreed to keep DBCA informed as work related to PFAS and the Ethel Gorge TEC progresses.
16 November 2021	Implementation committee meeting with KNAC.	Nyiyaparli people	Closure discussion of committee meeting included: • Nyiyaparli people feedback on closure plans • Traditional Owner values as they relate to closure and rehabilitation. • Update on closure planning activities. KNAC is developing a standard closure framework which will form the basis for ongoing consultation. It was also noted that closure will also form an element of ongoing social surrounds discussions.	**BHP Response** BHP will work through the KNAC standard closure framework, when available, in consultation with the Nyiyaparli people to establish social values and objectives.
18 November 2021	Newman. The presentation and discussion focused on PFAS sampling results at the Ophthalmia and Homestead borefields and Ophthalmia Dam, and the controls relevant to the Newman town drinking water supply	Water Corporation BHP	N/A	BHP provide a copy of the Trigger Action Response Plan (TARP) in development for Newman at the meeting.
25 November 2021	BHP presented to EPA Services and other key stakeholders in DWER on PFAS investigations (including current information on PFAS sources (BHP and third party) and preliminary PFAS concentrations, studies (including CRC Care Ethel Gorge TEC stygofauna work) and management (multi-level control system) in BHP's Newman Hub. Discussed that BHP is currently developing a Water Management Plan to demonstrate that the risk of PFAS contamination at the Newman Hub is low.	DWER – EPA Services BHP	N/A	BHP provided a hard copy of the preliminary draft Part IV Water Management Plan (PFAS) for the Western Ridge Proposal BHP has prepared the draft OB32 BWT Proposal Water Management Plan based on the approach to mitigating PFAS presented in the Western Ridge Water Management Plan.
10 March 2022	Implementation committee meeting with KNAC. Update on closure planning and specific update on Whaleback Mine Closure Plan BHP presented status of Contaminated Sites Management including planed investigations for potential PFAS. Further detail on Whaleback PFAS remediation	Nyiyaparli people	KNAC acknowledge the information – No action	N/A
19 October 2022	Implementation committee meeting with KNAC. Discussion on Closure Planning Processes and Project Phases (action from previous meeting)	Nyiyaparli People	KNAC acknowledge the information. KNAC to provide BHP their draft closure principle.	BHP will review the closure principles and use them to help inform closure planning and future engagements on closure.

Date	Description of Engagement	Stakeholders	Stakeholder comments / issue	Proponent response and / or resolution
November 2022	Memo Provided to BHP by KNAC – Draft Nyiyaparli Baseline Closure Principles / Preferences	Nyiyaparli people	Key matters of interest are as follows: • Safe and culturally appropriate post-mining access. • Post-closure landform design as natural as possible with inclusion of "nice places" (e.g., small water holes that represent nice camping spots). • Backfilling mine voids and avoidance of pit lakes. If residual voids are unavoidable consideration to be given to: - Providing post-mining access and rehabilitating backfilled area, if possible. - Alternative uses (e.g., solar farms). - Making pit lakes assets rather than liabilities. • Long term impacts upon places of outstanding cultural importance and repatriation of artefacts. • Drone footage of mining areas, visualisations of future impacts and visual impact assessment. • Ongoing consultation on mine closure design and rehabilitation, including the opportunity to be involved in monitoring activities, on-site workshops and review of and input into MCPs. • Baseline ethnoecological surveys. Opportunities for business tenders, employment and training.	BHP has incorporated acknowledgement of Nyiyaparli people's closure principles into Section 5.12 of this MCP and several forward work programs (Section 13.3) have been established to address them including optimising material movements and backfill and further consultation regarding landform and rehabilitation designs, post-mining access and repatriation of artefacts.
12 March 2024	BHP representatives provided an overview of the proposed activities under the Significant Amendment.	Nyiyaparli Implementation Committee meeting with KNAC and Nyiyaparli representatives	Comments raised regarding Archaeological and Ethnographic surveys that were planned to be undertaken.	BHP made commitment to ensure the survey design considered the comments raised by stakeholders.
26 – 27 March 2024	On site visit to Mt Whaleback mine and Orebody 29/30/35 mine to introduce the Proposal location, key components and existing land uses and environmental values. BHP presented an overview of the Orebody 29/30/35 Proposal.	DWER, EPA Services and DBCA	DWER raised queries in relation to Traditional Owner Values. EPA also raised queries about how BHP will maintain cultural values and access to areas of cultural significance post closure. Cumulative groundwater impacts were also discussed.	BHP explained that the Social Surroundings engagement was scheduled for May 2024. Hydrogeological studies completed for OB29/30/35 address interactions with surrounding aquifers and receptors.
14 16 May 2024	Social surroundings engagement including project overview, identification of existing values, potential impacts and proposed environmental management. On country discussion of water management, visit to Orebody 29/30/35 operations, proposed pipeline route and proposed OSAs.	Nyiyaparli representatives, KNAC, Preston Consulting, Stevens Heritage Services	KNAC provided a Social Surroundings Field Consultation Report (Stevens Heritage Services, 2024) detailing the actions and recommendations arising from the Social Surroundings engagement. Key matters discussed were: • Heritage areas to be avoided. • Infrastructure removal post closure. • Height of and erosion controls of OSAs. • Safe and culturally appropriate post-mining access, interactions with abandonment bunds. • Nyiyaparli representatives stated that they want BHP to commit to involving Nyiyaparli in water and other environmental monitoring and rehabilitation. Specifically, requests were made for: • More information to be provided about how BHP is going to rehabilitate areas consistent with Nyiyaparli's closure principles. • A future consultation with a focus on rehabilitation and closure, including visiting rehabilitated areas. • BHP to provide 'plain English' summaries of MCPs for BHP's major projects in the Nyiyaparli Determination Area. • BHP's closure discussions address impacts on animals, and particularly birds, in regard to soaks and pit lakes.	BHP and KNAC agreed to a modified pipeline route to avoid newly identified archaeological and ethnographic sites and the recommendations made. Points discussed during social surrounds: • BHP is investigating opportunities for Nyiyaparli people involvement in water quality monitoring and rehabilitation • Discussion on current Traditional Owner trainee program. • Discussion on current designs for safe and stable post closure landform designs including removal of infrastructure and access. In response to the specific requests that were made, BHP: • will review rehabilitation seed mixes with Nyiyaparli (via KNAC) as part of ongoing rehabilitation and closure stakeholder engagement. • will continue to refine closure source-pathway-receptor modelling during the planning stages to inform the understanding of impacts of soaks and pit lakes. BHP has provided KNAC with summaries of closure plans and is committed to working with the Nyiyaparli people to investigate how they might be engaged in rehabilitation and land management activities.

Date	Description of Engagement	Stakeholders	Stakeholder comments / issue	Proponent response and / or resolution
October 2024	KNAC comments on the Draft OB29/30/35 Proposal and associated documents including OB29/30/35 Draft Mine Closure Plan Rev 7	KNAC[9]	KNAC provided comments on OB29/30/35 Significant Amendment under S38E of the EP Act which included the OB29/30/35 MCP Revision 7 draft. Key comments included: • Nyiyaparli preference for backfill and no pit lakes • Impact to fauna from saline pit lakes • Hierarchy of influence in relation to preferred post closure land use • AMD residual pit wall exposure • Topsoil stockpiles and availability • People and country plan and Nyiyaparli closure principals • Creek diversion design and maintaining surface water flow post closure.	• Nyiyaparli preference on backfill and avoidance of pit lakes has been recorded in the OB29/30/35 MCP. • Impact to fauna / flora as part of a source-pathway-receptor and geochemistry assessment of any residual pit lakes is part of the closure forward works program for OB29/30/35. • Post closure land use is presented as “in advance of being confirmed”. The final post mining land use will be informed through Nyiyaparli (via KNAC) and other stakeholder consultation. OB29/30/35 mining area is a long life mine, therefore, stakeholder consultation including land use preferences will continue for the remaining mine life, with a key focus on Nyiyaparli Closure Principals. • AMD risk during operations and as part of the post closure landscape is low for OB29/30/35. • Topsoil at BHP is managed through the use of standards and procedures. Stockpiles are reconciled and growth media studies are ongoing. • The overarching closure and rehabilitation philosophy stated in the basis of design for OB30 and OB35 diversion is to recreate the hydraulic and sediment transport characteristics of the predevelopment creek system. As upstream proposed mining areas are developed (for example, Western Ridge), BHP will continue to model the cumulative impact to catchment and stream flow data and adjust design criteria, if required, via adaptive management.

[9] Comments on the Rev 7 OB29/30/35 Draft Mine Closure Plan are from KNAC not Nyiyaparli people

5 Collection and analysis of closure data

The following section provides a summary of details on the physical and biological environment within the OB29/30/35 Closure Plan Area including:

- Local climatic conditions and projected future climate change for the area (Section 5.2).
- Geology, soils, and waste materials characterisation including geochemical properties, soil and overburden structure and stability (e.g., erodibility) and growth medium characteristics (Sections 5.3 to 5.4).
- Seismicity (Section 5.5).
- Landforms, land systems and local and regional information on flora, fauna, ecology, communities and habitats (Sections 5.6 to 5.8).
- Hydrology and hydrogeology (Section 5.9).
- Visual amenity, cultural heritage and local land use (Sections 5.11 to 5.13).

The proposed closure management of OB29/30/35 presented in this plan is based on our current understanding of the surrounding environment and the outcomes of monitoring, studies and research trials.

Consistent with the adaptive management approach in the Guidelines for Mine Closure (2020a), BHP has commissioned several studies to inform relevant considerations for mine closure planning. The studies and trials are progressive and can be iterative, as many closure considerations are interlinked. Given the long life of the OB29/30/35 operation, the knowledge base associated with areas approaching closure / rehabilitation will be more mature than newer areas, or areas that have not yet been mined. As areas progress through operations to closure, additional studies will be conducted to help inform the closure and rehabilitation of these areas.

Closure approaches and designs will be refined over the coming years through further assessment and design studies. For major capital projects, which include closure projects, BHP has a defined study process that starts with an Identification Phase Study (IPS) that looks at possible closure options and then conducts sufficient technical work to enable these options to be refined to a list of viable alternatives and selection of a preferred alternative. Following selection of a preferred alternative, a Selection Phase Study (SPS) is conducted to refine and optimise the preferred designs / approaches. A Definition Phase Study (DPS) follows the SPS and develops detailed designs and execution plans.

Section 5.14 provides an overview of recent technical studies that have been completed to develop closure options and address knowledge gaps. Section 13.3 outlines the forward work programs aimed at addressing the remaining knowledge gaps identified in Section 5.

5.1 Area of influence

This section is focused on the baseline conditions associated with the area that may be impacted by the OB29/30/35 operation. In some instances, the area that may be impacted is localised (e.g., clearing of vegetation), while others may be more extensive (e.g., surface water and groundwater) and may be influenced by the cumulative impacts of nearby mining operations (for example, cumulative impacts of dewatering from the Eastern Pilbara operations). Given the proximity of some mining areas to each other, resources from one mining area may be used in the closure of another. Of particular relevance to this plan is:

- The influence that the Western Ridge operations may have on surface water and groundwater conditions at OB29/30/35. For this reason, these operations have been referenced in this plan, where relevant.
- The competent materials available at the adjacent Whaleback mine may be used in stabilising the erodible Marra Mamba landforms at OB29/30/35. Materials characterisation data for relevant Whaleback wastes are therefore included in this plan.
- The potential for contamination at some sites at Whaleback to influence conditions at OB29/30/35. These sites have, therefore, been discussed in this plan.

The boundary of the OB29/30/35 Closure Plan Area, and its relationship with the Significant Amendment Development Envelope and adjacent closure plan areas is shown in Map 1-2.

5.2 Climate

5.2.1 Existing climate

The OB29/30/35 Closure Plan Area is located in the Pilbara region of WA, which is a tropical semi-desert climate and experiences regular cyclonic activity during November to March. Characteristic climatic features of the region include seasonally low rainfall with high temperatures, high evaporation rates and a high daily temperature range.

Climatic information described in this section has been sourced from the closest operating Bureau of Meteorology (BoM) station at Newman Aero (BoM station number 007176).

Temperatures are generally high, with average monthly maximum temperatures at Newman ranging between 23°C in June and July to 39°C in December and January. Average monthly minimum temperatures at Newman range from 6.5°C in July to 25°C in January (Table 5-1). The hottest temperature experienced at Newman was 47°C in January 1998 (BoM, 2024a).

Table 5-1 Temperature at Newman Aero

Record	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
Mean maximum temperature °C	39.0	37.4	35.8	32.2	27.0	23.0	23.2	26.3	30.6	35.2	37.5	39.4
Mean minimum temperature °C	25.1	24.1	22.3	17.7	11.9	7.6	6.5	8.2	12.4	17.7	21.1	24.3

Source: BoM (2024a)

Rainfall in the Pilbara is highly variable with annual evaporation exceeding rainfall by as much as 2,000 mm per year (Table 5-2). The highest rainfall events are typically associated with cyclonic activity and thunderstorms which are common in the Pilbara region with approximately 20 to 30 occurring per year. The average annual rainfall is estimated to be about 320 mm (Table 5-2).

Table 5-2 Average monthly rainfall and evaporation

Record	Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
Rainfall (mm)	70.2	70.1	43.5	21.6	18.6	15.7	13.5	6.1	4.6	5.6	12.0	33.7	319.0
Evap. (mm)	290	232	216	182	109	108	125	121	166	237	267	293	2,346

Source: BoM (2024a)- Rainfall records (BoM station number 007176). BHP Billiton (2018a) - Evaporation records (Department of Agriculture 2013).

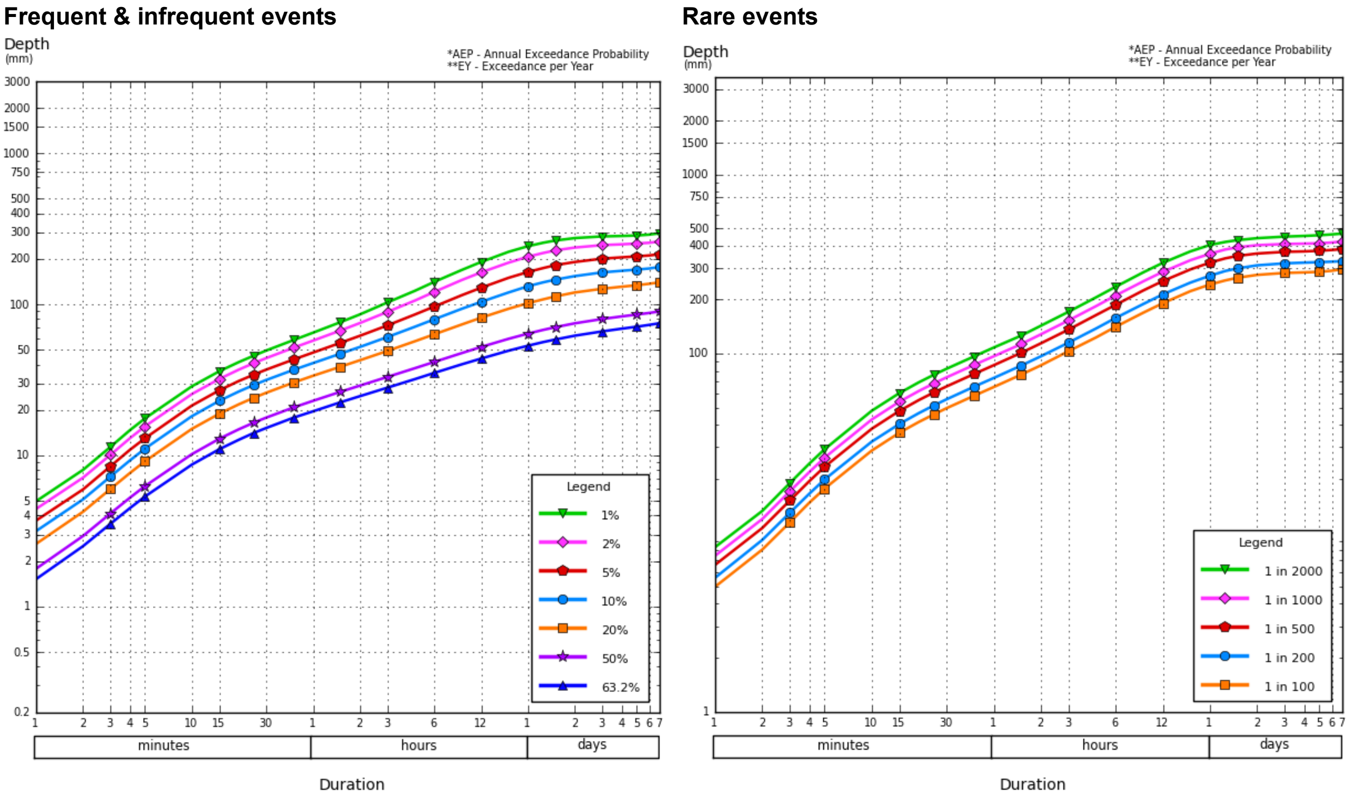
The highest daily rainfall event occurred in December 1999 with approximately 214 mm recorded, and the second highest daily rainfall event occurred in January 2020 with approximately 142.8 mm recorded (BoM, 2024a).

Rainfall intensity-frequency-duration (IFD) relationships (Table 5-3 and Figure 5-1) have been sourced from BoM (2016) and used for the OB30 and 35 creek diversion studies (Tetra Tech Proteus, 2020; Advisian, 2021b). The 2016 IFD data is still applicable (BOM, 2024b).

Table 5-3 IFD relationships for frequent and infrequent events

Duration	Rainfall depth (mm) in Annual Exceedance Probability (AEP) 1 in x year									
	1 in 1.58 (63.2%)	1 in 2 (50%)	1 in 5 (20%)	1 in 10 (10%)	1 in 20 (5%)	1 in 50 (2%)	1 in 100 (1%)	1 in 500	1 in 1000	1 in 2000
1 minute	1.52	1.78	2.6	3.16	3.71	4.43	4.98	6.60	7.42	8.29
30 minutes	15.2	17.8	26	31.6	37	44.1	49.5	65.5	73.6	82.2
1 hour	19.6	23	33.7	40.9	48	57.6	65	86.0	96.5	108
6 hours	35.2	41.6	63.4	79.7	96.8	121	141	187	211	236
12 hours	43.8	52.3	81.7	104	129	163	191	254	286	321
24 hours	53.3	64.1	102	132	164	207	243	322	361	404
48 hours	62.1	75	120	154	191	238	275	362	403	441
72 hours	66.3	80.1	127	163	201	247	282	370	409	450
96 hours	69.1	83.3	131	167	205	250	284	372	411	454
120 hours	71.2	85.7	134	170	208	253	286	375	413	458
144 hours	73.2	87.8	137	173	211	256	290	379	417	463
168 hours	75.1	89.9	140	177	215	261	296	383	423	468

Source: BoM (2016)



Source BoM (2016)

Figure 5-1 IFD relationships

5.2.2 Climate change

BHP accepts the Intergovernmental Panel on Climate Change's (IPCC) current view that warming is unequivocal, human influence is clear and physical impacts have occurred and will continue to intensify (IPCC, 2023). BHP believes the world must pursue the aims of the Paris Agreement with increased levels of national and global ambition to limit the impacts of climate change. BHP's Climate Transition Action Plan (BHP, 2021d) sets out the strategic approach to achieving our long-term greenhouse gas emissions reduction goals, and the Climate Change Global Standard (BHP, 2023i) focuses on climate change risk management and strategies. These strategies include operational greenhouse gas emissions reduction by using and investing in low emissions technology, supporting emissions reduction in our value chain, promoting product stewardship and increasing our resilience to physical climate change impacts.

Climate change is a complex issue, with inherent uncertainty about the timing, pace, and severity of possible impacts. Risks from climate change to the stability of landforms, mobilisation of contaminants and re-vegetation are some of the identified vulnerabilities considered in closure planning.

We have worked with the CSIRO to obtain regional analyses of climate change science and understand that climate change will amplify existing risks in BHP's mining and associated port and rail operations in the Pilbara region. CSIRO (2015) forecasted Pilbara region climate conditions for 2030 and 2050 under various emissions scenarios and concluded that:

- Conditions would be hotter (both averages and extremes) with higher potential evaporation:
  - Forecast temperature changes were 1.5 to 1.6°C for 2030 and 2.1 to 2.9°C for 2050.
  - Projected changes to evaporation ranged from annual increases of 3% to 4% for 2030 and from 4% to 7% for 2050.
- Tropical cyclones may decrease in number but increase in intensity and duration over the same period.
- There may be more unpredictable characteristics of other climate-related hazards, including flooding, storm surges and wildfires, e.g. in 2050 CSIRO forecasted up to 100% increase in days with extreme forest fire danger index (up to 44 days per year) from the current average of 23 days per year.

Climate models indicate that there could be wetter or drier conditions with models predicting wet conditions indicating rainfall increases of 3.2% by 2030 under an intermediate emissions scenario and 7.8% by 2050 under a high emissions scenario. Models predicting dry conditions indicate a decrease in rainfall from 4.2% by 2030 under an intermediate emissions scenario and 17% by 2050 under a high emissions scenario (CSIRO, 2015). Given the high level of uncertainty associated with the direction and likely magnitude of rainfall change, BHP conducts sensitivity analyses to understand the impacts of changes in rainfall to proposed closure designs where this may be critical to the design (e.g. flood protection bunds).

5.2.3 Knowledge gaps & forward work program

BHP is in the process of updating climate change projections to 2090 based on the latest generation of climate models. Relevant data will be incorporated into future revisions of the MCP.

5.3 Overburden characteristics

Materials at BHP sites are characterised based on their geochemical and physical characteristics. This characterisation process allows BHP to identify material types and manage their placement appropriately, including segregation and selective disposal of Potentially Acid Forming (PAF) overburden and selective placement of beneficial overburden. This approach is consistent with the Leading Practice Sustainable Development Program for the Mining Industry Mine Closure and Preventing Acid and Metalliferous Drainage handbooks (DISER, 2016a; 2016c).

5.3.1 Geological overview

5.3.1.1 Regional geology

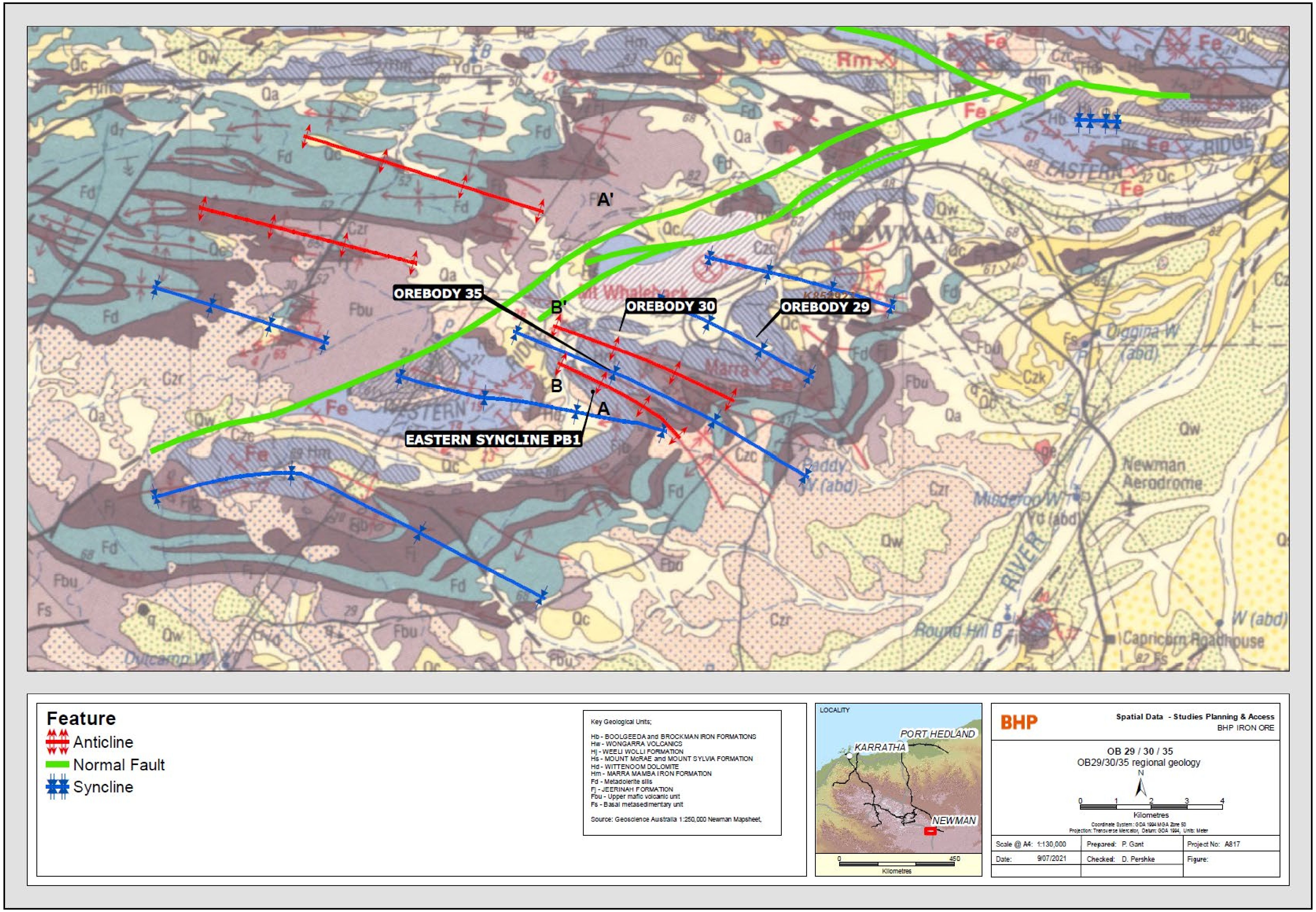
The Pilbara region comprises a portion of the ancient continental Western Shield that dominates the geology of Western Australia. The Western Shield is composed of pre-Cambrian, Proterozoic and Archaean rocks. The Pilbara Craton is overlain by Proterozoic rocks deposited in the Hamersley and Bangemall Basins. The Hamersley Basin which occupies most of the southern part of the Pilbara Craton can be divided into three stratigraphic groups: the Fortescue, Hamersley and Turee Creek Groups. Of the three groups, the Hamersley Group is the most relevant to the OB29/30/35 Closure Plan Area.

The Hamersley Group is approximately 2.5 km thick, and conformably overlies the Fortescue Group. It consists of a sequence of Banded Iron Formation (BIF), dolomites, shales, and acid volcanics, and is intruded by dolerite sills and dykes. It contains both the Brockman Iron Formation and the Marra Mamba Iron Formation, which provide most of the iron ore deposits in the Pilbara (Table 5-4 and Map 5-1).

Table 5-4 Generalised stratigraphy of the OB29/30/35 Closure Plan Area

Stratigraphy			Description
Group	Formation	Member	
Hammersley Group	Brockman Iron	Yandicoogina Shale	A sequence of interbedded chert and shale intruded variably by dolerite sills in its upper part in some areas. It often appears cherty in outcrop.
		Joffre	Planar bedded to poddy BIF with only minor shale interbeds.
		Whaleback Shale	Two zones: • A main upper zone (WS3) comprising numerous mesobands of chert and shale. • A lower zone consisting of four alternating macrobands of shale and BIF (WS1 / WB1 / WS2 / WB2).
		Dales Gorge	Alternating planar-bedded assemblage of 17 BIF and 16 S macro-bands and forms the dominant ore horizon in this Formation.
		Colonial Chert	Thin bedded shale and chert with some dolomite and BIF.
	Mt McRae Shale		Predominantly shale with some chert bands.
	Mt Sylvia		Thin-bedded shale, chert and dolomite with BIF bands.
	Wittenoom	Bee Gorge	Thinly laminated graphitic argillite, carbonate and chert.
		Paraburdoo	Thin to thick-bedded dolomite, minor chert and argillite, tabular bedding.
		West Angela	Dolomite, dolomitic argillite, minor chert.
	Marra Mamba Iron	Mt Newman	Podded BIF with interbedded carbonates and shales. It is the major ore-bearing horizon of this Formation. This member is divided into three units based on shale bands with the units being approximately 15 to 20 m thick.
		Macleod	BIF, cherts and carbonates with numerous interbedded shales and several prominent podded units.
		Nammuldi	Thick-bedded, poddy cherty BIF interbedded with thin shales.
	Jeerinah	Roy Hill Shale	Dark grey to black graphitic shale and chert; locally pyritic.
		Warrie	Dolomite with interbedded chert (locally ferruginous), shale and mudstone.

Source: Kneeshaw (2008)



Refer to Appendix N for a pdf version

Map 5-1 OB29/30/35 geology

5.3.1.2 Local Geology

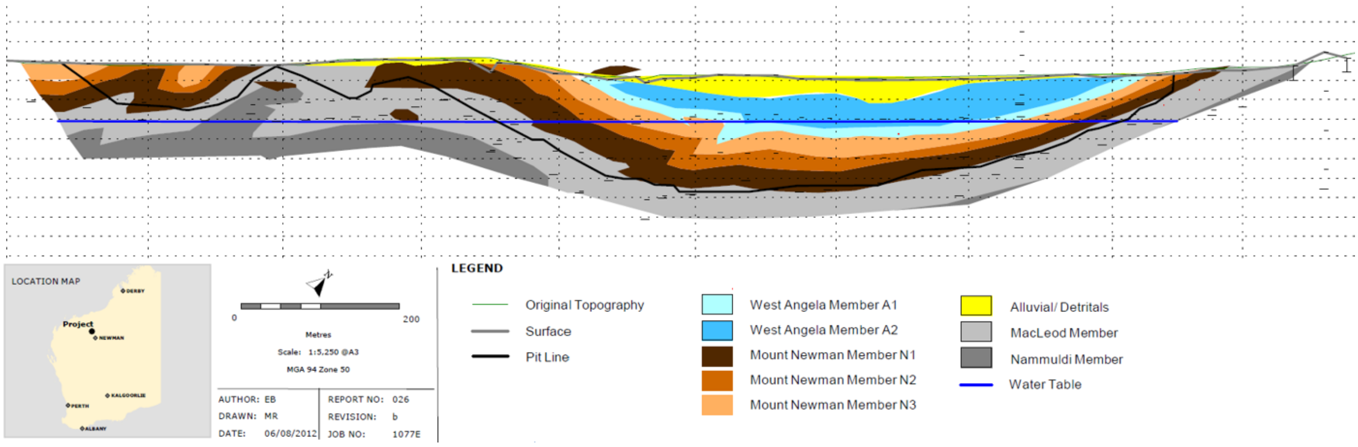
Geology in the vicinity of OB29/30/35 is structurally complex, comprising of a series of anticlines and synclines, cross-cut and offset by a regional fault system (Map 5-1). Individual deposits are further impacted by local scale folding and faulting.

The OB29/30/35 deposits are predominantly hosted by the upper members of the Marra Mamba Iron Formation (Mt Newman and MacLeod) (Figure 5-3), although mineralisation does extend into the lower Marra Mamba (Nammuldi Member) and into the overlying West Angela Member of the Wittenoom Formation. Overlying Detritals, where present, may also be mineralised (Kneeshaw, 2008).

OB29

OB29 is located within a large northwest plunging open syncline resulting in the existing pit having a horseshoe shape. The orebody is predominantly located in the Marra Mamba Iron Formation which is underlain by the Jeerinah Formation of the Fortescue Group (which outcrops to the immediate east and south of the deposit). The stratigraphically younger Brockman Iron Formation (which is mined in the Mt Whaleback Pit) outcrops to the north and northwest of OB29. The Paraburdoo Member of the Wittenoom Formation is also present within the pit shell (Figure 5-2) (RPS Aquaterra, 2012).

In the southeast of the deposit (toward the exposed hinge of the syncline), shallow alluvium and West Angela Shale occur above the groundwater level. As the structure plunges to the northwest, these units occur progressively deeper and below the groundwater level (RPS Aquaterra, 2012).



Source: Amended from RPS Aquaterra (2012)

Figure 5-2 Geological cross-section of OB29

The proportions of waste materials by stratigraphy that are predicted to be intersected by the pit are outlined in Table 5-5. Based on the current mine plan, the dominant stratigraphic units of waste materials are Tertiary Detritals, West Angela member of the Wittenoom Formation and MacLeod member of the Marra Mamba Formation (Table 5-5).

Table 5-5 OB29 waste material proportions by stratigraphy

Stratigraphy		Stratnum Code - Abbreviation	Percentage of Volume Mined to Date	Percentage of Volume to be Mined
Formation	Member			
Tertiary Detritals		TD3 (ST3), TD3 (GS3), TD2 (CA2), TD2 (CY2), TD2 (CY1), TD2 (VB2), TD1 (HC1),	26.0%	14.3%
Dykes / Sills		K	1.1%	2.3%
Surface Scree		SZ	1.5%	6.5%
Wittenoom Formation	Paraburdoo	OB	22.6%	16.1%
	Bee Gorge	OC	0.0%	0.1%
	West Angela	WA2, WA1	29.8%	27.5%
Marra Mamba Formation	Newman	N3, N2, N1	4.9%	10.1%
	MacLeod	MM	8.3%	14.3%
	Nammuldi	MU	5.6%	8.4%
Jeerinah Formation	Undifferentiated	JN	0.2%	0.3%

Stratigraphy		Stratnum Code - Abbreviation	Percentage of Volume Mined to Date	Percentage of Volume to be Mined
Formation	Member			
Unknown		LT2	0.0%	0.1%

Source: BHP (2024c)

OB30

OB30 is located on the steeply dipping southern limb of the Whaleback South Syncline. Strata are overturned and are generally dipping at approximately 50° to the south. The general stratigraphic sequence intersected in the area consists of the older Jeerinah Formation (Fortescue group) overlain by the younger Marra Mamba Iron Formation, in turn overlain by the Wittenoom Formation (Figure 5-3).

The Wittenoom Formation occurs immediately to the north of the OB30 pit. The Mt Sylvia and Mt McRae Formations outcrop further to the north, in the southern wall of the Mt Whaleback Pit. Lower members of the Marra Mamba Iron Formation (MacLeod and Nammuldi) and the Jeerinah Formation lie to the south of the OB30 pit (Figure 5-3).

The proportions of waste materials by stratigraphy that are predicted to be intersected by the pit are outlined in Table 5-6. Based on the current mine plan, the dominant stratigraphic units of waste materials are the West Angela members of the Wittenoom Formation and the Newman and MacLeod member of the Marra Mamba Formation (Table 5-6).

Table 5-6 OB30 waste material proportions by stratigraphy

Stratigraphy		Stratnum Code - Abbreviation	Percentage of Volume Mined to Date	Percentage of Volume to be Mined
Formation	Member			
Tertiary Detritals		TD3	11.8%	22.9%
Wittenoom Formation	Paraburdoo	OB	3.7%	24.5%
	West Angela	WA2, WA1	21.8%	25.1%
Marra Mamba Formation	Newman	N3, N2, N1	31.6%	9.6%
	MacLeod	MM	27.8%	14.2%
	Nammuldi	MU	3.4%	3.7%

Source: BHP (2024c)

OB35

OB35 is situated in the next (structurally higher) syncline from OB30 and is part of the Western Ridge Syncline (Figure 5-3). The strata present at OB35, from youngest to oldest are (Figure 5-3 and Figure 5-4):

- Paraburdoo member (Wittenoom Formation);
- West Angela member (Wittenoom Formation);
- Mt Newman member (Marra Mamba Iron Formation);
- MacLeod member (Marra Mamba Iron Formation);
- Dolerite sill (Jeerinah Formation); and
- Nammuldi member (Marra Mamba Iron Formation).

Thrust faulting is a predominant feature in the centre and west of the deposit (Figure 5-4). A dolerite dyke is present in the east of the deposit, which exclusively intrudes the Nammuldi Member. Tertiary Detrital units lie unconformably over the bedrock. The Detritals occur predominantly in the western part of the project area and along the valley present between two ridges (trending North West-Sout East) overlying the eastern part of the deposit.

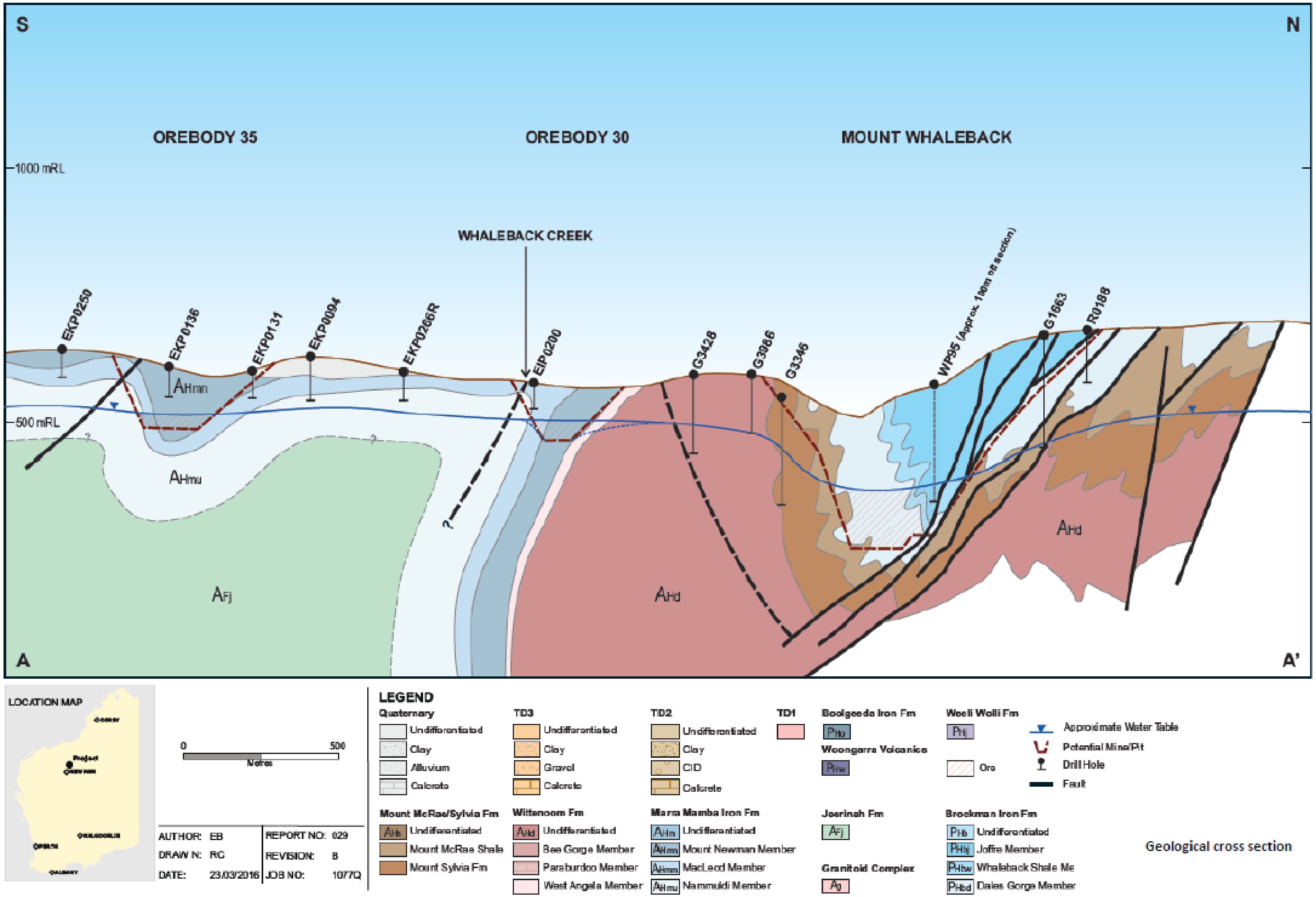
The proportions of waste materials by stratigraphy that are predicted to be intersected by the pit are outlined in Table 5-7. Based on the current mine plan, the dominant stratigraphic units of waste materials over the life of mine are Tertiary Detritals, and Newman and MacLeod members of the Marra Mamba Formation Table 5-7. In terms of materials yet to be mined, the Newman member of the Wittenoom Formation represent a significant proportion of waste materials to be extracted in the future.

Table 5-7 OB35 waste material proportions by stratigraphy

Stratigraphy		Stratnum Code - Abbreviation	Percentage of Volume Mined to Date	Percentage of Volume to be Mined
Formation	Member			
Tertiary Detritals		TD3, TD2	23.4%	10.9%
Dykes / Sills		K	0.0%	0.0%
Wittenoom Formation	Paraburdoo	OB	0.2%	0.0%

Stratigraphy		Stratnum Code - Abbreviation	Percentage of Volume Mined to Date	Percentage of Volume to be Mined
Formation	Member			
	West Angela	WA2, WA1	16.2%	14.1%
Marra Mamba Formation	Newman	N3, N2, N1	27.5%	72.2%
	MacLeod	MM	24.4%	1.2%
	Nammuldi	MU	8.3%	1.6%

Source: BHP (2024c)



Source: BHP (2022)

Figure 5-3 Geological section of OB30 & OB35

North of the deposit, between OB35 and OB30, strata dip gently to the south with a thin alluvial cover or outcropping Marra Mamba. To the south of the deposit, a thin cover of alluvium overlies the Marra Mamba and Wittenoom formations and also dips to the south but at a steeper angle (RPS Aquaterra, 2012).

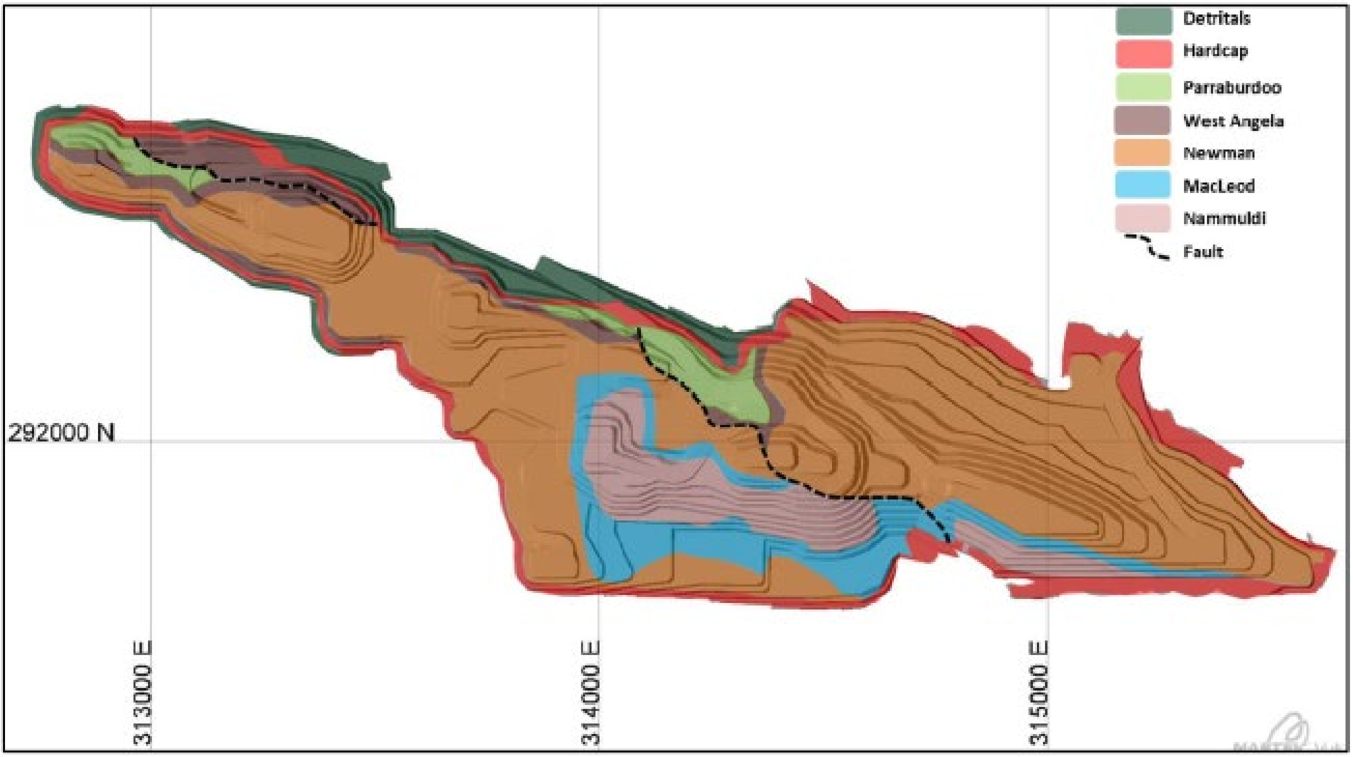


Figure 5-4 Intersection of main stratigraphic units at OB35

ES PB1

The dominant geological units associated with waste materials at ES PB1 are the Newman member of the Marra Mamba Formation followed by the West Angela member of the Wittenoom Formation (Table 5-8).

Table 5-8 Mining model ES PB1 waste material proportions by stratigraphy

Stratigraphy		Stratnum Code - Abbreviation	Percentage of Volume Mined to Date	Percentage of Volume to be Mined
Formation	Member			
Tertiary Detritals		TD3 (inc. ST3), TD2 (VB2)	2.9%	0.0%
Surface Scree		SZ	2.2%	4.5%
Wittenoom Formation	Bee Gorge	OC	2.1%	10.3%
	West Angela	WA2, WA1	23.4%	49.7%
Marra Mamba Formation	Newman	N3, N2, N1	47.5%	33.3%
	MacLeod	MM	21.9%	2.2%

Source: BHP (2024c)

5.3.2 Overburden classification system

BHP classifies wastes to inform the management of different waste rock types according to their physical and geochemical properties using two interconnected classifications: AMD class and physical property (Waste Material (WMAT)) class (Table 5-9). These classifications have been devised to support informed management of beneficial and problematic waste during mine planning. The preliminary classifications are included in mining and geological models, with classifications confirmed though analysis and inspection of blast cone chips prior to mining. Targeted test work is also conducted, as required, to validate AMD classification assumptions and physical materials properties (Sections 5.3.2.3 and 5.3.2.4).

Table 5-9 Geochemical and physical waste classification categories

Classification	Geochemical / Physical Stability Stratigraphy	Description
AMD 0	**Geochemically inert:** NAPP <3 kg H_2SO_4/tonne	AMD 0 overburden is segregated based on its physical properties into WMAT 1, WMAT 2 and WMAT 3 material types (see below).
AMD 1	**Geochemically problematic**: All stratigraphies below water table, NAPP ≥3 kg H_2SO_4/tonne	**Adverse AMD waste rock** for containment within OSAs following specific dumping guidance due to the adverse geochemical properties leading to AMD. **Management recommended** AMD 1: Paddocked dumped and encapsulated. AMD 2 / AMD 3: Encapsulated by at least 10 m of geochemically stable waste**.**
AMD 2	**Geochemically problematic**: All stratigraphies above water table, NAPP ≥3 kgH_2SO_4/tonne	
AMD 3	**Geochemically problematic**: All non-bedrock stratigraphies, i.e., Detritals. NAPP ≥3 kgH_2SO_4/tonne; includes alluvial, Scree (Sz) and Tertiary Detritals (TD1, TD2, and TD3)	
WMAT 1	**Geochemically inert:** AMD 0, NAPP <3 **AND** **Physically inert:** Hard cap	**Beneficial competent and inert waste rock** for placement on outer OSA surfaces due to inherent hardness, mean rock size (rockiness) and physical properties that promote a stable landform surface. **Management recommended** To be used on final surface with a minimum thickness of 1 m.
WMAT 2 / WMAT 3	**Geochemically inert:** AMD 0, NAPP < 3 **AND** **Physically problematic**: Mt Newman, MacLeod, Nammuldi, West Angela, Paraburdoo, Bee Gorge, Jeerinah Dolerite, Alluvials / Detritals	**Potential (WMAT 2) and Certain (WMAT 3) geochemically inert but physically problematic waste rock** for placement within OSAs, beneath outer surface material due to the unfavourable physical properties (dispersive, fine grained) that promote a highly erosive and unstable landform surface. **Management recommended** Avoid placement on final surface. To be placed below WMAT 1.

Notes: NAPP – Net Acid Production Potential (see below for explanation)

Further detail on the geochemical and physical classification systems summarised in Table 5-9 is provided in the relevant sub-sections below.

5.3.2.1 Geochemical classification

Introduction to AMD

AMD is used to describe low-quality seepage or drainage that has been affected by the oxidation of sulphide minerals (primarily pyrite), and / or by the dissolution of acid generating sulphate minerals (such as jarosite, alunite, melanterite etc.).

AMD may be produced when sulphide minerals are exposed to oxygen and water, or when acid sulphate salts are leached. Oxidation of sulphide minerals and / or leaching of acid sulphate salts may result in the production of sulphate (SO_4^{-2}), acid (H+), release of metals (Mg, Ca, Fe, Al, Mn, Zn, Cu, Ni, As, etc.) and salinity (SO_4^{-2}, Ca, Mg, HCO_3^-, Cl^-) depending on mineralogy. For AMD to occur, a sample must contain sulphides or acid generating sulphates. If a sample does not contain reactive sulphur, then AMD reactions cannot occur.

AMD can be acidic, pH circum-neutral, alkaline or saline (INAP, 2014; DISER, 2016c). Whether contact water is acidic and metalliferous (acid drainage), neutral / alkaline and metalliferous (neutral metalliferous drainage) or just saline (high sulphate, saline drainage) largely depends on the relative proportion of sulphide minerals (acid generating) and carbonate minerals (acid neutralising) in the source materials.

Acidic drainage is generated when the acid generating capacity of a material exceeds its acid buffering capacity (Acid Neutralising Capacity; ANC). In this case, the drainage is acid, contains elevated metal concentration and is saline (mostly sulphate salinity).

Neutral metalliferous drainage is formed when the acid generating capacity of a material is less than its ANC. In this case, the drainage is near neutral / alkaline (around pH 6-8) and can contain low levels of metals that are soluble at higher pH if they are present (manganese, cobalt, zinc, arsenic). Salinity is dominated by sulphate, calcium, magnesium and bicarbonate.

Saline drainage (oxidative) occurs when the acid buffering capacity of a system far exceeds its acid generating capacity; in this case, drainage pH is alkaline (>pH 8) and saline (mostly sulphate, calcium, magnesium, carbonate salinity) and has limited (potentially manganese) or no metals in solution.

The hazard for metalliferous and saline drainage associated with AMD reactions is linked to total sulphur (and specifically sulphide sulphur) concentrations. The higher the sulphur and ANC concentrations in Non-Acid Forming (NAF) materials, the higher the potential to generate neutral metalliferous and saline drainage. It is generally accepted that neutral metalliferous and saline drainage are generally of concern for materials characterised by total sulphur concentration above 1 wt.%.

Distinct from AMD reactions, other potential processes that may release salinity and metals are associated with the dissolution of readily soluble mineral groups such as salts, some sulphates (gypsum, epsomite), and carbonates (non-oxidative metalliferous and saline drainage). Some of these mineral groups may contain impurities and / or metals absorbed on their surface that may impact the quality of contact water upon mineral dissolution. However, based on the mineralogy of the stratigraphic units mined across BHP deposits, these minerals are not expected to be present in large quantities. Thus, it is not expected that non-oxidative metalliferous and saline drainage will be a key process impacting on contact water quality. Leach test data can assist with understanding the impacts on contact water quality associated with oxidative and non-oxidative processes.

Use of competent rock (WMAT 1, which is rocky and durable) on the final landform surface will minimise the potential for mobilisation of salts / metals associated with non-oxidative weathering in run-off and contact water.

BHP geochemical classification system

BHP has historically identified Potentially Acid Forming (PAF) material in geological and mine planning block models based on total sulphur (S) content, degree of weathering and lithology, and the focus was on material known to have a high acid generating potential (i.e. unweathered black shales). However, since 2015, improvements have been made to procedures for identifying and coding PAF that may contribute to AMD in geological and mine planning block models. These improvements are based on the collection of extensive geochemical characterisation data across BHP's operations, and learnings from preliminary AMD risk assessments and research studies.

BHP now classifies PAF according to the Net Acid Production Potential (NAPP) system. The NAPP classification evaluates the balance between the acid generating and acid neutralising potential of a sample or overburden block. The pre-mining water table is used as a geochemical boundary, above which, material is assumed to be completely weathered (oxidised sulphur) and below which, the material is assumed to be partially or completely unweathered (reduced sulphur). Where unweathered (un-oxidised) material is assessed as having a NAPP ≥3 kg H_2SO_4/t, it is classified AMD1. Weathered and detrital material having a NAPP ≥3 kg H_2SO_4/t is classed as AMD2 or AMD3, respectively (Table 5-9). AMD1, AMD2 and AMD3 overburden are PAF and are managed according to their geochemical hazard. Thus, the current AMD classification manages geochemical risk associated with sulphide oxidation (pyrite) and acid sulphate salts leaching (acid generating sulphates).

The classification uses primary assay data to estimate the acid generating and acid neutralisation capacity of a sample. Regardless of the acid generating mineral (i.e. sulphides or sulphates), the classification embedded in the geological and mining models assumes that all sulphur is associated with pyrite, which it is usually not, and thus is especially conservative for AMD2 and AMD3 overburden types. All mined materials are classed into inert (AMD0) or reactive (AMD1, AMD2, AMD3) groups based a NAPP cut-off value of 3 kg H_2SO_4/t, as follows:

- **NAPP <3 kg H_2SO_4/t:**
  - **AMD0**: inert overburden which is then segregated based on its physical properties into WMAT1, WMAT2 and WMAT3 material types (see below).
- **NAPP ≥3 kg H_2SO_4/t:**
  - **AMD1**: geochemically reactive overburden associated with fresh material (i.e. overburden located below the water table and assumed to contain pyrite).
  - **AMD2**: potentially geochemically reactive overburden located above the water table.
  - **AMD3**: associated with detrital lithologies and containing potentially geochemically reactive overburden.

AMD1 overburden is likely to contain fresh sulphides (i.e. pyrite) and thus, poses the highest risk to water quality. AMD2 materials are unlikely to contain sulphide minerals, however, they may contain acid sulphate minerals such as alunite, jarosite and Na-alum. AMD3 materials may contain fresh sulphides (pyrite), particularly in the lignite horizons associated with Tertiary Detritals 2 (TD2), while other stratigraphies within the Detritals may contain acid sulphate minerals. AMD1, AMD2 and AMD3 overburden can generate water of poor quality and thus require management. However, acid sulphate salts minerals are sparingly soluble and pose a much lower risk to water quality compared to AMD1 type overburden, as recently determined from on-going AMD studies conducted by BHP.

5.3.2.2 Physical classification

The WMAT classification manages physical property risks associated with how AMD0 material responds to weathering. AMD0 waste is segregated into three classes based on the propensity of each of the mined stratigraphic units to withstand erosion (Table 5-9):

- **WMAT 1**: comprises stratigraphies that are blocky, competent and resistant to erosion. This material is recommended for emplacement on the final surface with a minimum thickness of 1 m and used for armouring of final landforms. WMAT 1 is considered an asset, and should be differentially handled, stockpiled and / or placed on landforms in strategic locations.
- **WMAT 2**: is potential problematic waste, with properties to be confirmed during mining. WMAT 2 waste requires management and is to be placed at least 1 m below the final surface of OSAs.
- **WMAT 3**: known non-competent stratigraphies, to be placed at least 1 m below the final surface of OSAs.

Potentially fibrous materials

Waste and low-grade ore is also classified according to whether they are potentially fibrous materials. Any potentially fibrous materials that are encountered during mining are placed in OSAs or used for mine void backfill and are placed at least 1 m below inert, non-fibrous overburden.

5.3.2.3 Geochemical characteristics

BHP (2021a) conducted an AMD risk assessment for the waste rock at OB29/30/35 in accordance with BHP's AMD risk management procedure (WAIO, 2022b). This was supplemented by a source hazard assessment for ES PB1 (BHP, 2021f). The assessments were based on the outputs from the mining models for each deposit, which in turn relied on the chemical assay data contained within the BHP drill-hole database for the respective deposit (55,122 samples for the OB29/30/35 deposits and 2,290 samples for ES PB1). In addition, BHP's environmental geochemistry database was used to facilitate refinement, where needed, of the current understanding of the potential AMD hazard risk of key materials based on potential acidity, neutralising potential, metals and metalloids, and salts. Acid Base Accounting (ABA) data were used to validate the acid generation characteristics of a waste rock material through determination of the ANC and the maximum potential acidity (MPA), compared to the WAIO BHP AMD classification.

Given that high sulphate and excess ANC is a characteristic of both neutral metalliferous and saline drainage, sulphur and ANC results were used to assess the potential for this to occur. The neutral metalliferous and saline drainage hazard potential was also assessed through interrogation of the environmental geochemical dataset; specifically, sulphur speciation, Net Acid generation (NAG), and titrated ANC (BHP, 2021a).

An elemental enrichment assessment was also conducted using the Geochemical Abundance Index (GAI) (Förstner, Ahlf, & Calmano, 1993). The GAI quantifies an assay result for a particular element in terms of the average crustal abundance of that element. A GAI of 0 indicates that the content of the element is less than, or similar to, the average crustal-abundance. Generally, a GAI of 3 or greater signifies enrichment that warrants further examination (BHP, 2021a).

The results of these assessments are reported below.

Source Hazard Assessment

BHP (2021a) ranks the hazards posed by each source of AMD (waste rock[10], low grade ore[10] and pit wall exposures) based on the class and quantity of PAF that the source contains (Table 5-10 and Table 5-11). The source hazards for OB29/30/35 are summarised by deposit below.

Table 5-10 Source hazard categories (waste rock and low-grade ore)

Source Hazard	AMD 1 Volume (Mm^3)	AMD 2 or 3 Volume (Mm^3)
Low	<0.1	<1
Moderate	0.1 - 0.5	1 - 10
High	>0.5	>10

If a different source hazard risk exists between different AMD types, the highest source hazard risk applies.
Source: BHP (2021a)

Table 5-11 Source hazard categories (pit wall exposure)

Source Hazard	AMD 1 Surface Area (m^2)	AMD 2 or 3 Surface Area (m^2)
Low	<2,500	<25,000
Moderate	2,500 - 25,000	25,000 - 50,000
High	>25,000	>50,000

If a different source hazard risk exists between different AMD types, the highest source hazard risk applies.
Source: BHP (2021a)

Overview

Based on the material balance extracted from the mining block models and the BHP geochemical classification system at the time, the AMD risk associated with the OB29/30/35 and ES PB1 pits is low. All of the waste rock and low grade ore at ES PB1 is classified as AMD 0, and over 99% of the waste rock and low-grade ore volume (both already mined and to be mined) at the OB29/30/35 pits is classified as AMD 0. The data used in the assessment is 2021 is generally reflected by the data generated by the updated 2024 mine plan (see Section 5.3.1.2). An assessment of samples within the BHP geochemistry database from the

10 Note that while all waste rock (not ore) is likely to be stockpiled in the OSAs, low-grade ore may be stockpiled separately for blending and, ultimately, shipped out of site. The proportion of low-grade ore regarded as ore rather than mine waste is generally not known until excavated, and may change as a function of market conditions. There is, therefore, potential for some or all of the low-grade ore to be permanently stored in the OSAs (BHP, 2021a).

OB29/30/35 area was conducted to validate the BHP WAIO classification, and infer the geochemical characteristics of materials similar to those associated with these orebodies. Key observations are summarised below.

Further details of the AMD source hazard associated with each orebody are provided in the subsections following this overview.

Acid-Base-Accounting and Net Acid Generation tests

A review of ABA and NAG test results and comparison with AMIRA (2002) classifications (Table 5-12) indicated that (BHP, 2021a):

- Of the 70 ABA samples, 20 samples were classified as NAF, 49 samples were considered as Uncertain NAF (UC-NAF) and one sample from the Wittenoom Formation (Bee Gorge Member OC – Undifferentiated) was classified as PAF. Overall, the AMD classifications based on ABA-NAG data are consistent with the BHP AMD classification:
  - The PAF sample was correctly classified as AMD 1 in the BHP system;
  - NAF and UC-NAF classifications correlate well with the BHP classification of AMD 0 for 67 out of 69 samples. The exceptions were one NAF sample and one UC-NAF sample that were classified as AMD 1 according to the BHP system, which means that the BHP system is more conservative in the classification of PAF materials.
- Paste pH values ranged from slightly acidic to alkaline (pH 5.5 – 9.3), and the median paste pH values were circum-neutral for all stratigraphic groups, indicating little or limited stored acidity if any, and / or the absence of sparingly soluble sulphates.
- Paste Electrical Conductivity ($EC_{1:2}$) values ranged from 44 to 933 µS/cm, with the majority (70%) of samples having EC below 400 µS/cm, suggesting low to moderate salinity of paste extracts and limited readily soluble salts present in the samples.
- The median sulphur content was very low (≤0.05%) across all the stratigraphies. There were 36 samples with total sulphur below instrument detection limit, and the remaining 34 samples showed total sulphur ranging from 0.02% to 0.46% with an average of 0.05%.
- The distribution of ANC was more dependent on stratigraphy. Measured ANC values were typically below 10 kg H_2SO_4/t, however, 9 out of 11 OB samples recorded the highest ANC values (>800 kg H_2SO_4/t) among all stratigraphies. WA2 and JN samples showed relatively high median ANC values.
- The geochemical test results of 16 above water table samples from MU, MM, TD2 and CY2 stratigraphic units suggested that both total sulphur (≤0.04%) and ANC (≤7.2 kg H_2SO4/t) was low in these samples, indicating a strong NAF – barren signature due to weathering. The sulphur in these samples is likely in the form of sulphate (e.g. gypsum) due to neutral or slightly alkaline paste pH values.
- The only PAF sample (OC) had a relatively low total sulphur content of 0.18%; while the two samples with higher sulphur contents (one MU of 0.46%, and one WA2 of 0.19%) were classified as UC-NAF due to abundant ANC.

Table 5-12 AMIRA AMD classifications

AMIRA Classification	Definition
NAF	NAPP <0 and NAG pH of ≥4.5.
PAF	NAPP ≥0 and NAG pH <4.5.
UC	Where the NAPP and NAG results are not in agreement. Uncertain samples are generally given a tentative classification that is shown in brackets UC-NAF.

Source: AMIRA (2002)

Total elemental concentration

Total elemental scans were carried out on 31 samples which included 18 NAF, 12 UC-NAF and one PAF sample. Results were assessed using the GAI to identify elements that may be enriched with respect to the average crustal abundances. Stratigraphies assessed included MU, MM, OC, JN, N1, N2, OB, VB2 and CY2 (BHP, 2021a).

Total elemental analyses show enrichment in some elements, namely silver, arsenic, cobalt, iron, mercury, manganese, molybdenum, and selenium. However, an enrichment in a specific element does not imply mobility or bioavailability which are dependent on a number of factors such as elemental form (mineralogy), solubility, environmental conditions (e.g. reducing, oxidising), and volume (flow rate) of drainage (BHP, 2021a).

Elemental enrichment has shown some correlation with stratigraphic units. For example:

- All iron enrichment occurred in the Marra Mamba Iron Formation (MU and MM);
- Enrichments of arsenic, cobalt, manganese and molybdenum were only found in the Wittenoom Formation (OC);
- Enrichment of mercury was only found in N1 / N2 units of the Marra Mamba Formation;
- Enrichment of silver was observed in the Wittenoom Formation (OC) and Jeerinah Formation (JN); and
- Enrichment of selenium was observed in the Jeerinah Formation (JN) and Marra Mamba Iron Formation (N1/N2).

Short-term leach data

Short-term leach test data were available for 13 samples from OB29 and one sample from OB30. All these samples were classified as NAF or UC-NAF and had total sulphur ranging from <0.01% to 0.18%. The samples were sourced from MU, MM and OB stratigraphies. The test results suggest that:

- Leachate pH was circum-neutral with a range from pH 6.71 to pH 8.69.

- Leachate EC ranged from 89 µS/cm to 544 µS/cm with an average EC of 280 µS/cm, indicating low to moderate salinity in the leachates and limited readily soluble salts present in solids.
- Total alkalinity (predominantly bicarbonate alkalinity) of the leachates ranged from 4 to 185 mg/L as $CaCO_3$, with a median value of 14 mg/L as calcium carbonate ($CaCO_3$); while the acidity in the leachates was all below 5 mg/L as $CaCO_3$.
- The concentrations of elements that were entirely or mostly detectable (above lower detection limit) in the leachates included the major ions (sulphate, chloride, calcium, magnesium, sodium, and potassium) and a few trace elements (i.e., boron, barium, nitrate and strontium).
- Concentrations of elements that were found to be enriched in the total elemental scans (i.e., silver, arsenic, cobalt, iron, manganese, molybdenum and selenium) were generally below or close to the lower detection limit in the leachates, suggesting low mobility of enriched elements.
- Concentrations of aluminium, beryllium, bismuth, cerium, chromium, copper, nickel, phosphorous, lead, antimony, tin, thallium, vanadium, tungsten and zinc were also below or close to the lower detection limit in the leachates.

OB29

Waste rock and low grade ore

The AMD source hazard associated with OB29 is low. No AMD 1 waste or low grade ore has been mined to date and none is predicted to be mined in the future (Table 5-13). Small volumes of AMD 2 (40,307 m^3) have been mined to date and these have come from above the water table. A further 130,754 m^3 of AMD 2 waste is predicted to be mined from above the water table. The AMD 2 waste and low grade ore predicted to be mined over the life of operation comprises 0.2% of the overall waste / low grade ore from the deposit. All below water table waste and low grade ore is classed as AMD 0 (Table 5-13).

Approximately 0.4% of the material that has been or will be mined at OB29 has been classified as potentially fibrous (Table 5-13) and is, or will be managed as outlined in Section 5.3.2.2 and Section 9.1.10.

Table 5-13 OB29 - summary of waste rock and low-grade ore by AMD class

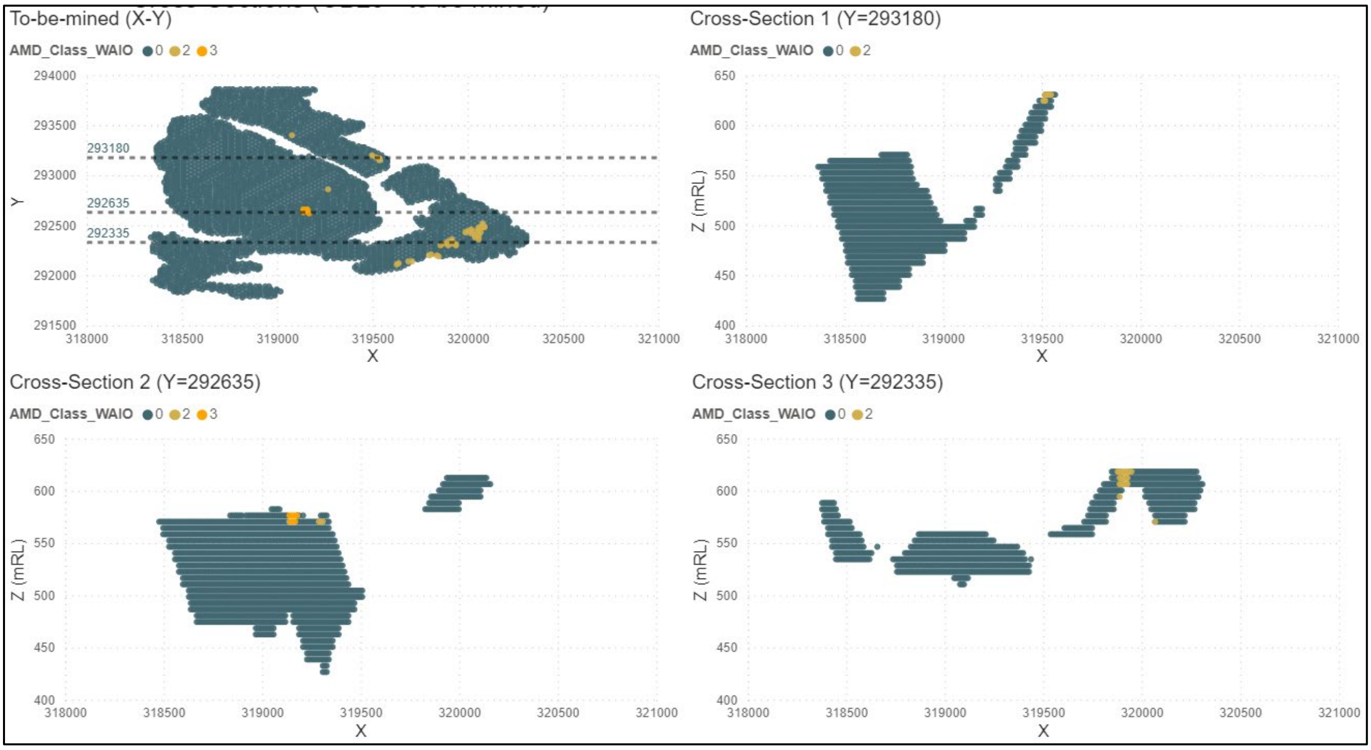
Status	Waste type	AWT / BWT	AMD 0 (m^3)	AMD 1 (m^3)	AMD 2 (m^3)	AMD 3 (m^3)	* N/R (m^3)	Potentially Fibrous	Total Volume (m^3)
As mined	Waste rock	AWT	20,012,336	-	40,307	-	-	296,991	20,349,634
		BWT	196,933	-	-	-	-	-	196,933
	Low grade ore	AWT	1,553,531	-	-	-	-	8,400	1,561,931
		BWT	45,380	-	-	-	-	-	45,380
To be mined	Waste rock	AWT	41,414,127	-	130,754	-	-	40,872	41,585,753
		BWT	29,527,163	-	-	-	-	40,862	29,568,024
	Low grade ore	AWT	6,849,541	-	-	-	-	-	6,849,550
		BWT	1,488,865	-	-	-	-	-	1,488,865
Total			**101,087,876**	**0**	**171,070**	**0**	**0**	**387,125**	**101,646,070**
% Total			**99.5%**	**0.0%**	**0.2%**	**0.0%**	**0.0%**	**0.4%**	**100.0%**

Notes: *AMD class undetermined where total sulphur data is unavailable.
AWT – above water table; BWT below water table

Source: BHP (2024c)

Data used in the AMD risk assessment (BHP, 2021a) indicated that, at the time:

- The as-mined AMD 2 waste blocks had been mainly associated with Wittenoom Formation (WA2 and WA1) and Marra Mamba Iron Formation (MM), and the to-be-mined AMD 2 wastes / low grade ore were predicted to be from the Marra Mamba Formation only (MM and MU). The units nominated as still to be mined mainly occur in the southeast of OB29 pit (Figure 5-5).
- The AMD 3 waste materials were associated with the Tertiary Detritals (TD2) stratigraphies of clay (CY2) and Surface Scree (SZ) only.



Notes: 2D X-Y view and cross sections including all waste rock, low grade ore and ore blocks

Source: BHP (2021a)

Figure 5-5 Spatial variability of AMD material predicted to be mined at OB29

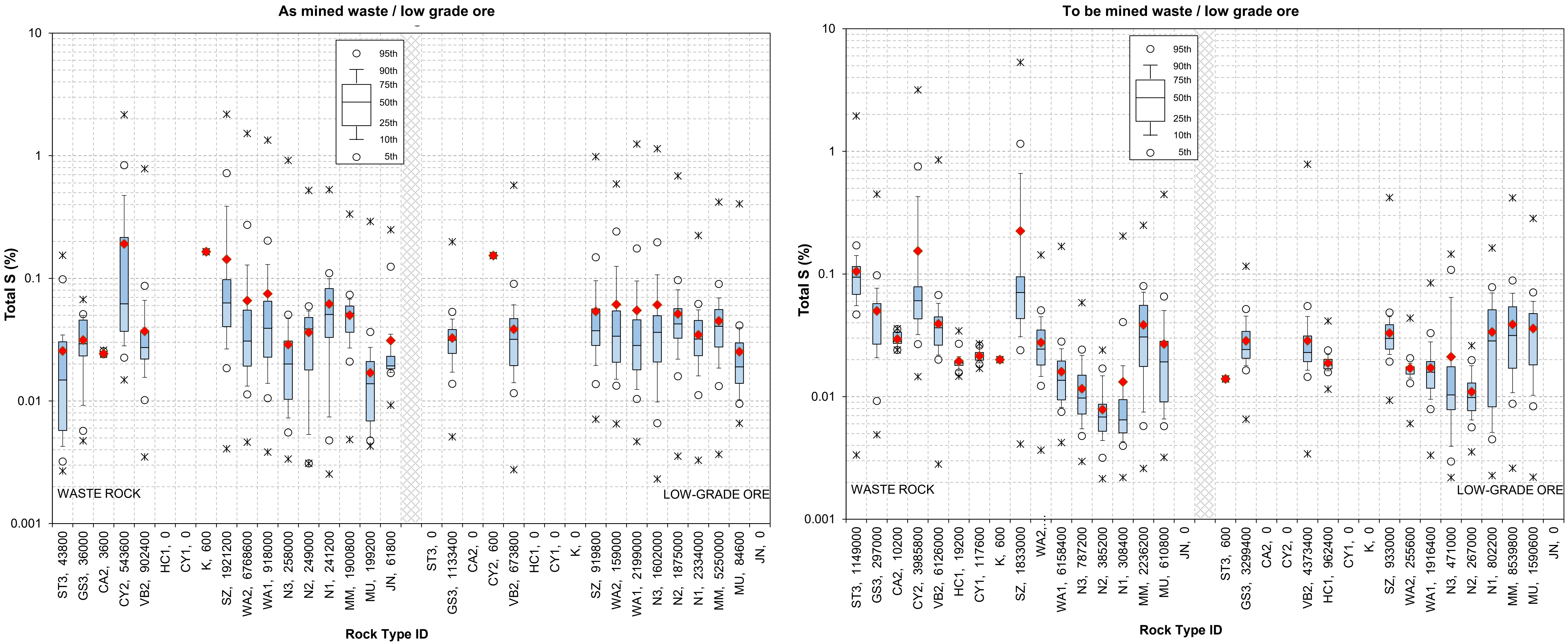
To date, the mined waste and low grade ore have had very low total sulphur concentration with approximately 88 % of waste rock and 95 % of low-grade ore having a total sulphur content below 0.1%. High sulphur blocks (≥1.0%) comprised only 0.59% of waste rock and 0.03% of low-grade ore volume. The median total sulphur was ~0.04% for both waste rock and low-grade ore blocks. The 75th Percentile sulphur was below 0.1 wt% for all waste rock stratigraphies except for CY2 (Tertiary Detrital clay) and the 95th Percentile sulphur was below or just above 0.1 wt% for all low-grade ore stratigraphies. CY2 represents approximately 4% of the total waste volume. Of the approximately 0.5 Mt of CY2 mined at the time of the assessment, only about 22,000 m^3 had a total sulphur content >1% (Figure 5-6) (BHP, 2021a).

The waste rock and low-grade ore nominated as still to be mined had very low sulphur with approximately 95% of the waste rock and 98% of low-grade ore characterised by very low total sulphur (<0.1%). High sulphur blocks (≥1.0%) were not present in low-grade ore blocks and comprised only 0.57% of the waste rock volume. Total sulphur distribution in waste nominated as yet to be mined was consistent with that reported for the mined-out waste. The average total sulphur is ~0.03% and ~0.02% for the waste rock blocks and low-grade ore blocks, respectively. Some waste blocks within the CY2 and SZ stratigraphies have high total sulphur, with the 95th Percentile near or just above 1% total sulphur (Figure 5-6). However, based on the BHP NAPP classification, only 0.2% and 0.9% of waste volumes for CY2 and SZ have been classed as AMD 3 (BHP, 2021a).

The median ANC was ~11.8 kg H_2SO_4/t and ~6.2 kg H_2SO_4/t for waste rock blocks and low-grade ore blocks mined at the time, respectively. For the same stratigraphy, the ANC of waste rock blocks was generally higher than that of the low-grade ore blocks. The CA2, JN and SZ stratigraphies showed relatively higher ANC distribution (i.e., ≥ 30 kg H_2SO_4/t) (Figure 5-7) (BHP, 2021a).

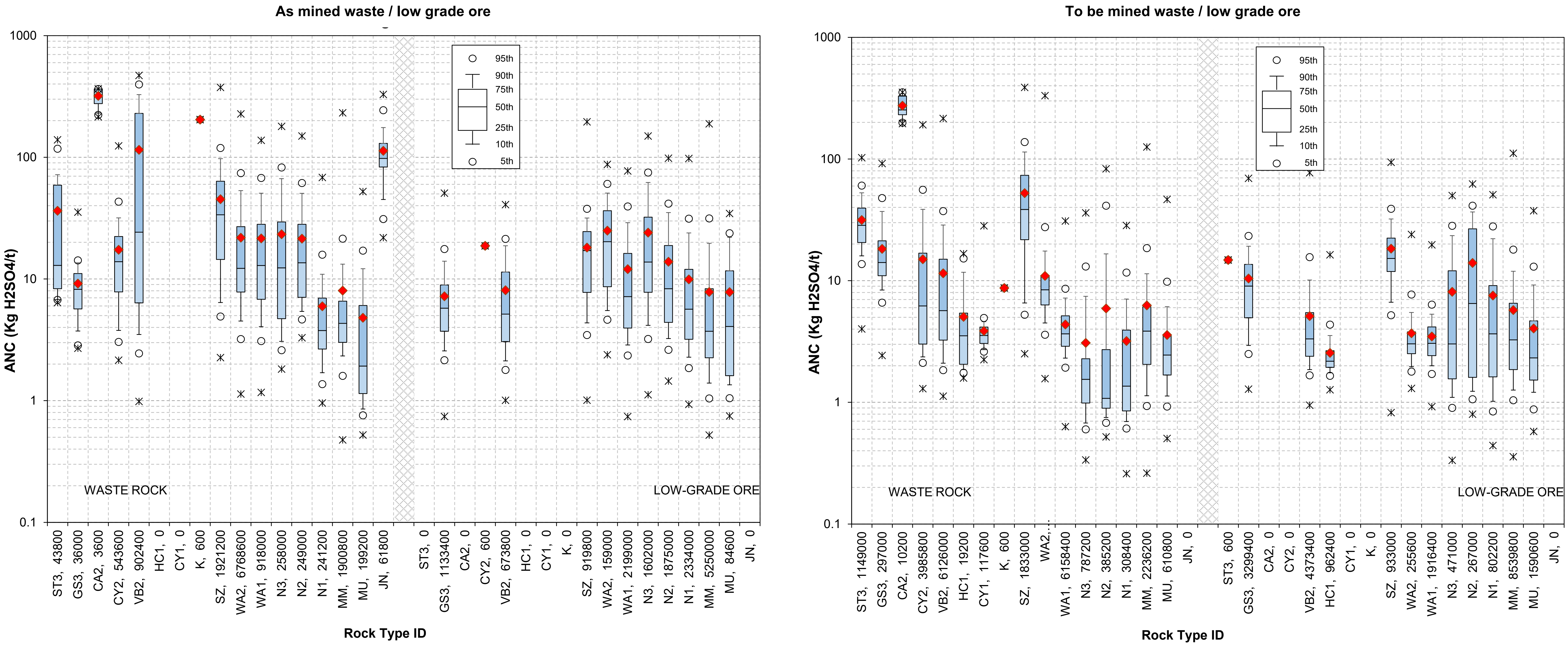
The median ANC of waste / low grade ore nominated as yet to be mined was ~7.0 kg H_2SO_4/t and ~3.6 kg H_2SO_4/t for waste rock and low-grade ore, respectively. For the same stratigraphy, the ANC of waste rock blocks was expected to be generally higher than that of low-grade ore blocks. The CA2, SZ and ST3 stratigraphies showed relatively higher average ANC distribution (i.e., ≥ 30 kg H_2SO_4/t). Calcrete (CA2) in particular, had elevated ANC with average values in excess of 100 kg H_2SO_4/t (Figure 5-7). Approximately 10,000 m^3 of Calcrete was predicted to be mined (BHP, 2021a).

With regard to neutral metalliferous and saline drainage at OB29, there was a total of 368,400 m^3 of as-mined AMD 0 waste, and 547,200 m^3 of AMD 0 waste yet to be mined, where the weighted average sulphur is ≥ 0.5%. These volumes represented less than 1% of the total material to be mined at OB29. The low abundance of sulphur-rich NAF (AMD 0) waste suggests a relatively low neutral metalliferous and saline drainage risk (BHP, 2021a).



Notes: The volume of waste / low grade ore in m[3] for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021a)

Figure 5-6 OB29 distribution of total-sulphur as a function of stratigraphy



Notes: The volume of waste / low grade ore in m³ for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021a)

Figure 5-7 OB29 distribution of ANC as a function of stratigraphy

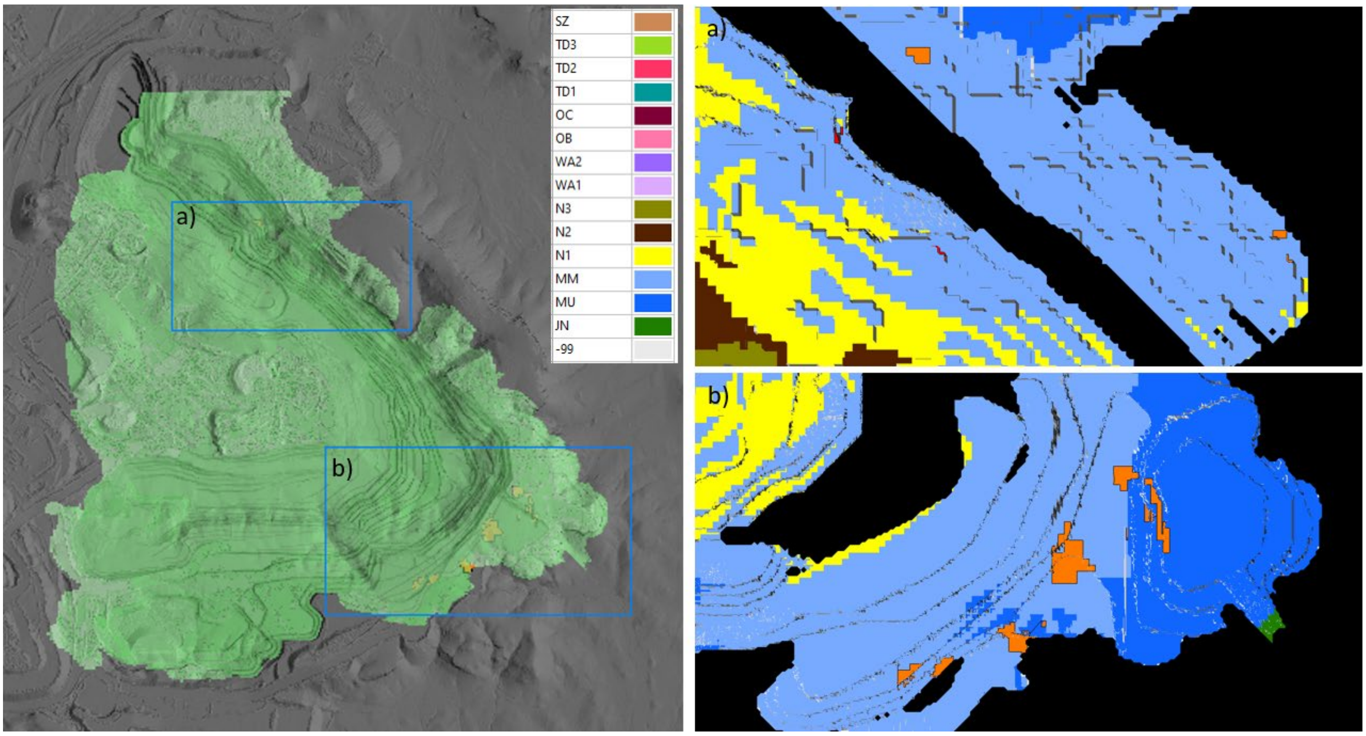
Pit wall exposure

Mapping of pit wall stratigraphy has not been assessed for the updated mine plan. However, the level of risk is considered to be comparable to the outcomes of the mapping conducted in 2021 (BHP, 2021a) and described below.

The final OB29 pit shell was expected to contain two insignificant areas of AMD 1 exposure on the pit walls, however, the current mine plan indicates this is no longer the case (see Table 5-13). Therefore, reference to AMD 1 in Figure 5-8 a can be disregarded.

Three areas of AMD 2 are located on the eastern side of the northern section of the pit (Figure 5-8 a), within the MM stratigraphic unit, at depths between 550 and 630 mRL. The remaining areas of exposed AMD 2 material are on the eastern side of the southern section of the pit (Figure 5-8 b), within the MM and MU stratigraphic units, at depths between 570 and 630 mRL. Updated materials data from the current mine plan (see Table 5-13), indicates that only 0.2% of the mined waste is classified as AMD 2 and therefore the area of exposed AMD 2 material is also likely to comprise a small percentage of the total surface area of the pit shell.

Together the AMD 1 and 2 exposures represent a low source hazard.



Note: the AMD 1 exposures are red (see right hand side of inset a)). The AMD 2 exposures are orange.
Source: BHP (2021a)

Figure 5-8 Pit wall exposures of AMD 1 and AMD 2 in relation to OB29 pit all stratigraphy

OB30

Waste rock and low grade ore

The AMD source hazard associated with OB30 is low. Most of the material mined to date has been from above the water table (Table 5-14). Around 87% of the waste predicted to be mined over the life of OB30 (including waste mined to date as well as to be mined in the future) is AMD 0 (Table 5-14). Approximately 13% of the material that has been or will be mined at OB30 has been classified as potentially fibrous and is, or will be managed as outlined in Section 5.3.2.2 and Section 9.1.10.

During mining, blast hole chips are collected from the mining bench and tested to assign a final AMD classification to the waste blocks. A further program of additional testing prior to mining is, therefore, not necessary (BHP, 2021a).

Table 5-14 OB30 - summary of waste rock and low-grade ore by AMD class

Status	Waste type	AWT / BWT	AMD 0 (m^3)	AMD 1 (m^3)	AMD 2 (m^3)	AMD 3 (m^3)	* N/R (m^3)	Potentially Fibrous	Total Volume (m^3)
As mined	Waste rock	AWT	10,110,898	-	-	-	-	1,697,543	11,808,441
		BWT	-	-	-	-	-	-	-
	Low grade ore	AWT	323,378	-	-	-	-	-	323,378
		BWT	29,045	-	-	-	-	-	29,045
	Waste rock	AWT	24,627,720	-	-	-	-	1,894,769	26,522,488

Status	Waste type	AWT / BWT	AMD 0 (m^3)	AMD 1 (m^3)	AMD 2 (m^3)	AMD 3 (m^3)	* N/R (m^3)	Potentially Fibrous	Total Volume (m^3)
To be mined		BWT	7,656,803	-	--	-	-	2,992,729	10,649,532
	Low grade ore	AWT	827,349	-	-	-	-	-	827,349
		BWT	1,273,172	-	-	-	-	-	1,273,172
Total			**44,848,365**	**0**	**0**	**0**	**0**	**6,585,041**	**51,433,406**
% Total			**87.2%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**12.8%**	**100.0%**

Notes: *AMD class undetermined where total sulphur data is unavailable.
AWT – above water table; BWT below water table
Source: BHP (2024c)

Both the waste / low grade ore blocks already mined and those predicted to be mined at OB30 show consistently low sulphur concentrations (<0.1%). The median total sulphur is below 0.02% for both waste rock and low-grade ore blocks already mined, and 0.01% for those to be mined (Figure 5-9) (BHP, 2021a).

ANC values are higher in waste rock compared to low grade ore with the (BHP, 2021a):

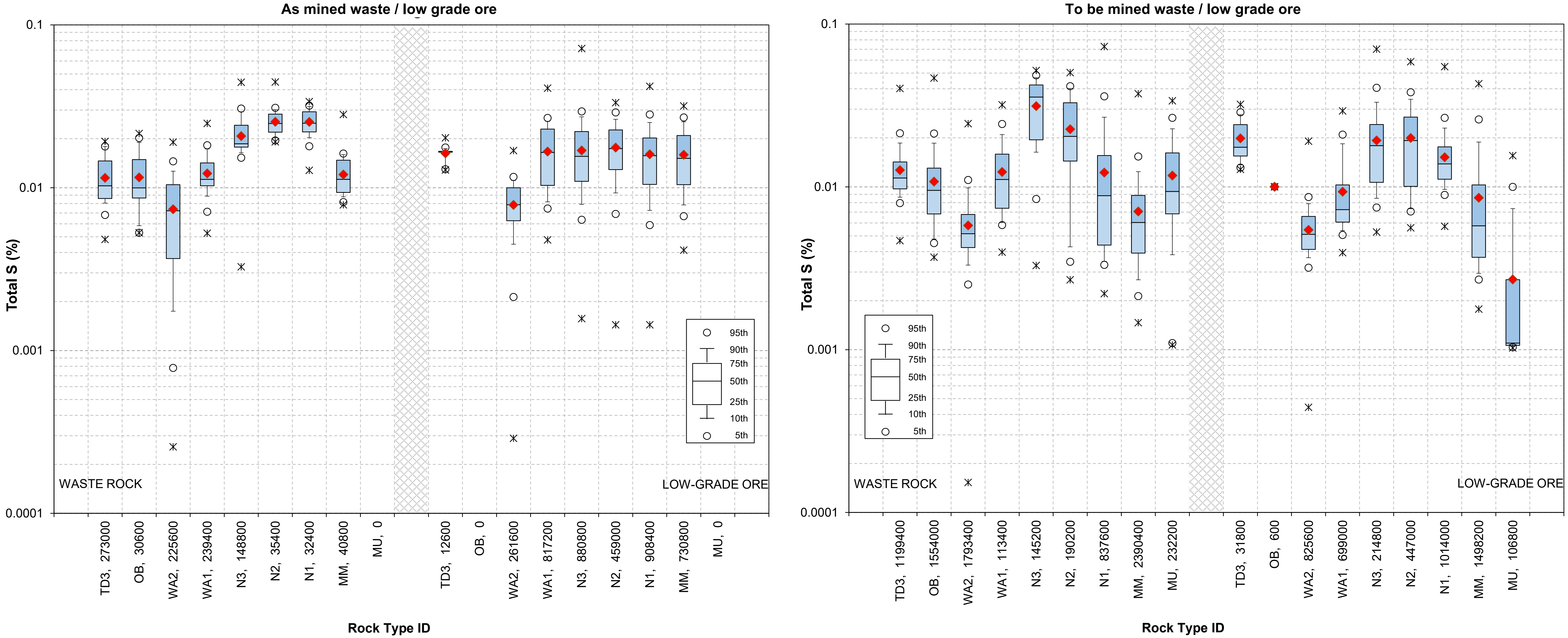
- Median ANC of waste rock already mined being ~31.3 kg H_2SO_4/t which is ~ 4 times higher than the median ANC of low-grade ore blocks (~6.9 kg H_2SO_4/t).
- Median ANC of waste rock blocks yet to be mined being ~22.9 kg H_2SO_4/t compared to that of low-grade ore blocks (~4.2 kg H_2SO_4/t).

The stratigraphy with the most abundant ANC is the Paraburdoo Member of the Wittenoom Formation (OB). The mining model predicts a total volume of ~1,500,000 m^3 of OB material with very low sulphur content (<0.05%), indicating that these waste materials have the potential for use in AMD management or civil work (BHP, 2021a).

There are no AMD 0 (NAF) blocks with a weighted average sulphur ≥ 0.5% at OB30. The risk of saline and neutral metalliferous drainage is therefore negligible.

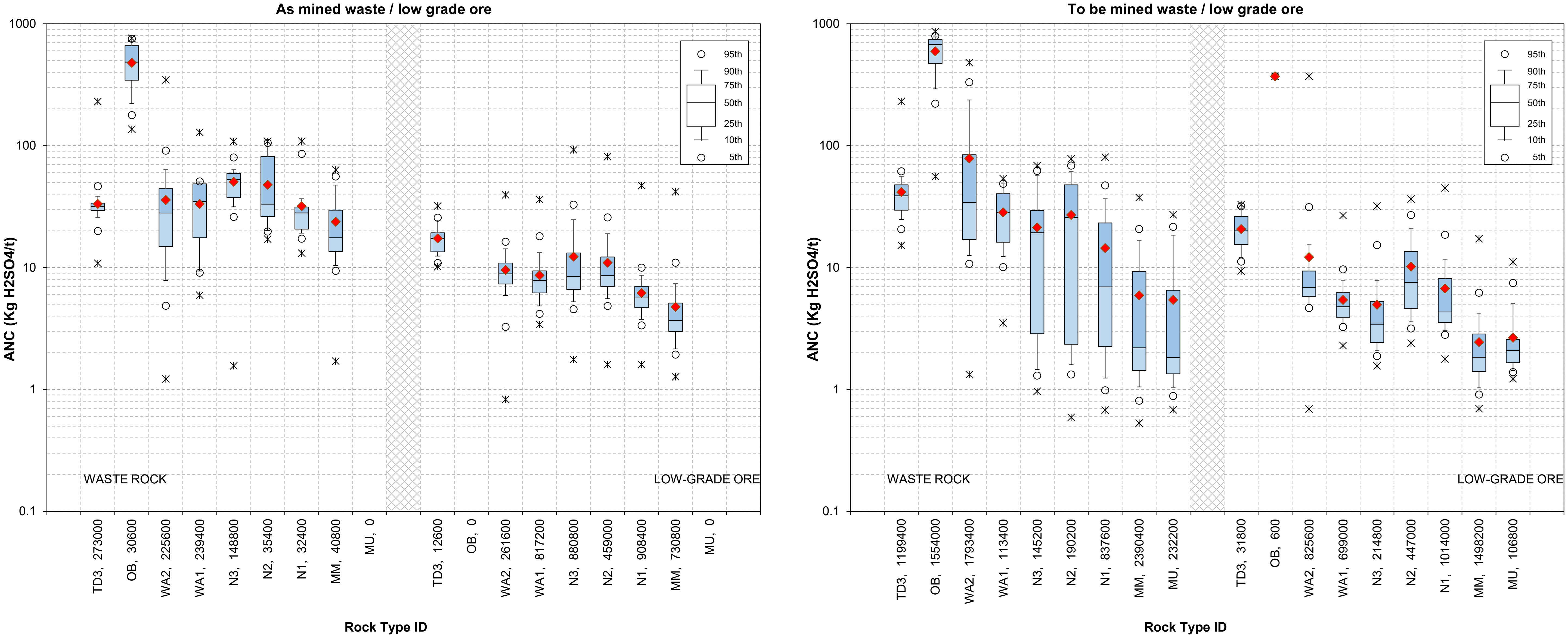
Pit wall exposure

Mapping of pit wall stratigraphy has not been assessed for the updated mine plan. However, the level of risk is considered to be comparable to the outcomes of the mapping conducted in 2021 (BHP, 2021a) and described below. The mining model for OB30 does not contain any AMD 1, 2 or 3 materials, only AMD 0 material. As a result, no exposures of AMD 1, 2 or 3 materials are predicted for the final pit wall of OB30 (BHP, 2021a).



Notes: The volume of waste / low grade ore in m³ for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021a)

Figure 5-9 OB30 distribution of total-sulphur as a function of stratigraphy



Notes: The volume of waste / low grade ore in m³ for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021a)

Figure 5-10 OB30 distribution of ANC as a function of stratigraphy

OB35

Waste rock and low grade ore

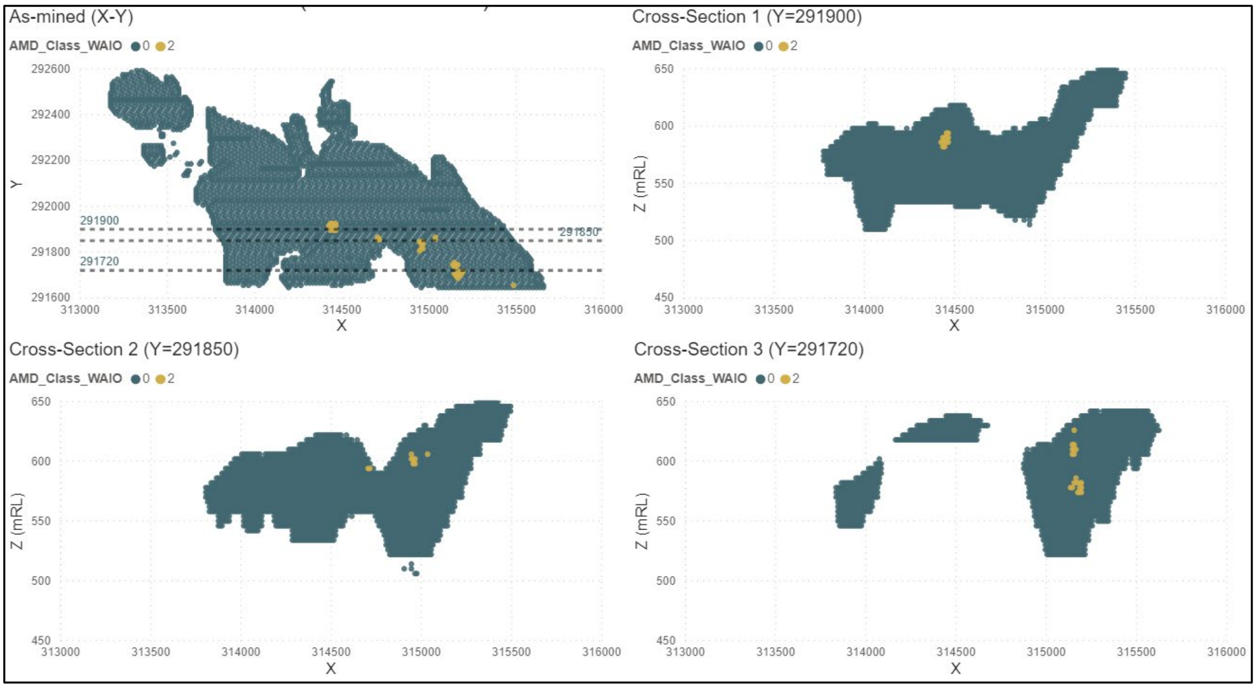
The AMD source hazard associated with OB35 is low. Only minor volumes (less than 0.1%) of AMD 1 waste has been mined to date and none is predicted to be mined in the future (Table 5-15). The locations of several waste / low grade ore blocks with respect to the water table are uncertain, however, all are classified as AMD 0 (except for 317 m^3 of AMD 2 low-grade ore material) and, therefore, represent a very low source hazard. In total, the orebody is associated with 2,000 m^3 of AMD 2 material all of which has already been mined and has primarily been associated with below water table waste (Table 5-15). The AMD 2 materials have been mostly distributed at the southern section of OB35 (Figure 5-11), and all have been associated with the Marra Mamba Formation. There are no AMD 3 wastes / low grade ore associated with the orebody (Table 5-15) (BHP, 2021a; 2024c).

Approximately 40% of the material that has been or will be mined at OB35 has been classified as potentially fibrous and is, or will be managed as outlined in Section 5.3.2.2 and Section 9.1.10.

Table 5-15 OB35 - summary of waste rock and low-grade ore by AMD class

Status	Waste type	AWT / BWT	AMD 0 (m^3)	AMD 1 (m^3)	AMD 2 (m^3)	AMD 3 (m^3)	* N/R (m^3)	Potentially Fibrous	Total Volume (m^3)
As mined	Waste rock	AWT	7,304,206	-	-	-	-	13,389,990	20,694,196
		BWT	14,645,598	2,000	-	-	-	3,643,761	18,291,360
	Low grade ore	AWT	502,874	-	317	-	-	-	503,191
		BWT	474,630	-	-	-	-	-	474,630
To be mined	Waste rock	AWT	50,271	-	-	-	-	67,159	117,430
		BWT	2,541,400	-	-	-	-	-	2,541,400
	Low grade ore	AWT	18,345	-	-	-	-	-	18,345
		BWT	376,630	-	-	-	-	-	376,630
Total			**25,913,954**	**2,000**	**317**	**0**	**0**	**17,100,910**	**43,017,182**
% Total			**60.2%**	**0.0%**	**0.0%**	**0.0%**	**0.0%**	**39.8%**	**100.0%**

Note: *Water table location undetermined. AWT – above water table; BWT below water table
Source: BHP (2024c)



Notes: 2D X-Y view and cross sections including all waste rock, low grade ore and ore blocks
Source: BHP (2021a)

Figure 5-11 Location of as mined AMD 2 material at OB35

OB35 is a low sulphur deposit. Of the wastes and low-grade ore mined to date, approximately 99% and 98% respectively have had very low total sulphur (<0.1%) and all of the waste / low grade ore yet to be mined is predicted to have a very low sulphur content (<0.1%) with the median being <0.01%. Of the wastes / low grade ore mined to date, only about 1,600 m^3 had elevated sulphur values of ≥1.0%. All of these were associated with Tertiary Detritals 3 (TD3) (Figure 5-13). These materials were all classified as AMD 0 in accordance with BHP's NAPP classification process (Section 5.3.2). The median total sulphur was ~0.01% and ~0.03% for waste rock and low-grade ore mined at the time of the study, respectively (Figure 5-13) (BHP, 2021a).

The median ANC of waste rock and low-grade ore mined at the time of the study was ~2.1 kg H_2SO_4/t and ~3.2 kg H_2SO_4/t, respectively. The Wittenoom Formation materials (OB, WA2 and WA1) had relatively higher average ANC than the Marra Mamba Iron Formation (N3, N2, N1, MM and MU) materials. TD2 (most likely Calcrete) and OB represented the waste rock stratigraphies with the highest ANC (Figure 5-14) (BHP, 2021a).

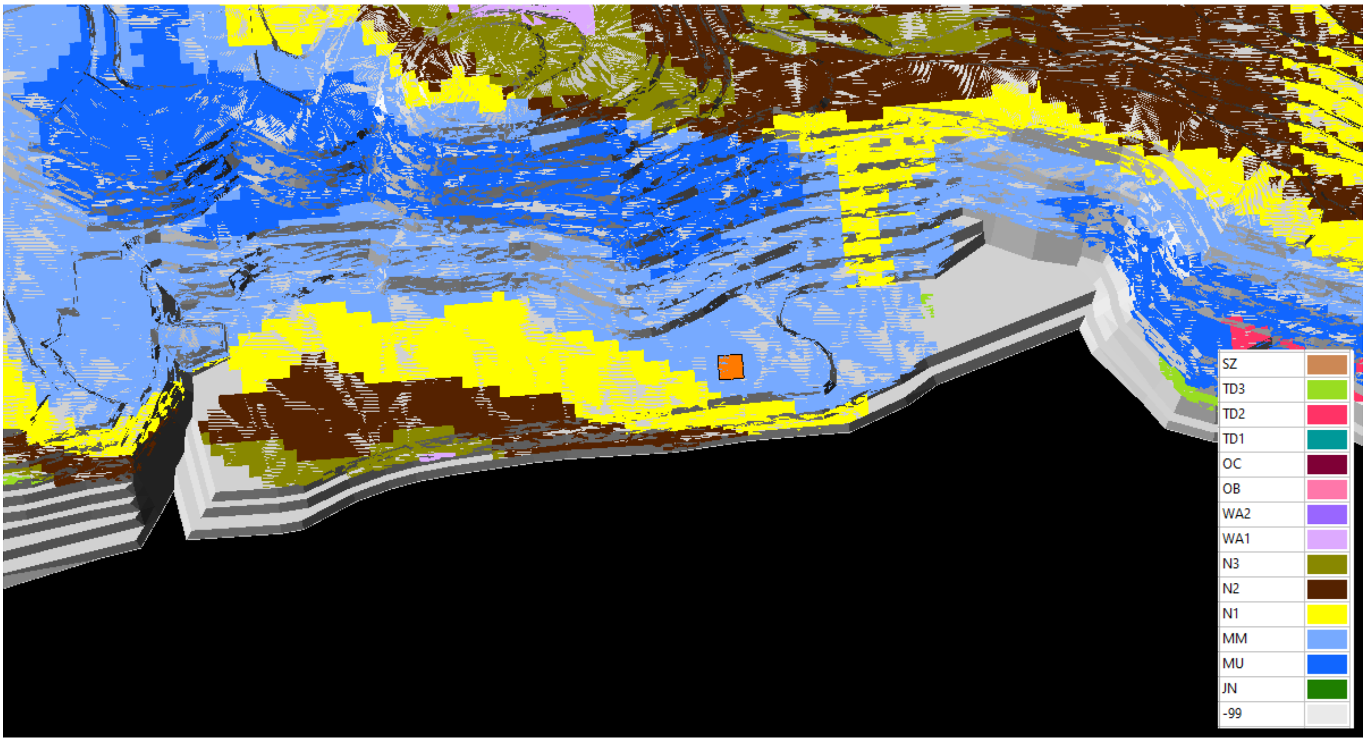
For waste rock and low-grade ore that was yet to be mined, the median ANC was predicted to be ~2.7 kg H_2SO_4/t and ~3.0 kg H_2SO_4/t, respectively. Similar to the wastes that had been mined, TD2 blocks have relatively higher ANC than other stratigraphies (i.e., ≥ 30 kg H_2SO_4/t) (Figure 5-14). This is likely associated with Calcrete horizons (BHP, 2021a).

In relation to saline and neutral metalliferous drainage, there was an insigificant volume (10,400 m^3) of as-mined AMD 0 waste (9,600 m^3 TD3 and 800 m^3 WA1) with total sulphur ≥ 0.5%. These TD3 / WA1 blocks, comprise 0.05% of the total as-mined AMD 0 waste. The blocks are all surficial and above the water table. Sulphur is, therefore, assumed to be oxidised. Thus, the hazard for neutral metalliferous and saline drainage generation from waste rock and / or low-grade ore (if any) already stored in the OSAs is negligible for OB35 (BHP, 2021a).

Pit wall exposure

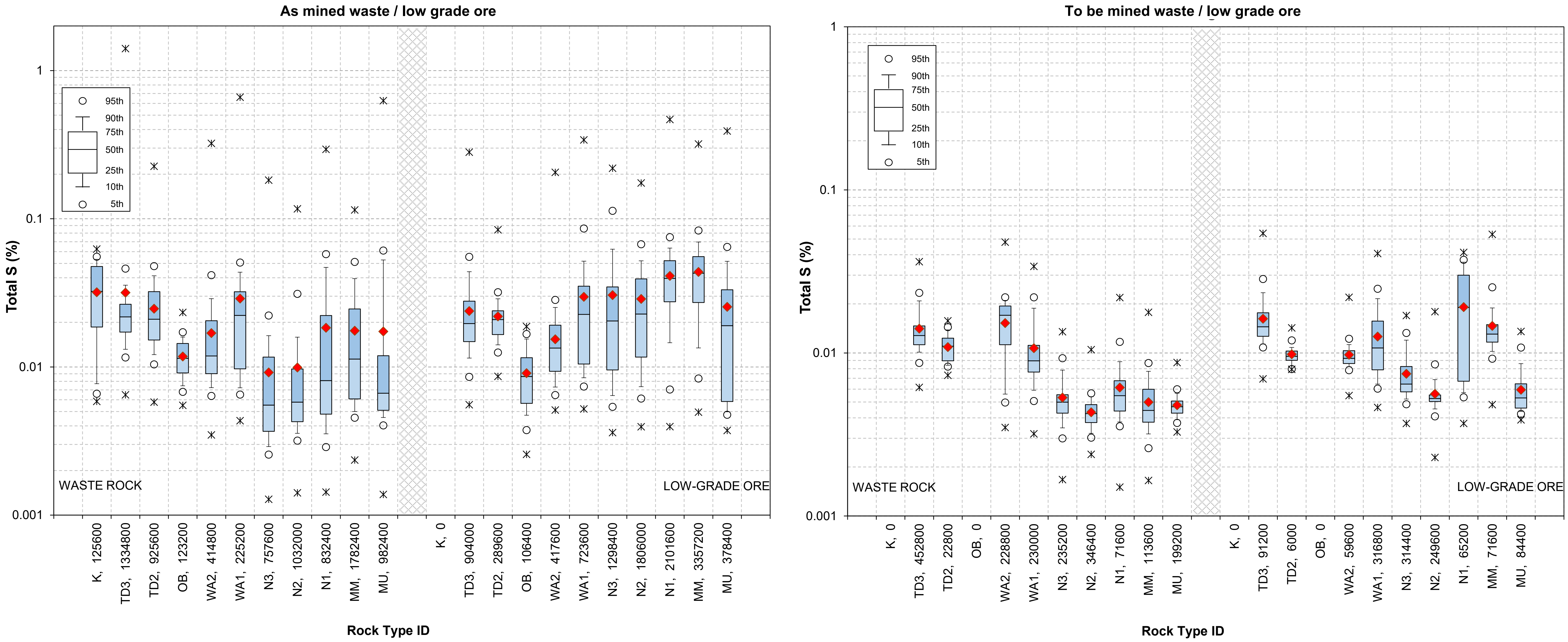
Mapping of pit wall stratigraphy has not been assessed for the updated mine plan. However, the level of risk is considered to be comparable to the outcomes of the mapping conducted in 2021 (BHP, 2021a) and described below.

An insigificant area of AMD 2 material (~400 m2) is exposed on the wall of the final OB35 pit shell (Figure 5-12). This area represents <0.1% of the total pit surface and represents a low source hazard. This exposure is located on a bench at approximately 615 mRL within the MM unit.



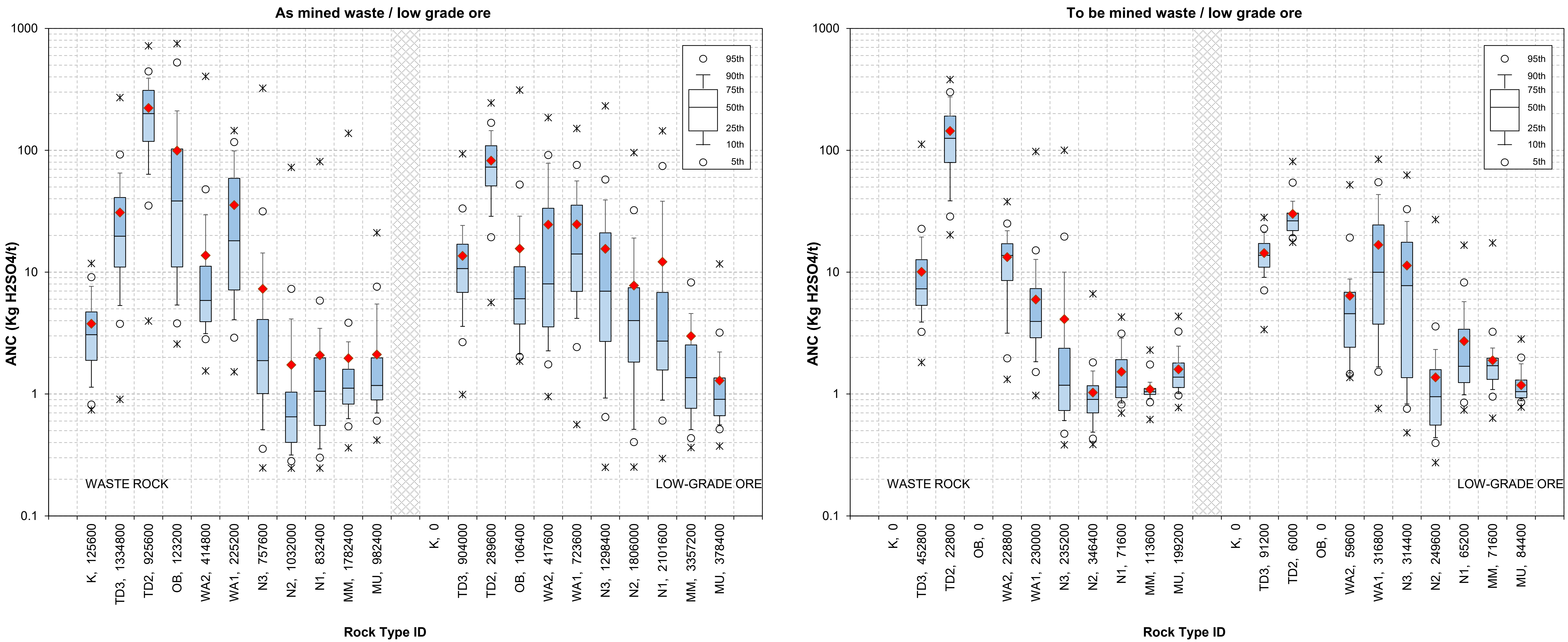
Note: The AMD 2 exposure is shown in orange outlined in black
Source: BHP (2024c)

Figure 5-12 Pit wall exposure of AMD 2 in relation to OB35 pit wall stratigraphy



Notes: The volume of waste / low grade ore in m³ for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021a)

Figure 5-13 OB35 distribution of total-sulphur as a function of stratigraphy



Notes: The volume of waste / low grade ore in m³ for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021a)

Figure 5-14 OB35 distribution of ANC as a function of stratigraphy

ES PB1

Waste rock and low-grade ore

Most of the waste rock and low-grade ore is classified as AMD 0, with minor volumes of AMD 2 waste mined to date and projected to be mined in the future (see Table 5-16).

ES PB1 is a low sulphur system with the 95th percentile for total sulphur being 0.32 wt.% for waste rock and 0.07 wt.% for low grade ore (Figure 5-15). Total sulphur concentrations are higher in Detrital stratigraphies (ST3, VB2, SZ, and TD23; median greater than 0.1 wt.%) and lower in Marra Mamba and Wittenoom Formation rock types, for both waste and low-grade ore (Figure 5-15).

The median ANC for waste rock is predicted to be 11 kg H_2SO_4/t compared to 4 kg H_2SO_4/t for low grade ore (Figure 5-16). The ANC distribution across stratigraphic units (Figure 5-16), shows elevated values with the median near 100 kg H_2SO_4/t for Detrital units SZ and VB2, and moderate ANC at median values of approximately 15 kg H_2SO_4/t for Wittenoom Formation rock types WA2 and OC.

While most of the waste rock and low-grade ore has been classified as non-acid forming (AMD 0), the potential for neutral metalliferous and saline drainage was investigated in AMD 0 materials by assessing the distribution of sulphur across these domains (Figure 5-15). Data shows that 98% of the low-grade ore has total sulphur < 0.1 wt.%. Due to the low sulphur concentration and low ANC (Figure 5-16), the AMD 0 low-grade ore is expected to have no hazard for generation neutral metalliferous and / or saline drainage. This material is considered barren and generally inert.

Approximately 0.5% of the material that has been or will be mined at ES PB1 has been classified as potentially fibrous and is, or will be managed as outlined in Section 5.3.2.2 and Section 9.1.10.

Table 5-16 ES PB1 - summary of waste rock and low-grade ore by AMD class

Status	Waste type	AWT / BWT	AMD 0 (m^3)	AMD 1 (m^3)	AMD 2 (m^3)	AMD 3 (m^3)	* N/R (m^3)	Potentially Fibrous	Total Volume (m^3)
As mined	Waste rock	AWT	3,540,272	-	20,186	-	-	29,217	3,589,676
		BWT	0	-	-	-	-	-	0
	Low grade ore	AWT	1,385,956	-	-	-	-	-	1,385,956
		BWT	0	-	-	-	-	-	0
To be mined	Waste rock	AWT	2,554,616	-	1,279	-	-	11,012	2,566,907
		BWT	58,638	-	-	-	-	-	58,638
	Low grade ore	AWT	310,579	-	-	-	-	-	310,579
		BWT	7,901	-	-	-	-	-	7,901
Total			**7,857,963**	**0**	**21,465**	**0**	**0**	**40,229**	**7,919,657**
% Total			**99.2%**	**0.0%**	**0.3%**	**0.0%**	**0.0%**	**0.5%**	**100.0%**

Note: *Water table location undetermined.
AWT – above water table; BWT below water table

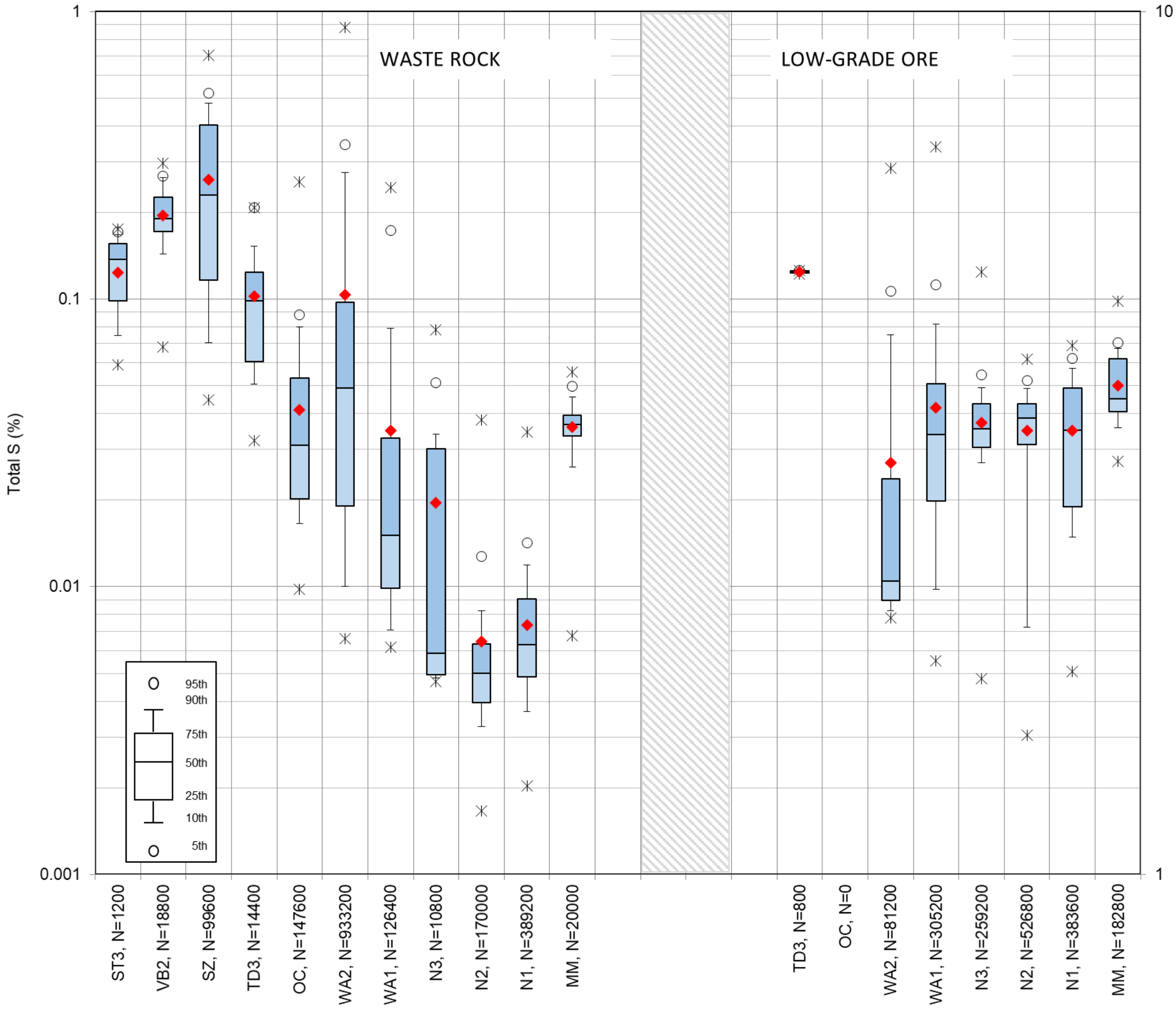
Source: BHP (2024c)

The vast majority of the AMD 0 waste rock (82%) has total sulphur < 0.1 wt.%. An additional 16% of the waste rock has total sulphur ranging from 0.1 to 0.5 wt.%, while an inconsequential amount, has total sulphur greater than 0.5% but less than 1 wt.% (Figure 5-15). Stratigraphic units with slightly elevated sulphur (>0.1 wt.%) and elevated ANC are associated with:

- Detritals, which represent a minimal percentage (less than 5%) of the total waste to be mined and stored on site. All Surface Scree (SZ), representing the dominant rock type with elevated sulphur within the Detritals (70%), will be mined from the top sections of the pit, at maximum depths of 7 m below ground level. It is not expected that sulphides will be present in the mineral assemblage of this surface stratigraphic unit. Based on BHP's regional geochemical database, some alunite may be present in higher sulphur waste rock, but available alkalinity (and ANC) is likely to neutralise in situ any small amount of acidity that may be generated with leaching of small amounts of alunite, if present. SZ waste is expected to have limited or no capacity to generate and / or release neutral metalliferous and / or saline drainage upon leaching.
- Wittenoom Formation (WA1, WA2 and OC):
  - Approximately 25% of the WA2 waste, amounting to 12% of the total waste volume, has sulphur concentration greater than 0.1 wt.% but less than 1 wt.%. Of this volume, 90% has a sulphur concentration less than 0.5 wt.%. All WA2 AMD 0 waste is located above the water table, and as such it is not expected that sulphides will be present within this oxidised stratigraphy. However, from BHP's regional geochemical database, alunite is known to occasionally occur in stratigraphic units within the Wittenoom Formation, but, due to the slow dissolution and leaching rates of this mineral, the low sulphur concentration of

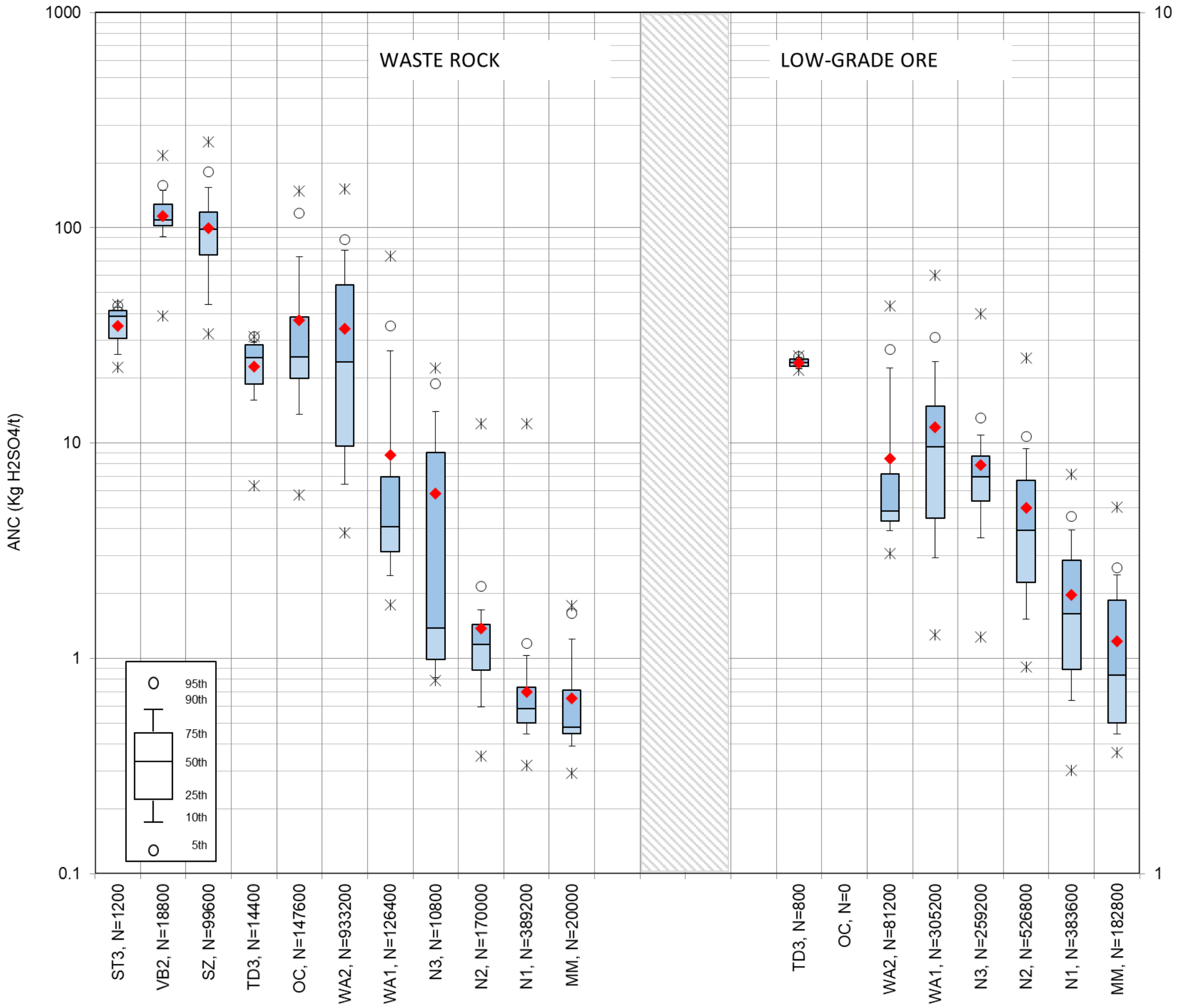
the WA2 waste, and the limited tonnage of waste with sulphur > 0.1 wt.%, generation of neutral metalliferous and saline drainage is not expected from this waste type.

- Similarly, the low waste / low grade ore volumes of the WA1 unit with total sulphur >0.1 wt.% mean that if alunite is present in WA1 waste rock with higher sulphur, it is more than likely that any acidic contact water will be neutralised in-situ due to the available ANC and is not expected to generate or release neutral metalliferous and / or saline drainage upon leaching.
- Less than 0.2% of OC waste has total sulphur concentrations > 0.1 wt.%. Due to the low proportion of OC waste with elevated sulphur concentration, even in the event that alunite may be present, the small amount of acidity that may be produced due to leaching of alunite bearing waste is more than likely to be compensated by the alkalinity present in contact water from NAF waste. OC waste is expected to behave as inert material, with limited or no capacity to generate and or release neutral metalliferous and / or saline drainage upon leaching.



Notes: The volume of waste / low grade ore in m^3 for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021f)

Figure 5-15 ES PB1 distribution of total-sulphur as a function of stratigraphy



Notes: The volume of waste / low grade ore in m³ for each stratigraphic unit is reported next to the rock type ID
Source: BHP (2021f)

Figure 5-16 ES PB1 distribution of ANC as a function of stratigraphy

There were no samples in BHP's geochemistry database from within the ES PB1 footprint at the time that the AMD risk assessment was conducted (BHP, 2021f) and so information from BHP's regional geochemistry data set was interrogated to assess the geochemical properties of key wastes / low grade ore from this pit. This approach is valid as the geochemistry of rock types with similar sulphur and ANC concentrations is relatively consistent regardless of the pit of origin in the Pilbara. The database was filtered to select samples representative of the ES PB1 wastes / low grade ore; all samples were from above the water table and had sulphur concentrations consistent with the statistical distribution of the material to be mined at ES PB1 (BHP, 2021f). Key observations from this analysis are provided below.

Observations on elemental enrichment and leach testing results for the dataset relevant to ES PB1 from BHP's regional environmental geochemical database are as follows:

- **Tertiary Detritals:**
  - **SZ.** Of two samples tested for bulk chemistry, the GAI of one sample was significantly enriched in silver and iron. Leach tests were available for one sample characterised by low sulphur. The leachate had minimal trace metals mobilisation with most trace metals at concentrations below, or near, their detection limit.
- **Wittenoom Formation:**
  - **OC**. Of two samples tested for bulk chemistry, the GAI of one was significantly enriched in arsenic. The leachate had minimal trace metals mobilisation with most trace metals at concentrations below, or near, their detection limit.
  - **WA2.** The GAI of one sample of thirteen showed significant enrichment with respect to manganese, and one with respect to arsenic. Leach testing results were available for two samples and showed elevated concentrations of manganese. These

elevated values may be associated with the presence of colloids in the leachate that were not captured by the 0.45 µm filters used in the sample preparation.

- **WA1.** Of four samples for bulk chemistry, the GAI showed that none were significantly enriched in any of the element tested.

- **Marra Mamba Formation:**
  - **N2.** Of three samples tested for bulk chemistry, the GAI showed that no sample was significantly enriched in any of the element tested, with the exception of iron. Leach testing results were available for two samples which mobilised limited dissolved concentrations of trace metals such as manganese (0.01 to 0.03 mg/L), and selenium (0.001 and 0.004 mg/L).
  - **MM**. Of three samples tested for bulk chemistry, the GAI showed one sample was significantly enriched in iron. Leach tests for these samples showed that a sample with low paste pH mobilised trace metals including cobalt (0.023 mg/L), nickel (0.07 mg/L), aluminium (3.99 mg/L), iron (23.88 mg/L) and manganese (1.6 mg/L). While elevated concentrations of aluminium, iron and manganese are to be expected in low pH leachates, the concentration of iron appears too high when considering EC and sulphate concentrations (75 mg/L). It is possible that colloids not captured by the 0.45 µm filters used in the sample preparation, are responsible for these abnormally high concentrations of iron, aluminium and manganese.

Pit wall exposure

No pit wall exposures of AMD 1, 2 or 3 materials are expected. Most of the waste rock and all of the low-grade ore to be mined from ES PB1 are classified as AMD 0 and less than 22,000 m^3 of the waste is predicted to be AMD 2. This volume of AMD 2 is inconsequential.

5.3.2.4 Physical characteristics

As discussed in Section 5.3.1, the wastes from the OB29/30/35 operations are predominantly from the Tertiary Detritals and Wittenoom and Marra Mamba formations. Material characterisation and field trials have been undertaken on waste types from these formations and their associated stratigraphic units to further understand their erosion characteristics. The waste material classes outlined in Table 5-9 have been derived from the results of this material characterisation program.

Characterisation has included physical modelling including rainfall simulation and overland flow undertaken within laboratory conditions using predicted rainfall events based on local rainfall data. Laboratory methods including rainfall simulation and overland flow over a range of gradients have been undertaken resulting in quantification of:

- Inter-rill erodibility (Ki).
- Rill erodibility (KR)
- Critical Shear (tc)
- Effective Hydraulic conductivity (Ke)

These data have then been used in numerical modelling to assess how well a specific waste rock type (or blends of waste types) behave under surface flow conditions. The following numerical modelling tools have been used to assess the erosion behaviour of different materials:

- Water Erosion Prediction Project (WEPP) model.
- SIBERIA landform evolution model.
- Revised Universal Soil Loss Equation (RUSLE).

Work to date has identified that the majority of the wastes associated with the OB29/30/35 deposits, are erodible (WMAT 2/3 – refer to Section 5.3.2.2), therefore, specific management is required in OSA design and construction techniques, to provide a stable landform. Detritals can contain high proportions of clay rich materials or high levels of coarse fragments, significantly altering their response to erosive forces.

Further to the classifications embedded in the mining model:

- Outback Ecology (2005; 2006) characterised wastes at Whaleback (Wittenoom Dolomite; Joffre BIF and beneficiation waste) which have relevance to the OB29/30/35 closure plan since the Wittenoom dolomite is present at OB29/30/35 and competent materials at Whaleback (such as Joffre BIF and beneficiation waste) can be transported to OB29/30/35 for rehabilitation given the proximity of these operations to each other.
- Landloch (2013) was commissioned to characterise waste at OB29/30/35 and evaluate the erosional stability of Marra Mamba wastes and hard cap.

Further details of the outcomes of these studies are provided below.

Characterisation

The characterisation studies have focused on the dominant waste types at OB29/30/35 and potential sources of competent materials, given the erodible nature of the dominant wastes.

Wittenoom Dolomite & Whaleback competent materials

Outback Ecology (2005; 2006) tested Wittenoom Dolomite, Whaleback beneficiation waste and Joffre BIF. The results of materials characterisation testing are provided as Appendix D-1. In summary:

- EC was low;

- Exchangeable sodium percentage (ESP) was low indicating that materials are not sodic;
- The fine fraction of the beneficiation rejects was sandy containing a low percentage of clay compared to other wastes. Sandy soils have a poor water holding capacity, but potentially high infiltration and drainage which enhances their resistance to erosion.
- The loamy fine fraction of BIF materials typically had a moderate water holding capacity.
- The weathered dolomite had greater clay content which means it will generally have slow water penetration and drainage, but high-water holding capacity.
- The fines fraction of many of the materials recorded high crust strength values in the MoR test which indicated that they have the potential to be hard setting.

Marra Mamba & hard cap materials

Landloch (2013) collected a number of samples from OB29 and OB30 and sent them for laboratory analysis. Samples were taken from Marra Mamba, OB29 hard cap and a number of other waste materials (see Appendix D-1 for sample descriptions and analytical results). The properties of the shaley Marra Mamba wastes were found to be relatively consistent for all samples tested, although the ESP was variable and could be high (>6%), indicating that the clay fraction would have a tendency to disperse. If rock content is low, these materials may be prone to tunnelling. The elevated ESP values for some Marra Mamba samples would also render the surfaces of these wastes likely to hard set when exposed to rainfall. Material surfaces that hard set tend to allow more run-off, and as a result may be more prone to erosion. Materials were (Landloch, 2013):

- Typically, alkaline pH.
- Non-saline.
- Loamy in texture, having clay contents ranging from 13-26%.
- Low rock content.

The other wastes (shales and some hard cap and detrital materials) had similar properties though they tended to have lower ESP values that would be unlikely to cause clay dispersion (Landloch, 2013).

The rocky materials assessed had low particle density and high-water absorption values, indicating that the materials were already highly weathered and likely to continue to weather rapidly when exposed directly to the atmosphere. As such, the shaley coarse fraction of the wastes could be expected to weather into silt and clay size particles, acting to resupply surfaces with erodible sediment in the long term, decreasing the tendency for these surfaces to armour, and maintain higher rates of erosion (Landloch, 2013).

Given that there was only minor variation in the Marra Mamba materials analysed, only one bulk sample (from OB29) was selected for further assessment of the erosion characteristics of these materials, and it was considered that these results would be applicable to inform the designs of all ex-pit landforms at OB29/30/35. A sample of the hard cap material was also sourced from OB29 as it was visibly the most erosion resistant material available (Landloch, 2013).

Erosion Modelling

Wittenoom Dolomite & potentially competent Whaleback materials

Outback Ecology (2006) subjected samples of Wittenoom Dolomite, Joffre BIF and beneficiation waste to rainfall simulation and measured the run-off and soil lost from each sample (Table 5-17).

Table 5-17 Summary of erodibility properties of Wittenoom Dolomite & Whaleback competent materials

Material	Average inter-rill soil loss rate ($g/m^2/hr$)	Erodibility Rating	Comments
Beneficiation Waste	51	Low	High infiltration, minor surface seal, high % coarse material – well armoured Potential to ‘hard set’
BIF Joffre	18	Low	High infiltration, high % coarse material – well armoured
Wittenoom Dolomite	3378	High	Low infiltration, minor surface sealing Potential to ‘hard set’

Source: Outback Ecology (2006)

The results of the rainfall simulation were used to inform WEPP modelling of the materials over linear slopes of 20° and 15°, and a concave slope with a maximum slope of 20° (Table 5-18). Using an average erosion threshold of 0.6 $kg/m^2/y$ (6 t/ha/y), the beneficiation wastes and Joffre BIF would be suitable on the outer slopes of OSAs at all of the modelled geometries, but the Wittenoom Dolomite formation would require different landform geometries or addition of rock to improve stability (Table 5-18).

Table 5-18 Outputs of WEPP modelling

Material	Average Annual Soil loss (kg/m^2)		
	20° uniform slope	15° uniform slope	Concave slope (max 20° angle)
Beneficiation Waste	0	0	0
Joffre BIF	0.5	0.3	0.1
Wittenoom Dolomite	24.2	18.9	8.8

Note: Slope lengths were assumed to be 200 m.
Cells shaded orange indicate batter configurations with predicted erosion values greater than 0.6 kg/m^2/y.
Cells shaded green indicate batter configurations with predicted erosion values less than 0.6 kg/m^2/y.
Source: Outback Ecology (2006)

The WEPP modelling showed that the influence of a concave slope shape (maximum angle of 20°) was strong in all cases where soil loss was predicted, with the rate of soil loss dropping to zero with increasing slope length for all materials tested (deposition occurs past this point). The predicted rate of soil loss on the 200 m concave slopes was typically at a maximum around 50 – 75 m (Outback Ecology, 2006).

Marra Mamba & hard cap materials

Laboratory measurements were made of run-off / erosion model parameters for the OB29 Marra Mamba and hard cap wastes. These parameters were then used in WEPP modelling. The results of WEPP simulations for linear batter slopes for OB29 Marra Mamba and hard cap wastes are provided in Table 5-19 and Table 5-20, respectively. Cells shaded orange indicate batter configurations with predicted erosion values (annual average and / or peak erosion) greater than the threshold values used for the study[11]. Cells shaded green indicate batter configurations with predicted erosion values less than the threshold values used for the study (Landloch, 2013).

Predicted erosion rates of the OB29 Marra Mamba waste (Table 5-19) were higher than the threshold values for all batter angles modelled. Development of stable landform batter designs for this material will likely involve increasing the erosion resistance of this material (e.g., by adding rock, or 'creation' of a rockier Marra Mamba waste), rather than modifying batter shape given that the materials still result in unacceptable erosion rates at very shallow (4°) slopes. Direct measurement of erodibility parameters for a rock augmented Marra Mamba would be ideal. However, based on previous research by Landloch on the role of rock in reducing erosion, rock contents in the order of 50-60% may be required to produce a stable Marra Mamba waste landform. The impact of topsoil addition on the erosion potential of the Marra Mamba waste should also be considered as its application will likely increase erosion resistance, given Pilbara topsoils tend to contain some weather-resistant rock (Landloch, 2013).

Table 5-19 WEPP model outputs for linear batters sheeted with OB29 Marra Mamba waste

Vertical Lift Height (m)	Batter Gradient (°)				
	4	8	12	16	20
10	8.4 (13.7)	21.7 (33.7)	32.1 (51.2)	39.0 (65.8)	43.7 (75.3)
15	8.2 (12.5)	23.2 (32.4)	36.4 (50.2)	46.2 (65.2)	53.5 (78.9)
20	7.8 (11.0)	23.3 (31.7)	38.1 (49.9)	49.3 (64.3)	58.7 (78.5)

Notes: values are mean annual erosion rates (t/ha/y) average over the entire slope length, and (in brackets) peak mean annual erosion rates representing the maximum predicted erosion at a point on the batter slope.
Cells shaded orange indicate batter configurations with predicted erosion values (annual average and/or peak erosion) greater than the threshold values.
Source: Landloch (2013)

The predicted erosion rates for the OB29 hard cap material (Table 5-20) were much lower than the Marra Mamba materials (Table 5-19) and it was predicted that the material could be used as a sheeting material over the Marra Mamba waste or for mixing with Marra Mamba waste to create an augmented material with improved erosion resistance. Batter slopes 20 m high were predicted to be stable when gradients less than 16° were adopted. Use of 10-15 m high batter slopes increases the permissible batter gradient to 20° (the maximum gradient considered) (Landloch, 2013). The Landloch (2013) study assumed that mean predicted annual erosion rates measured for the entire slope must be less than 5 t/ha/y, and the maximum predicted mean annual erosion rates at any point along the slope must not exceed 10 t/ha/y. The understanding of erosion in the Pilbara has evolved since the 2013 Landloch study, and a rate of 6/t/ha/y mean annual erosion has been established as a threshold for mean annual erosion rates (Landloch, 2018). In addition, it has been established that the erosion rate at any point on a slope should not exceed the target threshold average rate by more than 100%. The results in Table 5-20 have been compared to the contemporary thresholds established by Landloch (2018) for consistency.

Table 5-20 WEPP model outputs for linear batters sheeted with OB29 hard cap waste

Vertical Lift Height (m)	Batter Gradient (°)				
	4	8	12	16	20
10	0.1 (0.1)	0.1 (0.5)	0.3 (1.6)	0.5 (2.6)	0.6 (3.3)
15	0.1 (0.3)	0.4 (2.6)	1.0 (5.1)	1.5 (7.0)	1.9 (8.3)
20	0.1 (0.6)	0.9 (4.6)	2.0 (8.7)	3.0 (11.6)	3.6 (13.6)

Notes: values are mean annual erosion rates (t/ha/y) average over the entire slope length, and (in brackets) peak mean annual erosion rates representing the maximum predicted erosion at a point on the batter slope.

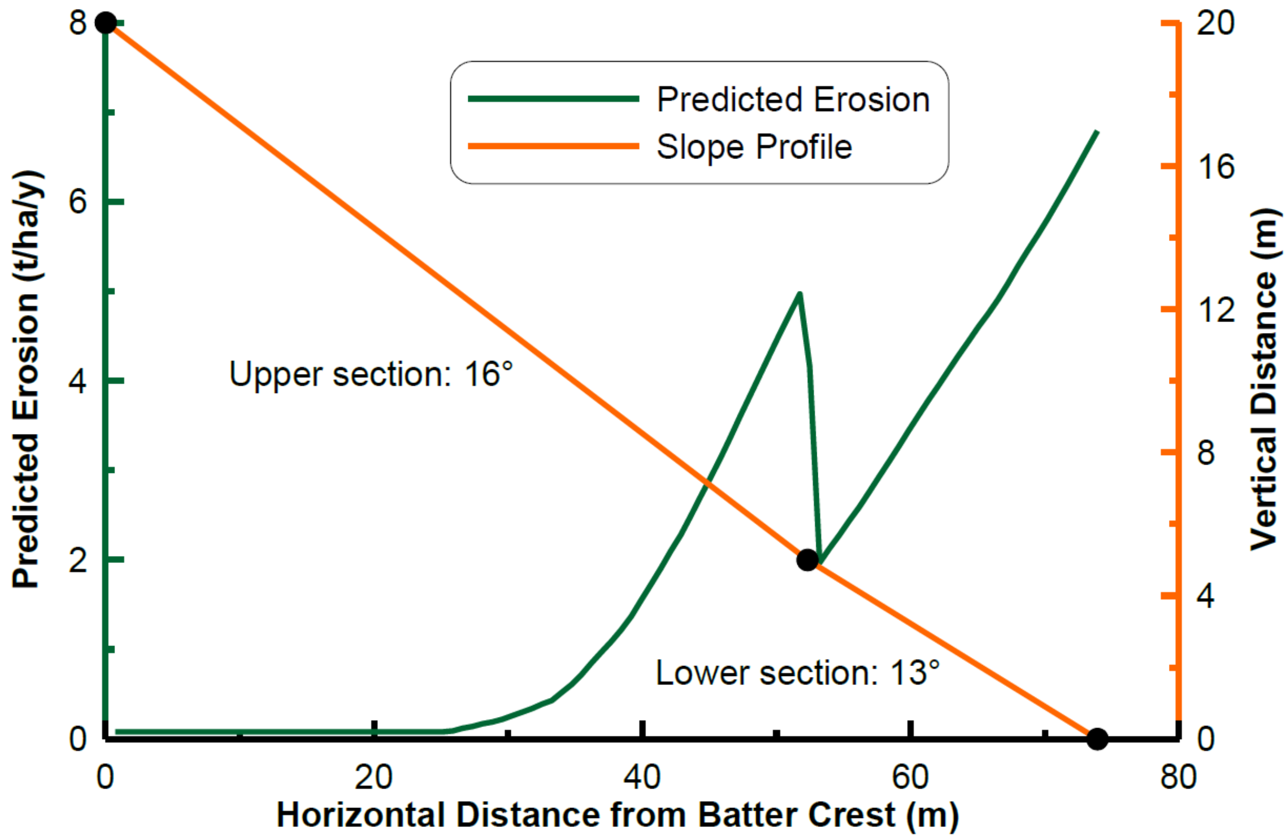
Cells shaded orange indicate batter configurations with predicted erosion values (annual average and/or peak erosion) greater than the threshold values[11] established for the study Cells shaded green indicate batter configurations with predicted erosion values less than the established threshold values[11].

Source: Adapted from Landloch (2013).

Although use of more complex batter shapes (i.e., concave batters) can often be used to reduce erosion rates to acceptable levels, the achievable reductions in erosion would be minor for the Marra Mamba wastes given the footprints typically available. Therefore, application of more complex shapes for these Marra Mamba materials would not yield useful results within the constraints of batter footprints typically allowed for in mine site landforms (Landloch, 2013).

Table 5-20 indicates that a 15m high lift section at 16° is predicted to be stable. Therefore, a concave profile (in practice this is a lift constructed as multiple linear sections of differing gradients) was constructed on OSAs at OB29 on the upper section. The lower lift section gradient was defined by reducing gradient and altering slope length until a 20m high lift was achieved with predicted erosion rates less than the threshold values.

Figure 5-17 shows the concave profile developed for OB29 hard cap waste which has been modelled to meet acceptable erosion rates. The predicted mean annual erosion for this profile was 2.0 t/ha/y, and the predicted peak erosion rate 6.8 t/ha/y. The required footprint for the concave profile would be 74 m, compared to 70 m for a linear-shaped batter with a gradient of 16°.



Source: Landloch (2013)

Figure 5-17 Predicted erosion along a 'concave' slope 20m high, sheeted with OB29 hard cap material

Table 5-21 Berm capacity requirements for OB29 Marra Mamba and hard cap wastes

Material	Backslope Gradient (°)	Backslope Gradient (%)	Required Berm Width (m)
Marra Mamba	1	1.7	92
	2	3.5	62
	3	5.2	50
Hard cap	1	1.7	36
	2	3.5	24
	3	5.2	20

Notes: A berm life of 200 years was assumed. Calculated berm capacity was reduced by 30% to provide a factor of safety and required berm widths were rounded up to the nearest metre.

Source: Landloch (2013)

Based on the results in Table 5-21, Landloch (2013) concluded that a berm width of 20 - 24 m (depending on backslope gradient) would still be sufficient for the concave profile shown in Figure 5-17, as the increase in slope length would be minor compared to a linear slope. Orebody 29 Hardcap materials require smaller-width berms because of their high infiltration capacities. Berm width specifications are also site specific, with consideration of the prevailing climate as well as material erosivity. Even though the Marra Mamba at Orebody 29 has a higher hydraulic conductivity than Marra Mamba analysed by Landloch at other BHP Pilbara sites, the climate at Newman is such that more intense storm events are predicted and hence runoff on an event basis can be higher.

5.3.3 Volume and availability

Approximately 90% of the waste material mined to date at OB29/30/35 and 95% of the material yet to be mined is classed as WMAT 3 and, based on the results of erosion modelling outlined in Section 5.3.2.4, requires competent material to provide long-term stability to ex-pit waste rock landforms. At this time, the current mine plan includes ex-pit OSAs and approximately 4.6 Mm^3 of competent rock will be required to provide rock armouring to stabilise the slopes of these landforms. This material will be sourced from the Mt Whaleback or other Newman hub operations and hard cap material segregated during the mining of OB29/30/35. Approximately 2.83 Mm^3 hard cap material has been mined at OB29/30/35 and stored in OSAs or stockpiles and there is an opportunity to further increase the stockpile of this material during the mining of future pit pushbacks.

Of the volumes of material yet to be mined, approximately 5 Mm^3 is predicted to be potentially fibrous material. This will be placed in accordance with the Mines Closure Design procedure (discussed in Section 9.1.10).

The current mine plan assumes partial backfill of OB 29 and OB35 but at this stage, assumes that areas of all the mine voids will remain open and that pit lakes will form post-closure. The backfill strategy will continue to be reviewed as mining progresses and is dependent on waste rock availability. The current overburden balance is provided in Table 5-22.

Table 5-22 Overburden balance for OB29/30/35

Schedule/Balance Element (Site Overburden Balance)	Estimated Total Quantity[1]
Current overburden volume	51 M LCM
Total overburden predicted at Life of Mine (LOM)	207 (includes 32 M LCM from current overburden volume)
OB29 below water table backfill (if required)	74 M BCM
OB30 below water table backfill (if required)	16 M BCM
OB35 below water table backfill (if required)	5 M BCM
Total backfilling requirement	**95 M BCM**

[1]Notes: void space has been measured in bank cubic metres (BCM) and backfill in loose cubic metres (LCM) to account for the swell factor when waste is extracted. A conversion factor of 1.25 has been used.

5.3.4 Knowledge gaps & forward work program

The following knowledge gaps and forward work program has been identified:

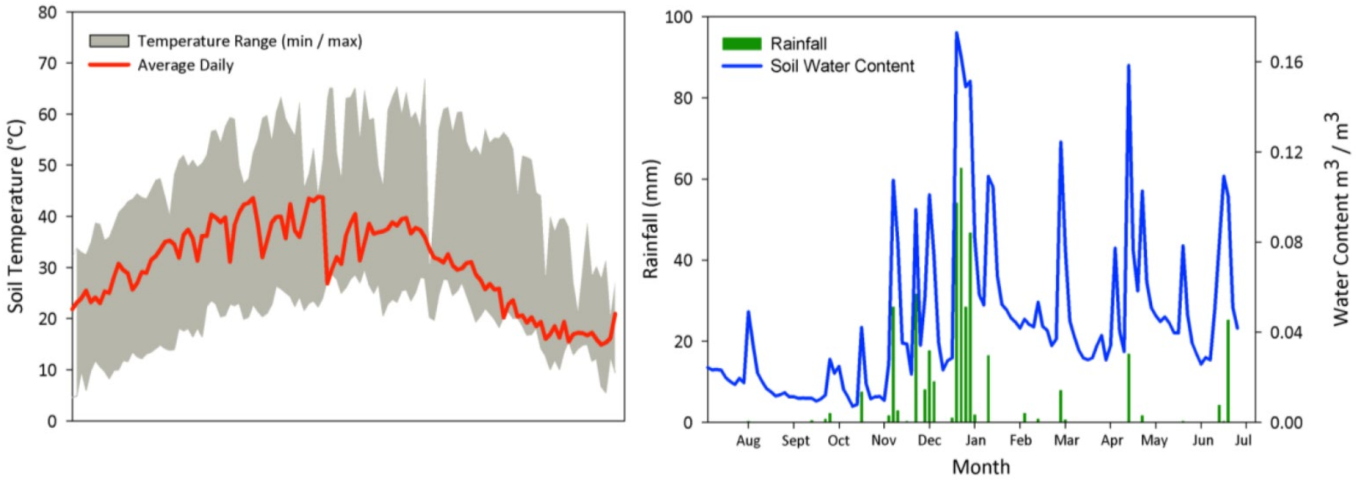
- Further geochemical investigations (as required) including:
  - Geochemical testing of Tertiary Detritals.
  - Leach testing of key stratigraphies.
  - Assessment of the geochemical hazard of high sulphur NAF waste to gain a better understanding of the potential for neutral metalliferous drainage.
- Final volumes of material to be backfilled (dependent on mine plan, final pit designs and groundwater modelling).
- Gap analysis of existing knowledge of waste characteristics and ongoing characterisation of waste to address gaps and inform final landform designs, with a focus on confirming the competent waste balance.
- The volume and availability of waste and the competent waste balance will be refined on an ongoing basis, as the mine plan is updated.

5.4 Soil characteristics

5.4.1 Pilbara soil environment

The Pilbara soil environment is as follows:

- Soil temperatures range from a low of 5°C during winter to over 65°C during summer (Figure 5-18).
- Soils experience intermittent periods of wetting and drying, which occurs more frequently during the summer months (December to March) (Figure 5-18).
- During intense summer rainfall events soil temperatures drop with the influx of soil moisture (for example, from 65°C to 25°C when fully saturated).
- Following a large rainfall event, due to high evaporation rates, soil dries quickly (with soil moisture rarely persisting in the top 5 cm of the soil profile beyond one week) (Figure 5-18).
- Lower evaporation rates from May to August mean that smaller rainfall events that occur during this time can lead to relatively high soil moisture levels, but these increases in soil moisture are short-lived due to evaporation (Figure 5-18).



Notes: Recorded during 2013/2014 at a depth of 3-5 cm below the soil surface at a site in the Pilbara near Newman, WA
Source: Erickson, Barrett, Symons, Turner, & Merritt (2016)

Figure 5-18 Relationship between soil temperature, rainfall and soil moisture content

Temperature and soil moisture are inter-related and influence germination and establishment in the field. The majority of species will germinate over a wide temperature range (10-35°C), but require ample moisture, which is characteristic of cyclone rain events (with at least 4 rain events occurring within a 10-day period). Germination for the majority of species occurs in spring and summer (December to March), in correspondence with the highest moisture levels in the Pilbara (Restoration Seedbank Initiative, 2020a; 2020b; 2020c).

5.4.2 Regional soil-landscapes

The most recent and detailed mapping of WA's Rangelands and Arid interior was collated by Tille (2006) into a hierarchy of soil-landscape mapping units. Within this framework the OB29/30/35 operations fall in the Fortescue Province, an area that occupies 160,050 km^2. The Fortescue Province contains ten soil-landscape zones; OB29/30/35 is located within the Hamersley Plateaux Zone, which covers approximately 44,450 km^2 and is described by Tille (2006) as:

'Hills and dissected plateau (with some stony plains and hardpan wash plains) on sedimentary and volcanic rocks of the Hamersley Basin (Ophthalmia Fold Belt). Stony soils with Red shallow loams and some Red / brown non-cracking clays and Red loamy earths.'

5.4.3 Local soil characteristics

A baseline soils assessment was conducted by Halpern Glick Maunsell (1999). The assessment concluded that:

- The soil type that dominates the area was a fine-textured, dusky red silt-loam with a slight to moderate coarse fraction, and little or no pedologic organisation. The pH of the soil type was neutral to slightly acidic and salinity (measured as electrical conductivity) was typically low. The soil type generally occurred on ridges, low hills and stony undulating plains.
- Within Whaleback Creek, was a gradational soil, consisting of a red-brown silt-loam A-horizon to 20 cm in depth, above a B-horizon of grey-brown sandy loam. This eventually graded into clay with increased depth. The soil pH was neutral to slightly alkaline, with a higher electrical conductivity than other soils in the area.

- Tributaries of Whaleback Creek had soils consisting of a dusky red, silt-loam to clay loam with a deep A1 horizon (to 80 cm), and slight to moderate coarse fraction. The soil pH was neutral to slightly alkaline, with minimal organic material and low salinity.
- On the plains adjacent to Whaleback Creek tributaries, the soil comprised a dusky red silt loam with a deep A1-horizon, moderate red shale and BIF throughout the profile, and minimal organic matter in the upper 5 cm of the soil. Soil pH was slightly acidic to neutral, and salinity was low.

5.4.4 Topsoil balance

BHP conducted a review of the soil requirements for mine closure against existing stockpiles in FY24 (Table 5-23). The review concluded that Whaleback and OB29/30/35 requires approximately 2.86 Mm^3 of soil for closure, assuming that topsoil is used for ex-pit domains (OSAs, infrastructure and topsoil stockpile footprints). A deficit of approximately 1.49 Mm^3 is currently estimated.

Table 5-23 Whaleback and OB29/30/35 mining operations topsoil balance

Current Topsoil Stockpiles (m^3)	Topsoil requirements (m^3)	Deficit based on current Topsoil stockpiles (m^3)
1,365,000	~2,861,000	~1,496,000

Source: (BHP, 2024d)

Investigations into alternate growth media are summarised in Section 5.4.5.

5.4.5 Alternate growth media assessment

Outback Ecology (2005) conducted an assessment of the plant growth properties of Wittenoom Dolomite and materials from Whaleback that may be used for sheeting landforms at OB29/30/35. Analytical results are presented in Appendix D-1. The assessment concluded that:

- EC was low and all materials were likely to be suitable for plant growth.
- The pH of materials ranged from slightly acidic to slightly alkaline but fell within the range of pH values recorded for topsoils in the region.
- The Wittenoom Dolomite had moderate Cation Exchange Capacity (CEC) values which indicates that the soil has a moderate capacity to store nutrient cations.
- The extractable phosphorus, nitrogen and sulphur concentrations of the waste materials was similar or higher than concentrations recorded in topsoils in the region while potassium concentrations were typically lower. Potassium was not considered likely to be a critical factor for plant growth.
- The beneficiation wastes had low water holding capacity and the Joffre BIF and Wittenoom Dolomite had moderate and high water holding capacities, respectively.

As part of Landloch's (2013) study to assess the characteristics of wastes at OB29/30/35 (Section 5.3.2.4), an analysis of key characteristics relevant to plant growth was also conducted (see Appendix D-1 for results). In summary, the materials were found to be:

- Typically, alkaline pH.
- Non-saline.
- Moderately fertile, though low in total nitrogen and organic carbon.
- Loamy in texture, having clay contents ranging from 13-26%.
- Having low plant available water.

5.4.6 Knowledge gaps & forward work program

Further assessment of the plant growth potential of different materials is required.

The topsoil balance shows a significant deficit in topsoil availability for rehabilitation however, there is some uncertainty around how much topsoil is currently stored. Additional survey effort is required to verify topsoil volumes.

5.5 Slope stability and seismicity

5.5.1 Seismic hazard analysis

In 2012, a probabilistic seismic hazard assessment was conducted on selected BHP operations in the Pilbara, including Whaleback (Meynink Engineering Consultants, 2012). The assessment was based on area seismic sources as no evidence of recent fault activity was recognised close to the BHP operations in the Pilbara during the preliminary neotectonic observations. The observations showed that an inferred segmented fault system appears to run across the area; however, there was no indication of recent fault activity (Meynink Engineering Consultants, 2012).

The Meynink (2012) study estimated peak ground acceleration values at Whaleback for different types of material and different probabilities of exceedance (Table 5-24). Given the proximity of Whaleback to the OB29/30/35 mining areas, similar peak ground accelerations could be expected since the seismic hazard assessment was based on area sources rather than individual faults that may control the hazard of a particular site.

Table 5-24 Estimated peak ground acceleration values

Probability of Exceedance in 50 years	Peak Ground Acceleration (g)			
	Tertiary Sediments (vs^{30} 500 m/s)	Moderately Weathered Rock (vs^{30} 760 m/s)	Shale (vs^{30} 865 m/s)	Fresh BIF (vs^{30} 1800 m/s)
2%[1]	0.220 g	0.202 g	0.194 g	0.141 g
5%[2]	0.123 g	0.109 g	0.105 g	0.076 g
10%[3]	0.076 g	0.067 g	0.064 g	0.047 g

Notes: [1]equivalent to 2475 years return period
[2]equivalent to 975 years return period
[3]equivalent to 475 years return period

Source: Meynink Engineering Consultants (2012)

Since the Meynink study, recent observations at North Flank, withing the Mining Area C Hub, have confirmed a significant fault structure traversing the north wall of a pit, showing clear cross cutting relationships and displacement of the Detritals sequence. The fault traverses the entire Detritals stratigraphic sequence (>100 metres in thickness) and breaks through the Quaternary Detritals surface colluvium unit at the current surface. This implies relatively recent re-activation of basement fault structures in the Pilbara region that affect the youngest Quarternary aged deposits (<2Ma).

In the Australian context, Meynink Engineering Consultants (2012) concluded that the peak ground acceleration values estimated from the study correspond to a low to moderate seismic hazard. Recent observations have not given BHP reason to believe that the seismic hazard is significantly higher.

5.5.2 Knowledge gaps & forward work program

Detailed slope stability analyses of final mine voids will be required to inform measures for managing long term pit wall stability (particularly in areas adjacent to permanent creek diversions) and final abandonment bund locations.

5.6 Landforms and land systems

5.6.1 Topography

The topography of the Mt Whaleback operations area, including OB29/30/35, are influenced by the regional geology. The hills bounding the southern sides of the valleys tend to be low-lying and are formed from the Marra Mamba Iron (Marr Mamba) and Jeerinah Formations, whilst the higher, more scarp slopes on the northern margins of the valleys (i.e. Mt Whaleback and Western Ridge) are formed from the Brockman Iron (Brockman) Formation (BHP, 2024b).

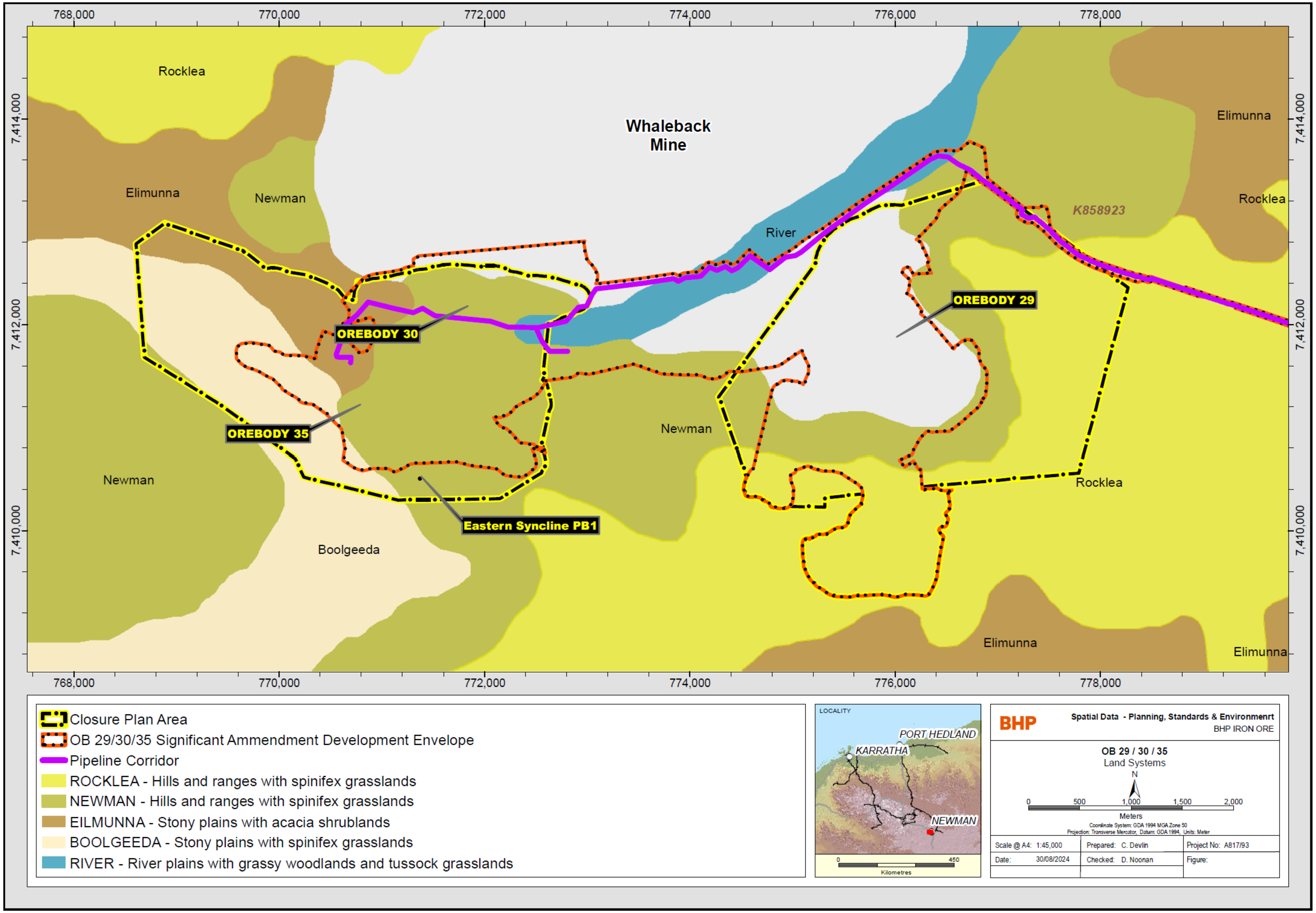
5.6.2 Land systems

Land systems across much of the grazing and pastoral lands of WA were surveyed, described and categorised during a series of surveys conducted by the Department of Agriculture. The OB29/30/35 Closure Plan Area lies within the Pilbara Region, which was surveyed in the period between 1995 and 1999, by Van Vreeswyk et al. (2004), with the results published in Technical Bulletin No. 92.

The survey by Van Vreeswyk et al. mapped 102 land systems for the Pilbara region, five of which underlie the OB29/30/35 Closure Plan Area (Map 5-2 and Table 5-25). The Newman land system was the dominant pre-mining land system followed by the Boolgeeda and Elimunna land systems.

5.6.3 Knowledge gaps & forward work program

No knowledge gaps relevant to closure have been identified.



Refer to Appendix N for a pdf version

Map 5-2 OB29/30/35 land systems

Table 5-25 Land systems underlying OB29/30/35

Land System	Landform Unit	%Land System in Pilbara[1]	Soil	Vegetation Association
Boolgeeda	**1. Low hills and rises** Isolated hills and low rises usually <500 m in extent, surface mantles of very abundant pebbles and cobbles of ironstone, basalt and other rocks; relief up to 20 m.	4%	Stony soils and red shallow loams.	Hummock grasslands of *Triodia wiseana* (hard spinifex) and *Triodia vanleeuwenii* with very scattered acacia shrubs.
	2. Stony slopes and upper plains Very gently inclined slopes and upper interfluves immediately downslope from adjacent hill systems, dissected up to 5 m by dendritic or sub-parallel small creek lines, surface mantles of common to very abundant pebbles of chert ironstone, quartz and other rocks.	20%	Red shallow loams or red loamy earths.	Hummock grasslands of *T. lanigera, T. wiseana* (hard spinifex) or scattered tall shrublands of *Acacia aneura* (mulga), *A. ancistrocarpa* (shiny leaf wattle), *A. atkinsiana* and other acacias, occasional eucalypt trees and prominent hard spinifex ground layer.
	3. Stony lower plains Almost level plains downslope from unit 2, surface mantles vary from few to very abundant ironstone and other pebbles; subject to sheet and channelised flow from units 1 and 2.	65%	Red loamy earths.	Hummock grasslands *T. wiseana, T. lanigera* (hard spinifex) or *T. pungens* (soft spinifex). Also scattered to moderately close tall shrublands of *A. aneura* and other acacias with hard and soft spinifex ground layer.
	4. Groves Small (up to 20 m long) arcuate drainage foci occurring infrequently on units 2 and 3.	1%	Red loamy earths.	Moderately close woodlands or tall shrublands of *A. aneura* with sparse low shrubs and tussock or hummock grasses.
	5. Narrow drainage floors and Channels Dendritic and parallel flow zones and creek lines on slopes and plains (units 2 and 3), only 5-10 m wide in upper parts becoming wider on lower plains, larger channels may be braided and incised up to 3 m.	10%	Red loamy earths and minor self-mulching cracking clays. Channels with riverbed soils.	Scattered to close tall shrublands or woodlands of *A. aneura, A. atkinsiana, Corymbia hamersleyana* (Hamersley bloodwood) with sparse low shrubs and hummock and tussock grasses. Occasionally hummock grasslands of *T. pungens.*
Elimunna	**1. Hills and low rises** Low (up to 15 m) isolated hills and rounded rises with surface mantles of abundant or very abundant pebbles and cobbles of basalt and other rocks.	10%	Stony soils and red shallow loams.	Hummock grasslands of *Triodia wiseana* (hard spinifex) or very scattered shrublands of *Acacia* and *Senna* spp.
	2. Stony plains Level to gently undulating plains extending up to 4 km, mantles of abundant pebbles of basalt, quartz and ironstone.	45%	Red / brown noncracking clays.	Very scattered to scattered mixed height shrublands with *Acacia aneura* (mulga) other acacias, *Senna* spp. (cassias) and *Eremophila* spp. Occasionally with patchy *Triodia* spp. (hard spinifex) understorey.
	3. Gilgai plains Level plains with gilgai microrelief with or without surface mantles; up to 1 km in extent or as a mosaic of patches 10-50 m in size occurring on unit 2.	26%	Self-mulching cracking clays and red deep loamy duplex soils.	Patchy tussock grasslands with *Eragrostis xerophila* (Roebourne Plains grass), *E. setifolia* (neverfail), *Astrebla pectinate* (barley Mitchell grass) with isolated shrubs mainly *Eremophila* and *Senna* spp.
	4. Hardpan plains Level plains subject to sheet flow, mantles of many to abundant ironstone pebbles.	6%	Red loamy earths.	Very scattered tall shrublands of *A. aneura* and other acacias.
	5. Groves Discrete drainage foci (up to 50 m long by 5-15 m wide) arranged more or less at right angles to sheet flow on stony plains and hardpan plains (units 2 and 4).	1%	Red loamy earths.	Moderately close to close tall shrublands of *A. aneura* with numerous other shrubs and patchy perennial grasses.

Land System	Landform Unit	%Land System in Pilbara[1]	Soil	Vegetation Association
	6. Drainage floors Level tracts within units 2 and 3 with variable surface mantles and patches of gilgai microrelief, with central channels or sluggish internal drainage lines.	12%	Self-mulching cracking clays.	Tussock grasslands with *Astrebla* and *Eragrostis* spp. or very scattered to moderately close tall shrublands of *Acacia* spp. with various low shrubs and patchy tussock and / or hummock grasses.
Newman	**1. Plateaux, ridges, mountains and Hills** Mountain tracts, plateaux and strike ridges, relief up to 400 m; level or rounded plateaux summits and mountain crests, ridges and indented escarpments with vertical upper cliff faces and moderately inclined to very steep upper scree slopes; surface mantles of abundant to very abundant pebbles, cobbles and stones of ironstone, jaspilite, chert and other rocks. Also outcrop of parent rock.	70%	Stony soils, red shallow loams and some red shallow sands.	Hummock grasslands of *Triodia wiseana, T. brizoides, T. plurinervata* (hard spinifex) with very scattered to scattered shrubs and trees including *Acacia* and *Senna* spp., *Grevillea wickhamii* (Wickham's grevillea), *Eucalyptus leucophloia* (snappy gum) and other eucalypts. Occasionally hummock grass is *Triodia biflora* (soft spinifex).
	2. Lower slopes Gently inclined concave slopes mostly less than 400 m in extent with mantles of very abundant pebbles and cobbles of ironstone and other rocks.	20%	Stony soils on upper margins with red loamy earths on lower margins.	Similar to unit 1.
	3. Stony plains Gently undulating lower plains and interfluves up to 500 m in extent with mantles of abundant to very abundant pebbles of ironstone.	5%	Stony soils, red shallow loams with some red loamy earths.	Hummock grasslands of *Triodia wiseana, T.* spp. (hard spinifex) with isolated to very scattered shrubs of *Acacia* and *Senna* spp. and occasional eucalypt trees. Occasionally hummock grasslands of *Triodia pungens* (soft spinifex).
	4. Narrow drainage floors with channels Almost level floors up to 400 m wide but usually much less in valleys, mantles of abundant pebbles of ironstone and other rocks; channels up to 200 m wide with cobble bed loads.	5%	Red shallow loams, red loamy earths. Channels with riverbed soils.	Smaller floors support hummock grassland of *Triodia pungens* with very scattered shrubs. Larger floors and channels support tall shrublands / woodlands of *Acacia* spp. and *Eucalyptus victrix* (coolibah) with tussock grass or hummock grass understoreys.
Rocklea	**1. Hills, ridges, plateaux and upper slopes** Rounded, very gently inclined or undulating crests and plateaux surfaces with moderately inclined to very steep, sometimes benched, upper slopes; surface mantles of very abundant cobbles and pebbles mostly of basalt, also much outcrop of basalt; relief up to 110 m.	65%	Stony soils, red shallow loams and calcareous shallow loams.	Hummock grasslands of *Triodia wiseana, T.* spp. (hard spinifex) or, less frequently, of *T. pungens* (soft spinifex) with isolated to very scattered shrubs such as *Acacia inaequilatera* (kanji) and *Senna* spp.
	2. Lower slopes Very gently inclined to gently inclined slopes extending up to 1 km downslope from hills (unit 1), surface mantles of abundant to very abundant pebbles and cobbles mostly of basalt, also outcrop of basalt.	15%	Red shallow loams and red shallow sandy duplex soils.	As for unit 1.
	3. Stony plains and interfluves Gently undulating to undulating plains, interfluves and low rises up to 1.5 km in extent, surface mantles of abundant to very abundant pebbles and cobbles of basalt and occasionally shale and other rocks.	10%	Calcareous shallow loams, red sandy earths and shallow red / brown non-cracking clays.	Hummock grasslands of *Triodia wiseana* or, less frequently, *T. pungens* with isolated to very scattered shrubs such as *Acacia inaequilatera*. Occasionally grassy shrublands with *Acacia, Senna* and *Eremophila* spp.
	4. Gilgai plains Level plains up to 500 m in extent with gilgai microrelief and variably abundant surface mantles of basalt pebbles and cobbles.	1%	Self-mulching cracking clays.	Tussock grasslands with *Astrebla pectinate* (barley Mitchell grass), *Eragrostis xerophila* (Roebourne Plains grass) and other perennial grasses.

Land System	Landform Unit	%Land System in Pilbara[1]	Soil	Vegetation Association
	5. Upper drainage lines Narrow headwater valleys with branching drainage tracts mostly <200 m wide, unchanneled or with central channels up to 10 m wide.	4%	Red shallow sands and calcareous shallow loams. Channels with riverbed soils.	Hummock grasslands of *Triodia wiseana* or *T. pungens* with very scattered to scattered acacia shrubs and occasional *Corymbia hamersleyana* (Hamersley bloodwood) trees.
	6. Drainage floors and channels Almost level floors rarely more than 400 m wide, central tracts with braided channels and stony banks; major trunk channels up to 50 m wide.	5%	Red loamy earths with red shallow sandy duplex soils and red / brown non- cracking clays	Scattered to moderately close tall shrublands or woodlands of *Acacia* and *Eucalyptus* spp. with numerous undershrubs and hummock grass understoreys or tussock grass understoreys.
River	**1. Sandy levees and sand sheets** Narrow (generally <300 m wide), ill-defined sandy levees flanking units 2 and 5 and raised up to 5 m (occasionally higher) above unit 3; also, as broader sandy sheets, moundy surfaces.	15%	Mostly red deep sands with red sandy earths, red loamy earths and some riverbed soils.	Hummock grasslands of *Triodia pungens* (soft spinifex) with very scattered to moderately close shrubs such as *Acacia trachycarpa* (miniritchie) and *A. inaequilatera* (kanji). Tussock grasslands of *Cenchrus ciliaris* (buffel grass), *Eragrostis eriopoda* (woolly butt) with very scattered to scattered acacia shrubs and trees or open eucalypt woodlands with grass understorey of *C. ciliaris.*
	2. Upper terraces Level, upper terraces marginally higher (1-2 m) than unit 3, up to 500 m wide, surface mantle absent or few to many water-worn pebbles; subject to occasional flooding.	5%	Red deep sands.	Hummock grasslands of *Triodia* spp. (hard spinifex) or *T. pungens* (soft spinifex) frequently with no shrubs, occasionally isolated to very scattered *Acacia* spp. shrubs and trees such as *Hakea subarea* (corkwood).
	3 Flood plains and lower terraces Level flood plains and terraces flanking single and multiple channels of the major rivers, commonly 300-800 m wide but up to 2 km in lower reaches, often with moundy surfaces; subject to fairly regular flooding.	50%	Deep red / brown non-cracking clays and red loamy earths.	Tussock grasslands of *Cenchrus ciliaris* (buffel grass) or hummock grasslands mainly of *Triodia pungens* (soft spinifex). Also scattered to moderately close *Eucalyptus victrix* (coolibah) or acacia woodlands / tall shrublands with prominent tussock grass understorey of *C. ciliaris, Chrysopogon fallax* (ribbon grass), *Eulalia aurea* (silky brown top) and others or hummock grass understorey of *Triodia pungens*.
	4. Stony plains Level to very gently inclined plains up to 500 m in extent with surface mantles of common to very abundant pebbles and water worn cobbles; some are active flood areas over old cobble beds between minor and major channels, others are raised above general flood levels.	10%	Red shallow loams and red shallow sands.	Hummock grasslands of *Triodia* spp. (soft and hard spinifex) with very scattered to scattered acacia shrubs. Also, woodlands / tall shrublands with *Eucalyptus victrix, Acacia* spp. and tussock and hummock grasses.
	5. Minor and major channels Channels 30-1,000 m wide between sandy banks 1-10 m above channel beds, bed loads of sand, gravel, pebbles and stones.	20%	Riverbed soils	Channels - no vegetation. Banks - close or closed fringing woodlands with *Eucalyptus camaldulensis* (river red gum), *E. victrix, Melaleuca argentea* (cadjeput), *M. glomerata, Sesbania formosa* (white dragon tree), *Acacia coriacea* (river jam) with understorey of sedges and grasses including *Cyprus vaginatus, Cenchrus ciliaris* and *Triodia pungens.*

[1]Note: Area percentages indicate the estimated proportion of each landform represented in the Pilbara region.
Source: Van Vreeswyk et. al. (2004)

5.7 Vegetation

5.7.1 Regional flora and vegetation

The Australian Natural Resources Atlas identifies 89 bioregions across Australia and 419 sub-regions. The OB29/30/35 Closure Plan Area is located within the Pilbara region of the Interim Biogeographic Regionalisation of Australia (IBRA) (Department of the Environment and Energy, 2016) (Map 5-3).

The Pilbara region, which actively drains into the Fortescue, De Grey and Ashburton River systems is divided into four sub-regions; Chichester (PIL1), Fortescue Plains (PIL2), Hamersley (PIL3) and Roebourne (PIL4). The OB29/30/35 Closure Plan Area lies within the Hamersley sub-region (Map 5-3), which is described by Kendrick (2001) as follows:

> *"PIL3 is the Southern section of the Pilbara Craton. Mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite). Mulga low woodland over bunch grasses on fine textured soils in valley floors, and Eucalyptus leucophloia over Triodia brizoides on skeletal soils of the ranges."*

Regional vegetation mapping was originally undertaken by Beard (1975) and later refined by Shepherd et al. (2002). Two vegetation associations are present within the OB29/30/35 Closure Plan Area as (Spectrum, 2024):

- Association 18 - low woodland; mulga (*Acacia aneura*)
- Association 82 - hummock grasslands, low tree steppe; snappy gum over *Triodia wiseana*.

A third vegetation association, located within the pipeline corridor that is part of the Significant Amendment, but outside of the OB29/30/35 Closure Plan Area is:

- Association 29 - sparse low woodland; mulga, discontinuous in scattered groups.

5.7.2 Local flora and vegetation

Since commencement of mining at Mt Whaleback in the 1960s, BHP has commissioned approximately 40 flora and vegetation surveys across the area to support environmental approvals and conditions. Map 5-4 shows the vegetation mapped in the immediate vicinity of the OB29/30/35 Closure Plan Area.

Detailed vegetation mapping was completed across the Significant Amendment Development Envelope by Spectrum in 2024 (Spectrum Ecology, in prep 2024). The final report was not available at the time of writing, however, preliminary outcomes are summarised below and will be revised on receipt of the final report. Previous mapping has indicated that the dominant vegetation association of the closure planning area are complexes of *Triodia* hummock grasslands, supporting a variety of *Triodia* species (*T. wiseana, T. brizoides, T. pungens, T. vanleeuwenii*. Shovelanna Hill (S. van Leeuwen 3835), and *T. longiceps*), with low open woodlands of *Eucalypts* (*E. leucophloia* subsp. *Leucophloia* and *E. xerothermica*) and *Corymbia hamersleyana* over shrublands including *Acacia spp.*, *Petalostylis labicheoides,* and *Gossypium robinsonii* (Table 5-26 and Map 5-4). Twelve introduced flora species were previously recorded by Spectrum Ecology (2022), 11 of which are classified as permitted, s11 weeds.

5.7.3 Flora of conservation significance

No Threatened Species listed under the BC Act, or the EPBC Act have been recorded within the OB29/30/35 Closure Plan Area or are likely to occur (Onshore Environmental, 2013a; GHD, 2011; Spectrum Ecology, 2022; in prep 2024).

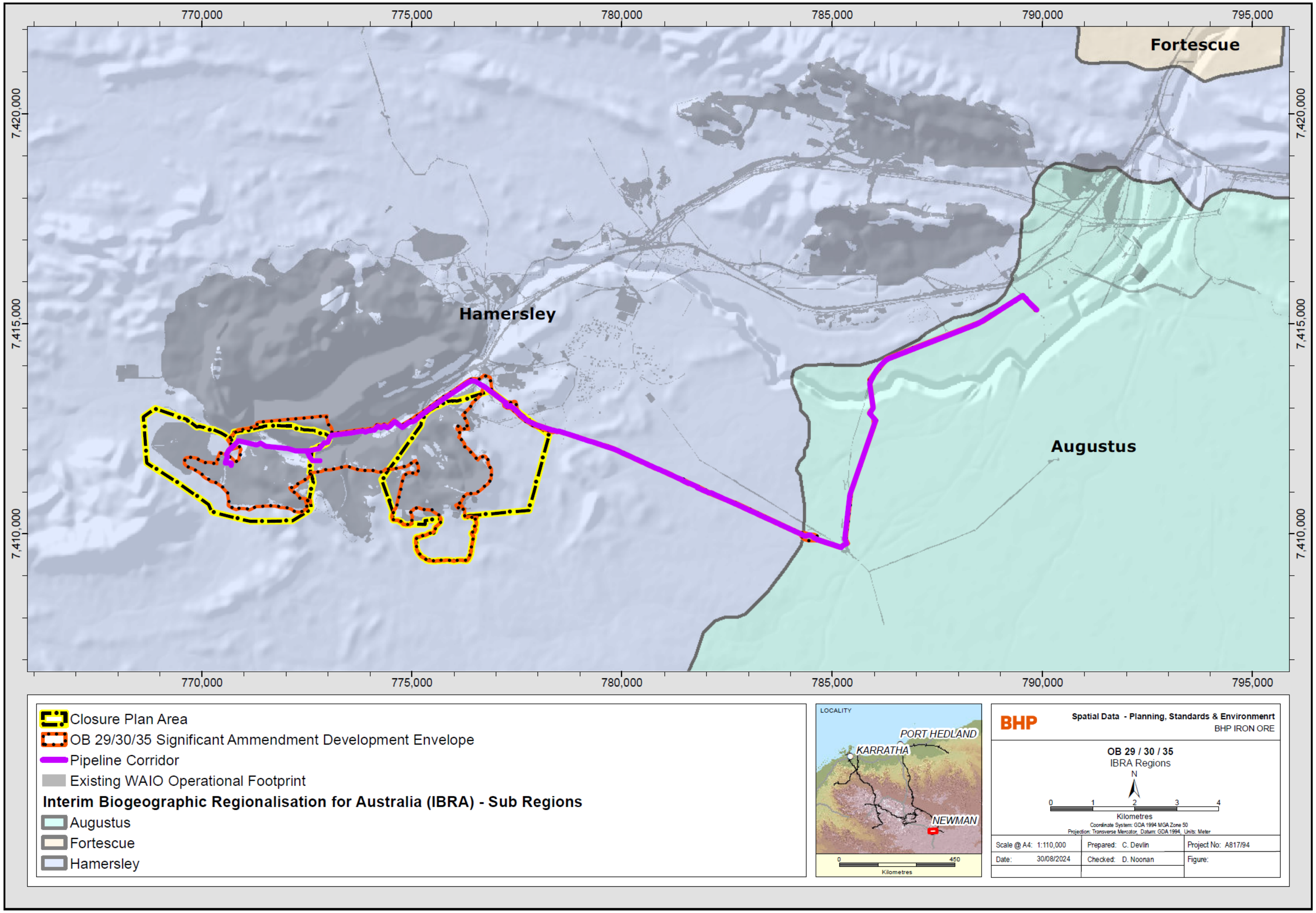
Targeted surveying completed by Spectrum in 2024 recorded two Priority species (Spectrum Ecology, in prep 2024), neither of which occur within the Closure Plan Area. Two priority flora species were recorded from nine locations during the survey conducted by Spectrum Ecology (2022), however, none of the species were identified within the OB29/30/35 Closure Plan Area (Map 5-4). The priority species were: *Amaranthus centralis* (P3), *Aristida jerichoensis* var. *subspinulifera* (P3), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Themeda* sp. Hamersley Station (M.E. Trudgen 11431) (P3).

5.7.4 Threatened or priority ecological communities

No ecological communities in the Pilbara are listed as Threatened Ecological Communities (TECs) under the Commonwealth EPBC Act and none of the mapped vegetation associations within the OB29/30/35 area were identified as State listed TECs or Priority Ecological Communities (PECs) (GHD, 2011; Onshore Environmental, 2013a; Spectrum Ecology, 2022; in prep 2024).

Table 5-26 OB29/30/35 Vegetation Associations

Broad Formation	Code	Vegetation association
Triodia Hummock Grassland	HC TwTbrTp EllCh AmaGrwhAb	Hummock Grassland of *Triodia wiseana, Triodia brizoides* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over High Open Shrubland of *Acacia maitlandii, Grevilllea wickhamii* subsp. *hispidula* and *Acacia bivenosa* on red brown sandy loam on hill crests and upper hill slopes.
	HS TbrTw AiAprHc ErfrErpd	Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* with High Open Shrubland of *Acacia inaequilatera, Acacia pruinocarpa* and *Hakea chordophylla* over Open Shrubland of *Eremophila fraseri* and *Eremophila platycalyx* subsp. *pardalota* on red loamy sand on lower hill slopes and foot slopes.
	HS TsTwTp EllCh AhiAaa	Hummock Grassland of *Triodia vanleeuwenii*. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Acacia hilliana* and *Acacia adoxa* var. *adoxa* on red brown sandy loam on hill slopes.
	ME TpTlo ExAciCh PlApypGoro	Hummock Grassland of *Triodia pungens* and *Triodia longiceps* with Low Woodland of *Eucalyptus xerothermica, Acacia citrinoviridis* and *Corymbia hamerselyana* over High Shrubland of *Petalostylis labicheoides, Acacia pyrifolia* var. *pyrifolia* and *Gossypium robinsonii* on red brown clay loam on medium drainage lines and surrounding floodplains.
	SP TpTb Eg PlAbAanc	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Open Mallee of *Eucalyptus gamophylla* and Shrubland of *Petalostylis labicheoides, Acacia bivenosa* and *Acacia ancistrocarpa* on red brown loamy sand on stony plains and foot slopes.
	SP Ts Ai	Hummock Grassland of *Triodia vanleeuwenii*. Shovelanna Hill (S. van Leeuwen 3835) with High Open Shrubland of *Acacia inaequilatera* on red brown loamy sand on lower hill slopes and stony plains.
Triodia Open Hummock Grassland	SP Tl AancApa ApAprCh	Open Hummock Grassland of *Triodia lanigera* with Open Shrubland of *Acacia ancistrocarpa* and *Acacia pachyacra* and Scattered Low Trees of *Acacia paraneura*, *Acacia pruinocapra* and *Corymbia hamerselyana* on red sandy loam on stony plains.
	HS TsTpTb AaAprAw AteEreErll	Open Hummock Grassland of *Triodia vanleeuwenii*. Shovelanna Hill (S. van Leeuwen 3835), *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura, Acacia pruinocarpa* and *Acacia wanyu* and Open Shrubland of *Acacia tetragonophylla, Eremophila exilifolia* and *Eremophila latrobei* subsp. *latrobei* on red sandy loam on hill slopes.
*Cenchrus Tussock Grassland	MA CcTtEua ChCa AbAtpAss	Tussock Grassland of *Cenchrus ciliaris, *Themeda triandra* and *Eulalia aurea* with Low Open Woodland of *Corymbia hamersleyana* and *Corymbia aspera* over High Open Shrubland of *Acacia bivenosa, Acacia tumida* var. *pilbarensis* and *Acacia sclerosperma* subsp. *sclerosperma* on brown loamy sand on levee banks of major drainage lines.
Acacia Low Open Forest	HS AcaoAaApr ScaErllAb TbrTw	Low Open Forest of *Acacia catenulata* subsp. *occidentalis, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Scaevola acacioides, Eremophila latrobei* subsp. *latrobei* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* on red brown clay loam on breakaway scree slopes and steep hill slopes.
Acacia Low Woodland	FP AcaoAaEx Erff Tp	Low Woodland of *Acacia catenulata* subsp. *occidentalis, Acacia aptaneura* and *Eucalyptus xerothermica* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* over Open Hummock Grassland of *Triodia* pungens on red sandy loam on floodplains.
	FP ApAaApr AsyErffPto CcAriArc	Low Woodland of *Acacia paraneura, Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Acacia synchronicia, Eremophila forrestii* subsp. *forrestii* and *Ptilotus obovatus* over Open Tussock Grassland of *Cenchrus ciliaris, *Aristida inaequiglumis* and *Aristida contorta* on red brown loam on floodplains.
	SP AprAa AiAb Ts	Low Woodland of *Acacia pruinocarpa* and *Acacia aptaneura* over Scattered Shrubs of *Acacia inaequilatera* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia vanleeuwenii*. Shovelanna Hill (S. van Leeuwen 3835) on red brown clay loam on stony plains.



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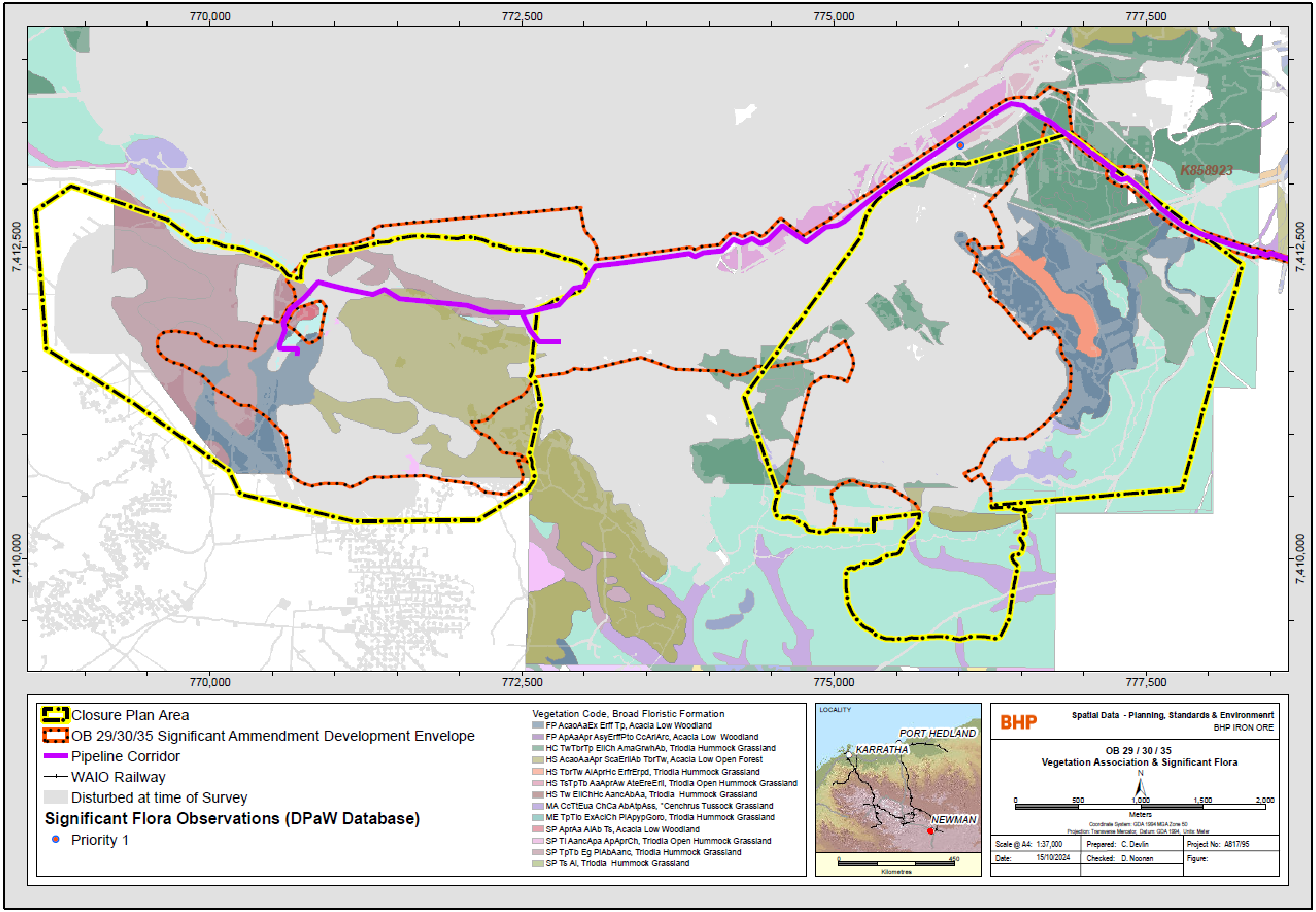
Map 5-3 IBRA sub-regions



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Map 5-4 **OB29/30/35 vegetation and significant flora**

5.7.5 Weeds and declared plants

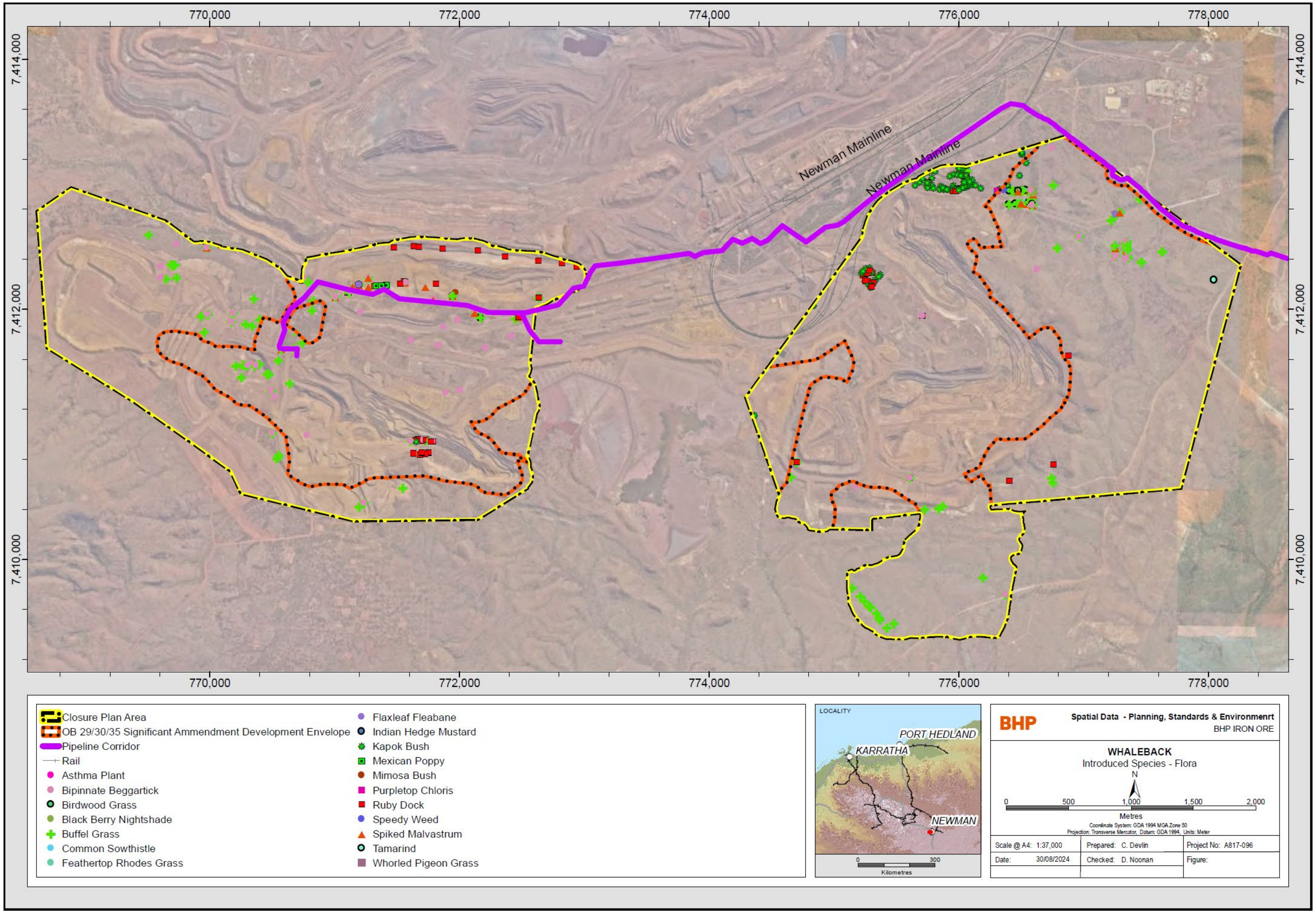
Eighteen introduced species have been identified within the OB29/30/35 Closure Plan Area in previous surveys (Table 5-27 and Map 5-5). The most common recorded species is **Aerva javanica* (Kapok Bush). Introduced flora species occur predominantly in existing disturbance and infrastructure areas. None of the introduced flora species are listed as Weeds of National Significance or as a Declared Pest under the BAM Act.

Introduced flora species at OB29/30/35 are managed in accordance with the WAIO Weed management Procedure (WAIO, 2020).

Table 5-27 Introduced flora species recorded within the OB29/30/35 closure planning area

Scientific Name	Common Name	Ecological Impact	Invasiveness	Notes
Aerva javanica	Kapok Bush	High	Rapid	A common weed in the Pilbara rangelands, preferring deeper soils and disturbance. Recorded along drainage lines and in disturbed areas. Permitted under s11 of the BAM Act (DPIRD, 2024).
Argemone ochroleuca	Mexican Poppy	Unknown	Rapid	Permitted under s11 of the BAM Act (DPIRD, 2024).
Bidens bipinnata	Spanish needles	Unknown	Rapid	Recorded along creek lines and adjacent valley plains, often in association with buffel grass. Permitted under s11 of the BAM Act (DPIRD, 2024).
Cenchrus ciliaris	Buffel Grass	High	Rapid	This species is widespread throughout the Pilbara, originally introduced as a cattle fodder by the pastoral industry. Most infestations recorded at OB29/30/35 have occurred along creek lines and adjacent valley plains, and other areas recently disturbed and used as borrow pits and topsoil storage. Permitted under s11 of the BAM Act (DPIRD, 2024).
Cenchrus setiger	Birdwood Grass	High	Rapid	Established as a fodder grass in pastoral areas, birdwood grass is now found in sand dunes, plains, rangelands, stony hillsides and floodplains. Permitted under s11 of the BAM Act (DPIRD, 2024).
Chloris barbata	-	High	Rapid	Permitted under s11 of the BAM Act (DPIRD, 2024).
Chloris virgata	Feathertop chloris	High	Rapid	Permitted under s11 of the BAM Act (DPIRD, 2024).
Conyza bonariensis	Flaxleaf Fleabane	Unknown	Slow	Permitted under s11 of the BAM Act (DPIRD, 2024).
Chamaesyce hirta	Asthma Plant	Low	Slow	Permitted under s11 of the BAM Act (DPIRD, 2024).
Flaveria australasica Hook.	Speedy Weed	Unknown	Unknown	Permitted under s11 of the BAM Act (DPIRD, 2024).
Malvastrum americanum	Spiked Malvastrum	High	Rapid	Recorded along drainage lines and in low open forest and grasslands. Permitted under s11 of the BAM Act (DPIRD, 2024).
Rumex vesicarius	Ruby Dock	High	Rapid	Preferred habitat is sandy alluvial and gravelly ironstone soils. It commonly occurs in disturbed sites and along roadsides. Not listed
Setaria verticillata	Whorled Pigeon Grass	High	Rapid	Permitted under s11 of the BAM Act (DPIRD, 2024).
Sisymbrium orientale	Indian Hedge Mustard	Low	Unknown	Grows on variety of different soil types. Permitted under s11 of the BAM Act (DPIRD, 2024).
Solanum nigrum	Black Berry Nightshade	Low	Rapid	Permitted under s11 of the BAM Act (DPIRD, 2024).
Sonchus oleraceus	Common Sowthistle	Low	Rapid	Permitted under s11 of the BAM Act (DPIRD, 2024). Environmental weed classified as having rapid invasiveness and low ecological impact (DBCA, 2019a).
Tamarindus indica	Tamarind	Low	Slow	Permitted under s11 of the BAM Act (DPIRD, 2024).
Vachellia farnesiana	Mimosa Bush	High	Rapid	Permitted under s11 of the BAM Act (DPIRD, 2024).

Source: Onshore Environmental (2013a); GHD (2011); BHP (2021c); DPIRD (2024); DBCA (2019a)



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Map 5-5 OB29/30/35 introduced flora species locations

5.7.6 Groundwater dependent vegetation

Vegetation associations occurring along drainage channels and adjacent floodplains in the OB29/30/35 Closure Plan Area support the facultative[12] tree species *Eucalyptus camaldulensis* subsp. *refulgens* and / or vadophytic[13] tree species *Eucalyptus victrix* and *Eucalyptus xerothermica*.

Given that groundwater levels are in excess of 30 m below ground level, groundwater is unlikely to be accessible for plant uptake. It is, therefore, unlikely that the facultative and vadophytic species mapped in the area rely on groundwater. The remaining vegetation associations within the OB29/30/25 Closure Plan Area are xerophytic, plant species with no reliance on groundwater, and therefore not at risk from being impacted by groundwater drawdown (Onshore Environmental, 2013b).

5.7.7 Knowledge gaps & forward work program

Vegetation communities have a role in providing habitat for fauna, and research is currently being planned on fauna habitat for key species.

5.8 Fauna

The habitats and fauna identified in the vicinity of the Whaleback and OB29/30/35 Closure Plan Areas are consistent with those identified for the Hamersley (PIL03) subregion of the Pilbara bioregion and the Augustus (GAS3) subregion of the Gascoyne bioregion.

5.8.1 Fauna habitats

Six fauna habitat types have been described and mapped within the OB29/30/35 Closure Plan Area (Table 5-28, Map 5-6). All of the fauna habitats are broadly distributed and well represented across the Pilbara bioregion and surrounding regions, and support fauna assemblages which are generally common and widespread (Onshore Environmental, 2013a; Biologic, 2011a; Halpern Glick Maunsell, 1999).

Five of the mapped fauna habitats are considered to be high or moderate value for terrestrial vertebrate fauna as they provide critical and / or supporting habitat for significant fauna species, specifically major drainage line, gorge / gully, mulga woodland, drainage area and sandy plain (Table 5-28). The major drainage line and gorge / gully (including caves) habitats have been identified to be of high value.

Rehabilitated sites and anthropogenic habitats such as quarries, camp sites, mine sites etc. may provide alternative living and foraging spaces for several significant species, especially the Northern Quoll. Several bird species (including migratory species) may use anthropogenic water bodies (Onshore Environmental, 2013a). Northern Quolls and many species of herpetofauna have found alternative living and feeding grounds in these disturbed habitats. Star Finches and several other bird species use the artificial water bodies in the vicinity of the study area.

The level of habitat prospectivity for Short Range Endemic (SRE) fauna within and immediately adjacent to the OB29/30/35 Closure Plan Area is generally low, compared to surrounding areas and bioregion, due to the relative similarity in vegetation assemblage between the different habitats (Biologic, 2011b).

No permanent natural water features / pools have been mapped within the Closure Plan Area.

Eleven broad fauna habitat types were also mapped by Astron (2024) along the pipeline corridor that is part of the Significant Amendment, but outside of the OB29/30/35 Closure Plan Area. The eleven habitat types are aligned with the six identified within the OB29/30/35 closure planning area and are described in Table 5-28.

Table 5-28 Description of key fauna habitat types in the vicinity of the OB29/30/35 closure planning area

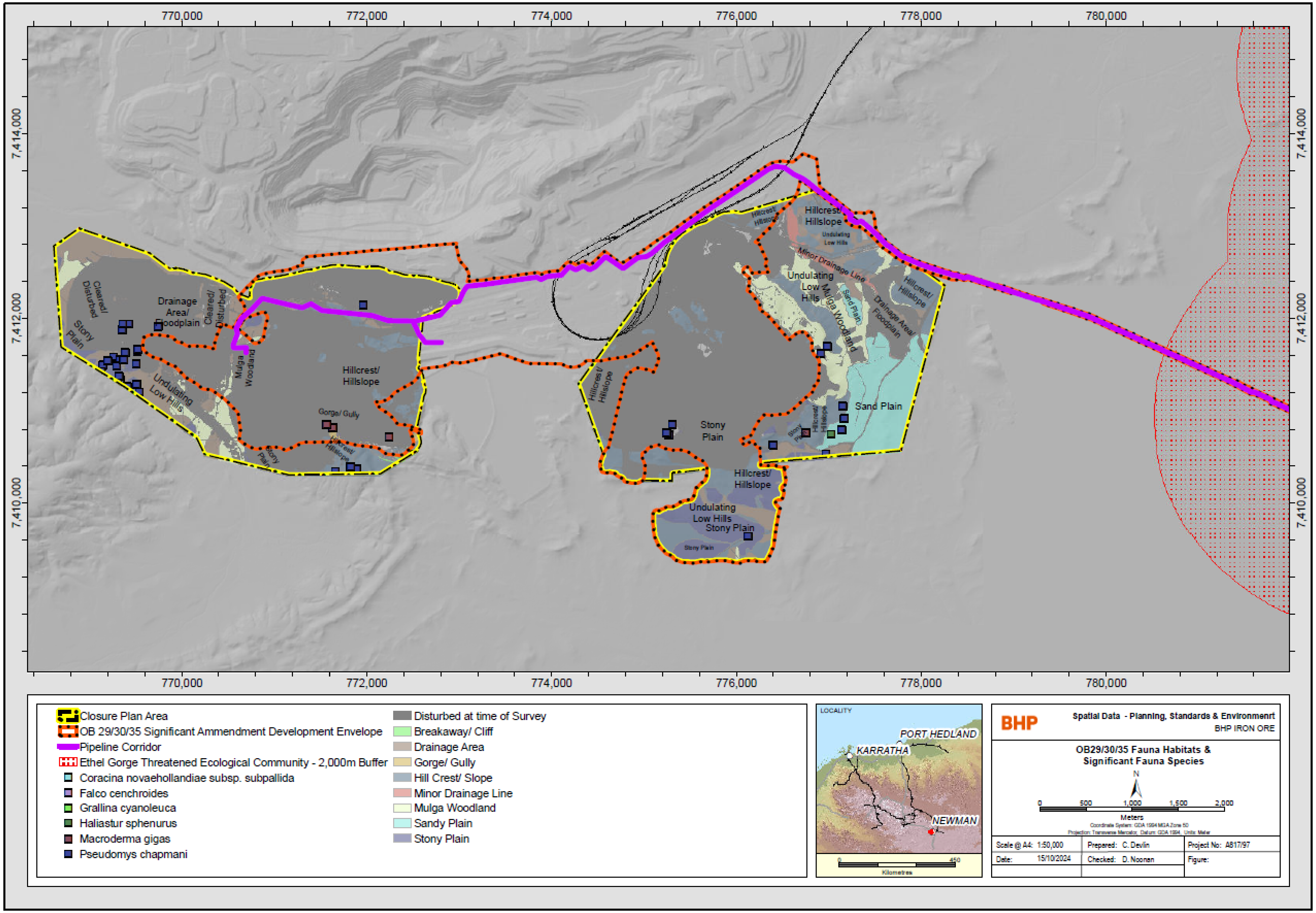
Habitat Type	Description (Astron, 2024)	Value to significant fauna [(1)]
Breakaway/Cliff	Exposed rock formations often associated with Hillcrest/Hillslope, Gorge/Gully or Drainage lines.	Provides limited potential roosting habitat for Ghost Bat (where this habitat occurs within the Development Envelope it is in close proximity to existing active mining operations).
Drainage Area/Floodplain	Flat plains next to drainage lines, often grasslands and or woodlands with soft/clay soils. Often mixed shrubland with emergent *Eucalyptus*/*Corymbia* species over *Triodia* hummock grassland.	Supporting foraging habitat for Ghost Bat
Hillcrests / slopes	Characterised by large open rocky areas with open grasslands, predominantly *Triodia* hummock grasslands with emergent *Eucalyptus* trees, *Acacia* stands and mixed shrubs.	Provides limited potential roosting habitat for Ghost Bat (caves)

[12] Facultative Phreatophytes are capable of opportunistically using groundwater. They can function as both a vadophyte and a phreatophyte.
[13] Vadophytes primarily use water held in the vadose (unsaturated) zone that occurs above the water table.

Habitat Type	**Description** (Astron, 2024)	**Value to significant fauna** [(1)]
Major Drainage Line	Large drainage channel. Rocky substrate often washed away. Presence of mature *Eucalyptus*/*Corymbia* trees over mixed shrubs and tussock and *Triodia* grasses.	Unlikely to support Ghost Bat foraging where within 12 km of a critical roosting cave[(2)] (as this habitat is fragmented and adjacent to active mining) Supporting foraging habitat for Ghost Bat (outside of 12 km)
Medium Drainage Line	Medium drainage channel often with thick *Acacia* growth along banks.	Supporting foraging habitat for Ghost Bat
Minor Drainage Line	Small drainage channel. Often with thick *Acacia* growth along banks and is less likely to support surface water or long following rainfall.	Critical foraging habitat for Ghost Bat where within 12 km of a critical roosting cave[(2)].
Mulga woodland	Stands of mulga over clay or stony substrate.	Supporting foraging habitat for Ghost Bat[(3)].
Sandy/Stony Plain	Stands of *Acacia* or other shrubs over *Triodia* hummock grassland over clay or stony substrates.	Critical foraging habitat for Ghost Bat where within 12 km of a critical roosting cave[(2)].
Stony Plain	Broad flat low-lying plains to undulating plain in soft loamy soils. Scattered *Acacia* stands over *Triodia* hummock and tussock grassland.	Critical foraging habitat for Ghost Bat where within 12 km of a critical roosting cave[(2)].
Undulating Low Hills	Low stony hills and slopes with dissected valleys and drainage on stony soils. Scattered *Acacia* and *Hakea* species over low *Triodia* hummock grassland.	No value to significant fauna.
Wetland	Permanent water, often with reeds present. Presence of large *Eucalyptus* and *Corymbia* trees in areas.	Supporting foraging habitat for Ghost Bat.

Source: Astron (2024)

1. Value to significant fauna relates to Threatened fauna species know to have records within the Development Envelope (i.e. Ghost Bat).
2. A critical roosting cave is classified as Category 1 or 2 roost, or Category 3 roost adjacent to a Category 1 or 2 roost (Bat Call 2022).
3. Astron (2024) identified Mulga Woodland as critical Ghost Bat foraging habitat, however, Mulga Woodland habitat within the Development Envelop is more than 12 km from a critical roosting cave and as such has been classified as supporting foraging habitat.



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Map 5-6 Fauna habitat and significant fauna species observed locations

5.8.2 Vertebrate fauna

A total of 29 vertebrate fauna surveys have been undertaken in the Whaleback and OB29/30/35 areas (Onshore Environmental, 2013a; Biologic, 2011a; Halpern Glick Maunsell, 1999). Biologic (2011a) identified 328 potential species in the area based on a desktop review and recorded 165 of the species during a survey. Species recorded consisted of 21 native and 6 introduced mammals, 82 birds, 53 reptiles and 2 amphibians. The recorded fauna assemblage is considered typical of the Pilbara bioregion.

Introduced fauna recorded during the survey were cattle (**Bos taurus*), Dingo / Dog (**Canis familiaris*), Horse (**Equus caballus*), donkey (**Equus asinus*), rabbit (**Oryctolagus cuniculus*) and feral cats (**Felis catus*) (Biologic, 2011a). Feral animals are managed by the Site Environment Team according to the WAIO Animal and Pest Management Plan (WAIO, 2022e), as linked to compliance obligations at each specific site. Feral cat monitoring has recently been commissioned at selected ghost bat caves across various project areas. The scope includes monitoring of caves at Western Ridge (3 caves), Jimblebar (2 caves), Ninga (3 caves), Catjedra; Gorge (1 cave) and MAC / South Flank (6 caves).

More recent vertebrate fauna surveys have been undertaken in association with the surplus water pipeline, which is proposed for construction on tenements covered by another MCP. However, the outcome of the survey is included here for completeness. Astron (2024) undertook a survey comprising 69 habitat assessment sites to identify, assess and map fauna habitat types. Targeted search methods for significant vertebrate fauna were undertaken including 16 motion sensor camera sites (particular focus on Northern Quoll and Pilbara Olive Python), eight acoustic bat recorder sites, two autonomous recording unit sites (for Night Parrot), four plot/transect search sites (for Bilby), cave assessments and other visual observations.

5.8.3 Significant fauna

A total of fifteen significant species have been recorded in and around the OB29/30/35 Closure Plan Area during fauna surveys (Onshore Environmental, 2013a; Biologic, 2011a). The most recent survey was undertaken by Astron (2024) and was focused on the pipeline corridor that is the subject of the Significant Amendment approval. Astron (2024) did not identify any Matters of National Significance (MNES), or other significant fauna species during the survey which was completed between September and October 2023. However, 10 significant species were considered to have a high post-survey likelihood of occurrence (Astron, 2024): Pilbara olive python, ghost bat, Pilbara leaf-nosed bat, common sandpiper (*Actitis hypoleucos*) (MI; MI), wood sandpiper (*Tringa glareola*) (MI; MI), common greenshank (*Tringa nebularia*) (MI; MI), marsh sandpiper (*Tringa stagnatilis*) (MI; MI), western pebble-mound mouse (*Pseudomys chapmani*) (P4), peregrine falcon (*Falco peregrinus*) (OS) and Gane's blind snake (*Anilios ganei*) (P1). These species have been recorded within or proximate (within 5 km) to the survey area on previous surveys, and supporting habitat was identified during the survey.

Significant fauna species recorded during previous surveys within the OB29/30/35 Closure Plan Area and surrounds, and their preferred habitats are listed in Table 5-29 (refer to Map 5-6 for locations).

Table 5-29 Priority fauna species recorded within the OB29/30/35 closure planning area and immediate surrounds

Scientific Name	Common Name	Conservation Status	Comment
BC Act and EPBC Act Listed Species			
Mammals			
Dasyurus hallucatus	Northern Quoll	BC Act Endangered EPBC Act Endangered IUCN Endangered	Suitable habitat includes: • Gorge • Major drainage line. OB29/30/35 lies on the extreme southern limit of this species' range.
Macroderma gigas	Ghost Bat	BC Act Vulnerable EPBC Act Vulnerable IUNC Vulnerable	The distribution of Ghost Bats is influenced by the availability of suitable caves and abandoned mine shafts for roost sites. This species was recorded in the gorge and gully habitat and was expected to have been foraging in the area as none of the caves in this habitat were deep enough to be considered roost sites. It may also forage in crest / hill slope habitats.
Birds			
Actitis hypoleucos	Common Sandpiper	BC Act Migratory EPBC Act Migratory IUCN Least Concern	Use both permanent and ephemeral terrestrial wetlands. Key habitat includes: • Gorge / gully • Major drainage lines • Drainage areas Anthropogenic water bodies may provide suitable feeding, resting and shelter sites for these species while enroute to wintering sites.
Tringa glareola	Wood Sandpiper	BC Act Migratory EPBC Act Migratory IUCN Least Concern	
Tringa nebularia	Common Greenshank	BC Act Migratory EPBC Act Migratory IUCN Least Concern	

Scientific Name	Common Name	Conservation Status	Comment
Tringa totanus	Common Redshank	BC Act Migratory EPBC Act Migratory IUCN Least Concern	
Tringa stagnatilis	Marsh Sandpiper	BC Act Migratory EPBC Act Migratory IUCN Least Concern	
Falco peregrinus	Peregrine Falcon	BC Act Other Specially Protected IUCN Least Concern	The gorge and gully habitats in the study area provide nest sites for this species and it is expected to forage over all habitat types as part of its home range.
Reptiles			
Liasis olivaceus barroni	Olive Python	BC Act Vulnerable EPBC Act Vulnerable	The study area lacks the large gorge and gully habitats preferred by this species, though it may utilise the available waterbodies to traverse the landscape, especially the major drainage lines.
Other Significant Species			
Mammals			
Pseudomys chapmani	Western Pebble-Mound Mouse	DBCA Priority 4 IUNC Least Concern	Vast areas of suitable habitat for this species are present within the hillcrest and slope habitats and stony areas of the sandy plains and mulga woodland
Sminthopsis longicaudata	Long-tailed Dunnart	DBCA Priority 4 IUNC Least Concern	Suitable habitats are breakaways or rocky outcrops on hilltops
Birds			
Ardeotis australis	Australian Bustard	IUCN Least Concern	Suitable habitats, include: • Crest / hill slope • Mulga woodland • Sandy plains for foraging
Merops ornatus	Rainbow Bee-eater	IUCN Least Concern	Suitable habitat includes: • Gorge • Major drainage line Artificial wetlands created by mining may also provide suitable habitat for this species.
Neochmia ruficauda subclarescens	Star Finch	IUCN Least Concern	Suitable habitats include: • Gorge / gully where areas of Typha occur • Major drainage line The species may also use artificial wetlands in the area that contain large areas of *Typha*.

DBCA classification Priority 4 (rare, near threatened and other species in need of monitoring); IUCN – International Union for Conservation of Nature

Sources: Onshore Environmental (2013a); Biologic (2011a); IUCN (2016) accessed March 2024.

5.8.4 Subterranean fauna

Subterranean habitat in the area was described and assessed by Bennelongia (2013) and can be summarised in general terms as consisting of Tertiary Detritals, which occur in association with creek lines and valleys, and underlying Hamersly Group bedrock comprising a matrix of mudstone, siltstone, chert, dolomite and shale (Bennelongia, 2019). The majority of detritals in the vicinity of the orebodies are above the water table and, in general, only deeper aquifers in mineralised rock provide potential habitat.

5.8.4.1 Troglofauna

In 2011, Bennelongia Environmental Consultants (Bennelongia, 2011) conducted a survey of troglofauna at OB 29 and OB35. The troglofauna community at OB29 and OB35 consisted of 14 species of nine Orders. This represents low richness compared with other sites in the Pilbara (Table 5-30). Two arachnid Orders were recorded: Pseudoscorpionida (two species), and Araneae (one species). The only crustacean Order collected was Isopoda (one species). Millipedes were represented by one Order: Polyxenida (one species). Pauropods were represented by the only known Order in this group (Pauropodina) (one species). Three insect Orders were collected: Thysanura (one species), Blattodea (one species) and Hemiptera (four species). Four of the 14 species recorded at the study site were not known from elsewhere, namely: Pauropodina sp. B9, Hanseniella sp. B6, Symphyella sp. B7 and Ploiaria sp. B2. None of the troglofauna taxa, nor the communities recorded in the development envelope, are listed or recognised as conservation priorities under state or federal legislation.

Species composition and abundance at OB35 was found to be similar to that of other areas of the Ophthalmia Range. This suggests that there is good connectivity of troglofauna habitat at OB35 with surrounding areas at both a local and sub-regional scale.

Table 5-30 Results of troglofauna studies in the vicinity of Whaleback & OB29/30/35 compared to other local studies

Troglofauna Studies Undertaken	Summary Results
OB35 Mt Whaleback area (Bennelongia, 2011)	15 species representing 9 orders collected
Jimblebar (Wheelarra Hill) area (Bennelongia, 2013)	38 species representing 14 orders collected
Eastern Ridge (Bennelongia, 2015)	32 species representing 16 orders collected
Western Ridge (Bennelongia, 2021)	22 species, 7 of which were singletons, but the remaining were collected from more than one bore or are known to have wider distributions.
Western Ridge targeted survey (Bennelongia, 2022)	27 species of troglofaunal occurring at Western Ridge with 11 species currently known only from Western Ridge.

5.8.4.2 Stygofauna

Approximately 78 stygofauna species have been recorded from within the Newman area with 59 of these recorded in the Ethel Gorge TEC (Section 5.8.6). Table 5-31 summarises some of the key stygofauna fauna findings from various surveys across BHP's operations in the vicinity of OB29/30/35.

Table 5-31 Results of stygofauna studies within the vicinity of Whaleback and OB29/30/35

Stygofauna Studies Undertaken	Summary Results
Whaleback, OB29 and OB35 (ALS Global, 2011)	20 species representing 6 orders collected
OB29/30/35 Mt Whaleback area (Bennelongia, 2013)	Nine species recorded in the Orebody 29, 30 and 35 area
Orebody 17/18 area (Bennelongia, 2014a)	One species recorded near the mine and a further two species from the alluvial plain to the south of the operations
OB31 (Bennelongia, 2014b)	Eleven species belonging to seven groups (Nematoda, Rotifera, Ostracoda, Copepoda, Syncarida, Amphipoda and Tubificida)
Wheelarra Hill (Jimblebar) area (Bennelongia, 2013)	Fifteen species recorded in the vicinity of the mine and an additional nine species recorded on the adjoining Sylvania Station
Eastern Ridge and Homestead Creek area (Bennelongia, 2020)	87 species recorded from within the area where modelled groundwater drawdown during operations is greater than, or equal to, two metres over and above the natural climatic fluctuations
Western Ridge (Bennelongia, 2021)	Depauperate community comprising one species of syncarid, three species of earthworms and a number of nematodes which are widespread and are not significant.
Eastern Ridge and Jimblebar (Stantec, 2022)	A total of 26 stygofauna species were recorded, from six higher level taxonomic groups: Amphipoda, Bathynellacea, Copepoda, Isopoda, Ostracoda and Oligochaeta. This included 13 core taxa (taxa endemic to the wider Newman area, including the Ethel Gorge TEC).

There have been 25 species of stygofauna recorded within the drawdown area of OB29/30/35 (Bennelongia, 2019) with 23 of the 25 known from outside the impact footprint. Two species, the oligochaetes Enchytraeidae sp. OB3 and Naididae sp. N08 have only been recorded from within the drawdown area, although there is some evidence to support their wider distributions (Bennelongia, 2019).

In 2013, Bennelongia (2013) assessed potential impacts to stygofauna from mining below the water table at OB29/30/35. The surveys of the area recorded only nine species, which is depauperate[14] in comparison with the wider Newman area, due to the OB29/30/35 area having poorer quality stygofauna habitat. The main stygal habitat within the OB29/30/35 Closure Plan Area is BIF, which is less prospective for stygofauna than saturated Tertiary Detritals and calcrete (Bennelongia, 2013; ALS Global, 2011).

All the species collected within the area of predicted groundwater drawdown associated with OB29/30/35 are known, or considered highly likely, to occur in locations not impacted by mining and associated activities (ALS Global, 2011; Bennelongia, 2019). It appears likely that the OB29/30/35 aquifer system extends beyond the area into the Ophthalmia floodplain. Thus, habitat for the stygofauna community within the area will remain on the Ophthalmia floodplain following groundwater drawdown (Bennelongia, 2013).

5.8.5 Short range endemic species

No confirmed SRE invertebrate fauna species are known to occur within the OB29/30/35 Closure Plan Area. The most recent SRE survey for the OB29/30/35 area was conducted by Biologic Environmental Survey (Biologic , 2024) and covered an area of 582 ha. The survey included database searches and literature review which identified 146 taxa representing five Confirmed SRE and 141 Potential SRE taxa recorded from within 40 km of the survey area.

[14] Lacking in numbers or variety of species.

Two SRE invertebrate surveys were undertaken in 2023, and habitat assessment were carried out at 37 sites across the survey area. Biologic (2024) identified five habitat types, with the majority (98%) consisting of habitats of low significance to SRE invertebrate fauna. The habitats were:

- Low significance:
    - Undulating Low Hills
    - Drainage Area / Floodplain
    - Medium Drainage Line
- Moderate significance
    - Hillcrest / Hillslope
- High significance
    - Breakaway / Cliff

Sampling was conducted at 25 of the 37 sites and 21 taxa from SRE groups were identified based on morphological and molecular identification. Of the 14 named taxa, nine were considered Potential SRE and the remaining five were considered widespread (Biologic , 2024). None of the 'confirmed' SRE taxa identified in the desktop assessment were found during the surveys.

There were 40 specimens collected during the survey including 5 Arachnida Araneae (spider), 16 Arachnida Pseudoscorpions (pseudoscorpion), 2 Arachnida Scorpiones (scorpion), 1 Cilopoda Geophilomorpha (centipede), 1 Chilopoda Scolopendromorpha (centipede), 3 Malacostraca Isopoda and 12 Armadillidae (Biologic , 2024).

Terrain in the OB29/30/35 Closure Plan Area can be considered part of the one gully / ridge system and habitat. This connectivity, coupled with the distribution data of significant SRE taxa at near-by Western Ridge, indicates that any SRE community occurring in the OB29/30/35 Closure Plan Area is highly likely to occur within the surrounding areas (Biologic, 2011a).

5.8.6 Threatened or Priority Ecological Community

The nearest TEC is the Ethel Gorge aquifer stygobiont community, a State listed TEC. The Ethel Gorge Aquifer Stygobiont Community is listed as an Endangered TEC endorsed by the Western Australian Minister for Environment, since some stygofauna species are endemic to Ethel Gorge. The stygofauna habitat comprises saturated calcrete and alluvium aquifers, which underlie the broad Ophthalmia Valley and Ethel Gorge; the latter containing the most abundant and diverse community.

The current spatial extent of the Ethel Gorge TEC and 2 km buffer zone, as defined by DBCA, is understood to be based on the surface expression of calcrete in the area. The quality of stygofauna habitat is influenced by the level of connectivity between pores, cavities, and fractures, which facilitate fauna movement and dispersal (RPS Aquaterra, 2014).

The main habitat area lies approximately 7 km east of the OB29/30/35 operations, and the 2 km buffer zone for the TEC is outside of the of the OB29/30/35 Closure Plan Area (Map 5-6, Section 5.8.2). The Ethel Gorge Aquifer Stygobiont Community has the potential to be impacted by changes in groundwater level and water quality post closure. However, studies completed by Bennelongia (2013), as part of the OB29/30/35 below water table mining approval concluded that none of the stygofauna species known from within the predicted groundwater drawdown extent for the approved proposal were considered likely to be restricted to, or have a substantial proportion of its population, within the area of predicted groundwater drawdown.

5.8.7 Knowledge gaps & forward work program

The return of fauna is important to the Nyiyaparli people and research is being planned to investigate fauna habitat attributes of importance for significant species and the key species of significance to the Nyiyaparli people.

5.9 Hydrology

5.9.1 Surface water

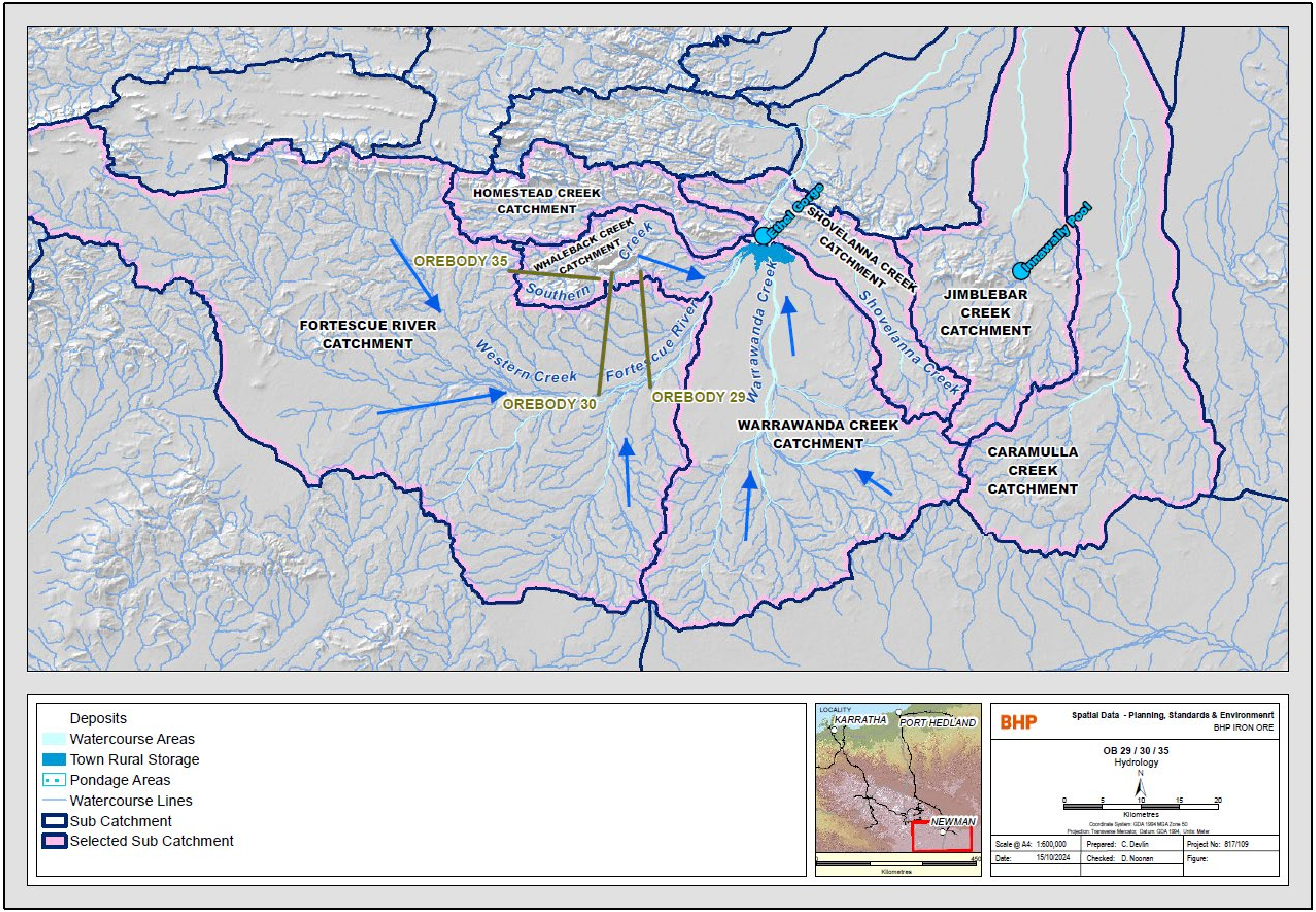
5.9.1.1 Regional hydrology

At the regional scale, OB29/30/35 is located within the Upper Fortescue River catchment (Whaleback Creek and Fortescue regional sub-catchment) (Map 5-7). The main drainage feature is Whaleback Creek, which is an ephemeral creek that flows in a north easterly direction between OB30 which is located to the north of the creek, and OB29 and OB35 which are located to the south (Map 5-8). Whaleback Creek drains into the Upper Fortescue River which, in turn, drains in a northeasterly direction into Ophthalmia Dam. Ophthalmia Dam also receives inflows from the Warrawanda Creek.

Upstream of Ophthalmia dam, Whaleback Creek has a catchment area of 205 km^2 with a main channel length of 35 km, and Fortescue River has a catchment area of 2,890 km^2 with a main channel length of approximately 125 km (Map 5-7). Southern Creek is a major tributary that drains the Eastern Ridge area and discharges into Whaleback Creek (Map 5-8). The catchment of the Southern Creek tributary was altered by construction of the OB35 creek diversion in 2023 (see Section 5.14.5 and 9.2.3.1), and it now has a catchment area of 13.3 km^2 upstream of its junction with Whaleback Creek, and a channel length of about 7.2

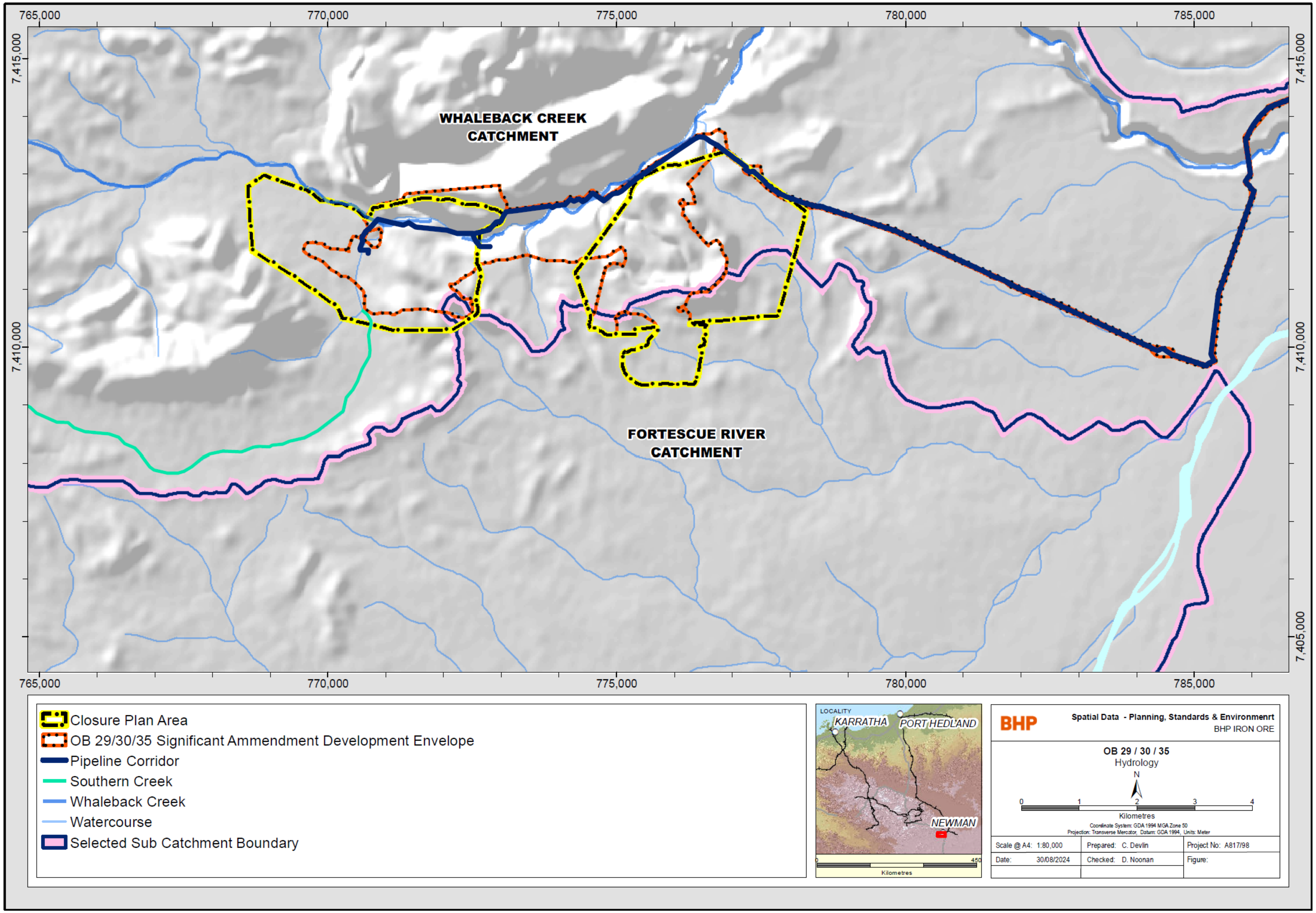
km (Advisian, 2021b). The upstream section of Southern Creek receives most of its flow from Western Ridge which comprises steep rocky hills located to the southwest of OB35 (WAIO, 2018a).

Most streamflow in the region is related to heavy rainfall, which mainly occurs between December and March. Approximately one to three runoff events occur annually. Therefore, no routine streamflow monitoring is undertaken on these waterways. In the smaller channels, streamflow is typically of short duration and ceases soon after rainfall. In larger creek channels, flow can persist for several weeks, and sometimes months, following major rainfall events such as those associated with tropical cyclones. (WAIO, 2018a).



Refer to Appendix N for a pdf version

Map 5-7 **Regional hydrology and surface water**

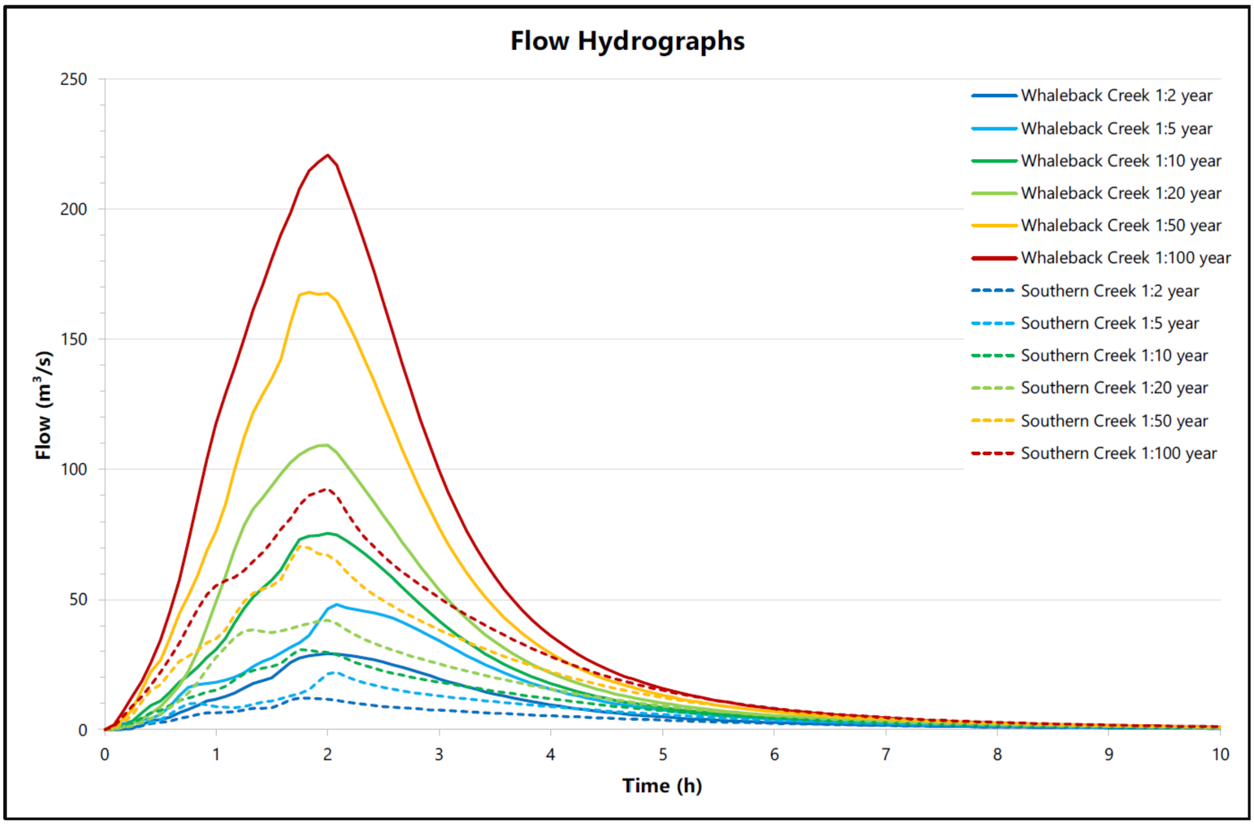


Refer to Appendix N for a pdf version

Map 5-8 **Local hydrology**

Catchment flows

Figure 5-19 shows flow hydrographs (up to the 1 in 100 Annual Exceedance Probability (AEP) event) for conditions in Whaleback Creek and Southern Creek prior to construction of the OB30 and OB35 creek diversions. Table 5-32 identifies the peak flow rates adopted for baseline hydraulic modelling of Whaleback Creek and Southern Creek (Tetra Tech Proteus, 2020; Advisian, 2021b). This information was used to inform the creek diversion designs (discussed in Sections 5.14.5, 5.14.6 and 9.1.2.1).



Source: Advisian (2021b)

Figure 5-19 Flow hydrographs for pre-diversion conditions in Whaleback and Southern creeks

Table 5-32 Peak flow rates for Whaleback Creek and Southern Creek (pre-diversion conditions)

Flood Event (1 in X AEP)	Peak Flow (m³/s)	
	Whaleback Creek	Southern Creek
1 in 2	29	12
1 in 5	48	20
1 in 10	75	30
1 in 20	108	44
1 in 50	166	69
1 in 100	223[15]	92[16]
1 in 1,000	496	200
1 in 10,000	1,263	496

Source: BHP / Advisian (2021b); Tetra Tech Proteus (2020)

Advisian (2021b) conducted hydraulic modelling of the pre-diversion Whaleback Creek reach which would be impacted by the OB30 diversion, and the reaches immediately upstream and downstream. The outputs of this modelling included velocity, shear

15 1 in 100 AEP peak flows in the Whaleback catchment have been estimated using a variety of methods and range from 167 to 575 m³/s. The estimate of 223 m³/s has been derived from a runoff routing (RORB) rainfall-runoff model (Advisian, 2021b).

16 1 in 100 AEP peak flows in Southern Creek catchment have been estimated using a variety of methods and range from 58 to 111 m³/s. The estimate of 92 m³/s has been derived from a RORB rainfall-runoff model (Advisian, 2021b).

and stream powers along these reaches and are presented in Appendix F. Comparison of the hydraulic modelling results for the three reaches indicates that hydraulic intensity increases when travelling from upstream to downstream, and that similarities exist between the S-Curves for the upstream and existing reaches of Whaleback Creek, whereas there is a distinct difference in the S-Curves for the downstream reach. This is because the downstream reach is essentially an existing diversion comprising a trapezoidal channel, whilst the upstream and existing reaches are more similar to a natural creek. The upstream reach is the least impacted by mining, so the results from the upstream reach are considered most representative of pre-development conditions and have, therefore, been used to develop threshold hydraulic performance criteria for inclusion in the Basis of Design for the OB30 creek diversion (Advisian, 2021b).

Ophthalmia Dam

Ophthalmia Dam was commissioned in 1981 as a Managed Aquifer Recharge (MAR) scheme, to maintain groundwater levels within the Ethel Gorge aquifer, to support the Ophthalmia Borefield for the Newman town water supply. The MAR scheme is passive where water from the dam infiltrates into the underlying aquifers. The Ophthalmia Dam system is adjacent to and partially overlies the Ethel Gorge aquifer system, which supports the Ethel Gorge TEC.

The Ophthalmia Dam system is located approximately 15 km east of OB29/30/35 and receives surplus mine water from the approved Orebody 29/30/35 BWT mines and other approved operational BHP eastern mines (currently Eastern Ridge, Jimblebar and OB31). Discharge is also authorised from the Western Ridge mine and OB32 BWT mine (part of Eastern Ridge) however, discharge has not started from these mines as dewatering has not yet started. The Ophthalmia Dam system comprises the dam, infiltration basins and recharge ponds.

Surplus water is discharged to the Ophthalmia Dam system via pipelines and water from the dam infiltrates into the Ethel Gorge aquifer (i.e. there is no direct discharge of surplus water to creeks).

The construction of Ophthalmia Dam has altered the natural flow regime of the Upper Fortescue River and appears to have prevented or reduced medium-sized flows (recurrence interval of one to three years) from reaching the downstream floodplain and natural flows emanating from the upper catchment have been partially attenuated. Uncontrolled releases of water to the Upper Fortescue River tributaries occur when the dam fills from rainfall events and overtops the spillway. BHP also undertakes controlled releases of water from Ophthalmia Dam to the Upper Fortescue River tributaries for environmental management or for dam safety and maintenance purposes, and most releases have been less than three months per year. The Ophthalmia Dam is not included within the scope of this MCP.

5.9.1.2 Local hydrology

OB29

OB29 lies within the catchment of Whaleback Creek although the south side is close to the Fortescue River catchment boundary (Map 5-8). The north side of the pit is located relatively close to Whaleback Creek, however, the pit crest is a minimum of 8 m above the creek.

The catchment area reporting to OB29 is about 1.6 km^2, mainly consisting of the pit area itself but also including a small 0.2 km^2 area to the east of the orebody. This external catchment comprises two deeply incised gullies which would be unfeasible to divert. The natural drainage of the catchment area to the west of OB29 is northwards towards Whaleback Creek and does not impact on the OB29 pit. This catchment has been largely disturbed by mining developments (OSA and haul roads), which has changed natural drainage patterns (WAIO, 2018a).

OB30

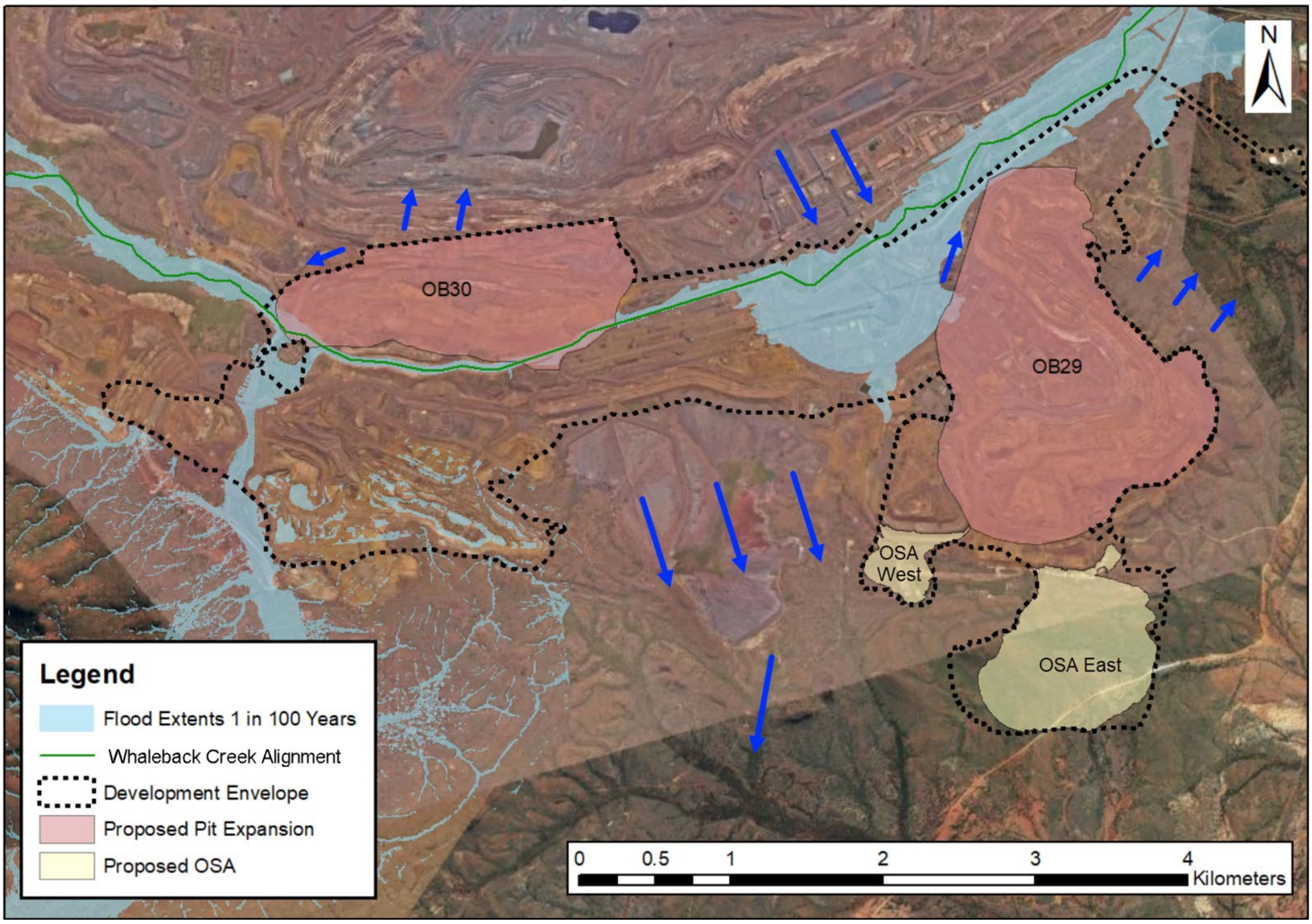
OB30 is located between Whaleback Pit and Whaleback Creek (Map 5-8). The southern pit perimeter is within the Whaleback Creek floodplain and Whaleback Creek flows within 50 m of the pit via a creek diversion. At this point, Whaleback Creek has an upstream catchment area of about 83 km^2 which includes approximately 29 km^2 from the Southern Creek catchment. Apart from the area of the pit within the Whaleback Creek flood plain, the pit is generally internally draining with no other external catchments reporting to the pit (WAIO, 2018a; Hydrobiology, 2020a).

OB35

OB35 is located south of Whaleback Creek and is surrounded by landscape that will discharge runoff into the pit, with the northern pit edge about 700 m from the creek (Map 5-8). The pit intercepts the natural pathway of Southern Creek which flows northwards through the OB35 development area (WAIO, 2018a). However, a creek diversion has been installed around the pit.

There are some local sub-catchments, which are intercepted by the OB35 pit but they have small catchment areas less than 1 km^2. A small area of the pit (about 0.06 km^2) is located in the Fortescue River catchment (Map 5-8) (WAIO, 2018a).

Figure 5-20 shows the direction of local flow in relation to OB29/30/35 (BHP, IN DRAFT 2024).



Source: BHP (IN DRAFT 2024)

Figure 5-20 Direction of local flow

5.9.1.3 Geomorphology

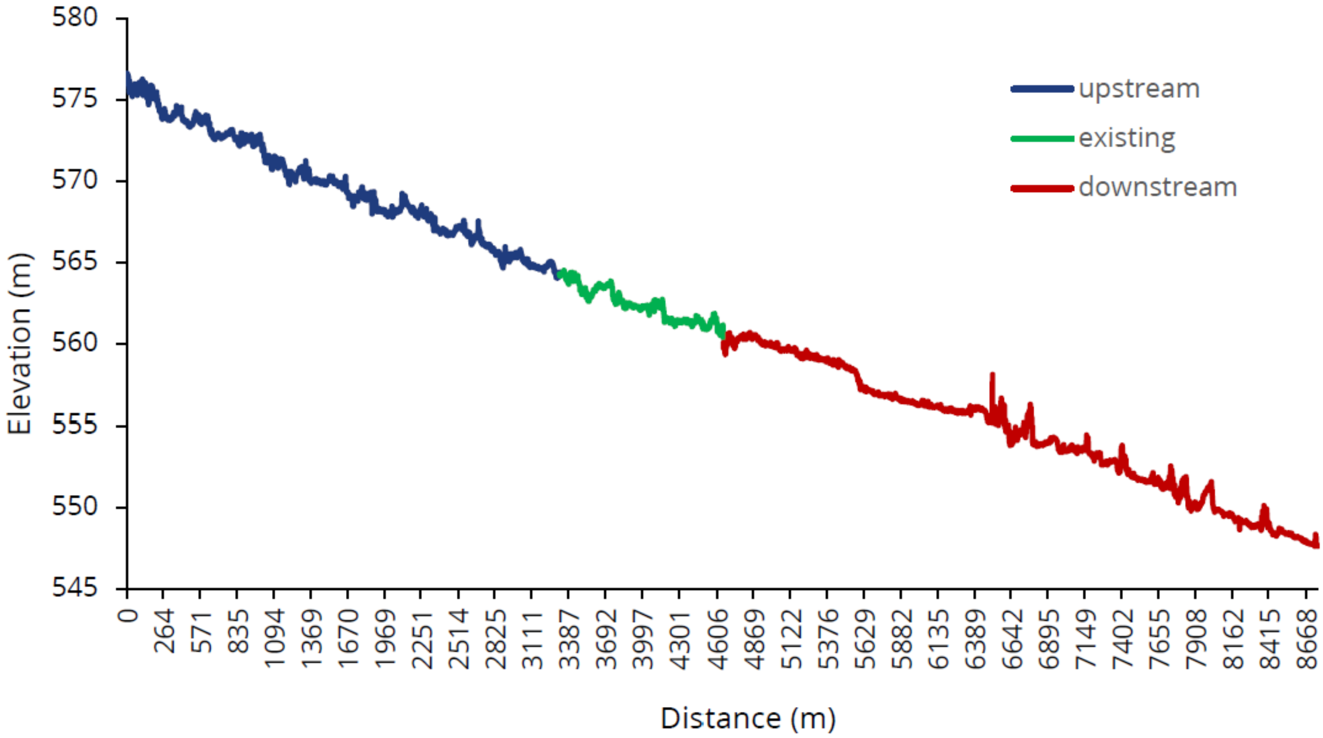
Whaleback Creek

Hydrobiology (2020a) conducted a review of the geomorphology of Whaleback Creek to inform the now constructed OB30 creek diversion design (refer to Section 5.14.6). The review considered the geomorphology in the following reaches of the creek:

- Upstream – reach upstream of the diversion (3,314 m).
- Pre-diversion– previous reach that was diverted by the OB30 creek diversion (1,217 m).
- Downstream – reach downstream of the diversion (4,578 m). This reach includes a previous diversion which is about 1.5 km long and contains a single grade control structure composed of rocks to overcome the potential impacts related to the change in slope associated with the shortening in channel length. The diversion has been designed to accommodate a flow of 575 m^3/s (WAIO, 2018a).

The findings of the geomorphic analysis are described below, noting that recommendations from the study were adopted into the final design and construction of the diversion.

Whaleback Creek has an average bed gradient of 0.34% along its flow path (Figure 5-21), and it generally follows a low sinuosity, irregularly meandering planform with straight reaches where it has been previously diverted at the eastern side of the OB30 pit. The creek is highly varied in the hydraulic habitats along its length in terms of channel width, shape, depth and bank characteristics, and sediment deposition. The in-channel features include broad, flat and largely armoured gravel bed, vegetation induced bars, microhabitat features associated with vegetation induced deposition, and long straight featureless sections. Despite the widespread armouring, where flows have eroded through the armouring, large, incised pools have developed. Further details of the geomorphology associated with each reach are provided below.



Source: Hydrobiology (2020a)

Note: Reference to 'existing conditions' is related to pre-diversion conditions.

Figure 5-21 Gradient of Whaleback Creek

Upstream reach

The upstream reach was the least disturbed of those investigated by Hydrobiology (2020a), and the banks were predominantly vegetated along its length. This reach was characterised by (Hydrobiology, 2020a):

- A low sinuosity planform with irregular broad meanders (sinuosity = 1.13) and low gradient.
- A wide floodplain extending on both sides of the creek line, although the floodplain was confined in some locations by ridgelines and mining infrastructure.
- Considerable variability in both planform and cross-section, including alternating sections of small bar forms (micro-bars) and featureless straight, uniform river reaches.
- Considerable heterogeneity in bed forms, bank attached features, and hydraulic habitats throughout the reach, including mid-channel bars, bank attached bars (point / lateral), benches, inset floodplains, and a predominantly irregular channel shape. Bed forms were largely armoured by coarse, iron-rich gravel overlaying finer material (e.g., sands). Where the channel had eroded into the armoured material, considerable incision appeared to occur in response, which was indicative of a channel where shear stresses were very close to the shear strength threshold of the armoured material. Several examples of lag deposits were also observed above the armoured layer, generally associated with vegetation.
- Banks were generally convex and moderately sloped (38%), but they ranged from steep (>60%) concave slopes to moderate to flat (<30%) convex slopes. The northern side comprised steeper slopes as flood protection for the adjacent mine pit.
- Most banks were stable and well vegetated, with only isolated examples of bank erosion noted. Bank erosion was generally associated with the localised bed incision noted above. Where bank erosion had occurred, a range of bank sediments was exposed, including finer, over bank deposits, gravelly colluvial matrices, and gravel fluvial matrices, suggesting that:
  - Bank material was sourced from a range of processes (fluvial, floodplain, hillslope).
  - The reach had undergone historic lateral migration.

Pre-diversion reach

The pre-diversion reach of Whaleback Creek was characterised by:

- Low sinuosity (sinuosity = 1.13) and an irregular channel shape, which was consistent with the channel upstream, although its gradient was slightly lower than the upstream reach and the tightest bend (radius = 63 m) more closely approximated that of the downstream reach.
- Relatively narrow floodplains to the south compared to the creek upstream and downstream.
- Disturbed land and the OB30 pit along its northern edge and the steep and high northern banks that protect the pit from flooding were a distinctive feature of this reach.

- Average width dimensions (bank full, bed and bench) and bank slopes (36.6%) were between those of the upstream and downstream reaches, though it was deeper on average than (bank full height = 2.3 m).
- A gently sloping asymmetrical floodplain with slightly convex slopes along the southern edge while the northern banks were often steep and slightly concave (influenced by the proximity of mine infrastructure).
- High variability of bedforms which reflected the reach immediately upstream. For example, mid-channel bars and point bars were present, as well as variable widths and depths that indicated riffle and / or micro-bar habitats. In channel features reflected those observed upstream, but also the increased proximity to the mine. These features included:
  - Gravel armouring of the bed.
  - Vegetation driven deposition, exhibited in bank attached and longitudinal bars, as well as the micro-bar form.
  - Long, straight, featureless sections.
  - Low, gradual sloped banks.
  - Steeper banks associated with incision into the armoured bed and / or adjacent mine infrastructure.
  - Bank erosion associated with incision into the armoured bed.
  - Similar bank material as that in the upstream reach.

Downstream reach

The downstream reach can be divided into two distinct sub-reaches; the previous existing diversion and the remaining reaches. Both were affected by the proximity of mine infrastructure and the reach was the most disturbed out of the three reaches assessed. The reach was characterised by:

- A low gradient (0.0037 m/m), and less sinuous (almost straight) planform (sinuosity = 1.05) as a result of the previous diversion works.
- A narrow floodplain confined by mine infrastructure to the north and south. The floodplain extended further to the southern side than the north. Frequency of floodplain activation would likely be less than the upstream reaches, particularly within the diversion, due to its greater channel capacity and flow confinement within the channel.
- Steep and high banks along much of the northern bank to provide flood protection to the OB30 pit.
- The reach was highly varied along its length:
  - The eastern length generally comprised an irregular channel shape and flat to moderate composite bank slopes, with some benches and concave banks also present. The in-channel features of the eastern section reflected those seen within the upstream reaches including bed armouring, gravel bars / benches and associated vegetation, low gradual banks, and bed deepening in association with incision into the armoured layer.
  - The western end (diversion) was almost straight and characterised by:
    - A relatively uniform trapezoidal channel shape with generally convex, symmetrical and steep banks and very few in-channel features such as bars / benches.
    - An oversized channel that was wider and deeper than the majority of other observed reaches of Whaleback Creek, and capable of conveying much greater discharges.
    - A featureless bed with no obvious thalweg throughout much of the diversion.
    - Vegetation driven deposition, with significant vegetation encroachment, particularly at the diversion offtake and in the upstream sections where deposition of finer material was more prevalent. Large stands of vegetation and associated bar formation were noted, particularly in the upstream sections of the diversion.
    - A gravel bed mixed with a surficial layer of deposited fines throughout the diversion. This was particularly the case in the vicinity of the diversion offtake, where the backwater created at the offtake had resulted in considerable deposition of fines.
    - A gradual coarsening in bed material in a downstream direction in the diversion, suggesting that the diversion was more capable of mobilising finer sediment than the offtake. Regardless, much of the diversion still consisted of surficial deposits of fine sediment. Some of this fine material would have been delivered via wind erosion of site sediments, but the majority would be sourced from upstream or eroding embankments. The greater presence of fines within the diversion in comparison with the upstream reaches suggests that velocities within the diversion channel, at least in the more frequent flows, are lower than other reaches. This is likely to be as a result of the wide, flat bed dispersing the flows across the entire bed width. Larger bank full events would likely mobilise these finer sediments.
    - A large channel-wide grade control structure about mid-reach in the diversion, which was constructed to moderate the bed gradient within the diversion.

Southern Creek

Depending on gradient, the upstream section of Southern Creek alternates between a defined channel with coarser bed material, and sheet flow over finer silts and sands. The channel is braided with a typical 0.5 m flood depth and wide floodplain (WAIO, 2018a).

In contrast, the downstream section of Southern Creek is well defined with a single creek channel with typical depths of 1 - 2 m and about 6 m wide. The creek intersects bedrock in places and vegetation is generally absent. Bed material reflects the varying material further upstream and ranges from silt to very coarse gravel (WAIO, 2018a).

5.9.1.4 Whaleback Creek sediment transport / scour assessment

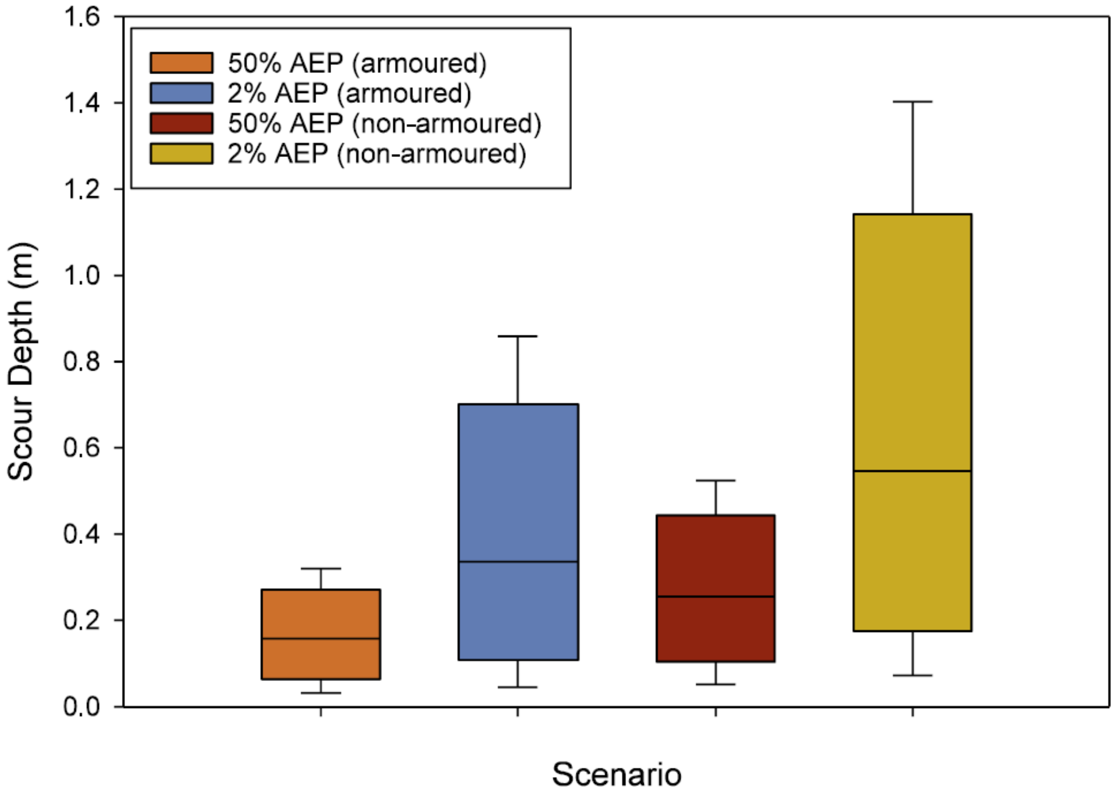
Hydrobiology (2020a) conducted a sediment transport and scour assessment of the Whaleback Creek alignment, prior to diversion works, to inform the design of the now constructed OB30 diversion. The study concluded that, based on stream power data:

- Sediment transport rates were generally low throughout the downstream reach during the more frequent events, whereas in the upper reaches these events would be more capable of transporting finer sediments.
- During the less frequent events, all reaches would exhibit similar sediment transport rates.

Modelling was conducted to assess scour depths associated with armoured and unarmoured scenarios whereby the particle size of the bed material was varied to simulate what might happen when the armoured material was removed (Figure 5-22). The results showed that the potential for scour was:

- Predictably low for the 1 in 2-year (50%) AEP for both the armoured and non-armoured scenarios, suggesting that little bed scour would occur during more frequent events.
- Low for the armoured 1 in 50-year (2%) AEP scenario, suggesting that the armoured layer would largely protect the bed against scour during these less frequent events.
- Far greater for both the 1 in 2 (50%) and 1 in 50-year (2%) AEPs for the unarmoured scenario, suggesting that once the armoured layer was removed there was a greater potential for bed scour to occur.

These results reflect the observations that the bed is largely protected by the armoured layer, but where the armoured layer has been removed, large scour holes have been created.



Source: Hydrobiology (2020a)

Figure 5-22 Scour depth analysis

5.9.1.5 Surface water quality

Typical surface water quality results show that Whaleback Creek is slightly basic (pH <8) with an average total dissolved solids content (TDS) of around 140 mg/L. Total suspended solids (TSS) fluctuate widely and can range from less than 10 mg/L to over 1,000 mg/L (WAIO, 2018a).

Table 5-33 provides a summary of the surface water monitoring results for Whaleback Creek over the time period 1998 - 2023 at the locations shown on Map 5-9. Internal trigger values have been exceeded:

- Occasionally for:

  - pH, TDS, TSS, aluminium, chloride, iron, bicarbonate, magnesium, manganese, sulphate and zinc, but with the exception of zinc, median concentrations[17] fall below the trigger values. The furthermost downstream location on Whaleback Creek reported a median concentration for zinc of 0.03 compared to an internal guideline of 0.026.
- Cadmium, carbonate and lead, but in general, results for these parameters were below detection limits.
  - Nitrates, however, the downstream results were less than those measured at the upstream location.
- Twice for chemical oxygen demand (COD) at the upstream Whaleback location.
- On several occasions for copper and nickel, however, downstream results are not inconsistent with the ranges measured in the upstream location.

Salinity at the Fortescue River (Newman) gauging station is lower than that in Whaleback Creek, typically varying between a TDS of 20 to 100 mg/L after a major flow event, with an average around 40 mg/L (WAIO, 2018a).

Table 5-33 Surface water monitoring results

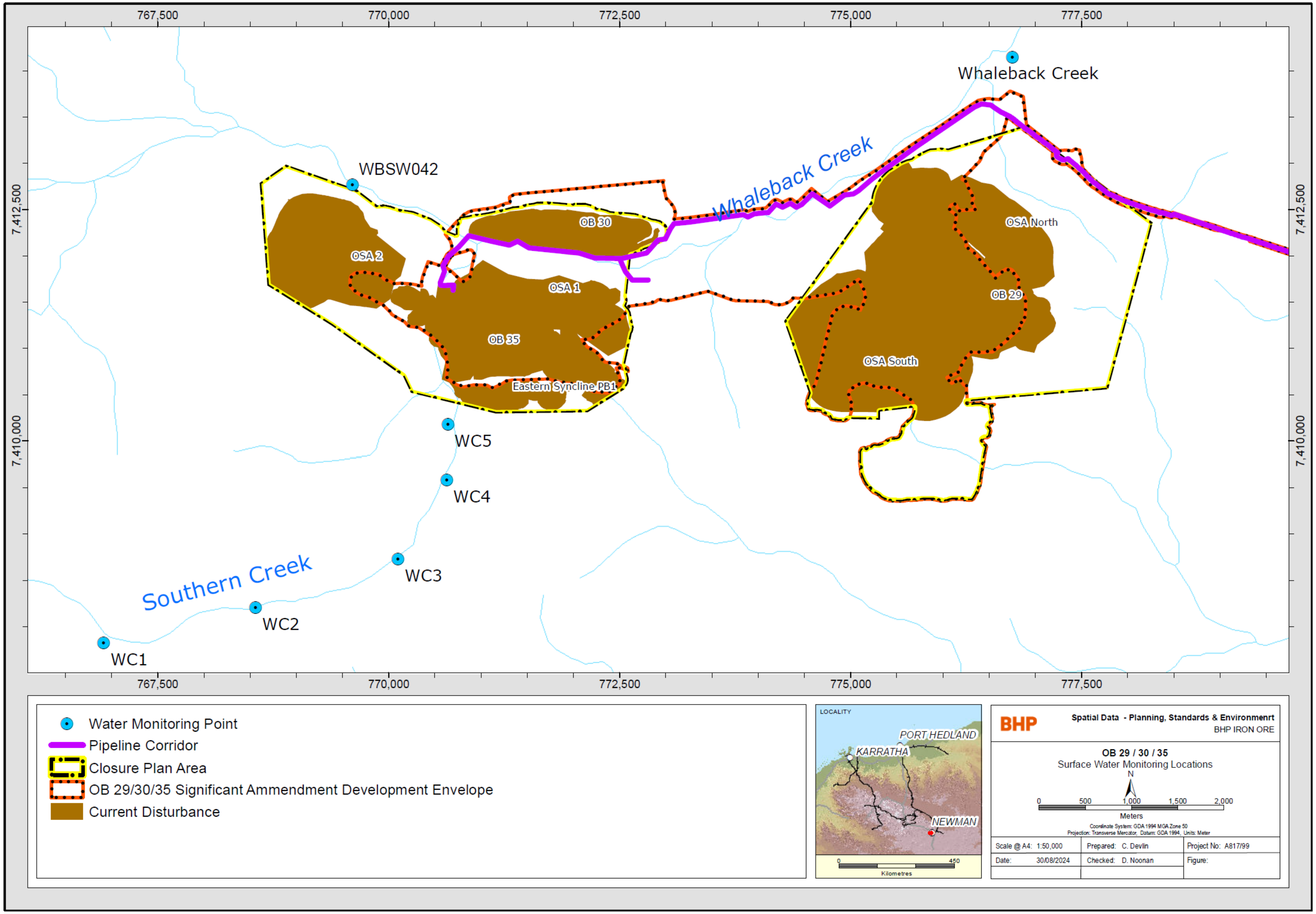
Sample Point		WBSW042 (Whaleback Creek Upstream)	WBSW043 (Whaleback Creek Downstream)	WBSW105 (Whaleback Creek Downstream)	Internal Guideline
Sample Date		**1998 - 2023**	**1998 - 2023**	**1998 - 2023**	
Parameter (mg/L unless specified otherwise)	pH (units)	6.5 - 8.2	5.9 – 8 (Median 6.9)	5.7 - 8.6 (Median 6.8)	6 - 8
	TDS (grav @ 180 °C)	32 - 210	55 - 400	12 - 600	<500
	TSS	<5 - 4,600 (Median 194)	<5 – 5,200 (Median 115)	6.6 - 1,700 (Median 150)	<440
	Ag (silver)	<0.001	<0.001	<0.001	<0.001
	Al (aluminium)	<0.1 - 1.6 (Median 0.2)	<0.005 - 2.8 (Median 0.2)	<0.005 - 3.4 (Median 0.2)	<0.42
	As (arsenic)	<0.001 - 0.003	<0.001 - 0.002	<0.001 - 0.005	<0.013
	B (boron)	0.007 - 0.062	0.036 - 0.13	0.034 - 0.098	<0.37
	Ca (calcium)	0.8 – 88 (Median 12)	3 - 52 (Median 14)	<1 - 980 (Median 8.35)	<1000
	Cd (cadmium)	<0.0001 - 0.003[A]	<0.0001 - 0.002[B]	<0.0001 - 0.005[C]	<0.0002
	Cl (chloride)	<1 - 310 (Median 10)	<1 - 75 (Median 15)	<1 - 120 (Median 6)	<67
	CO_3 (carbonate)	<1 – 2[D]	<1	<1	<1.5
Parameter (mg/L unless specified otherwise)	COD	<5 - 2,100[E]	15 - 220	17 - 33	<442
	Cr (chromium)	<0.001 - 0.04	<0.001 - 0.01 (Median 0.002)	<0.001 - 0.04	<0.04
	Cu (copper)	<0.001 - 0.03	<0.001 - 0.04	<0.001 - 0.01	0.0014
	Fe (iron)	<0.1 - 5.1 (Median 0.2)	<0.005 - 5.1 (Median 0.3)	<0.05 - 3.4 (Median 0.38)	0.58
	HCO_3 (bicarbonate)	10 - 470 (Median 60)	15 - 160 (Median 35)	9 -180 (Median 30)	<87
	Hg (mercury)	<0.0005	<0.0005	<0.0005	0.0006
	K (potassium)	<0.5 - 7.9 (Median 3.1)	2 - 11 (Median 4)	1.5 - 820 (Median 4.4)	2000
	Mg (magnesium)	<0.5 - 79 (Median 4.8)	1.7 - 36 (Median 7.3)	<1 - 65 (Median 3.9)	<9

[17] Median values have only been provided where there were 25 or more results exceeding detection limits

Sample Point		WBSW042 (Whaleback Creek Upstream)	WBSW043 (Whaleback Creek Downstream)	WBSW105 (Whaleback Creek Downstream)	Internal Guideline
Sample Date		1998 - 2023	1998 - 2023	1998 - 2023	
	Mn (manganese)	<0.001 - 2.2	<0.001 - 0.77 (Median 0.01)	<0.001 - 1.02 (Median 0.01)	<1.9
	Mo (molybdenum)	<0.001 - 0.002	<0.001 - 0.002	<0.001 - 0.002	<0.01
	Na (sodium)	<1 - 230 (Median 8.8)	1.2 - 51 (Median 8.4)	<1 - 150 (Median 5)	<230
	Ni (nickel)	<0.001 - 0.02	<0.001 - 0.04	<0.001 - 0.07	<0.011
	NO_3 (nitrate as nitrogen)	0.95 - 30	0.07 - 2.7	0.06 – 8.5	<0.7
	Pb (lead)	<0.001 - 0.005[F]	<0.001 - 0.007[G]	<0.001 - 0.007[H]	<0.0034
	Se (selenium)	<0.01	<0.01	<0.001 – 0.01	<0.011
	SO_4 (sulphate)	<1 - 170 (Median 10)	<10 - 230 (Median 30)	<1 - 190 (Median 15)	<50
	Total N (nitrogen)	<0.1 – 7 (Median 0.8)	<0.1 - 7	<0.1 - 12	<50
	Total P (phosphorous)	<0.05 - 0.79	<0.05 - 1.4	<0.05 - 1.7	<12
	Zn (zinc)	<0.005 - 0.14 (Median 0.02)	<0.005 - 0.04 (Median 0.02)	<0.005 - 0.15 (Median 0.03)	<0.026

Source: BHP internal database and Annual Environmental Report (BHP, 2023l)

Notes: Median values have only been provided where there were 25 or more results exceeding detection limits
[A] 2 samples of 55 were above detection limits, [B] 2 samples of 57 were above detection limits, [C] 3 samples of 56 were above detection limits, [D] 1 sample of 50 exceeded detection limits, [E] 2 of 9 samples exceeded the internal guideline, [F] 1 sample of 61 was above detection limits, [G] 1 sample of 56 exceeded detection limits, [H] 2 samples of 56 exceeded detection limits



Refer to Appendix N for a pdf version

Map 5-9 **Surface water monitoring locations**

5.9.2 Groundwater

The groundwater regime in the Newman area has been altered by groundwater abstraction for water supply and to dewater orebodies to access below water table ore. Groundwater abstraction for mine dewatering activities at Orebody 29/30/35 was approved in 2014 and started at OB29 in 2015 and OB35 in 2016. As at May 2024, dewatering of OB30 and the Western Ridge orebodies has not started. Given the proximity of other existing (Whaleback and Western Ridge) operations to the OB29/30/35 mine, and the inter-relationship of the aquifer systems in the area, this section references these operations even though they are covered by separate closure plans (BHP, 2023n; 2023m).

5.9.2.1 Aquifers

As described in Section 5.3.1, the geology of the OB29/30/35 area is structurally complex, comprising a series of anticlines and synclines, cross-cut and offset by a regional fault system. The two main aquifer types are the:

- Regional aquifer; and
- Local orebody aquifers.

Regional Aquifer

The regional aquifer generally comprises weathered dolomite of the Paraburdoo Member of the Wittenoom Formation, which occurs in sub-crop along the Whaleback and Southern Creek valleys. The overlying Tertiary Detritals are generally above the water table, but where they are saturated, they also form part of the regional aquifer system (BHP, 2024b).

To the north-west of Newman, the Whaleback Creek valley narrows significantly. It is possible that the dolomite aquifer (i.e., Paraburdoo Member) may not be present in sub-crop in this area. As such, groundwater flow in this area may be through the alluvium (if saturated) or more likely through secondary permeability (developed as a result of mineralisation or faulting) within the Marra Mamba / West Angela Member (BHP, 2022).

The regional dolomite aquifer over the eastern part of the OB29/30/35 and Western Ridge area is likely to have both high storage (most likely karstic) and high hydraulic conductivity whereas the storage in the western area may be lower (BHP, 2022).

Orebody Aquifers

The orebody aquifers comprise the mineralised Brockman Iron Formation that make up the Mt Whaleback and northern Western Ridge orebodies, and the mineralised Marra Mamba that make up the OB29/30/35 and Eastern Syncline orebodies. The orebody aquifers are usually well delineated by the extent of the high-grade ore, with a halo of lower grade ore (with moderate permeability) around it (BHP, 2024b).

All the orebody aquifers are potentially high permeability and high storage (BHP, 2022).

5.9.2.2 Groundwater levels

Pre-mining groundwater levels have been estimated to be around (BHP, 2024b):

- 520 to 524 mRL at OB29
- 519 to 523 mRL at OB30
- 520 to 523 mRL at OB35

Pre-mining groundwater levels in the surrounding areas have been estimated to be around (BHP, 2024b):

- 519 to 522 mRL at Western Ridge
- Greater than 580 mRL in the unmineralise Brockman to the north
- Less than 480 mRL to the northwest of OB30. This is considered likely to be influenced by dewatering of the Whaleback orebody and not part of the regional or local OB29/30/35 aquifer system.

Historic data showed that between 2006 and 2014, levels across the OB29/30/35 Closure Plan Area varied from a minimum 519 mRL to a maximum of almost 526 mRL as a result of natural fluctuations (local rainfall recharge and long term trends) as well as water supply pumping (BHP, 2022). Dewatering commenced at OB29 in 2015 and OB35 in 2016. By 2020, water levels in the OB29 area had fallen between 20 m (in the northern part of the orebody) to 35 m (in the southern part of the orebody). During the same period, water levels at OB30 had fallen approximately 15 m to around 508 mRL and approximately 24 m to around 499 mRL at OB35 (BHP, 2020c; 2022).

5.9.2.3 Conceptual model for OB29/30/35

The conceptual groundwater flow model is provided in Figure 5-23. The OB29/30/35 area is characterised by hydraulically connected regional (weathered dolomite and some Tertiary Detritals) and Marra Mamba orebody aquifers. The connection of the regional aquifer to the Marra Mamba orebodies is either through mineralisation of the West Angela Shale, or the absence of it (BHP, 2022).

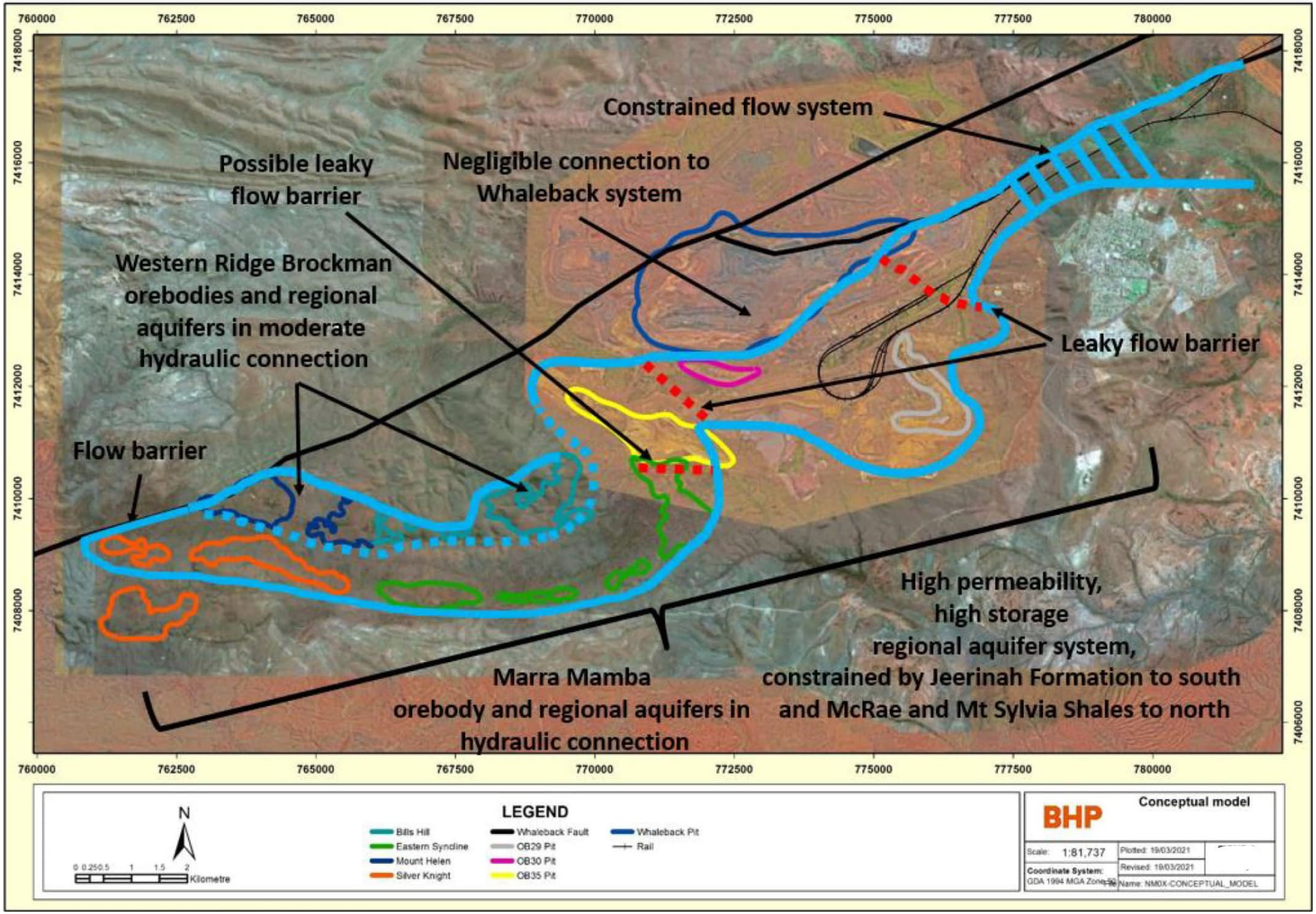
The aquifers are bounded by the low permeability Mt Sylvia Formation and Mt McRae Shale to the north (isolating this system from the Whaleback orebody aquifer) and the low permeability Jeerinah Formation to the south (BHP, 2022).

Analysis of long-term groundwater levels between 1968 and 2015 (BHP, 2024b) concluded that there is a clearly delineated zone of high conductivity and strong hydraulic connectivity through the regional and local aquifers in the immediate OB29/30/35 area which is distinct from a lower quality aquifer system to the east. The analysis also provided evidence for the existence of a leaky flow barrier just east of OB29 and the barrier parallel to the flow direction formed by the Whaleback Fault in the east and the lower permeability, unmineralise material both to the south and north of OB29/30/35.

Further analysis of groundwater drawdown data collected since 2015 has provided the following key findings (BHP, 2024b):

- The OB29 and OB30 orebody aquifers are well connected to the regional aquifer.
- The OB30 aquifer is very well hydraulically connected to the OB29 regional and / or orebody aquifers and has some degree of separation from the OB35 aquifer.
- The regional dolomite is likely to present both high transmissivity and high storage.
- There is no obvious disconnection to the regional aquifer between OB29 and OB30. There is evidence of leaky flow barriers at either end of the system.
- The OB35 orebody and adjacent regional aquifers are well connected through the northern part of OB35 aquifer.
- The hydraulic connection between the OB35 and Eastern Syncline orebody aquifers is limited.

The findings of the groundwater level assessment support earlier observations associated with the aquifers as described below.



Source: BHP (2024b) Sketched thick blue lines are interpreted groundwater flow barriers from the geological mapping.

Figure 5-23 OB29/30/35 conceptual groundwater flow model

Evidence of aquifer leaky flow barrier

The regional aquifer system appears to be continuous between the Whaleback Fault in the west and a flow barrier just to the east of OB29 (BHP, 2022). Analysis of the long-term and dewatering datasets from across the area was undertaken to assess the connection between the Whaleback aquifer system and the OB29/30/35 aquifer system (BHP, 2024b). The review concluded that there is either no connection between the Whaleback and OB29/30/35 aquifer systems, or, if there is, it is very limited, with a low maximum potential flow rate. This is illustrated in Figure 5-24 which shows the behaviour of bores HEOP0360M, HWHB0644M and HEOP0384M located in the regional aquifer, east of OB29. The observations at these three bores diverge from the orebody and other regional aquifer observations in two ways (BHP, 2024b):

- the initial levels (2014) range from 521 to 522 metres above Australian Height Datum (m AHD). These were 4 or 5 m lower than the observations at other OB29 area bores, such as HWHB1514M.
- the response to the OB29 hydrodynamic trials and dewatering was subdued compared to the orebody and other regional aquifer bores.

The exact nature of the leaky flow barrier to the east of OB29 is unknown (it may be rock mass or structural). Between this barrier and the main Ethel Gorge aquifer system (about 9 km along the flow path to the east) there is evidence of a reduced regional aquifer transmissivity (which could be due to the reduction in aquifer width, reduced dolomite permeability or structural features). The groundwater levels within the OB29/30/35 and Ethel Gorge aquifer systems are homogenous throughout their individual extents but differ by about 15 m between the two systems (Figure 5-25). Between these aquifer systems, there is a gradual gradient which suggests a change in rock mass properties or geometry (i.e., reduction in permeability, saturated thickness, aquifer width or transmissivity) rather than structural controls (although this is also possible) (BHP, 2022).

There is also some evidence for lower transmissivity within the regional system to the north of OB35 (i.e., between OB35 and OB30), but this appears to be less significant than the barriers at the western and eastern ends of the system. Both the OB30 orebody and regional aquifer, and the OB29 regional aquifer water levels showed a very similar response to the OB35 orebody aquifer water levels during the OB29 dewatering trial and initial stages of dewatering of both orebodies. However, from early 2018, the observations started to diverge (with OB35 levels decreasing more than the others) suggesting an emerging hydraulic disconnect between OB35 and the regional aquifer to the west. The mechanism behind this is unknown and the extent to which it reduces flow is unknown. It may, however, provide increasing disconnection between the dewatering in the east (OB29 and OB30) and the west (OB35 and Western Ridge) as water levels fall further (BHP, 2022).

At Western Ridge, the Marra Mamba orebodies in the south are hydraulically connected to the regional system (the observed drawdown response so far, is indistinguishable between the two aquifer types). There may be a degree of hydraulic disconnect between the adjacent OB35 and Eastern Syncline orebodies (i.e., drawdown does not pass unimpeded from one to the other, but first travels through the regional aquifer), since the Eastern Syncline orebody bores have recorded less drawdown than seen in OB35 during the dewatering trials (refer to Section 5.9.2.2). The Brockman orebodies in the north appear to have some connection to the regional aquifers but less than the Marra Mamba orebodies in the south. This is due to the presence of significant thickness of Mt McRae Shale and Mt Sylvia Formations in this area (BHP, 2022).

There is a significant head gradient between the Whaleback and OB29/30/35 aquifer systems, which suggests that there is either no connection between the Whaleback and OB29/30/35 aquifer systems, or if there is, it is very limited with a low maximum potential flow rate (BHP, 2022).

The OB29 orebody aquifer has shown signs of compartmentalisation and heterogeneity (given the differences in groundwater drawdown in the northern and southern parts of the orebody to date), but this may be due to the maturity of dewatering at this location and the large amount of monitoring.

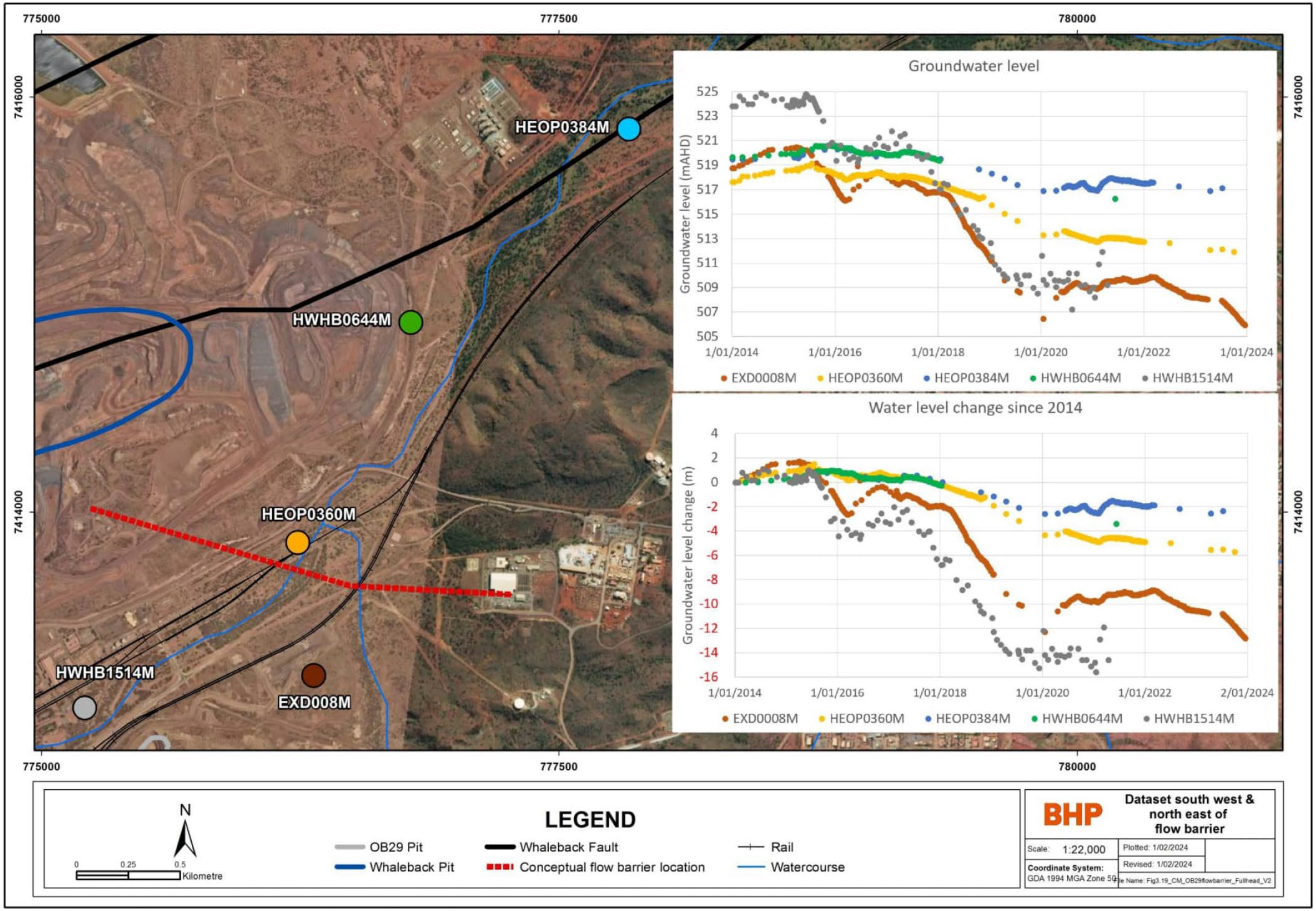
5.9.2.4 Groundwater throughflow

Prior to dewatering at OB29 and OB35, groundwater flow was from west to east. The regional Tertiary Detrital / dolomite aquifers are assumed to be continuous from OB29 to the Ethel Gorge system (BHP, 2024b). The aquifers pass north of Newman and then turn south east, passing to the south of OB25 (Eastern Ridge) and merging with the western site of the Ethel Gorge system, east of Ophthalmia Dam (see Figure 5-25).

Long term monitoring data show that the area has had a complex past, with anthropogenic and natural stresses acting on the groundwater system resulting in head changes in some parts of the regional aquifers being more than 20 m, over approximately 50 years of monitoring (BHP, 2024b). However, it does suggest flow within the regional aquifer is inhibited between OB29/30/35 aquifer system in the west and the Ethel Gorge aquifer system in the east. The western boundary of this constrained zone is formed by the flow barrier that exists just to the east of OB29 and the eastern boundary occurs southwest of the Eastern Ridge OB25 pit.

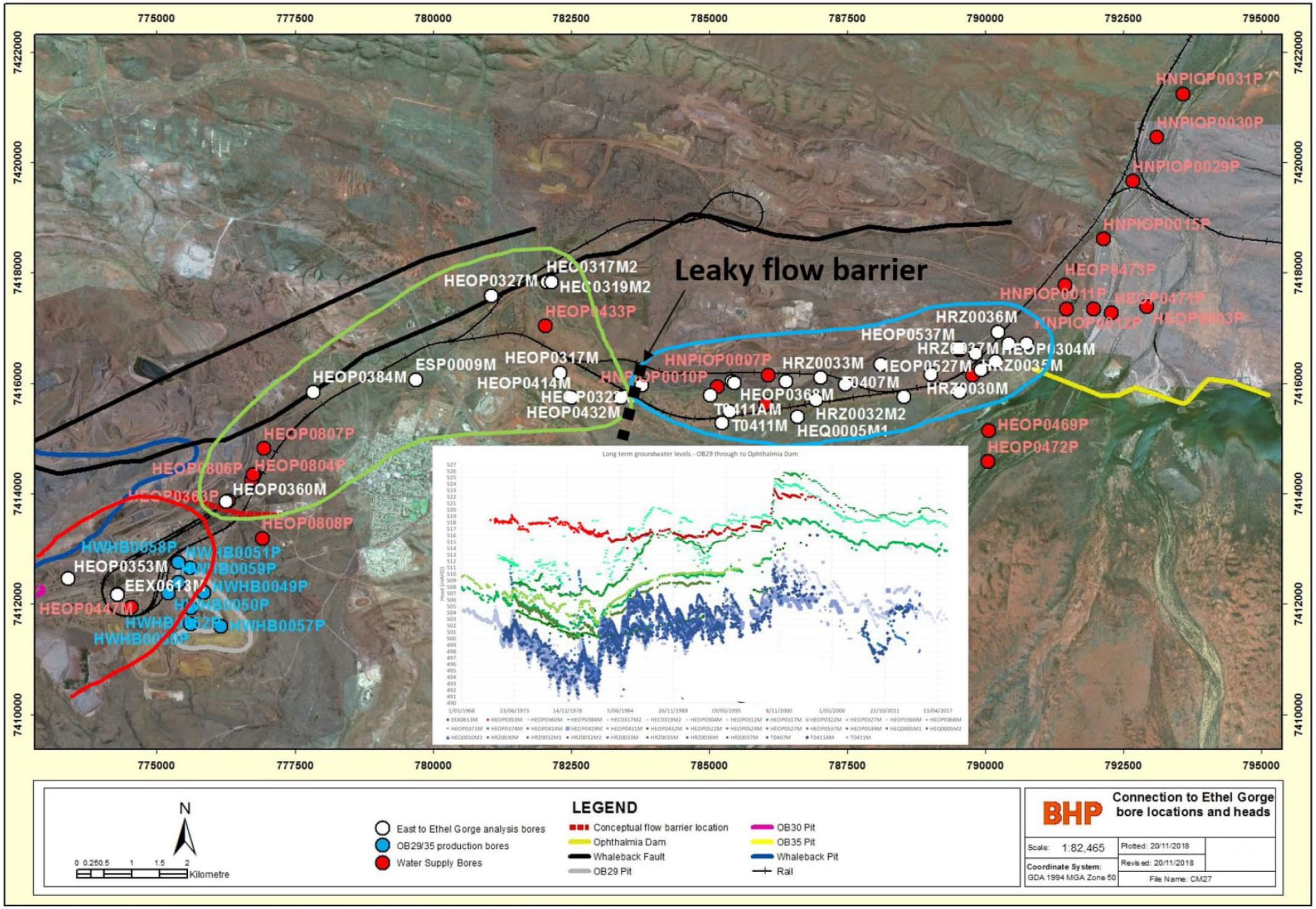
Estimates of throughflow from the area just east of OB29 to the Ethel Gorge aquifer, whilst uncertain, suggest that flow from the west to east, at varying depths is in the range of (BHP, 2024b):

- 280 m^3/d at 20 m depth
- 700 m^3/d at 50 m depth
- 1,400 m^3/d at 100 m depth.



Source: BHP (2024b)

Figure 5-24 Observed groundwater levels either side of the leaky flow barrier east of OB29



Source: BHP (2022; 2024b)

Figure 5-25 Groundwater heads showing limited connection to Ethel Gorge aquifer

5.9.2.5 Recharge & discharge

Recharge

The Pilbara is characterised by high local evaporation rates and a generally low soil infiltration capacity. This results in recharge occurring exclusively during major rainfall events (15-25 mm/day) (McFarlane, 2015).

Recharge is expected to occur primarily via the base of drainage lines including Whaleback Creek and associated tributaries. Regional recharge is considered likely to be more prevalent in areas where bedrock is exposed. Throughflow from upstream aquifers to the west is considered to be minimal due to the isolating effects of the Whaleback fault (see Section 5.9.2.3). Similarly, throughflow from the north and south of the study area is unlikely due to the presence of low permeability shales (BHP, 2024b).

Aquifer recharge following rainfall is a regular occurrence and a gradual recession of groundwater levels is typically observed in the drier months following the wet season (BHP, 2023j). Extremely high recharge rates are possible as evidenced by the response to the 1999/2000 wet season. This has happened once within the almost 50 years of observation history, but, given the apparent high hydraulic conductivity and storage of the dolomite and orebody aquifers around OB29, this event resulted in a very significant amount of recharge to the system (BHP, 2022).

For the purposes of predicting long-term groundwater behaviour for closure planning, recharge inputs were calculated based on CSIRO projections from *Hydroclimate of the Pilbara: past, present and future* (CSIRO, 2015).

Discharge

Depth to groundwater in the regional aquifers in this area ranges from a minimum of about 30 m around OB29 to a maximum of about 90 m towards the western end of Western Ridge. This depth to water suggests that groundwater / surface water interaction and evapotranspiration do not occur in this area (BHP, 2022).

Groundwater abstraction for both water supply and dewatering purposes accounts for significant discharge from the groundwater at OB29/30/35, both historically and at present (BHP, 2024b).

Once dewatering has ceased, discharge will still occur through evaporation of water from pit lakes remaining in open voids.

5.9.2.6 Pit lakes

A post-mining closure groundwater model was developed (BHP, 2024b) and modelled for a period of 600 years commencing 2056. The post-mining model builds on the predictive dewatering operation model that extends from 2022 to 2056. The predictive closure model was used to predict final recovery water levels and to predict the speed of recovery. The base case of the model assumed that OB29 and OB30 pit voids remain as voids and that some backfill occurs in OB35. Although other scenarios were also tested (i.e., backfill of all voids), the base case is presented here because it aligns closest with the current mine plan and is considered sufficient to establish an understanding of expected groundwater behaviour following closure. Further modelling will be undertaken as the mine plan evolves.

The results of the model indicate pit lakes will form in the pit voids and will reach equilibrium at between:

- 476 and 480 m AHD in OB29
- 480 and 483 m AHD in OB30.

Groundwater level recovery for OB35 was not modelled as part of the base case however a small pit lake is expected to form in the residual void.

The system is predicted to reach equilibrium approximately 144 years after dewatering ceases and will remain lower than the 522 m AHD pre-development groundwater level. As the equilibrium pit lake water level will be lower than the pre-development groundwater level, the pit voids are predicted to remain as groundwater sinks. The pit lake modelling is preliminary in nature and therefore the results are indicative only and should be viewed as conceptual (BHP, 2024b). The modelling supports findings of the alternate mine void closure study that was conducted in 2022 (BHP, 2022) and is discussed in Section 5.14.4.

5.9.2.7 Water quality

Groundwater in the area is dominated by bicarbonate with no dominant cations. There are slight but distinct groupings for water in the Whaleback and OB29/30/35 regions with the slightly more evolved waters associated with the Brockman Formation showing generally higher TDS (~800) and tendency toward magnesium where the Marra Mamba waters show a tendency toward calcium. Both water types are generally associated with recharge and the lower TDS indicates that the Marra Mamba and dolomite aquifers have a more active recharge regime. The distinct boundaries between the water types also suggests little to no mixing which supports the idea that these two compartments are poorly connected (BHP, 2022).

The groundwater at OB29/30/35 is generally fresh to marginal with TDS between 520 and 350 mg/L and pH within the neutral range (BHP, 2023j). EC levels are below the upper internal trigger limit (and often below the lower limit). Water quality from production bores is generally within internal trigger values. Isolated minor exceedances have been observed for (Table 5-34) Zinc at OB29 and OB30.

Table 5-34 Summary of OB29/30/35 production bore water quality

Analyte	OB29 Production Bores[(1)]	OB30 Production Bores	OB35 Production Bores	Internal Reference Values
Aluminium (mg/L)	<0.005 – 0.001	<0.005 – 0.022	<0.005	0.3
Arsenic (mg/L)	<0.001	<0.001	<0.001	0.001
Barium (mg/L)	0.004 – 0.028	0.007 – 0.026	<0.001 – 0.004	
Bicarbonate Alkalinity as HCO_3 (mg/L)	370 – 480	320 – 490	450 - 500	
Boron (mg/L)	0.16 – 0.29	0.14 – 0.31	0.2 – 0.28	0.37
Cadmium (mg/L)	<0.0001	<0.001	<0.001	0.002
Calcium (mg/L)	47 – 71	48 – 63	57 – 69	
Chloride (mg/L)	78 – 170	76 – 110	81 – 380	
Chromium (mg/L)	<0.001	<0.001	<0.001	0.001
Copper (mg/L)	<0.001 – 0.001	<0.001	<0.001	0.02
EC at 25°C (µS/cm)	910 – 1300	760 – 1000	980 – 1000	1100 – 1400
Fluoride (mg/L)	0.4 – 0.5	0.3 – 0.5	0.4 – 0.5	
Iron Sol. (mg/L)	<0.005 – 0.18	<0.005 – 0.52	<0.005 – 0.02	0.77
Lead (mg/L)	<0.001	<0.001	<0.001	0.0034
Magnesium (mg/L)	46 – 65	42 – 62	54 – 57	
Manganese (mg/L)	<0.001 – 0.18	<0.001 – 0.3	<0.001 – 0.20	1.9
Mercury (mg/L)	<0.00005	<0.00005	<0.00005	0.0006
Molybdenum (mg/L)	<0.001	<0.001	<0.001	0.002
Nickel (mg/L)	<0.001 – 0.005	<0.001	<0.001	0.011
Nitrate as NO_3 (mg/L)	<0.05 – 1.4	<0.05 – 2.1	0.05 – 1.1	
pH (pH)	7.4 – 8.1	7.6 – 8.2	7.7 - 8.2	6.0 – 9.0
Potassium (mg/L)	3.6 – 5.5	3.4 – 6.4	5.5 – 5.9	
Reactive Silica as SiO_2 (mg/L)	14 – 18	10 – 21	21– 22	
Selenium (mg/L)	<0.001 – 0.001	<0.002	<0.001	0.011
Silica (mg/L)	14 – 17	10 – 20	19 – 22	
Sodium (mg/L)	56 – 120	44 - 82	54 – 64	
Sulphate as $SO_{4\ 2-}$ (mg/L)	61 – 88	37 – 74	51 – 230	
Suspended Solids (mg/L)	<5 – 67	<5 – 340	<5 – 11	
TDS at 180°C (mg/L)	520 – 750	410 – 580	520 – 570	
Total Hardness as $CaCO_3$ (mg/L)	310 – 440	290 – 410	380 – 410	
Zinc (mg/L)	<0.005 - 2	<0.0005 – 0.19	<0.005 – 0.007	0.14

Source: OB29 and OB30 from BHP (2020b). OB35 from BHP (2023j)

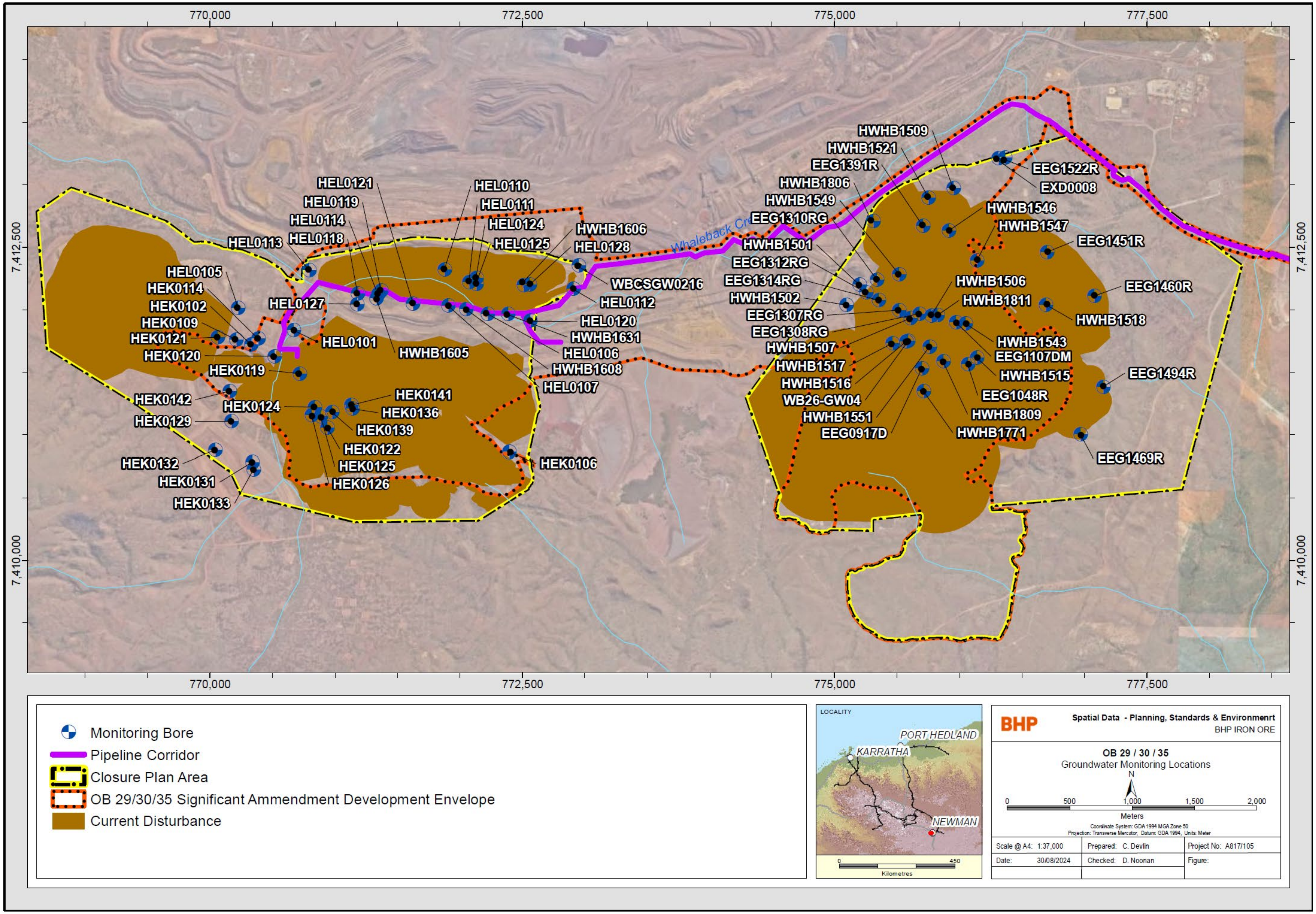
Notes:

(1) Abstraction ceased in December 2020 and only recommenced in 2023, and so no additional chemistry data had been collected at time of writing.

In addition to the production bores at OB29/30/35, five environmental monitoring bores were installed in FY20 at the locations shown on Map 5-10 to provide a view of the baseline water quality conditions in these locations.

At the time of review (HGG, 2023), only one sampling round had been undertaken and the results are shown in Table 5-35. In general, water quality is within internal trigger values with the exception of:

- An exceedance of arsenic levels at Bore HWHB1808M;
- Exceedance of molybdenum at three of the bores (HWHB1806M, HWHB1807M and HWHB1808M); and
- Exceedances of selenium at two bores (HWHB1804M and HWHB1807M).



Map 5-10 **Location of groundwater monitoring bores**

Table 5-35 OB29/30/35 environmental groundwater monitoring bores

Analyte	Environmental monitoring bores					Internal Trigger Values
	HWHB1804M	HWHB1805M	HWHB1806M	HWHB1807M	HWHB1808M	
Aluminium (mg/L)	0.005	0.008	<0.005	0.008	<0.005	0.3
Arsenic (mg/L)	<0.001	<0.001	<0.001	0.001	0.007	0.001
Barium (mg/L)	0.009	0.029	0.055	0.016	0.059	
Bicarbonate Alkalinity as HCO_3 (mg/L)	410	380	500	420	430	
Boron (mg/L)	0.18	0.21	0.22	0.23	0.22	0.37
Cadmium (mg/L)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.002
Calcium (mg/L)	50	67	55	60	54	
Chloride (mg/L)	75	210	130	190	110	
Chromium (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	0.001
Copper (mg/L)	<0.001	<0.001	<0.001	<0.001	<0.001	0.02
EC at 25°C (µS/cm)	880	1400	1300	1300	1100	1100 – 1400
Fluoride (mg/L)	0.5	0.3	0.7	0.5	0.5	
Iron Sol. (mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	0.77
Lead (mg/L)	0.015	<0.001	<0.001	<0.001	<0.001	0.0034
Magnesium (mg/L)	52	74	68	72	60	
Manganese (mg/L)	0.11	0.002	0.18	0.16	0.11	1.9
Mercury (mg/L)	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	0.0006
Molybdenum (mg/L)	0.001	<0.001	0.019	0.005	0.003	0.002
Nickel (mg/L)	<0.001	<0.001	<0.001	0.01	0.002	0.011
Nitrate as NO_3 (mg/L)	0.2	33	<0.05	0.65	0.1	
pH (pH)	8.5	8.2	8.4	8.2	8.4	6.0 – 9.0
Potassium (mg/L)	3.5	3.4	6	4.2	5.2	
Reactive Silica as SiO_2 (mg/L)	25	37	21	21	21	
Selenium (mg/L)	0.022	0.001	<0.001	0.029	<0.001	0.011
Silica (mg/L)	22	35	20	19	20	
Sodium (mg/L)	62	87	97	81	68	
Sulphate as SO_4^{2-} (mg/L)	46	120	84	100	83	
Suspended Solids (SS) (mg/L)	<5	38	3300	67	8	
TDS at 180°C (mg/L)	500	830	770	780	590	
Total Hardness as $CaCO_3$ (mg/L)	340	470	420	450	380	
Zinc (mg/L)	0.012	<0.005	<0.005	<0.005	<0.005	0.14

Source: HGG (2023)

5.9.3 Eco-hydrological assets

Ecohydrology provides an understanding of relationships between hydrological regimes and ecosystems.

An ecohydrological asset which has a degree of regional water dependency is referred to as an ecohydrological receptor. An ecohydrological receptor might be sensitive to changes in regional groundwater and / or surface water. In contrast, ecological assets are defined as areas which do not have a regional water dependency, such as ecological systems which rely on direct rainfall or local perched aquifer systems away from mining areas and will not be affected by the mining activities.

There are three key eco-hydrological assets local to OB29/30/35; Ethel Gorge, Newman Water Reserve, and riparian vegetation communities (Map 5-11).

5.9.3.1 Ethel Gorge TEC

As discussed in Section 5.8.6, the Ethel Gorge TEC is a groundwater stygofaunal community, with the core habitat located about 7 km from the OB29/30/35 MCP area (Map 5-11).

Ethel Gorge is a regional outflow zone for the upper reaches of the Fortescue River Catchment, with the Homestead, Whaleback, Shovelanna and Warrawanda Creeks all converging with the Fortescue River just upstream of Ethel Gorge. The natural recharge system for the calcrete and alluvium aquifers in this area is predominantly from river flows. Historical data show impacts on groundwater levels in the area in response to the water supply abstraction from the Ophthalmia Borefield, prior to the construction of Ophthalmia Dam. The hydraulic behaviour of the Ethel Gorge groundwater system has been dominated by Ophthalmia Dam since it was commissioned in 1981. The dam impounds and retards flood waters in the Fortescue River to allow larger volumes of infiltration over a prolonged period. The dam now provides a significant source of recharge to the calcrete and alluvium aquifers to mitigate the impact of groundwater abstraction. Consequently, the dam has maintained groundwater levels nearer natural conditions at Ethel Gorge. The conceptual eco-hydrological model for Ethel Gorge is shown in Figure 5-26.

5.9.3.2 Newman Water Reserve Priority 1 drinking water source area

The OB29/30/35 Closure Plan Area sits within the Newman Priority 1 drinking water source area which contains the Ophthalmia and Homestead Borefields (Map 5-11). These borefields are located approximately 15 km and 10 km to the east and north of OB29/30/35, respectively; and provide the potable water requirements of the town of Newman, the mining operations and associated infrastructure for the life of the project.

The borefields abstract groundwater from alluvial and chemical sediments that have in-filled palaeovalleys associated with the Fortescue River and its tributaries. Some of the bores within the Ophthalmia Borefield also draw water from the Wittenoom Formation (Department of Water, 2009).

The potable water supply bores are drawing from a superficial aquifer system, and therefore the water quality and quantity is heavily influenced by the quality and quantity of surface water. The surface water catchment of Whaleback Creek contributes a significant proportion of the recharge of the superficial aquifer from which the Ophthalmia Borefield draws water (Department of Water, 2009).

Bore V18 is located in the vicinity of the Mt Whaleback Operations and is used as a process water supply bore for the Yarnima power station. In the event that the potable supply from one of the other borefields is compromised, this bore may be used as a short-term emergency supply (BHP Billiton, 2013b).

5.9.3.3 Riparian vegetation communities

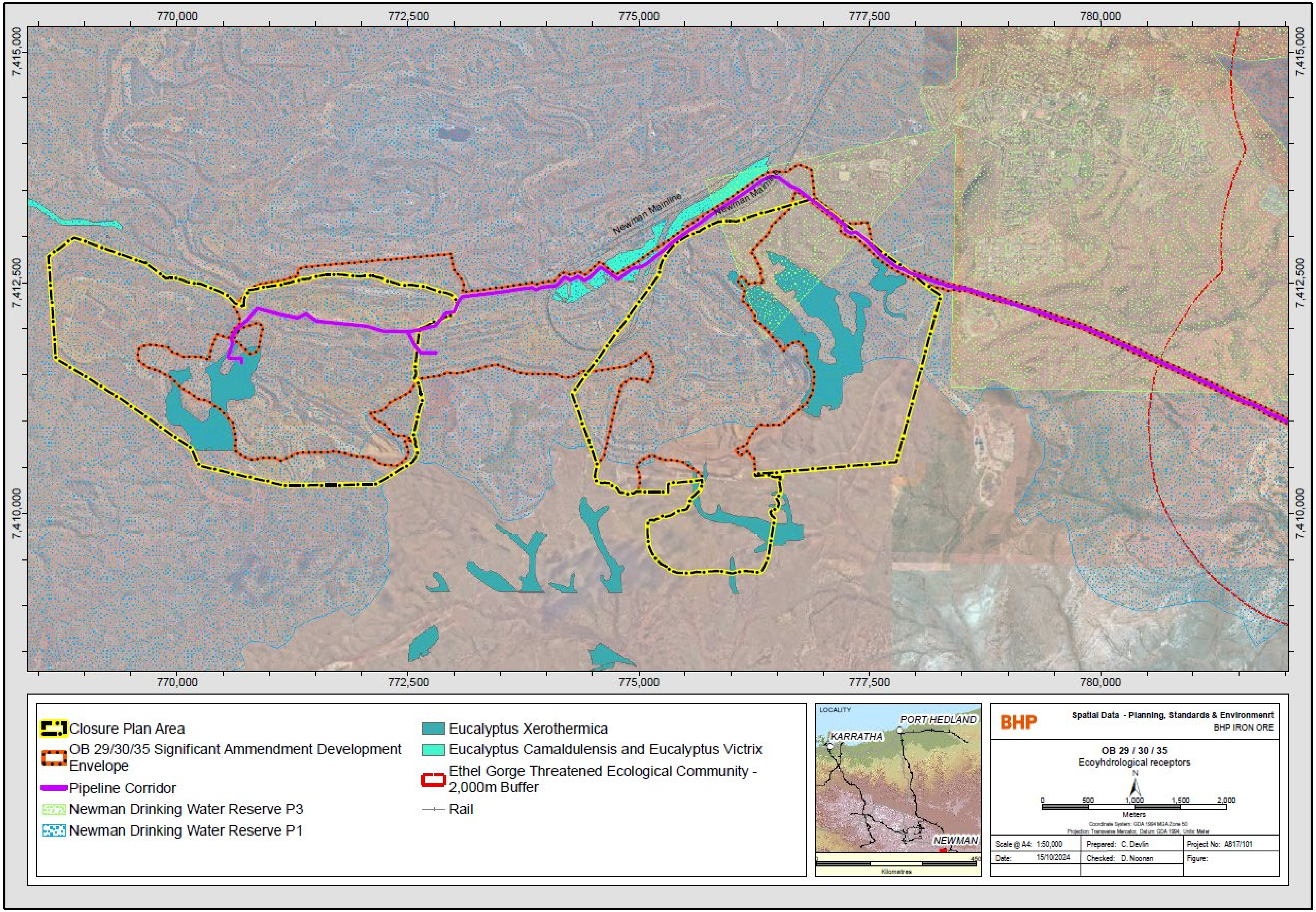
Whaleback Creek and Southern Creek support riparian vegetation communities along their main drainage channels and adjacent floodplains (Map 5-11). As discussed in Section 5.7.6, these communities include the facultative tree species *Eucalyptus camaldulensis* subsp. *refulgens* and / or vadophytic tree species *Eucalyptus victrix* and *Eucalyptus xerothermica*. Given that interpreted pre-abstraction groundwater levels below these areas are in excess of 30 m below ground level, it is unlikely that these communities rely on groundwater.

The entire upstream catchment area of Ethel Gorge hosts approximately 3,650 ha of Eucalypt woodland communities including *E. camaldulensis* and *E. victrix*.

5.9.4 Knowledge gaps & forward work program

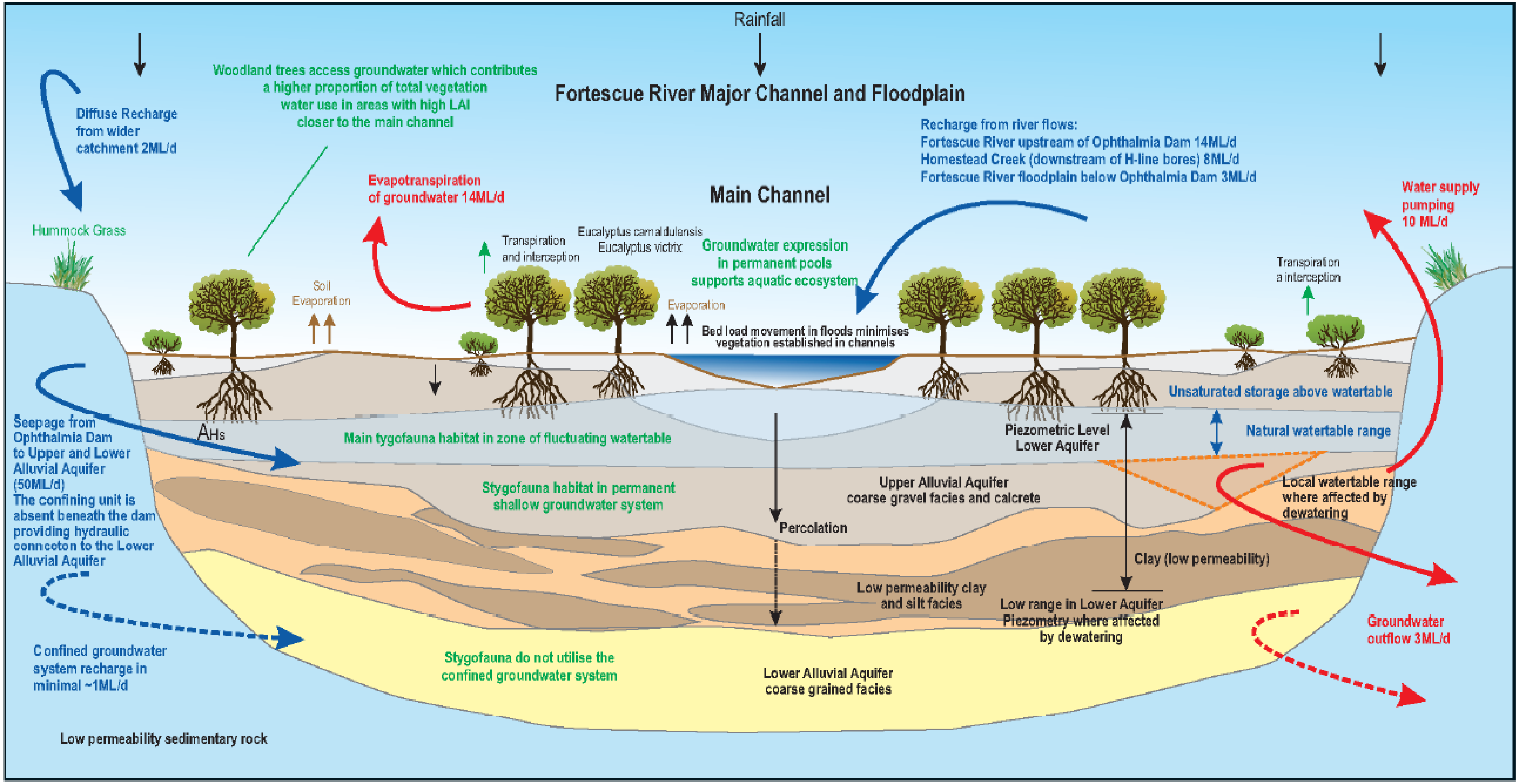
The conceptual and numerical groundwater models will continue to be refined over the life of the mine as new information becomes available following dewatering and additional monitoring, including monitoring along the western side of Whaleback Fault.

In 2023 Hydrogeochem Group (HGG) (2023) was engaged to undertake a review of the groundwater and surface water monitoring databases at Mt Whaleback and OB29/30/35 to assess their adequacy for overall identification and management of closure risks. Although some groundwater conditions and trends could be established, and operational compliance conditions could be met, HGG (2023) identified some limitations for closure planning associated with the locations, cadence and scope of the current monitoring program. In response, BHP is revising the monitoring program to ensure it is fit for purpose for managing closure risks. The forward works are included in Table 13-3.



Refer to Appendix N for a pdf version

Map 5-11 OB29/30/35 key ecohydrological assets



Source RPS Aquaterra (2014)

Figure 5-26 Ethel Gorge ecohydrology conceptualisation

5.10 Site contamination

Table 5-36 summarises the known and suspected contaminated sites that have been recorded within the OB29/30/35 closure planning area. The listed sites have been reported to DWER through the annual contaminated sites Mandatory Audit Report (MAR). In addition to those sites that are located directly within the OB29/30/35 closure planning area, a hydrogeological assessment has indicated that it may be possible for PFAS from the Whaleback Rail Loop Precinct (WB25) to impact on the OB29 dewatering bores. A Remediation Action Plan (RAP) has been developed for Rail Loop pond and has been approved by a contaminated sites auditor. A trigger action response plan (TARP) is in place to monitor the operational dewatering bores for PFAS.

The locations of the suspected contaminated sites associated with this MCP are shown in Map 5-12. Suspected contaminated sites in surrounding areas, but not associated OB29/30/35 are addressed in the Mt Whaleback MCP (BHP, 2023n).

Table 5-36 OB29/30/35 suspected contaminated sites

Ref. No	Name	Contaminant of Concern	Status
WB02	Whaleback asbestos waste disposal area	Asbestos waste	Designated area for the disposal of asbestos materials. Asbestos is buried and complies with current requirements. Preliminary Site Investigation (PSI) complete. Site management plan developed in 2020 and implemented, which included capping of the Asbestos dump. The sub-area was reclassified as 'Remediated for restricted use' on 15 September 2022
WB03	Bioremediation land farm	Hydrocarbons	Designated area for the remediation of contaminated soil that is generated as part of routine mining operations. The soil is remediated in accordance with the site operational environmental licence. PSI and Detailed Site Investigation (DSI) completed in 2021. As per the 2023 MAR, sub area deemed suitable for ongoing industrial commercial land use. Further data validation sampling of stockpiles and drainage network required for reclassification.
WB08	ANFO Storage facility	Ammonium Nitrate	PSI and DSI completed in 2020. The sub-area has been demonstrated as currently suitable for commercial/industrial land use (mine site operations). A 'Remediated restricted use' classification could be considered, however would need to be supported by an Interest Only Deposited Plan (IODP).
WB12	Ponderosa Workshop	Hydrocarbons	PSI and DSI completed 2020. As per the 2023 MAR, sub area deemed suitable for ongoing industrial commercial land use. A 'Remediated restricted use' classification could be considered, however would need to be supported by an IODP.
SP07	Graveyard Area	Hydrocarbons	The SP07 Graveyard is utilised for the handling of waste and decommissioned equipment. PSI and DSI completed in 2020. As per the 2023 MAR, sub area deemed suitable for ongoing industrial commercial land use. A 'Remediated restricted use' classification could be considered, however would need to be supported by an IODP.
WB33	Former Fire Fighting Training Ground	PFAS	The former fire training ground is located within the SP07 Graveyard area and is fenced off to the north along the access track. PSI and DSI completed 2021. As per the 2023 MAR, sub area deemed suitable for ongoing industrial commercial land use. A 'Remediated restricted use' classification could be considered, however would need to be supported by an IODP.
WB09	Diesel Distribution Pipeline	Hydrocarbons	A subsurface diesel pipeline was historically present underlying the WB09 site. PSI completed 2014, DSI completed 2021. As per the 2023 MAR, Suitability for commercial/industrial land use remains subject to residual data gaps being addressed for reclassification. Groundwater hydrocarbon plume delineation once dewatering ceases.
WB18 & WB20	Former diesel fired power station Former power station open drains	Hydrocarbons / PFAS	Various PSIs and DSIs completed. Voluntary Audit Report (VAR) completed 2021 Suitability for commercial/industrial land use remains subject to residual

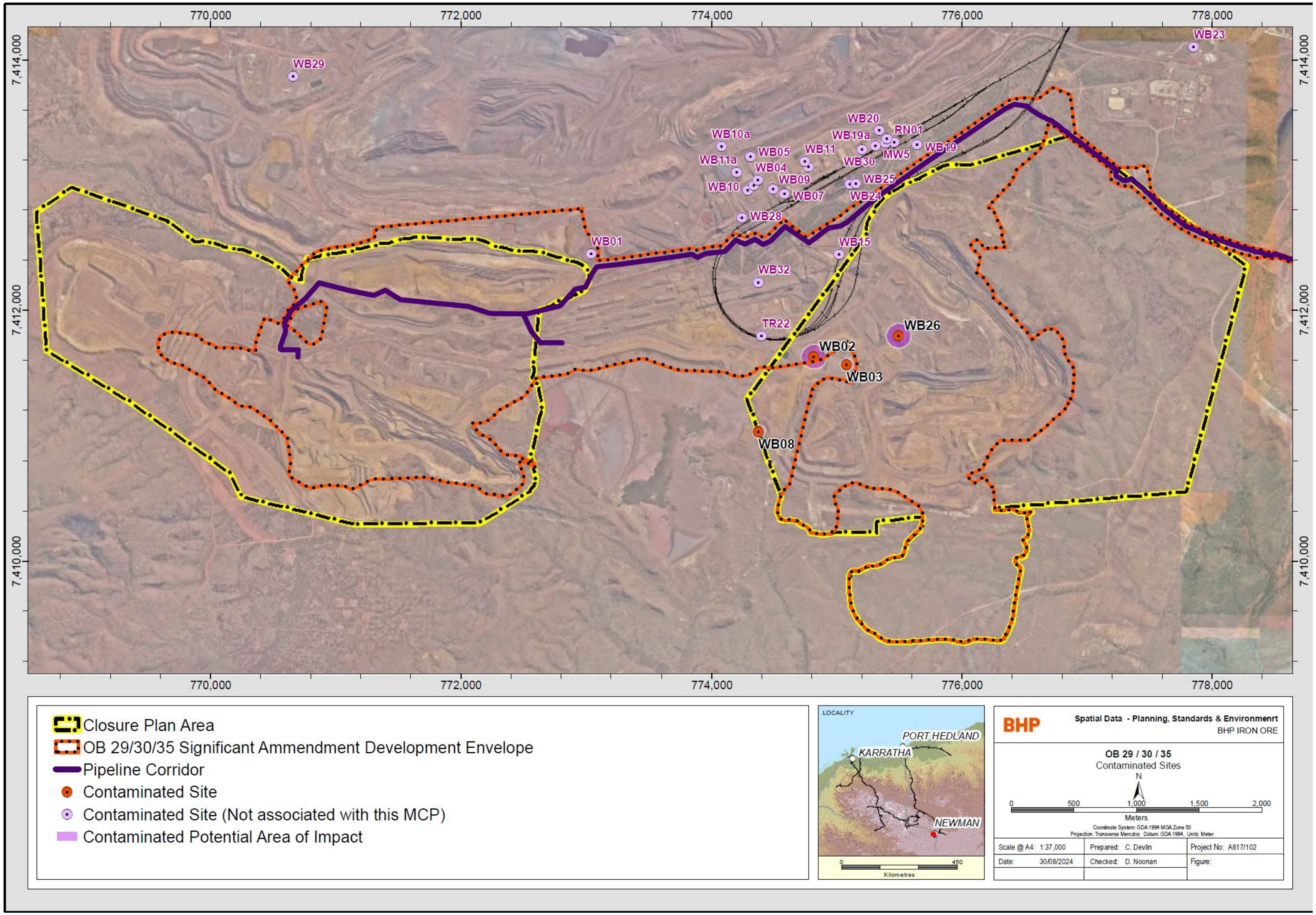
Ref. No	Name	Contaminant of Concern	Status
	Fuel farm and rail diesel tank unloading facility		data gaps being addressed (underlying PFAS in groundwater), the area is included in the Whaleback sitewide PFAS site management plan and ongoing groundwater monitoring.
WB21	Whaleback ARD Dam and Evaporation Ponds	AMD, Metals, Salts	PSI completed in 2023. DSI planned for 2024.
WB24 & WB25	Whaleback Rail Loop Ponds	Hydrocarbons / PFAS	Various PSIs and DSIs completed. Remediation (capping) of WB24 completed as per the RAP. WB24 site management plan completed 2019. WB25 site management plan in prep. VAR completed for both WB24 and WB25 in 2021. Area capped in 2022. As per the MAR 2023, area deemed suitability for commercial/industrial land use remains subject to residual data gaps being addressed (underlying PFAS in groundwater), the area is included in the Whaleback sitewide PFAS site management plan and ongoing groundwater monitoring.
WB26	Newman fire training ground - OB29	Hydrocarbons / PFAS	PSI and DSI has been completed. PFAS concentrations were found in shallow soils above the adopted PFAS National Environmental Management Plan (NEMP) 2020 ecological indirect exposure criteria. In addition, groundwater samples had concentrations of Perfluorooctane Sulfonic Acid (PFOS) above the NEMP freshwater 99% species protection level, but below the NEMP freshwater 95% species protection level, drinking water and recreational quality guideline values. A risk assessment has indicated that the site presents a low risk to receptors. A RAP has been developed and is scheduled for implementation in the period 2022 to 2023. As per the MAR 2023, area deemed suitability for commercial/industrial land use remains subject to residual data gaps being addressed (underlying PFAS in groundwater), the area is included in the Whaleback sitewide PFAS site management plan and ongoing groundwater monitoring. Site specific site management plan currently being written (2024).

Source: BHP (2024a)

As discussed in Section 9.1.8, in areas where the potential for soil and / or groundwater / surface water contamination has been identified, assessment and remediation is generally managed in accordance with the CS Act and DWER requirements (including sampling / analysis and remediation / management) during a site's operational life.

5.10.1 Knowledge gaps & forward work program

Identified areas of contamination will be investigated and managed in accordance with the requirements of the *Contaminated Sites Act 2003* (CS Act). This includes remediation of the PFAS in accordance with the approved RAP.



Refer to Appendix N for a pdf version

Map 5-12 OB29/30/35 contaminated sites

5.11 Visual amenity

A landscape and visual impact risk assessment was conducted as part of BHP's Strategic Environmental Assessment proposal (BHP Billiton, 2016). The review concluded that Newman and its surrounds are a priority area for management due to its population being located in close proximity to potential impact.

The review was focused on the additional impact of new development rather than the situation post-closure. In assessing impacts, it, therefore, noted that mining is already a prevalent land use surrounding Newman and that direct impacts to visual amenity would be relatively minor, as the Strategic Proposal would only likely result in an intensification of an existing impact type.

5.11.1 Knowledge gaps & forward work program

Following closure, the land use context of the OB29/30/35 mine will change and the visual characteristics of each closure landform will need to be considered in this new context. It is also acknowledged that the Strategic Environmental Assessment proposal study was based on publicly accessible viewpoints and did not necessarily consider landscape views relevant or significant to the Traditional Owners. Further work is required to consider the visual characteristics of landforms during the detailed design phase.

5.12 Cultural heritage & values

The OB29/30/35 Closure Plan Area is situated within the boundary of the Nyiyaparli Native Title Determination [WCD2018/008]. BHP and Nyiyaparli representatives have been jointly conducting heritage surveys and consultation within the OB29/30/35 Closure Plan Area. Work has included baseline surveys to identify and avoid heritage values, and detailed investigations and consultation to understand significance, define management strategies and support approval processes.

As a result of the surveys, heritage sites have been recorded within the OB29/30/35 operational area. The locations and extent of the recorded heritage sites are not presented in this MCP out of respect for the wishes of Traditional Owners.

Some of the Nyiyaparli people's cultural values are articulated in the "*Nyiyaparli People and Country Plan Fortescue Marsh 2023 - 2032*[18]" (KNAC, 2023). Key elements of this plan with potential relevance to mine closure planning, rehabilitation and post-closure management and maintenance are summarised below.

- The plan specifically identifies Fortescue Marsh, Caramulla Creek and Ethel Gorge as important sites of cultural significance. Fortescue Marsh is described as of immense cultural significance and there are several important ceremonial and mythological sites nearby. The flood plains continue to be used for hunting and camping.
- Continued access to sites of cultural significance is of importance. Nyiyaparli people engage in their culture by being on Country. This engagement is through storytelling, ceremony and law practice, hunting, fishing, and collecting bush fruits or vegetables. It is important to have and maintain access to Country to ensure cultural wellbeing, transfer of Traditional Knowledge, that law and ceremony continue to be carried out, and to spend time with family.
- Bush food harvest and preparation maintains an important place in Nyiyaparli people's diet and cultural practices. Important Bush meats (Mantu) include Jarnkurta (Emu), Marlu (Plains Kangaroo), Maruntu (Sand Goanna) and Marningarra (Bush Turkey).
- Bush plants are used by Nyiyaparli people for food (marta), to heal illnesses and ailments, to create artefacts and bough sheds during ceremony time, and as firewood. Ensuring that plants are healthy, and flourishing is central to the lives of animals, birds, fish, reptiles and Marlpa, who are themselves part of the seasonal, and long term inter-dependent relationships of life within Country. Some important Nyiyaparli plants are listed in Appendix K.
- Water holds great cultural significance to Nyiyaparli people. This includes permanent waterholes or springs known as Yindas, as well as seasonal creeks and soaks. Yindas and springs are places that need to be respected and the Nyiyaparli people follow specific cultural protocols at Yindas to show their respect. Yindas also provide important places for animals to rest and drink away from the largely arid landscape of Nyiyaparli Country.
- Appropriate fire management is important. Small patchy fires at the start of the dry season are used to clean up country for hunting, regenerating food and medicinal plants.
- The need to preserve the landscape, flora, fauna, and water for future generations to maintain stories and songlines, and bush tucker and medicine knowledge.

The values outlined in the Nyiyaparli People and Country Plan Fortescue Marsh 2023 - 2032 (KNAC, 2023), have been echoed in feedback to BHP on draft MCPs and social surroundings engagements. These include:

- Nyiyaparli representatives have expressed concern about the loss of fauna habitat across their country and are interested in the recreation of suitable habitats post-closure and during rehabilitation. BHP is in the process of planning a research program on fauna habitat.
- Nyiyaparli representatives have advised that native fauna is valued for hunting and can also have special meanings during different times of life for Nyiyaparli Traditional Owners. While all fauna are important, animals of particular cultural significance include:
  - Kangaroos;

[18] Note that the Nyiyaparli People and Country Plan was not developed in the context of mining operations. However, it has been used as a reference document by BHP to support improved understanding of the wishes and values of the Nyiyaparli people.

  - Wallabies;
  - Emus;
  - Turkeys;
  - Goannas (Gould's Sand goanna for hunting and Spinytail skink, Red nose skink, and blue tongue goanna for reintroduction to rehabilitated areas);
  - Birds (notably: willy wagtails, crows / ravens, black swans, kingfisher, curlew, eagles, eaglehawks, magpies);
  - Snakes;
  - Native bees;
  - Pebble Mouse;
  - Fish (notably Spangled Perch);
  - 'Porcupine' (echidna); and
  - Dingoes.
- The importance of the management of water including ephemeral creeks, temporary water features and impacts from abstraction / drawdown. However, management of water more broadly on a regional scale is also important to the Nyiyaparli people and other Traditional Owner groups, and it is each group's responsibility to manage water on their country as it travels to the next group.
- The importance of ongoing access to country. BHP will continue to enable access to the site for Nyiyaparli Traditional Owners as per the BHP and Nyiyaparli Comprehensive Agreement Land Access Protocol Entry.

KNAC has also provided initial information on the Nyiyaparli people's principles and preferences for closure, which provide further insight into values relevant for consideration during closure planning. The current draft of these principles is summarised below:

- Safe and culturally appropriate access.
- Preference for a post-closure land design to resemble (as close as possible) pre mining conditions. Constructed landforms should look as natural as possible and include 'nice places' (e.g., nice 'camping spots' that support healthy country by providing habitat and food sources for other animals etc.).
- Backfilling of voids, especially if they are in a highly visible area and / or require permanent creek diversions. If voids are unavoidable, consideration should be given to maintaining safe access and rehabilitation if possible, or alternative productive uses (e.g., solar farms).
- Natural surface and groundwater systems to be self-sustaining and non-polluting.
- Avoidance of pit lakes. If they are unavoidable, then consideration should be given to creation of an asset, not a liability (e.g., suitable for recreation, or another agreed purpose / standard).
- Potential long-term impacts upon places of outstanding cultural importance and repatriation of artefacts.

While the KNAC (2023) Nyiyaparli People and Country Plan Fortescue Marsh 2023 - 2032 and Nyiyaparli people's closure principles and preferences provide some insight into cultural values, further work is ongoing to gain a better understanding of the specific cultural values relevant to the closure of OB29/30/35. Social surrounds consultation undertaken with the Nyiyaparli people's representatives in May 2024 (Stevens Heritage Services, 2024) reiterated the values outlined above and made recommendations specific to the proposed expansion that is the subject of the Significant Amendment. Recommendations predominantly related to the alignment of the pipeline and avoidance of heritage places. However, some requests were specific to closure and rehabilitation as discussed in Table 4-2 of Section 4.3.

The Nyiyaparli people have expressed a strong interest in rehabilitation and closure with the aim of creating a post-mining landscape and land use which is suitable for future generations to use and learn from. This includes final landforms, the types of plant species to be used in seeding for revegetation, changes to surface and groundwater regimes following cessation of mining and dewatering and safety. BHP is committed to working with the Nyiyaparli people to investigate how they might be engaged in rehabilitation and land management activities.

5.12.1 Knowledge gaps & forward work program

Further work is ongoing to gain a better understanding of the cultural values relevant to the closure of OB29/30/35 as part of BHP's engagement program outlined in Section 4.2.

BHP is working to integrate the Nyiyaparli people's principles into its design philosophies and practices and has included reference to the principles in several of the forward work programs outline in Table 13-3.

5.13 Local land use

The OB29/30/35 closure planning area is located on Unallocated Crown Land. However, the Sylvania, Ethel Creek and Prairie Downs pastoral stations are located approximately 20 km to the east, 2 km to the south and 4 km to the west of the Closure Plan Area respectively.

The town of Newman lies approximately 2 km to the east of the OB29/30/35 Closure Plan Area. The town supports an airstrip, visitor accommodation and service industries. Several tourist attractions are located within Newman and its surrounds and are linked with the Warlu Way, which is a driving trail connecting Newman with Karijini National Park and coastal attractions.

The Aboriginal community of Jigalong is situated 130 km to the east of Newman and has a population of approximately 300 people.

The mine itself is located on the land of the Nyiyaparli people (Section 3.3.3) who have historically used this area for a range of traditional uses and continue to do so.

5.13.1 Knowledge gaps & forward work program

No knowledge gaps have been identified.

5.14 Design studies, research and trials

5.14.1 Rehabilitation trials and research

BHP has undertaken progressive rehabilitation at a number of its Pilbara Operations, which enable learnings from one project area to be applied to new areas through the adaptive management approach (Section 7.1). Assessment of rehabilitation monitoring results (Section 9.3.1) assists in refining closure techniques and completion criteria. Appendix G provides a summary of historical research findings and current research projects.

The outcomes of monitoring, research and trials are reported in further detail in the AERs for BHP's operations. Additional ongoing external research programs through the Botanic Gardens and Parks Authority and the University of Western Australia, continue to provide input to improving rehabilitation success across BHP's Pilbara Operations. Further details of this research are provided in Appendix G. The results and recommendations will be used to refine BHP's rehabilitation procedures.

5.14.2 Vegetation completion criteria research

Syrinx (2019) conducted a study to develop vegetation completion criteria for BHP's Pilbara sites (Appendix B). The outcomes of this study form the basis for the vegetation criteria outlined in Section 8.3, although targets and species lists have been refined since 2019, based on monitoring data (Syrinx Environmental, 2023).

The Syrinx (2019) study included an assessment of:

- The appropriate scale to which completion criteria should be applied.
- The type of metrics that are most appropriate for use in the Pilbara based on a literature review and review of baseline and reference site data.
- The timescale appropriate for measuring success.

A brief summary of the study outcomes is provided below.

Scale

Baseline and reference data were analysed across several scales (regional, hub, site and ecosystem). The data showed that:

- The site, hub and regional scales do not provide a meaningful basis of assessment for most attributes, because they are geographic and not climatic or ecological boundaries.
- Both land systems and vegetation types are key influencing variables in the Pilbara region. Comparisons using land systems is complex and does not tease out the key ecological differences useful to determining the appropriate reference scale for measuring rehabilitation success.

Vegetation at the broad scale (e.g., shrub-steppe, low woodland etc.) was, therefore, considered to be the logical reference unit for criteria. Across BHP's Pilbara operations, there are a variety of terrestrial and wetland ecosystems. The term ecosystem is applied at various scales, and in WA has been used at the scale of a specific community (e.g. wetland communities associated with Weeli Wolli Spring) as well as at the broader vegetation scale (e.g. spinifex grasslands) or geomorphic scale (e.g. claypan). In terms of rehabilitation, the specific pre-mining environment is generally significantly altered and does not necessarily form the appropriate target ecosystem for future rehabilitation. As such, the following major vegetation types defined in Beard et. al. (2013) were used as the target ecosystems for rehabilitation:

- Spinifex grasslands:
  - Low tree-steppe comprising a hummock grassland with an overstorey of scattered low trees and a spinifex layer dominated by Triodia wiseana.
  - Shrub-steppe comprising Triodia spp. with an open overstorey of shrubs such acacia, grevillea and mallee eucalypts. It is the characteristic vegetation of the interdunal swales and desert sandplains that receive less than 250 mm rainfall per annum, and on stony ground under higher rainfall conditions.
  - Shrub-steppe comprising Acacia pyrifolia over soft spinifex (Triodia pungens) occurs on the deeper soils on granite in the Abydos Plain, Oakover Valley and extends south into the Chichester Plateau.
  - Grass-steppe comprising a hummock grassland without emergent trees or shrubs which is classified according to the dominant spinifex species (Triodia spp.). A variety of herbs may be present between the hummocks, and the species composition of this component is dependent upon the amount and season of rainfall. Grass-steppe is not common and in general occurs as patches on rocky outcrops rather than in wide expanses.

- Low woodlands including open low woodland and sparse woodland. The Acacia aneura s.l. (mulga) low woodland, open low woodland and sparse woodland type is typical of the valley plains in the Pilbara Bioregion. It has an understorey of shrubs of Eremophila spp. and Senna spp. and annuals such as Ptilotus nobilis[19.]
- Bunch grasslands which comprise riverine sedgeland / grassland with trees and are associated with drainage lines. In the Pilbara the trees are mainly Eucalyptus victrix (coolibah) and E. camaldulensis (river gum) over mixed sedges from the families Cyperaceae and Restionaceae, and grasses (Aristida spp. and Eragrostis spp.).

Metrics

The most appropriate attributes for measuring completion success were defined on the basis of a literature review and naturalness, resilience and habitat value were identified as the key characteristics of importance. The most significant variables relevant to resilience (soil stability, pattern, richness) were found to be vegetation cover, species composition and buffel grass (*Cenchrus ciliaris*) cover, and those relevant to naturalness and habitat were structure and pattern. The key attributes capturing the objectives of naturalness, resilience and habitat connectivity were defined as:

- Bare ground;
- Vegetation types;
- Indicator species;
- Plant cover;
- Species richness;
- Reproductive capacity (resilience); and
- Weed invasiveness.

The approach to setting specific targets for the attributes was based on:

- The closure objectives, which are not seeking replication of nature, but conformity with naturalness, resilience of rehabilitated landscapes, and habitat connectivity.
- The variability within the Pilbara, which does not favour the use of averages for ecological targets, but ranges that capture the typical variability based on vegetation types and landform (weeds attributes).
- Disturbance impacts, such as from existing pastoral activities, road and rail corridors, townships etc, as well as wider climate influences, that have resulted in modifications to the pre-European condition.

In general, the targets applied to the attributes include:

- Minimum or maximum values, derived from reference sites (weeds, bare ground);
- Presence / absence data (indicator species); and
- Ranges (species richness, vegetation cover).

To best capture natural variability of vegetation covers within individual vegetation types, the ‘typical’ cover ranges for each stratum were determined for each of the major vegetation types based on data from reference sites. For each vegetation type and each stratum (tree, shrub, *Triodia*, other grasses, herb) ranges were determined using the interquartile range (IQR) statistical approach which accounts for variability. This approach divides a data set into four equal groups (by count of numbers), each representing a fourth of the distributed sampled population (Figure 5-27). The:

- Q1 (lower quartile) is the "middle" value in the first half of the rank-ordered data set and is equal to the 25th percentile of the data.
- Q2 (middle quartile) is the median value in the set and is equal to the 50th percentile of the data.
- Q3 (upper quartile) is the "middle" value in the second half of the rank-ordered data set and is equal to the 75th percentile of the data.

The interquartile Q1-Q3 range is defined as the difference between the largest and smallest values in the middle 50% of a set of data (Figure 5-27). Because of the natural variability of the Pilbara, and because the objectives are based around naturalness and resilience, and are not attempting to replicate natural vegetation communities, this approach effectively targets the ‘middle-range’ and is considered appropriate for application to all quantitative targets.

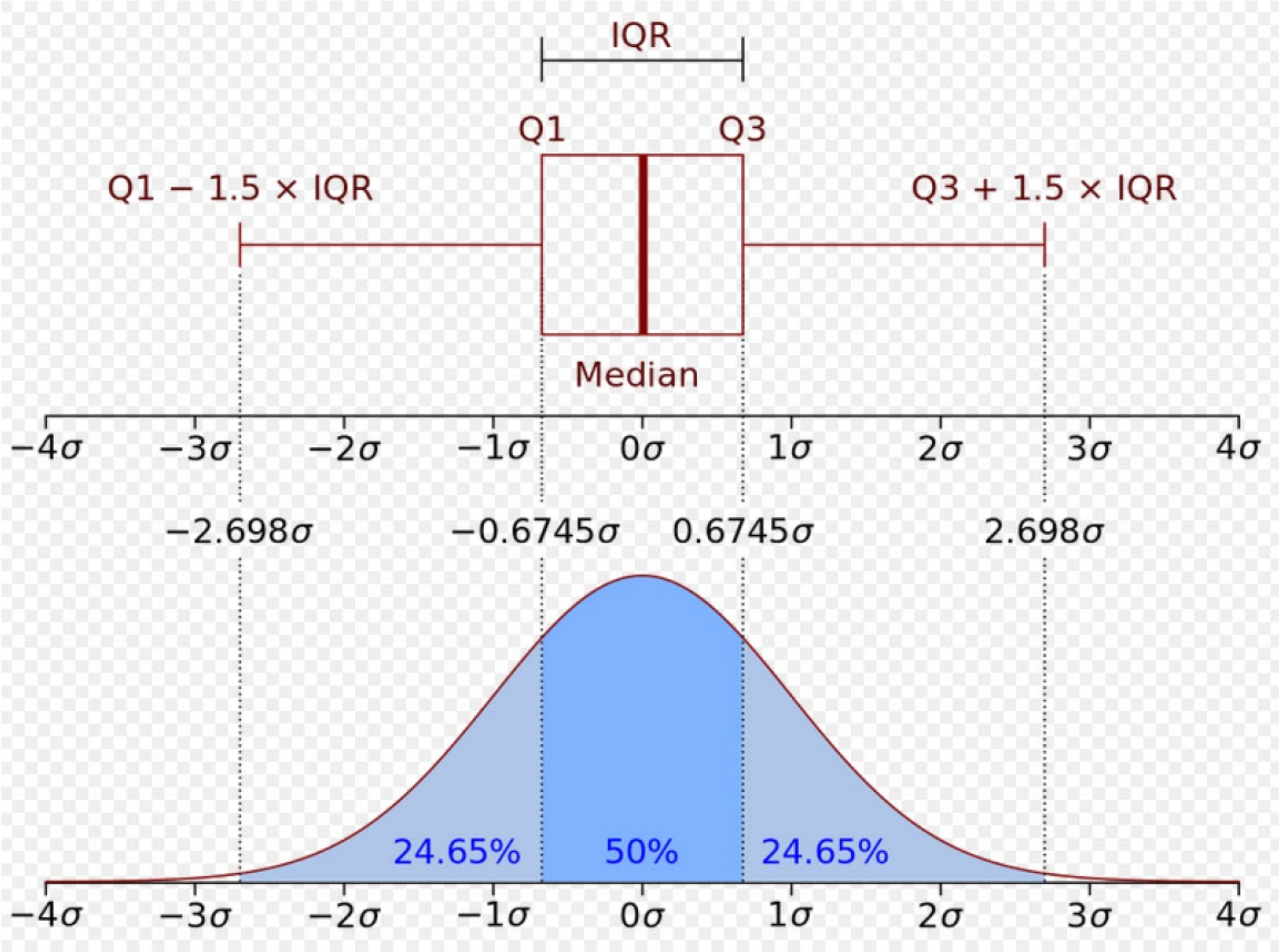
Buffel grass and BHP weed data were used as the basis for selecting weed targets. Buffel grass is the most significant weed in the Pilbara in terms of cover and extent. This species is not confined to mining operations and is seen by many pastoralists as an important component of pastoral lands. In 2016, the CSIRO (Webber, Batchelor, & Scott, 2016) aggregated data from 630 flora and vegetation reports which showed that buffel grass was widespread and known from nearly 12,000 locations. This included occurrences within lands managed for conservation. Given the wide spread of this weed, settling a blanket criterion of ‘no buffel grass’ within rehabilitation areas is not practical.

An analysis of data across BHP’s sites indicated that the average weed cover across all hubs is approximately 5.3% with buffel grass being the dominant weed.

Baseline weed cover values combined with BHP rehabilitation data have been used to set practical and appropriate completion targets. If the cover of buffel grass declines regionally with the tighter eradication controls, these targets would shift accordingly.

[19] Since the 2019 study this classification has been revised and is most likely *Ptilotus exaltatus*.

The occurrence of buffel grass correlates with landform more than vegetation type and is particularly dominant in drainage lines and floodplains at most sites. Separate targets have, therefore, been applied to hills, plains and drainage lines / floodplains to reflect this.



Source: Syrinx (2019)

Figure 5-27 The interquartile range (IQR) statistical approach adopted for setting cover targets

Timescale

To assess the appropriate timescales to use, data from all rehabilitation plots were aggregated into classes based on the age of rehabilitation, and assessed for *Triodia* cover, given this species is the major component of most of the target vegetation groups, and has typically been considered as the most important plant genera in terms of naturalness. The data suggested that measurement of a site against completion criteria after 15 years, and 20 years would not be an unreasonable time point for final assessment. Even with a sequence of good rainfall years and improvements in rehabilitation methods, it is unlikely that any site will be ready for assessment against completion criteria before 10 years, since even if some areas do attain the required metrics at this time, the site would need to sustain this during a poor climatic period and fire event to demonstrate resilience of the rehabilitation.

5.14.3 PAF cover design trials & monitoring

BHP has been researching PAF placement techniques and cover designs at Whaleback Mining Hub since 1997. As part of this research, it was established that layering PAF material with NAF material during overburden placement and covering with 5 m of NAF material significantly reduced gas and water flux within an OSA (and hence the potential for AMD generation) (Okane, 2020). Following this research, the WAIO AMD management standard requires that AMD 1 materials (higher risk overburden) are stored in a paddock dumped configuration, layered with inert overburden, to limit oxygen ingress into reactive overburden.

Further trials have been conducted on different final cover systems and have concluded that (Okane, 2020):

- A store and release cover system is an effective means of limiting moisture ingress into OSAs.
- Where run-off can be appropriately managed and erosion controlled, a system generating run-off during heavy rainfall, or multiple short period rainfall events, may be advantageous in reducing net percolation.

- Of the store and release cover system permutations, an enhanced store and release cover system incorporating a low flux layer and constructed of both WMAT 1 and WMAT 3 materials, is more effective at limiting net percolation than a cover without the WMAT 3 low flux layer.
- Vegetation increases transpiration and, therefore, net percolation.
- A thicker cover which includes a low permeability layer, likely results in lower seepage rates through the cover system and increased water residence time in the upper layer of cover material, enabling the material to remain above field capacity following rain events for longer than other cover systems. This facilitates successful establishment of vegetation and limits net percolation.

5.14.4 Alternate mine void closure scenarios

The void closure scenario at OB29/30/35 is under review and could comprise leaving the residual voids open at closure or partial backfill of one or more voids with waste rock or tailings[20]. The implications of these scenarios for groundwater levels and qualities following closure are described in Sections 5.14.4.1 and 5.14.4.2.

5.14.4.1 Changes to groundwater levels

As discussed in Section 5.9.2, the OB29/30/35 and Western Ridge aquifer systems are interconnected and consequently a precautionary approach has been adopted, and groundwater modelling was conducted to predict the cumulative change associated with the OB29/30/35 and Western Ridge operations (BHP, 2022). Changes to groundwater levels, resulting from the proposed Significant Amendment expansion, were also assessed (BHP, 2024b).

Groundwater level predictions for operations

The vertical drawdown of the groundwater level resulting from dewatering from pre-development water levels at:

- OB29 is 150 m.
- OB30 is 120 m.
- OB35 was assumed to be backfilled in the modelling that was completed by BHP (2022).

This drawdown at OB29 and OB30 is shallower than the predicted drawdown for the 2022 Western Ridge and Orebody 29/30/35 dewatering (200 m) (BHP, 2022), due to the shallower target dewatering depths. The predicted vertical drawdown in the regional aquifer for the 2024 Orebody 29/30/35 dewatering is similar to the predicted drawdown for the 2022 Western Ridge and Orebody 29/30/35 dewatering at the southern, western and most of the eastern boundaries of the model domain. Drawdown is less in the vicinity of Western Ridge, as the 2024 Orebody 29/30/35 modelling does not include dewatering from Western Ridge. Predicted drawdown is up to 70 m deeper for the 2024 Orebody 29/30/35 dewatering close to the northern boundary of the model domain north and east of OB35.

Based on the groundwater modelling, drawdown is expected to occur throughout the regional and local (orebody) aquifers in the area but is likely to be constrained by the Whaleback Fault in the west and the low permeability rocks to the south and north. To the east of this leaky flow barrier, drawdown is expected to reach about 120 m (although there is currently significant uncertainty associated with this estimate which will be reduced with monitoring along the dewatering pathway during operations).

In terms of flow across the eastern model boundary, the results show that the flow into the model from the east increases from about 0.5 megalitres (ML)/d to a likely equilibrium of about 9 ML/d. These results are considered conservative as they assume that a flow into the model domain and across the flow barrier east of OB29 of up to 10 ML/d is possible. This is high when the poorer hydraulic conditions east of the model boundary (which have not been modelled) are considered.

The modelled drawdown and boundary flow results have been used in conjunction with the conceptual model to estimate the total area of potential impact during operations, as shown in Figure 5-30. Within the model domain, the area of impact is as predicted by the simulated drawdown. Outside of the model domain, the area of impact has been estimated using a combination of the predicted flow into the OB29/30/35 and Western Ridge area through the boundary just to the east of OB29, and the hydrogeological conceptualisation from this point to the east (up to and including the Ethel Gorge TEC). The key assumptions influencing this prediction are:

- The constrained nature (resulting in low transmissivity) of the regional aquifer between the leaky flow barrier and the western part of the Ethel Gorge aquifer, and the low magnitude of flow in this direction.
- The nature of the western part of the Ethel Gorge aquifer (high transmissivity (T) and high Specific Yield (Sy)).

Based on these assumptions, it seems likely that drawdown will migrate eastwards into the low transmissivity part of the regional aquifer and may reach several tens of metres. However, when it reaches the high T and high Sy part of the regional aquifer further to the east, the drawdown will be curtailed due to the much larger amount of water in that system, and the control that Ophthalmia dam (with the captured surface water flows combined with the surplus water discharge from other BHP operations resulting in significant amounts of groundwater recharge) has on that system. Continued monitoring along the drawdown pathway will be required to confirm these conclusions.

[20] In the event that one or more pits are used to store tailings, this closure plan will be updated to incorporate information relevant to the closure of in-pit tailings facilities.

Groundwater level and recovery predictions for closure

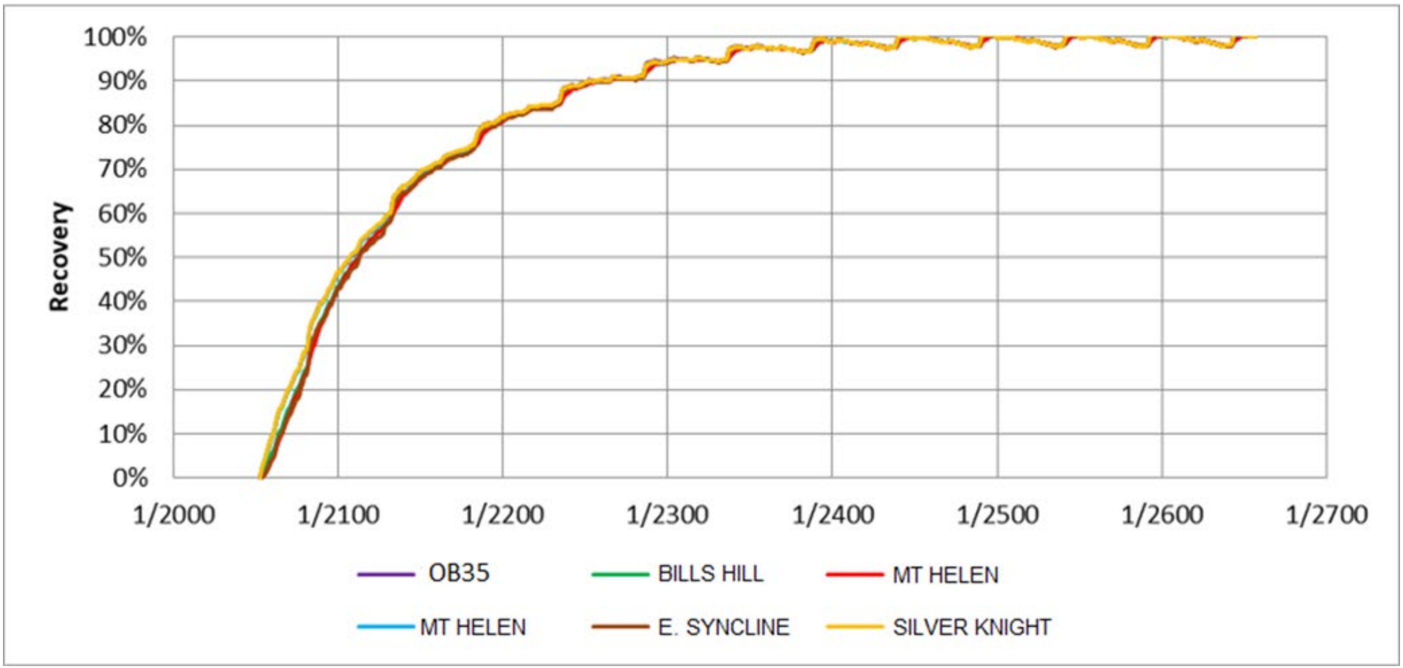
The base case model was used to simulate two closure scenarios (BHP, 2022; 2024b):

- **Backfill:** all mine voids are backfilled to above the pre-mining water table with similar material that was mined out. That is, aquifer parameters were not changed from the base case model.
- **Partial backfill**: assumes that OB35 void is backfilled and OB29 and OB30 pit voids remain open[21].

Backfill scenario

Modelling of the backfill scenario, undertaken in combination with the Western Ridge assessment (BHP, 2022) suggested that there is very little variation in the speed of recovery throughout the combined OB29/30/35 and Western Ridge area (Figure 5-28). Groundwater levels were predicted to recover and reach equilibrium after about 350 years in the 2022 assessment, which assessed the combine effects of Western Ridge (BHP, 2022) and after approximately 219 years in the 2024 assessment (BHP, 2024b). BHP (2022) predicted:

- 50% recovery after about 50 years; and
- 80% recovery after about 150 years.



Source: BHP (2022)

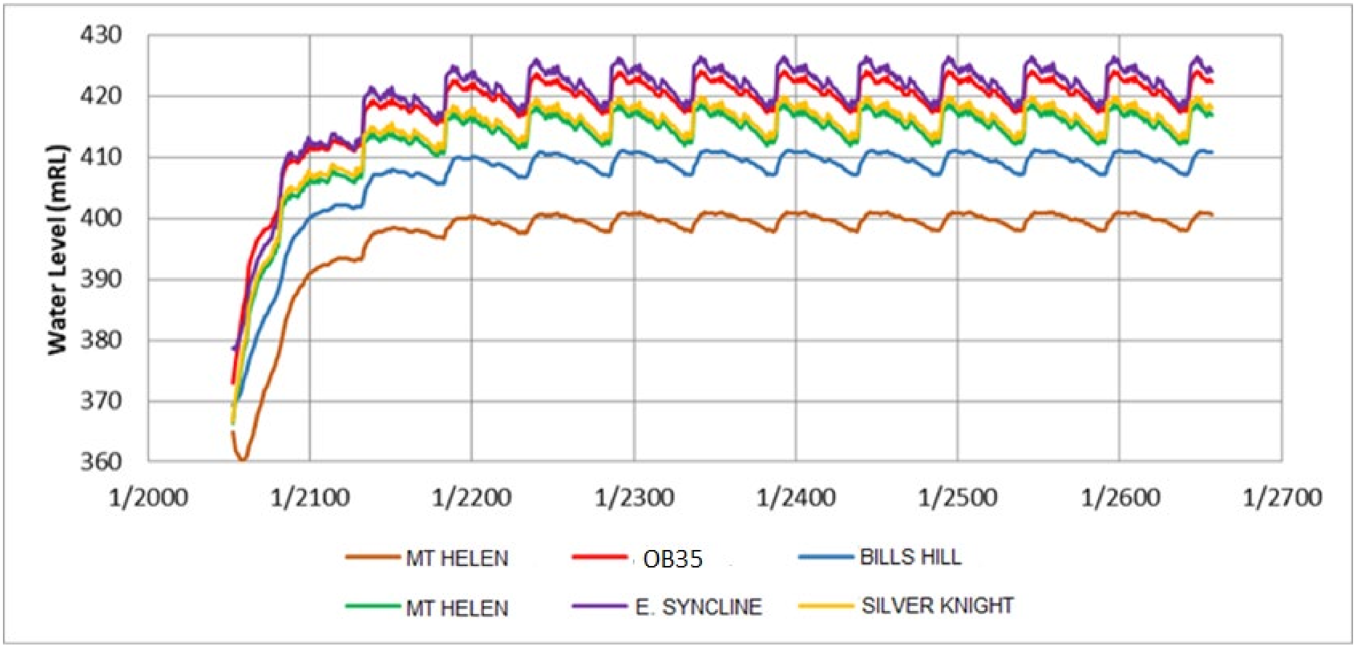
Figure 5-28 Backfill scenario – groundwater level % recovery over time

Partial backfill scenario

Modelling of the partial backfill scenario by BHP (2022) suggested that pit lakes would be expected to form at OB29 and OB30 (OB35 was assumed to be backfilled in the modelling), although there was some variation in pit lake levels depending on hydro-stratigraphy and depth of nearby voids. Equilibrium would be reached within about 144 years after dewatering ceasing, with most of the recovery happening in the first 50 years (Figure 5-29). The regional system was predicted to recover to about 420 mRL (compared to the 522 mRL pre-development level) (Figure 5-31 and Figure 5-29).

The regional system east of the OB29 leaky flow barrier recovers to about 450 mRL and the predicted groundwater flow into the model (from the east) at equilibrium is 7 ML/d compared to a pre-mining flow of 0.1 to 2 ML/d out of the model (i.e., from the west). The net difference in flow from the west would therefore be 7.1 to 9 ML/d post-closure.

[21] Void closure scenarios are under review. At the time that the groundwater modelling was conducted for the OB29/30/35 and Western Ridge operations, backfill of the OB35 pit with tailings was under consideration. In the event that this option is not pursued, further modelling will be conducted to assess the residual impact of leaving the void open. This is considered acceptable at this stage of the mine life since the collective influence of the remaining open voids at OB29/30/35 and Western Ridge is likely to have a greater influence over groundwater levels than that of the OB35 pit.



Source: BHP (2022)

Figure 5-29 Without backfill scenario – groundwater level (mRL) recovery over time

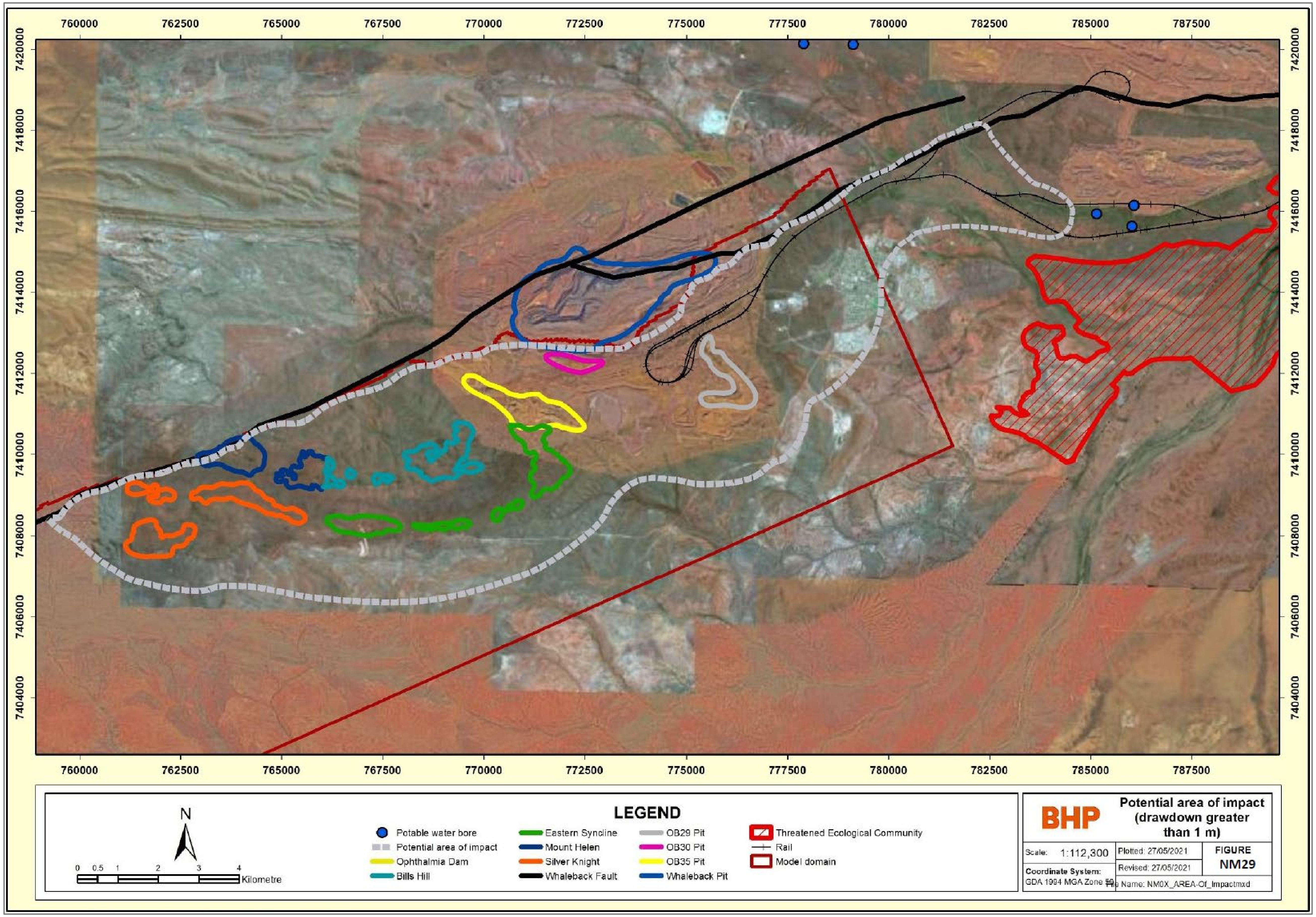
5.14.4.2 Changes to groundwater quality

Residual void scenario

In the event that mine voids remain open, any resulting pit lake will remain a terminal groundwater sink. As such, the risk of downstream impacts to groundwater quality will be very low. The salinity and metals concentration in the pit lakes will increase over time with evapo-concentration, but the AMD risk assessment (Section 5.3.2) shows that pit wall exposures of PAF are negligible and consequently the risk to pit lake quality from AMD is very low.

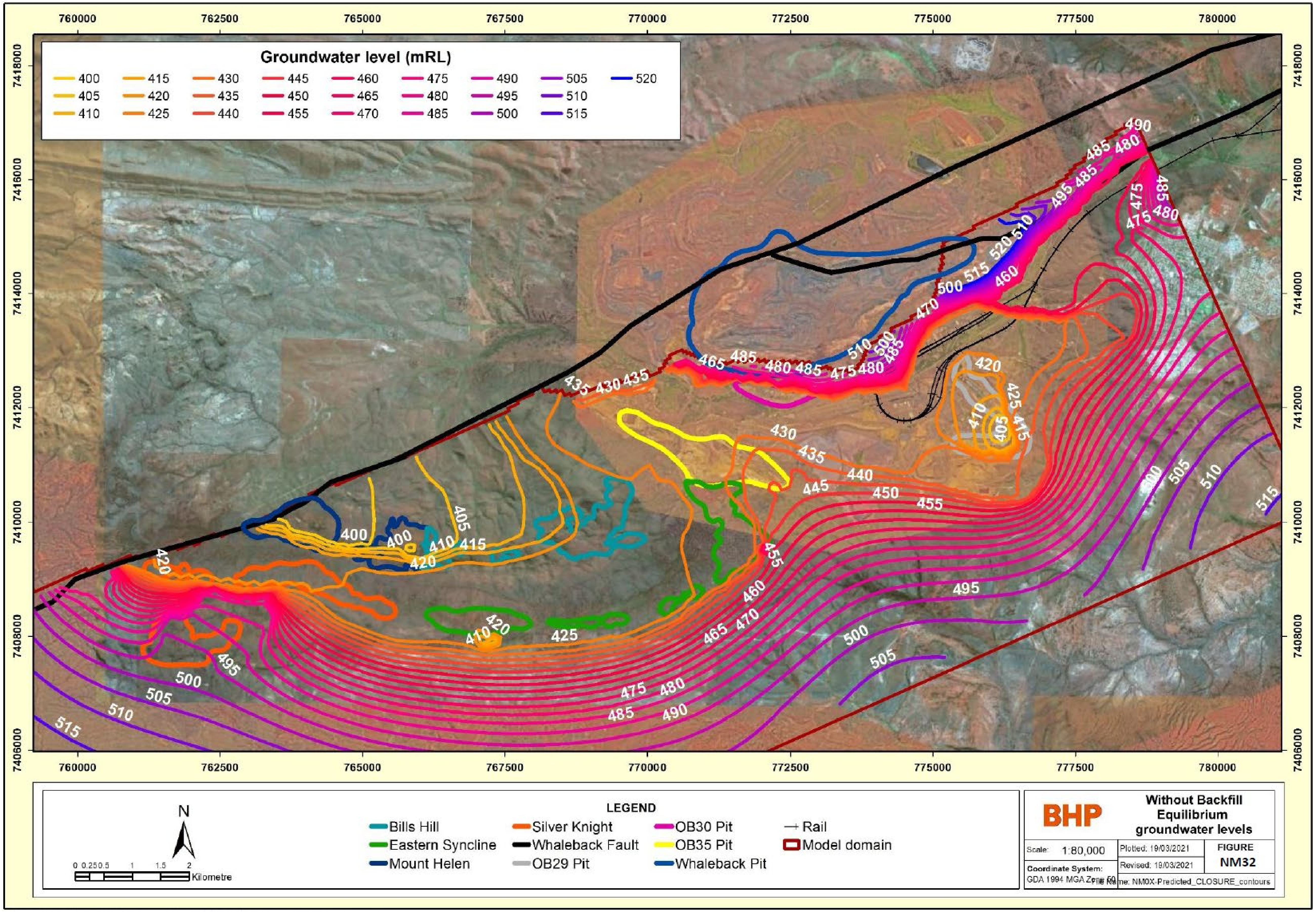
Full or partial backfill with waste material

Should the mine plan change, and the mine voids be completely backfilled or partially backfilled either to above the pre-mined water table level, or to a level that does not result in the development of a pit lake, it is possible that either a through-flow or a recharge system would form. Regardless of whether a through-flow or recharge pit develops, solute loads initially could be higher (compared with inflowing groundwater quality) due to contact with the backfill materials. As the pit water would be continually flushed, and the potential for evapo-concentration effects would be reduced, the resultant water quality would be likely to improve over time as the readily soluble mineral phases become depleted and flushed away.



Source: BHP (2022)

Figure 5-30 Potential area of impact (drawdown > 1 m) during operation



Source: BHP (2022)

Figure 5-31 Without backfill scenario – predicted groundwater levels at equilibrium

5.14.5 OB35 creek diversion

A discussion about the studies used to inform the OB35 creek diversion (formally known as the Phase 2 Southern Creek diversion) was included in the previous version of this MCP. The diversion has now been constructed and therefore closure design details are now included in Section 9.2.3.1. Modelling data that was used to support the design of the diversion is provided in Appendix H for reference.

5.14.6 OB30 creek diversion

The OB30 creek diversion will remain post-closure, and the drainage system will be upgraded to accommodate a 1 in 10,000-year flood event. A preliminary review of closure requirements has been conducted by Advisian (2021a; 2021b) who concluded that to accommodate a 1 in 10,000-year flood event:

- A constructed floodplain of approximately 200 m may be required for closure (Figure 9-21) so that the channel behaviour reflects that seen in the analogues. As shown on Figure 9-21, this flood plain impacts on the current footprint of the OSA 1. It is currently assumed that the portion of the OSA within the flood plain will be relocated.
- Closure bunds (Figure 9-22) would need to be 1 - 1.5 m higher than operational bunds. Current spatial constraints at the diversion outlet suggests that it may not be possible to locate the bunds outside of closure setbacks. As discussed in Sections 9.2.1 and 9.2.2, measures to increase pit wall stability (such as buttressing) will be considered, if required.
- Rock armour size does not need to increase compared to operations design.

A number of studies have been undertaken to support the operational design of the diversion and to establish the requirements for closure and are outlined below. Further design studies will be undertaken to support detailed design of upgrades required for closure as mine life progresses.

Channel geometry

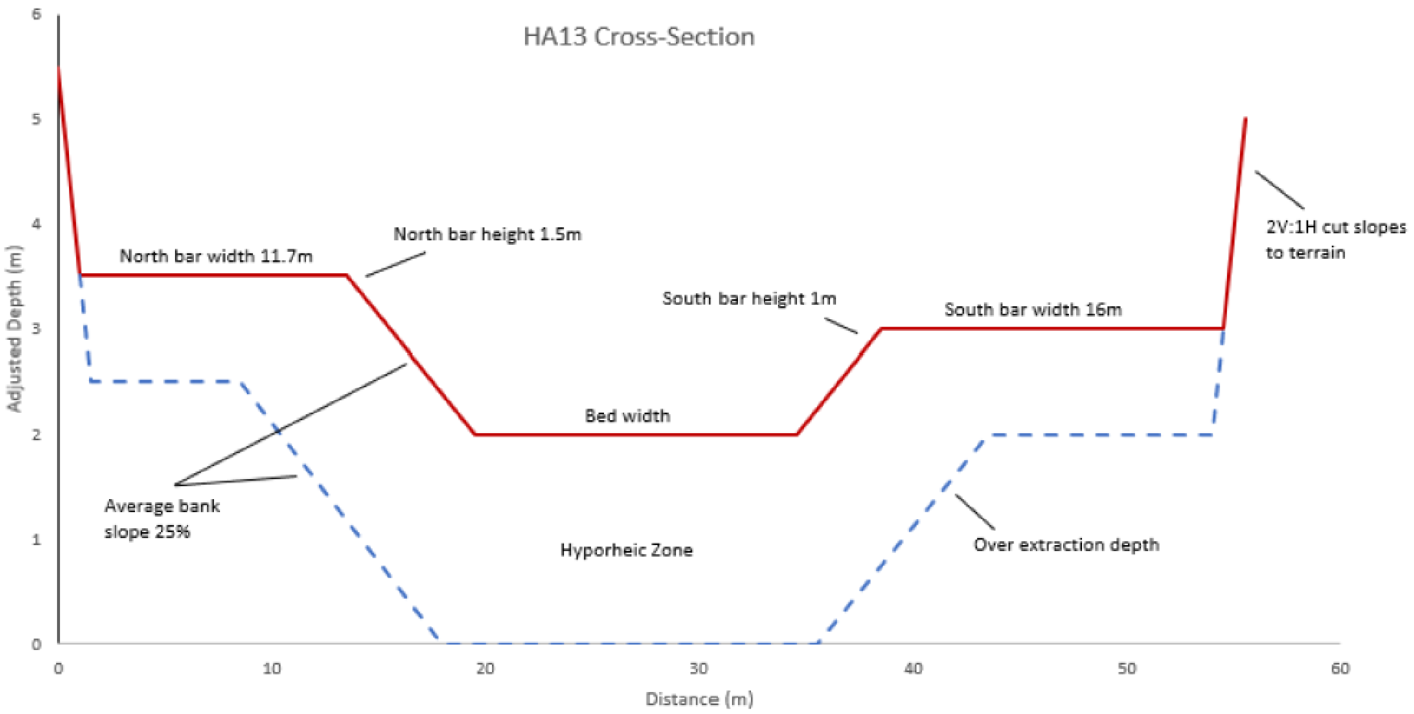
Based on the geomorphology, sediment transport and scour assessments (Section 5.9.1), Hydrobiology (2020a) recommended that the planform and reach based characteristics of the creek diversion design include consideration of:

- A low sinuosity planform (1.10 - 1.20) that reflects the existing (pre-diversion) and upstream reaches (rather than the straighter and more developed downstream reach) and moderate curvature bends that create hydraulic and habitat variability, including deposition features such as bars and benches.
- A low gradient design that creates continuity between the reaches upstream and downstream of the diversion. A gradual transition between the diversion and the upstream and downstream reaches that ensures no major 'jumps' in hydraulic grade or parameters.
- Bed width that has an average that reflects that seen in the upstream reach, comprised of a material consistent with existing reaches to maintain consistent roughness and sediment transport conditions.
- Wide, low bars / benches to confine low flows to a narrower channel and become colonised by vegetation to reflect the existing channel vegetation and roughness and stabilise banks to encourage manageable rates of erosion and sedimentation. These bars should (partly) consist of gravel material, like that observed in the existing channel (Section 5.9.1). The bench design for the diversion to be consistent with the natural conditions (Section 5.9.1).
- A hyporheic layer which has similar properties to that found in the analogue reach. Observations of sediment depths in the analogues and results of the scour assessment (Section 5.9.1) suggested that a depth of 2 m should be sufficient. However, actual depths to be dictated partially by the depth of the channel bed invert and depth of bed sediment immediately upstream and downstream of the proposed diversion.
- A constructed floodplain to be considered in the design so that the channel behaviour reflects that seen in the analogues.

It is expected that vegetation will re-establish naturally if the hydraulic regime is similar to the existing system.

Operational design

Conceptual drawings for the OB30 diversion are shown in Figure 5-32 and Figure 5-33 and include a low flow channel, flood plain and three flood bunds with minimum batter slopes of 1:2 (V:H) (Advisian, 2021a).



Source: Advisian (2020)

Figure 5-32 OB30 creek diversion operational cross section concept

Source: modified from Advisian (2020)

Figure 5-33 OB30 creek diversion preliminary operational concept design

Geomorphic assessment of operational design

Hydrobiology (2020b) conducted an assessment of the proposed OB30 creek diversion operational design and made the following observations:

- The sinuosity in the design (HA13) is about 1.06 which is marginally lower than the basis of design, but this is unlikely to pose an issue to geomorphic processes.
- The length and slope of the diversion is 2,295 m and 0.0028 m/m, which reflect the length (2,427 m) and slope (0.0032 m/m) of the pre-existing channel to be diverted.
- The tributary intersection remains an area of increased hydraulics and should be further investigated to evaluate the risk of a head cut that migrates upstream in Whaleback Creek and the tributary.
- Discontinuous bars are not included in the design but are likely to develop over time as sustainable scour of, and deposition adjacent to, the low flow channel margins occur. Benches are included in the design. Bed width reflects that seen elsewhere.
- Micro-bars should form within the diversion. An alternative would be to place small piles of larger rocks through the diversion to encourage the colonisation of vegetation and microhabitat features (i.e., microbars).
- The design reflects morphological features (i.e., wide narrow benches / inset floodplains between a higher terrace) observed in upstream reaches.
- Sediment deposition is likely to occur in the diversion during more frequent events.
- There is likely to be greater scour through the diversion than through the natural creek in 1 in 50 AEP events or greater. However, the likelihood of widespread channel change and / or loss of alluvium is low due to:
  - The infrequency of the events.
  - The very short duration where high scour stresses are experienced.
- The overall expectation is that deposition in more frequent events would be balanced by scour in rarer events over the life of mine.
- Inclusion of rock piles would enhance revegetation / roughness and reduce scour risk.

Further works were recommended to investigate potential modifications to the tributary, create a more gradual transition in channel morphology at the diversion inlet, and conduct a further assessment of the potential for scour adjacent to the levee and at key hotspots (Hydrobiology, 2020b).

Preliminary closure design

A preliminary proposed closure design is for the flood plain to be extended to 200 m for closure (refer to Section 9.2.3.2 for details).

Hydraulic modelling

The hydraulic performance of the preliminary closure design has been modelled for up to 100-year AEP events and compared to analogue conditions (Appendix F-2). The modelling results suggest that overall, there is a good fit between the hydraulics of the closure design and natural analogue (Advisian, 2021b):

- The 50th percentile peak velocity for the 1 in 2 AEP event is slightly lower than the natural analogue. For all other AEP events the 95th and 50th percentile values for the closure design are very similar to the natural analogue.
- The 95th and 50th percentile shear values for the closure design are slightly lower than the natural analogue for the 1 in 2 and 1 in 5 AEP events, but similar for all other events.
- The 95th and 50th percentile stream power values for the closure design are slightly lower for than the natural analogue for the 1 in 2 and 1 in 5 AEP events, but similar for all other events.

These results confirm that construction of a 200 m wide floodplain is a feasible closure solution that can replicate the pre-development hydraulics of the natural creek system (Advisian, 2021b).

Flood bund design study

The design criteria for flood bunds during operations and at closure are provided in Table 5-37.

Table 5-37 OB30 flood bund design criteria

Stage	Design Event (1 in X AEP)	Minimum Freeboard (m)	Minimum Batter Slopes (V:H)
Operations	100	1.0	1:2
Closure	10,000	0.0	1:2

Source: Advisian (2021a)

Flood bund geometry

Hydraulic modelling was conducted by Advisian (2021a) to inform the operational and closure designs for flood bunds. The modelling for operations was based on a nominal 50 m flood plain, whereas the modelling for closure assumed a 200 m flood plain. Modelling results for preliminary designs (Figure 5-34) indicated that bunds for the closure design must generally have a crest level approximately 1.0 to 1.5 m higher than the operations bunds to meet closure design requirements (i.e., not overtop during the 1 in 10,000 AEP event). If the closure flood plain of 200 m is not implemented (and the operational width of 50 m is maintained), the 1 in 10,000 AEP flood event exceeds the design height of the closure bunds at all locations (Advisian, 2021a).

An increase of 1.0 to 1.5 m in bund crest level will result in a widening of the cross-sectional footprint of flood bunds by 4 to 6 m. Given the constraints on space to the north and south of the proposed diversion, this larger footprint would encroach either into the diverted creek, reducing conveyance capacity, or into the pit, requiring backfill to maintain stability and potentially sterilising ore (Advisian, 2021a).

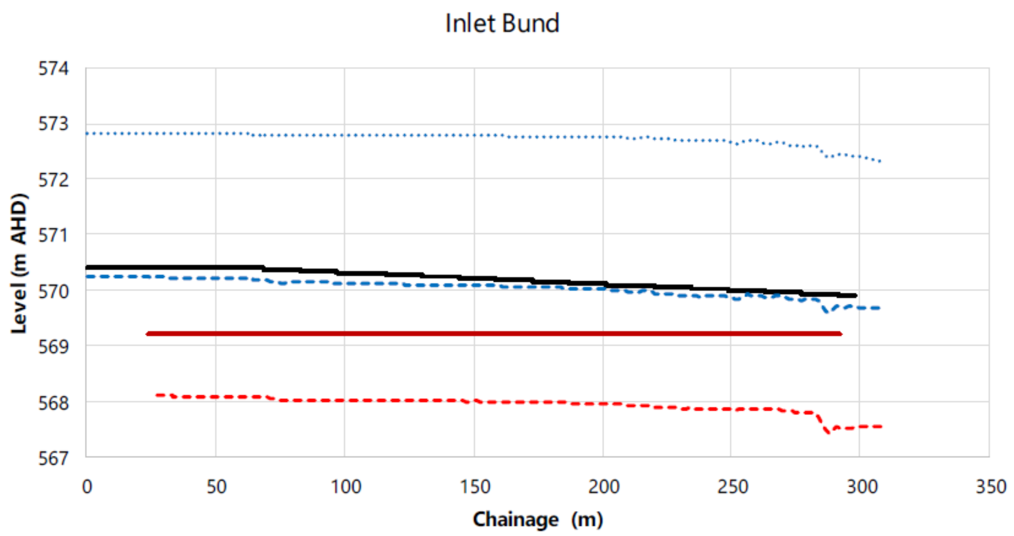
The sensitivity of the flood bund geometry to climate change was assessed by modelling Representative Concentration Pathway (RCP) 4.5 (moderate) and RCP 8.5 (worst case) climate scenarios for a 2060 design horizon (consistent with the mine's 40-year operational life). Table 5-38 presents design peak flows for the baseline, RCP 4.5, and RCP 8.5 floods for operations. The impact of climate change on extreme rainfall events is not well-defined, particularly given the inherent uncertainty associated with the extrapolation involved in the estimation of such events. As such, there is little value in applying RCPs to the closure design event (Advisian, 2021a).

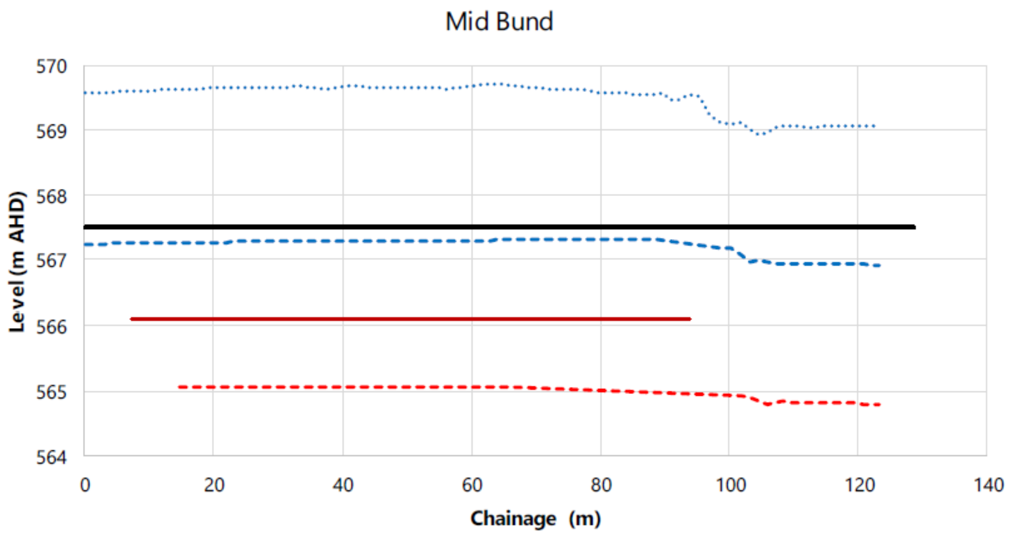
Table 5-38 Climate change scenarios for design peak flows

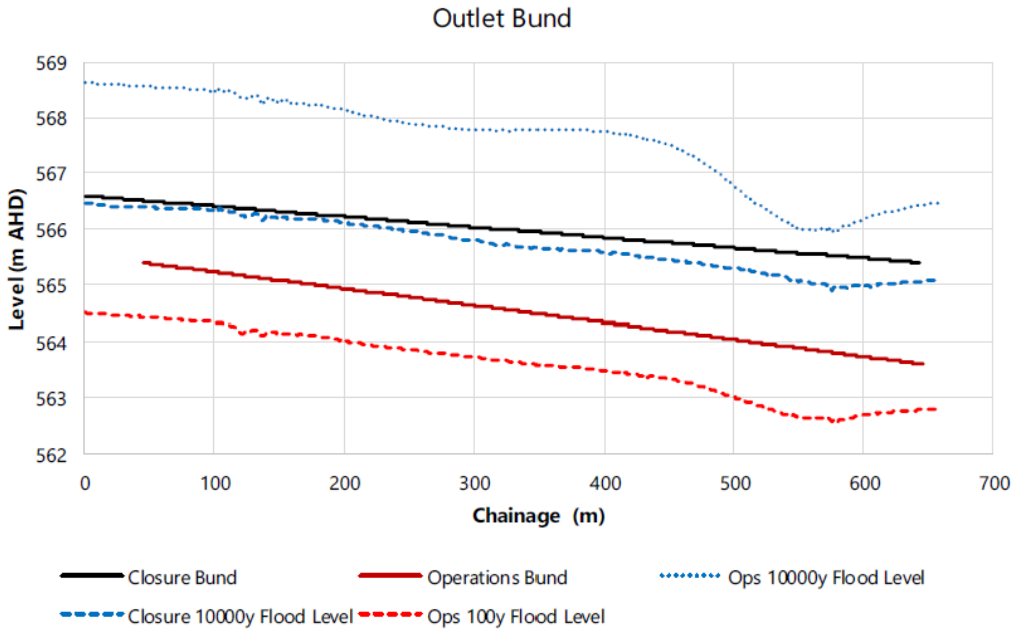
Diversion Design	Event	Peak Flow through Diversion (m^3/s)
Operations	1 in 100 AEP	313
	1 in 100 AEP (RCP4.5, 2060)	377
	1 in 100 AEP (RCP8.5, 2060)	414
Closure	1 in 10,000 AEP	1,758

Source: Advisian (2021a)

Increased flows through the diversion under the climate change scenarios result in higher flood levels at bund locations. The operations bund fully contains the flow in all scenarios, with freeboard reduced by up to 55% and 80% in the RCP 4.5 and RCP 8.5 scenarios, respectively (Advisian, 2021a).







Source: Advisian (2021a)

Figure 5-34 OB30 flood bund and surface water elevation profiles for operations & closure design events

Rock protection

High floodwater velocities in the vicinity of the flood protection bunds increase the risk of scour, potentially leading to failure of the bund. Rock protection can mitigate this risk and is specified according to the velocity of floodwaters expected to come into contact with the bund toe. For operations, peak velocities at the toe of the bund during the design event were extracted from the 2D hydraulic model. For closure, the maximum velocity in the diversion cross-section adjacent to the flood protection bunds was used. This is to account for potential channel migration that can occur over closure timeframes (Advisian, 2021a).

The results of modelling indicate larger rock is required during operations at the inlet and outlet bunds, and that the minimum rock class is either the same or reduced for closure for all bunds (Table 5-39). This is due to the widening of the floodplain (to 200 m) for closure that increases the area of shallow, low velocity flow. The rock placed for the operations design can therefore be left in place and extended with the bunds for closure (Advisian, 2021a).

Table 5-39 Rock armour required for operations and closure designs

Design	Event (1 in X AEP)	Mannings Roughness	Inlet Bund		Mid Bund		Outlet Bund	
			Velocity (m/s)	Class	Velocity (m/s)	Class	Velocity (m/s)	Class
Operations	100	Low	3.1	¼ tonne	2.4	Facing	3.8	¼ tonne
Closure	10,000	High	2.5	Facing	2.58	Facing	2.8	Light

Source: Advisian (2021a)

Rock protection must be keyed to a sufficient depth to prevent scour under the bund toes and subsequent failure of the bunds. In the existing creek, the surface sediment at the bed surface has a lower proportion of fines than the sub-surface alluvium, creating an armouring effect. That is, the armoured surface layer has larger sediment sizes than the unarmoured sub-surface layer. The bed-material of the proposed creek diversion is currently proposed to be backfilled from the excavated alluvium in the existing creek. The diversion alluvium is, therefore, likely to reflect non-armoured sediment sizes, as armouring of creek beds is a natural process that occurs over time. Based on the recommendations from Hydrobiology (2020a), the rock armour toe depth has been specified to 2.0 m below the invert of the low flow channel in the diversion adjacent to the bund for both operations and closure designs.

5.14.7 Closure planning groundwater monitoring network

There are several groundwater monitoring programs underway across the broader Newman Hub, which includes OB293035 (see Section 5.9.2). These include:

- Compliance monitoring of site surface water and groundwater quality (chemistry and water levels).
- Project monitoring (e.g., study/geochemistry specific).
- Water production monitoring for mine water management programs.
- Water resource and hydrogeological (water level).
- Pit water grab sampling (chemistry).

The monitoring programs have largely been established to support operational planning and compliance monitoring. Although there are a significant number of monitoring bores installed across the site, they are largely screened in the orebody aquifer and not the regional aquifers.

In 2022, HGG (2023) was engaged to undertake a review of the existing groundwater and surface water databases for the Mt Whaleback and OB293035 sites. The key objectives of the review were to:

- Assess if the current surface and groundwater monitoring programs indicate positive or negative trends in water quality that may be associated with impacts from mining activities, including AMD, salinity, and potential nitrate release to receptors.
- Assess if the current monitoring plans are suitable for overall risk management at closure and identify gaps/improvements, if any.
- Provide information to support the refinement of closure monitoring objectives for water quality.

The HGG review was completed in 2023 and identified several limitations to the effectiveness of the monitoring program for closure planning, including:

- Limited continuity of monitoring at most locations (gaps in the monitoring data).
- Spatial inconsistency across the site. Significant data is collected at some potential sources of contamination and data is collected at receptors, but limited data is collected along potential pathways. No groundwater sampling is undertaken in locations that represent baseline, background or reference conditions. Source-Pathway-Receptor (S-P-R) studies are therefore constrained.
- Some potential sources of contamination are not monitored adequately.
- Surface water monitoring is underrepresented within the database.

The following recommendations were made by HGG (2023) and by other recent studies prior to 2022:

- Identify reference bore locations and screening intervals.
- Review available bore logs to establish hydrostratigraphy / screened intervals.
- Complete a post closure source-pathway-receptor assessment for groundwater.
- Identify a set of bores for routine groundwater monitoring that focuses on the source-pathway-receptor context of the site after closure.
- Refine the analytical suite. This should include a standard number of analytes that allows geochemical water-typing and include Contaminants of Potential Concern (COPCs) from sources identified in the conceptual site model.
- Establish additional bores downstream of OSAs and the Mt Whaleback Tailings Storage Facility (TSF) remaining at closure to comply with closure commitments.

Recommendations were also made for the surface water monitoring program, including additional sampling locations, an expanded analytical suite and installation of continuous sampling on key ephemeral creeks.

A work program was established in 2023 to address the findings of the review and was underway at the time of writing this MCP. The scope of the work program is to review the existing groundwater monitoring setting and develop a detailed monitoring program targeted at closure planning. This will include identifying optimum monitoring locations, preparing detailed design specifications for monitoring bores, and developing a detailed monitoring plan that outlines the required analytical suite for each location, monitoring methodologies and monitoring frequencies. Supporting studies such as refinement of a S-P-R model will also be undertaken.

A consultant has been engaged to undertake the work program and the work was underway at the time of writing this MCP. Outcomes of the study will be incorporated into future versions of the MCP.

It is expected that additional groundwater monitoring bores may be recommended as an outcome of the study and BHP has forecast budget to install one additional bore per year over the next 3 years.

6 Post mining land use

As discussed in Section 8.2, BHP's overarching closure and rehabilitation objective is to develop a safe, stable, non-polluting, and sustainable landscape that is consistent with key stakeholder agreed social and environmental values and aligned with creating optimal business value. This objective and associated guiding principles for mine closure (see Section 8.2) set the framework for post-mining land use planning and have been taken into account in the consideration of the possible land use options for OB29/30/35 described below. Of particular relevance, is the guiding principle which states that the post closure land use should be sustainable and consider, inter alia, local land management practices and ongoing management requirements as well as the capability and constraints associated with the land post-mining.

6.1 Context

To support post-mining land use planning, BHP conducted a strategic post-closure land use opportunity assessment of its central and eastern Pilbara operations in 2019 (Pershke Consulting, 2019b). This assessment was informed by a context analysis (Pershke Consulting, 2019a) which identified various strategic objectives for, and initiatives within, the region from plans developed by:

- Economic development and land use planning agencies such as Pilbara Development Commission, Tourism WA and DPIRD.
- Conservation and environmental protection agencies such as DBCA and DWER.

The key themes arising from the review of strategic plans which could influence post-mining land use were:

- The need for economic diversification in the Pilbara. Various strategies to achieve this aim focused on:
  - Renewable energy production and export (Pilbara Development Commission, 2015; JTSI, 2018).
  - High value agriculture and cropping, aquaculture, algae biofuels and co-products (Pilbara Development Commission, 2015; JTSI, 2018).
  - Tourism, including opportunities to promote Aboriginal tourism (WPAC & Department of Planning, 2012; Pilbara Development Commission, 2015; Tourism Australia, 2011; Tourism WA, 2012).
  - Waste management (Pilbara Development Commission, 2015).
  - Space applications and support infrastructure (JTSI, 2018).
- Improving opportunities for pastoral businesses in the Pilbara including irrigated agriculture and carbon farming opportunities (DISER, 2020).
- Protecting and sustainably managing nature and biodiversity (Australian Government, 2017; Government of Western Australia, 2023).
- Improving outcomes for Aboriginal people (COAG & Coalition of Aboriginal & Torres Strait Islander Peak Organisations, 2019; DBCA, 2019b; DPIRD, 2017).

6.2 Opportunity identification

Based on the context analysis and a very broad review of the land use characteristics and capability in the OB29/30/35 mining area, Pershke Consulting (2019b) identified a number of land uses that might be further investigated. The location of the OB29/30/35 closure planning area on unallocated crown land in close proximity to Newman suggests that the site may lend itself to land uses which:

- May not be permitted on pastoral tenure such as large-scale renewable energy developments and industrial uses.
- Require close proximity to the labour available in Newman such as industrial uses, closed loop horticulture and aquaculture.

Other land uses which could also be considered include:

- Tourism - the site is located on the Warlu Way, but given its proximity to Newman, it offers no advantage in reducing distances between accommodation stops. However, should a market opportunity arise, it is possible that the mine could be repurposed to support a tourist attraction accessible from Newman.
- Use of water infrastructure / pit lakes to support irrigated agriculture. While the OB29/30/35 closure planning area is located on unallocated crown land, it is situated within 30 km of a pastoral lease area which has been assessed as having high suitability for irrigated agriculture.

Given the long life of the OB29/30/35 mine, the appropriateness / feasibility of different land uses will change over time and requires further investigation over the life of mine. Land uses would need to be compatible with the location of the site within a Priority 1 drinking water source area. In the interim the provisional land uses outlined in Section 6.3 have been assumed for closure planning purposes.

6.3 Post-mining land use

The post mining land use will be informed through stakeholder consultation. In advance of the post mining land use being confirmed for the OB29/30/35 mine, BHP has adopted land uses consistent with the Australian Land Use and Management (ALUM) Classifications (ABARES, 2016) and the underlying tenure of unallocated crown land, to guide the closure and rehabilitation of the site (Table 6-1 and Map 6-1). These provide an interim target to which closure and rehabilitation planning can work. However, we also recognise that the Nyiyaparli people will be custodians of the land post-closure, and further consultation is required to determine how traditional uses may be factored into these land use classifications. Feedback from KNAC on behalf of the Nyiyaparli people has indicated that it may be appropriate to factor in the following to the post-mining land use:

- Plant species of use for tucker, medicinal or other cultural significance to the Nyiyaparli People.
- Creation of habitat to encourage culturally significant species to re-occupy rehabilitation areas.
- Creation of places that the Traditional Owners can conduct cultural activities to replace those that have been lost through mining.
- Beneficial use of mine voids and pit lakes.

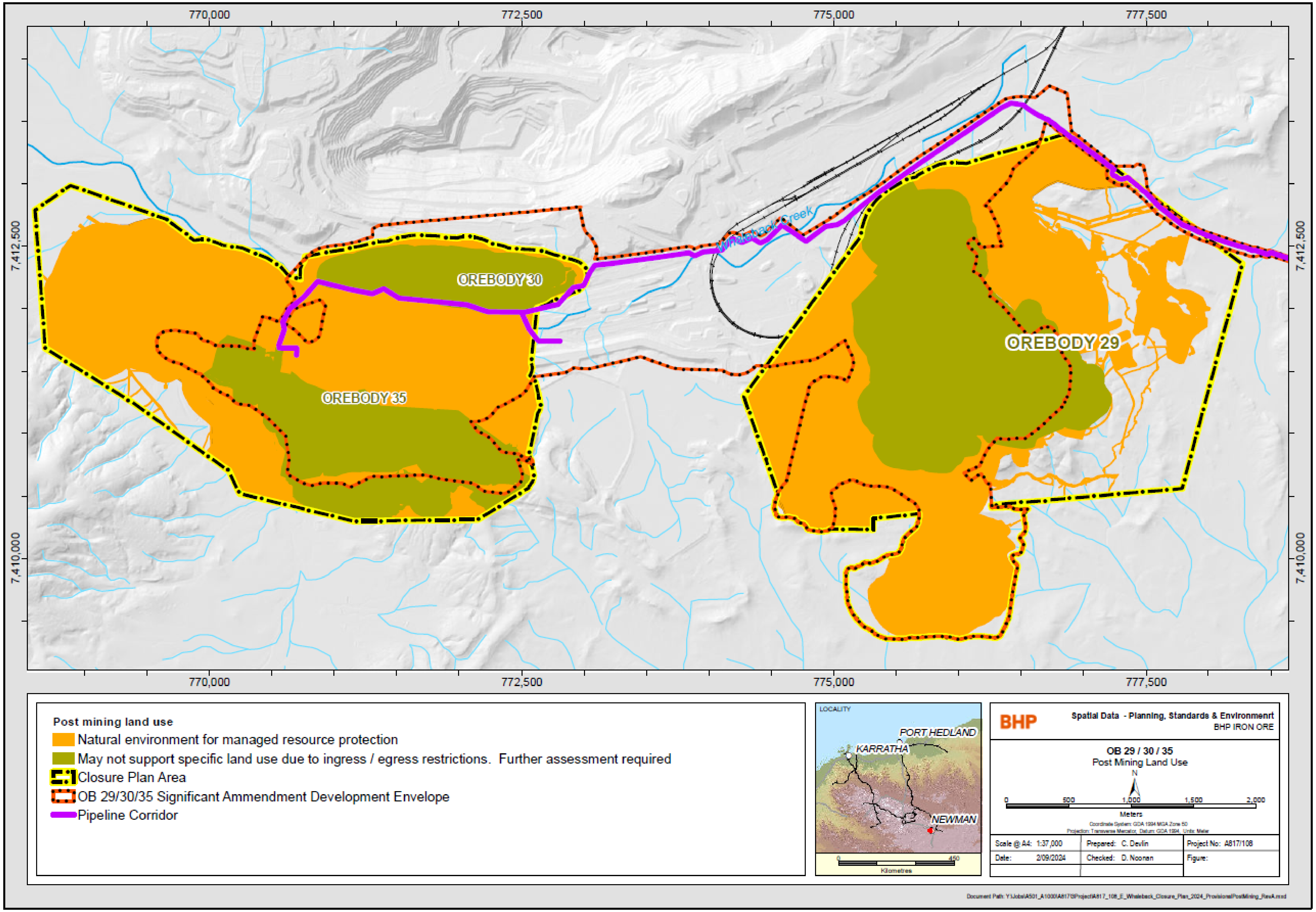
Depending on the final land use, and in line with the level of landscape disturbance at OB29/30/35, revegetated areas will align with the 'rehabilitation' outcomes as described in the National Standards for Ecological Restoration (SERA) (SERA, 2021) and, in line with this outcome, BHP will target two or three stars across each of the six attributes in the SERA (2021) framework.

Table 6-1 Provisional post-closure land use by site domain

Location	Domain	Post closure land use
Mining Area	OSAs / stockpiles / ROM	Natural environment for managed resource protection.
	ISAs	May not support any specific land-use due to access restrictions. Further assessment required.
	Infrastructure	Natural environment for managed resource protection.
	Landfill	Natural environment for managed resource protection.
	Mine Voids	May not support any specific land-use due to ingress / egress restrictions. Land use classification may be 'extractive industry not in use'. Further assessment required. BHP acknowledges concerns raised by KNAC on behalf of the Nyiyaparli people about the restricted post-closure access to pits and will continue to optimise pit closure strategies, including backfill designs, that may, in some instances allow for safe access, however, regulatory requirements for managing access will also need to be met.
	Creek diversions & flood protection	Natural environment for managed resource protection.

6.4 Knowledge gaps and forward work program

BHP has developed a strategic plan for the ongoing investigation of post-mining land uses during the life of mine. As potential productive post-mining land uses emerge, these will be investigated and incorporated into the MCP, as appropriate.



Refer to Appendix N for a pdf version

Map 6-1 Provisional post closure land uses

7 Assessment and management of risk

Planning for closure is conducted over the life of an asset (Figure 7-1), and is updated via an adaptive management approach (Section 7.1) as mine plans change and data is gathered from operational monitoring activities and progressive closure studies. As a site approaches closure, studies become more detailed and closure plans and designs are optimised to integrate the various aspects of the closure designs.

The successful planning and execution of sustainable closure and rehabilitation in the Pilbara requires a holistic, long-term view of landscape scale outcomes coupled with progressive operational level activities that implement or preserve options toward meeting the outcomes. Applying adaptive management, BHP utilises a suite of modelling and assessment tools to assist in identifying closure issues and guide the application of management approaches to address them. Monitoring programs provide data and information to support and inform the progressive development of the mine closure strategy for a site.

Acknowledging the early phase of the OB29/30/35 mine's life, the focus at this stage of the MCP is on developing an understanding of the closure issues and ensuring processes are in place to develop appropriate closure strategies.

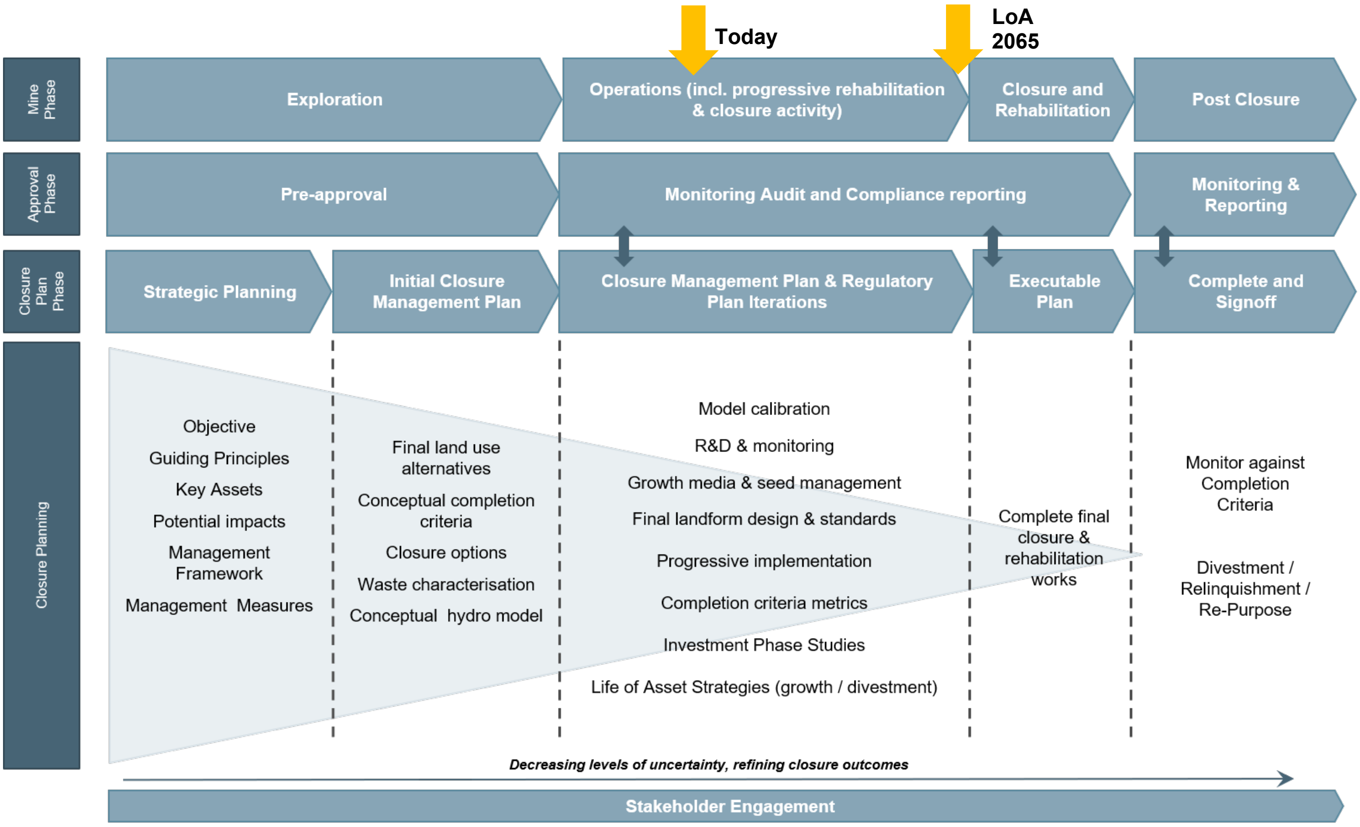


Figure 7-1 Closure planning over OB29/30/35 lifecycle

7.1 Adaptive management

The concept of adaptive management is a structured, procedural, iterative approach to decision making (see Figure 7-2). It allows incremental improvement in the success of mine closure techniques by review of rehabilitation monitoring data and integration of findings into forward work programs and future closure and rehabilitation designs. The adaptive management approach allows for the investigation and continual evaluation of preferred mitigation controls so that they are progressively improved and refined, or entirely alternate solutions adopted.

This adaptive management approach is applied to the OB29/30/35 operations and associated closure issues taking into consideration the results of rehabilitation and trials from BHP's other Pilbara Operations and best practice rehabilitation techniques used elsewhere in the mining industry.

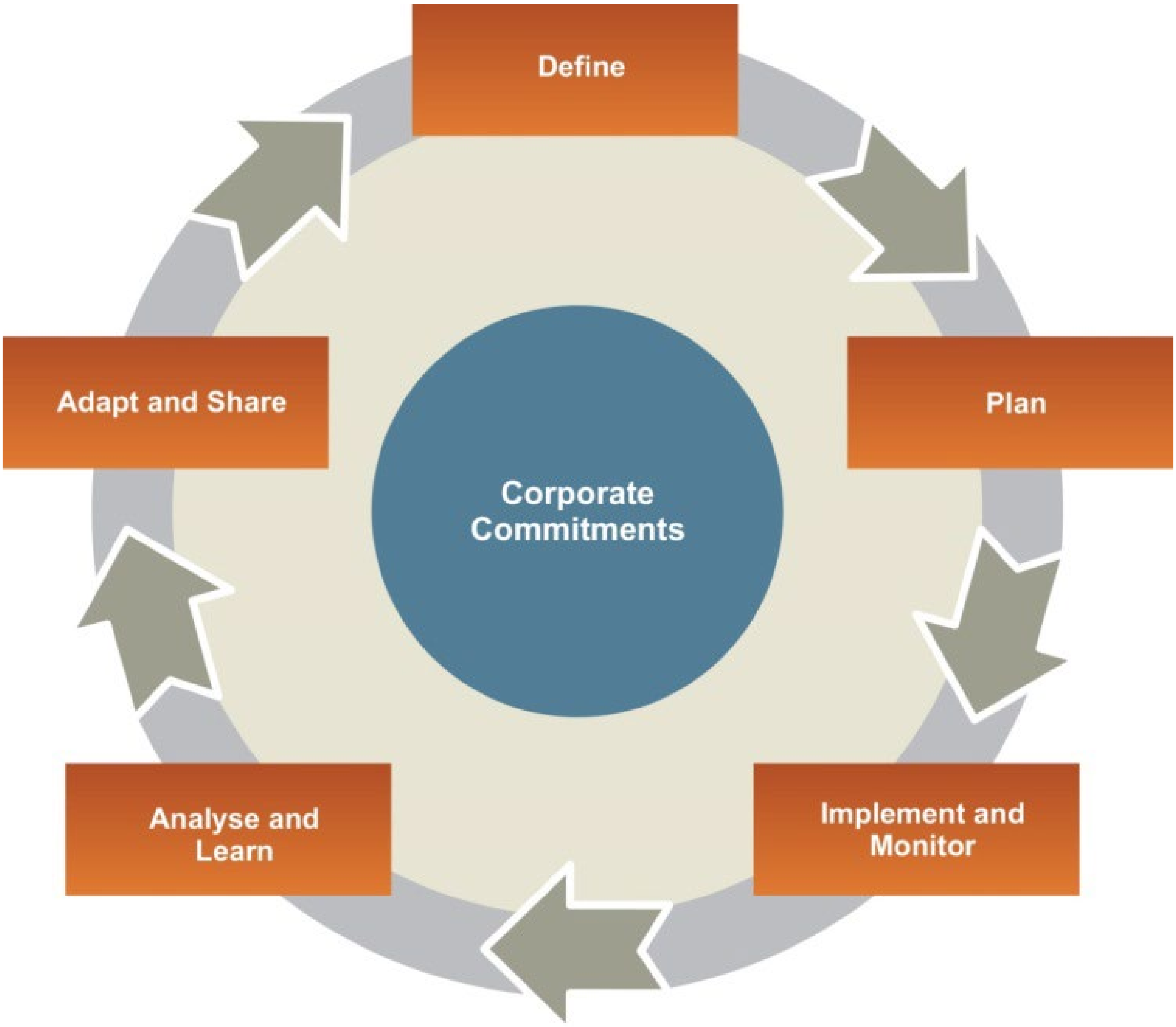


Figure 7-2 **Adaptive management cycle**

7.2 Risk management

Risk Management is an integral component of the BHP closure planning process. Risk management is undertaken to qualitatively and quantitatively guide the selection of closure options, assess specific risks and identify controls for the design and execution of closure projects.

In accordance with BHP's Corporate Alignment Planning process (BHP, 2023a) risk assessments are conducted for all of BHP's operations in order to prioritise and manage risks consistent with Australian Risk Management Standard Australian and New Zealand International Standards Organisation (AS/NZS ISO) 31000:2018 Risk Management – Principles and Guideline (Standards Australia, 2018).

The primary objective of BHP's risk assessment and management system is to minimise risk in all aspects of its operations, including closure planning. The risk assessment process for closure and the development of a risk profile are undertaken in accordance with BHP Our Requirements: Risk Management (BHP, 2023f) and the guidance included in DEMIRS (2020b) on environmental risk assessments for closure plans.

In the closure context, risk management processes include three main types of risk assessment:

- Closure planning risk assessment (health, safety, environment, legal, community, financial): a predominantly qualitative assessment (including stakeholder consultation) to identify mine closure risks and opportunities associated with closure and management strategies to preserve, maintain or enhance values or beneficial uses. These assessments also include consideration of post closure event risks (i.e., failure).

- Scientific risk assessments: scientific source, pathway and receptor risk assessment for environmental, ecological or human health risk involving technical specialists and quantitative assessment based on scientific data and information. For example, AMD risk assessments and ecological risk assessments.
- Construction / workplace risk assessments: as a closure project reaches execution, risk management is used to guide the effective management of risk in the execution phase.

Closure planning risk assessments are undertaken against closure scenarios to optimise the closure outcome. Mitigating unacceptable risks to a tolerable level may involve the development of control options against each of the risk factors, including the commissioning of additional technical studies and / or research. Such a process is iterative and is aimed at providing, on balance, the most appropriate closure outcome given the key risk drivers. Closure risks are reviewed annually at a minimum (BHP, 2023f) and are recorded and maintained in a closure risk register. As the mine closure strategy is developed, the risk assessments progressively mature with the increase in knowledge and information over the life of the mine.

Closure planning and construction risk assessments at BHP, involve people with a cross section of relevant knowledge and experience, including employees, contractors and other stakeholders. Stakeholders and specialists may be called upon to advise on aspect areas of significance or where in-house expertise is unavailable or unsuitable. Evaluation of identified risks is undertaken by the level of management that is consistent with the significance of the closure risk.

Scientific risk assessments are undertaken by specialists in the relevant field and are typically conducted to investigate the risks associated with a specific issue (e.g., significance of results from contaminated sites investigations) in more detail. The need for such investigations is identified through the closure planning process (i.e., review of knowledge base and closure planning risk assessments).

7.3 Change assessment

This section outlines the potential changes to surface water (Section 7.3.1.1) and groundwater (Section 7.3.1.2) flows / levels and qualities that will need to be managed during closure. Potential impacts to key ecohydrological receptors are outlined in Section 7.3.1.3. The closure implications of constructing the OB35 creek diversion and OB30 creek diversion (see Section 5.14) and the initial development of the mine voids were largely described in Revision 6 of this MCP. Therefore, only pertinent information is repeated in this section. Instead, this section is focused on potential changes resulting from the proposed expansion of the voids and OSAs that form the basis of the Significant Amendment approval (see Section 2.1.3).

7.3.1.1 Surface water

Potential impacts to surface water flows and quality are described separately in the relevant subsections below.

Change to surface water flows

Impacts to surface water flows can result from:

- Changes of surface water run-off where infrastructure or landforms intercept drainage lines;
- Natural creek sections located adjacent to pits which have the potential to capture and reroute drainage; and
- Surface water diversion / realignment structures.

Most of the OB29/30/35 Closure Plan Area sits within the Whaleback Creek catchment. BHP (IN DRAFT 2024) undertook a Surface Water Impact Assessment (SWIA) for the proposed expansion of Orebody 29/30/35 pits and OSAs and installation of the new OSAs and the new pipeline. The assessment determined that the new OSAs are outside of the 100-year flood extent and are in the upper reaches of the catchment. It also concluded that, combined with the expanded footprint of the mine pits and the existing OSA, the proposed expansion works would have a minimal impact on surface water availability based on estimated Fortescue River and Ophthalmia Dam catchment areas loss. A summary of the reduced catchment is provided in Table 7-1.

Table 7-1 Catchment area loss for OB 29/30/35

Landforms	Footprint Area (km²)			Reduction in Contributing Catchment^ (km²)		
	Existing	Proposed	Existing + Proposed	Existing	Proposed	Proposed
Pits	4.6	2.2	6.8	4.6	2.2	6.8
OSAs	-	1.3	1.3	-	0.9	0.9
Blocked catchment	0.8	-	0.8	0.8	-	0.8
Total	5.4	3.5	8.9	5.4	3.1	8.5

^ A catchment reduction of 0.7 applies to OSAs; 1.0 catchment reduction factor applied to partially backfilled pits and pit lakes.

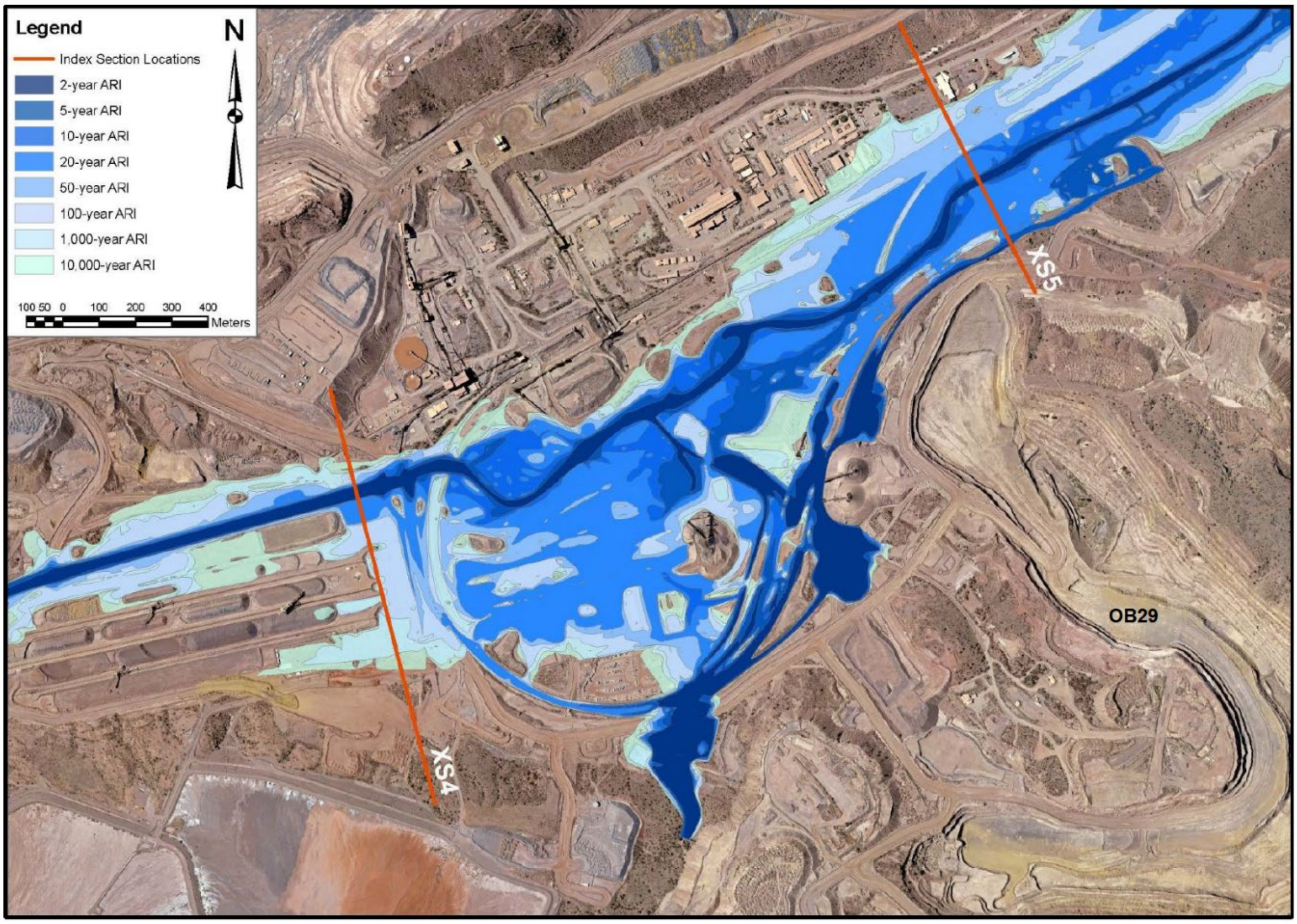
Source: BHP (BHP, IN DRAFT 2024)

The impact of changes to surface water availability during closure for the existing disturbance in the broader Whaleback Hub, plus the proposed additional disturbance associated with the Significant Amendment has been estimated to correspond to a 0.03%

reduction in the Upper Fortescue River catchment and is estimated to reduce the Coondiner Creek at Ophthalmia Dam Catchment by 0.28% (BHP, IN DRAFT 2024).

OB29

OB29 pit void only impacts a very small area of the Whaleback catchment and is not expected to require significant works at closure to manage surface water impacts. Although located relatively close to Whaleback Creek, the pit is located at a higher elevation and not subjected to flooding from the main creek (Figure 7-3). The catchment area directly intercepted by the mine workings and associated runoff volumes is not significant. Earlier modelling indicated bunding will be required to prevent capture of two small flow paths to the east of the pit (Aquaterra, 2006). Further modelling will be required to verify the location and size of these bunds for closure.



Source: MWH (2015)

Figure 7-3 OB29 flood extents

OB30

The main flood risk at OB30 is due to its close proximity to Whaleback Creek. The MWH (2015) hydraulic modelling showed that a 50-year event and above would spill into the pit. The OB30 creek diversion was subsequently constructed to manage the risk during operations. The SWIA (IN DRAFT 2024) found that the proposed expansion of OB30 will encroach on the 1 in 100 year flood level and further assessment will be required to determine the extent to which it encroaches on the 1 in 10,000 year flood extent as typically applied to closure designs.

As discussed in Section 5.14.6, the OB30 creek diversion will remain at closure and will require modifications to accommodate closure requirements. This will include construction of a floodplain and an increase in the height of some of the operational bunding. Preliminary modelling has shown that additional rock armouring, beyond what is used during operations will not be required.

OB35

A creek diversion has been installed at OB35 to manage risks associated with surface water flow. The current mine plan assumes that the OB35 creek diversion would remain post-closure. Features such as low flow channels have been incorporated into the design to allow the diversion to evolve into a natural system over time. It is therefore assumed that the current configuration of the OB35 creek diversion is suitable for closure. There is minimal additional disturbance at OB35 associated with the Significant Amendment and it is not expected to change the level of risk.

Changes to surface water quality

The main surface water quality risks from OB29 and OB35 are:

- Sediment laden run-off from OSAs (WAIO, 2018a), particularly while vegetation is establishing; and
- Erosion of the toes of OSAs from surface water flows.

The surface water environment at OB29/30/35 is subject to change as the mine develops (including changes to pit designs, construction of diversions and OSAs). In addition to this, neighbouring developments may also impact the surface water flows at OB29/30/35. Therefore, a reassessment of surface water drainage and OSA designs (including rock armour requirements) will be required as the site approaches closure.

As discussed in Section 5.3.2.3, the AMD risk associated with OB29/30/35 is very low and consequently, impacts to surface water from AMD would not be expected.

7.3.1.2 Groundwater

Open voids at the completion of below water table mining will result in the development of pit lakes that reach equilibrium on a balance of pit inflows and evaporation. These have the potential to impact local and regional groundwater levels.

Changes to groundwater levels

The current mine plan assumes that the below water table void at OB30 will remain open, OB29 will be partially backfilled in the south of the pit, but not above the water table, and OB 35 will be partially backfilled above the water table, with part of the void remaining below the water table. Given that the OB29/30/35 aquifer system is connected to that at Western Ridge, the mine void closure strategy for Western Ridge will influence the groundwater level outcomes from mining at OB29/30/35. The current preliminary mine plan for Western Ridge includes backfill of below water table pits through productive movement, however, this may be subject to change.

Modelling indicates that if all below water table voids (except OB35) were left open at closure, the net difference in flow from the west could be 7.1 to 9 ML/d post-closure and groundwater would reach equilibrium approximately 144 years after dewatering ceases at between (BHP, 2024b):

- 476 and 480 m AHD in OB29, and
- 480 and 483 m AHD in OB30.

If all voids were backfilled, groundwater levels are predicted to recover to pre-mining conditions (522 m AHD) about 219 years after dewatering ceases (BHP, 2024b). These two scenarios present ‘bookends’ that can be used to evaluate and guide closure strategies. If future modelling indicates an unacceptable impact, the residual void closure scenario for the combined OB29/30/35 (if approved) and Western Ridge mines will be reviewed.

Changes to groundwater quality

Pit lakes are likely to remain terminal groundwater sinks and consequently, the risk of impacts to groundwater quality is very low. Pit lakes will become more saline and metals concentrations will increase over time with the effects of evapo-concentration, but exposures of PAF are negligible and consequently the risk to pit lake quality from AMD is very low.

7.3.1.3 Impacts to eco-hydrological receptors

Riparian vegetation

Impacts to riparian vegetation, from groundwater drawdown due to dewatering during operations, are considered unlikely given the pre-mining depth to groundwater (Onshore Environmental, 2013b). The major riparian species in this region principally rely on vadose zone water that is periodically replenished by floods (Tetra Tech Proteus, 2020). The residual impacts to riparian vegetation from the OB29/30/35 development post-closure are expected to be minor since:

- The OB30 creek diversion has been designed to maintain similar hydraulic / flood characteristics to the original alignment and is designed with terraces where riparian vegetation can establish (9.2.3.2).
- Except along the land bridge section, the OB35 creek diversion design also includes terraces where vegetation would be encouraged to establish.

Groundwater resource

The Homestead and Ophthalmia borefields are not expected to be impacted by residual groundwater drawdown post-closure as (BHP, 2022):

- The Homestead borefield is north of the Whaleback fault, which behaves as a significant flow barrier.
- The Ophthalmia borefield is east of the model domain in the Ethel Gorge aquifer system, where there is expected to be limited connection.

It is expected that the OB29/30/35 pits will be groundwater sinks and consequently, no impact is expected to regional groundwater quality from these features.

Ethel Gorge TEC

Habitat for stygofauna is considered to be maintained by zones of permanent saturation in the shallow alluvial groundwater system. Over 40 years of monitoring data demonstrates that groundwater levels in this area fluctuate by up to 6 m in response to seasonal rainfall and runoff variations and that water quality has historically varied up to 2,500 mg/L TDS and current operational thresholds have been based on these ranges. The operational management triggers and thresholds are outlined in Table 7-2 and are considered precautionary.

Table 7-2 Ethel Gorge operational management trigger and threshold values

Receptor	Aspect	Monitoring and management values		
		Investigate (early warning trigger)	Action (trigger)	Mitigate (threshold)
Ethel Gorge Primary habitat monitoring zone	TDS	>2500 mg/L.	3000 mg/L or to be determined by Investigation Stage	4000 mg/L or to be determined by Action Stage.
	Change in water level	Aquifer water levels change 5 m[1] or a rate of 4 m/year.	Water levels change >6 m[1] or a rate of >4 m/year.	Water levels change >12 .m[1] or a rate of 8 m/year.
Early warning monitoring zone	TDS	Statistically significant increase by 20% from the interpreted seasonal baseline.	Statistically significant increase by 50% from the interpreted seasonal baseline.	-

Source: BHP (2018b)

[1]Note interpreted as the statistically significant aquifer response and change to water level in the Ethel Gorge primary habitat monitoring zone. Water level responses greater than the above thresholds may result from localised bore abstraction and these localised responses shall not bias the overall thresholds.

Drawdown during operations would not be expected to reach Ethel Gorge, with core habitat located approximately 7 km east of OB29/30/35, as the flow from the orebody aquifers to the regional aquifers to the east is constrained due to (BHP, 2022):

- A leaky flow barrier north-east of OB29 which reduces groundwater flow; and
- Possible changes in aquifer properties.

If drawdown impact to the regional aquifer north-east of OB29 did occur during operations, it is anticipated that it would be mitigated by the eastern mines surplus schemes and / or the passive effects of Ophthalmia Dam (BHP, 2022). The residual impact of leaving the OB29/30/35 voids open is expected to be low but will be further investigated during the mine life.

7.3.2 Knowledge gaps & forward work program

The mine void closure strategy for OB29/30/35 is under review and groundwater modelling may need to be revised to assess the final void configuration. Continued monitoring along the drawdown pathway will be required to confirm groundwater conceptual and numerical models.

As the OB29/30/35 mine approaches closure, surface water drainage conditions will need to be reassessed via updated modelling to take account of the final disturbance footprint at closure. These studies will inform closure designs including modifications to diversions and the need for rock armouring of constructed slopes.

7.4 Risk assessment

A closure planning risk assessment has been undertaken for the OB29/30/35 mining operations (Table 7-3). Participants included stakeholders within BHP with expertise in technical closure disciplines. In accordance with DEMIRS (2020b) guidance, the risks outlined in Table 7-3 only consider environmental risks. Within the definition of environment, BHP has also incorporated consideration of potential impacts to the community (e.g., in relation of safety of the site post-closure and impacts to amenity or sites of cultural significance). The approach taken to framing the risks in Table 7-3 is outlined in Section 7.4.1 and the risk matrix used to assess and prioritise risks is provided in Appendix I. Following ISO 31000 (Standards Australia, 2018), assessments of each risk consider the likelihood of a given level of consequences occurring rather than simply an assessment of the likelihood of an initiating event occurring (i.e., the initiating event **and** the assessed level of consequences occur). Worst case consequences would typically have extremely low likelihoods, whereas reasonably foreseeable consequences may have much higher likelihoods. In accordance with the BHP risk management standard (BHP, 2023f), the inherent risk assessment in Table 7-3 has typically assumed the maximum foreseeable loss and the residual risk assessment has typically assumed the reasonably foreseeable loss following application of controls.

Closure risks are reviewed annually at a minimum (BHP, 2023f).

Responsibilities for closure risk mitigation and management are addressed in BHP's internal processes and procedures. function (including; Mine Planning, Resource Modelling, Hydrology and Closure Planning teams) in conjunction with the Environment function's Rehabilitation and Biodiversity team, would lead integration of closure management requirements into the OB29/30/35 mining operations plan as part of the business planning process (as outlined in Section 1.4). The OB29/30/35 Mining Operations team would be responsible for implementing the plans.

Risk management measures will be refined progressively (in line with the adaptive management approach).

7.4.1 Approach to risk framing

The purpose of the closure risk assessment is to systematically identify those issues that require a closure design or management response and prioritise studies and design work to address those issues that will make a material difference to closure and stakeholder outcomes. Therefore, the way that the risks are framed, must meet these objectives and may require different approaches to be taken for different domains / features / aspects. This is so that an appropriate priority is assigned to key risks and that the outputs of the risk assessment can be used to frame an appropriate forward work program.

Table 7-3 is structured as follows:

- Column 1 outlines the Risk ID. This is used to link the risks with the completion criteria outlined in Section 8.3.
- Column 2 describes the risk event being considered and whether it is relevant to the inherent condition (i.e., current condition), or the closure condition (i.e., once closure controls have been applied).
- Column 3 identifies the domain(s) to which the risk applies.
- Following the Western Australian Biodiversity Science Institute (WABSI) guidance for completion criteria (Young, et al., 2019), Column 4 of Table 7-3 identifies those performance indicators / completion criteria that are relevant to each risk, to assist in identifying the importance of each set of criteria.
- Column 5 outlines the contributing causes to each risk event.
- Column 6 outlines the potential impact to receptors and provides links to sections of the MCP that describe potential impacts in more detail.
- Columns 7 to 9 provide the inherent risk ratings (relevant to the condition being assessed).
- Column 10 outlines the risk controls. These include controls implemented during planning as well as the measures incorporated into the designs outlined in Section 9. Links are provided to those sections within the MCP that describe the studies conducted during the planning phase to reduce residual risks.
- Columns 11 to 13 provide the residual risk ratings.

Column 14 summarises the improvement activities incorporated into the forward work program in Section 13.3.

Table 7-3 OB29/30/35 closure and rehabilitation issues identified

Risk ID	Risk Event (Source & Pathway)	Domain & features	Indicator / criteria	Causes	Impact to Receptors	Inherent Risk – Consequences	Inherent Risk – Likelihood	Inherent Risk – Risk	Controls (Treatment)	Residual Risk – Consequences	Residual Risk – Likelihood	Residual Risk – Risk	Improvement Activity
1.	Erosion or weathering event exposes buried waste rock and releases waste rock and / or sediment onto downslope areas.	OSAs	C3.4 C5.2	• Inadequate materials characterisation. • Mine planning schedules do not consider waste destination based on waste material characteristics. • Competent material is not identified and segregated for use in rehabilitation, where required. • Insufficient quantity of competent waste available for armouring. • Final landform design is not suited for the materials from which it is constructed. • Parameters used in surface water controls / erosion modelling do not reflect conditions under a climate change scenario. • OSA is located within the 1 in 10,000-year flood plain or flood event is incorrectly calculated. • Landform is not constructed to design.	• Failure of vegetation on eroded OSA areas. • Sediment load may enter Whaleback Creek, but no significant impact would be expected to the Fortescue River (Ethel Gorge area). • Sediment scars local downgradient vegetation, but there are no threatened species. • Impact to visual amenity along drainage lines.	3	Probable	Moderate	• Inert waste class coding is included within the mining model. • Materials characterisation (Section 5.3.2.4). • Segregation of competent hard cap waste at OB29/30/35 and competent waste stratigraphies at Whaleback (Section 5.3.3). • The Mines Closure Design Guidance Procedure (WAIO, 2022f) informs OSA design. • Landform design is based on materials characterisation and the outcomes of erosion modelling • Internal Design Review Process enables verification that closure design guidance has been incorporated into mine plans. • Assessment of compliance to plan • Rehabilitation works include construction supervision and post-construction inspections • Surface water modelling and construction of controls to prevent impacts to the stability of OSAs during extreme flood events. This could include rock armouring of the toes of OSAs, modification of diversions or the construction of additional surface water flow controls	2	Unlikely	Very low	• Ongoing review of competent waste balance taking into account Whaleback and OB29/30/35 deposits • Review and revision of landform designs following changes to OB29/30/35 mine plans, adjacent mining developments, and construction of creek diversions • Upgrade OB30 creek diversion to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments
2.	Geotechnical instability causes global failure of OSA into pit or adjacent land area.	Voids	C3.2	• Inadequate waste characterisation. • Mining planning schedules do not consider waste destination based on waste material characteristics. • OSA is located within the zone of instability of the pit. • OSA is located within flood zones that undermine the toe of the landform. • Landform is not constructed to design.	• Visual impact of failed area. • Failure of OSA compromises measures for preventing inadvertent access and leads to third party injury or fatality. • Failed area enters Whaleback or Southern creeks and impedes flow. *Note: the potential for fatalities or injury have been assessed under Risk 11. and is excluded from this assessment*	4	Probable		• Pit wall stability assessments • Where landforms are located within the zone of instability of the pit, consideration will be given to buttressing pit walls, backfill of the pit or relocation of the landform. In the case of the OB29 South OSA, the OSA will be extended as backfill into the south end of the OB29 pit • Where flood events could impact the stability of OSAs post-closure, measures for maintaining stability will be implemented which could include rehandling portions of the OSA out of the flood plain, rock armouring of the toes of OSAs, modification of diversions or the construction of additional surface water flow controls • Material from the OSA 1 that lies within the 1 in 10,000-year flood plain will be relocated or the surface water diversion for closure modified • Residual mine voids will be left in a geotechnically stable state and, where pit walls do not achieve stability completion criteria (static FoS ≥1.5), buttressing may be considered • Geological model (highlights fault zones) • Geotechnical pit model informs pit design • The Internal Design Review Process identifies pit setbacks and enables verification that closure design guidance has been incorporated into mine plans • Compliance to plans is assessed and rehabilitation works include construction supervision and post-construction inspections	3	Highly unlikely	Very low	• As the site approaches closure: - Conduct detailed pit wall stability assessments and identify the need for controls such as buttressing (Section 5.5.2). - Develop closure designs for creek diversions taking into account the disturbance footprint at closure

Risk ID	Risk Event (Source & Pathway)	Domain & features	Indicator / criteria	Causes	Impact to Receptors	Inherent Risk			Controls (Treatment)	Residual Risk			Improvement Activity
						Consequences	Likelihood	Risk		Consequences	Likelihood	Risk	
3.	AMD release from PAF within OSAs / ISAs or low-grade stockpiles remaining at closure that impacts groundwater and or surface water quality.	OSAs / ISA	C3.3 C5.2 C5.4	• Inadequate materials characterisation. • Mine planning schedules to not consider waste destination based on waste material characteristics. • Landform and PAF placement are not in accordance with designs.	• The AMD source hazard associated with the OB29/30/35 operations is low. There is predicted to be no AMD 1 waste or low-grade ore and only minor volumes of AMD 2 and 3 (Section 5.3.2.3). • The potential for saline and neutral metalliferous drainage to occur is also low (Section 5.3.2.3). • Impacts to groundwater and surface water quality are, therefore, expected to be low. *Note consequence has been rated based on the waste from the OB29 pit as this presents the highest source hazard.*	2	Unlikely	Very low	• Materials characterisation information is incorporated into mining models • Geochemical testing and AMD risk assessment conducted (Section 5.3.2.3). • Management of mined AMD 2 and 3 materials to minimise the potential for AMD generation; generally comprising placement within OSAs such that there is 10 m of inert waste between these materials and the surface of the OSA • WAIO standards and procedures - AMD Management Standard (WAIO, 2022a). - BHP Global AMD Management Standard (BHP, 2021e). - Reactive Ground and AMD Potential: Mining Design and Dumping Procedure (WAIO, 2022c). - Reactive Ground and associated gases Procedure 0129611 (WAIO, 2024b). - Mines Closure Design Guidance Procedure (WAIO, 2022f) outlines the framework for reactive waste management. - Preliminary AMD Risk Assessment Procedure 0132980 (WAIO, 2022b). - Rehabilitation Planning and Execution Procedure (WAIO, 2023d). • Assessment of compliance to plan • Pre-closure monitoring including monitoring of surface water and groundwater (Sections 10.1.5, 10.1.7 and 10.1.8).	2	Highly unlikely	Very low	Further geochemical investigations (as required) including (Section 5.3.4): • Geochemical testing of Tertiary Detritals. • Leach testing of key stratigraphies. • Assessment of the geochemical hazard of high sulphur NAF waste to gain a better understanding of the potential for neutral metalliferous drainage.
4.	Impact to pit lake quality from AMD	Void	C3.3 C6.1	• Pit wall exposure of PAF material causes AMD that impacts pit lake quality.	• The AMD source hazard assessment shows that predicted pit wall exposures of PAF material are negligible and present a very low risk (Section 5.3.2.3). • Migratory fauna that may use anthropogenic water bodies have been detected in the area (Section 5.8.2).	2	Unlikely	Very low	• Geochemical testing and AMD risk assessment conducted (Section 5.3.2.3). • WAIO standards and procedures - AMD Management TPI (WAIO, 2022a). - BHP Global AMD Management Standard (BHP, 2021e). - Mines Closure Design Guidance Procedure (WAIO, 2022f). - Preliminary AMD Risk Assessment Procedure 0132980 (WAIO, 2022b).	2	Highly unlikely	Very low	-
5.	Change to groundwater levels from open voids at OB29/30/35 has unacceptable impacts at key receptors.	Voids	C5.3	• Evaporation from open voids draws down groundwater levels. • Inadequate understanding of hydrogeology and / or inadequate sensitivity testing within predictive assessments (e.g., climate scenarios, regional cumulative impacts). • Ophthalmia Dam removal reduces groundwater recharge to Ethel Gorge.	• Modelling indicates if all below water table voids at OB29/30/35 (including potential cumulative impacts from Western Ridge) were left open at closure, the net difference in flow from the west could be 7.1 to 9 ML/d, and if all voids were backfilled, groundwater levels are predicted to recover to pre-mining conditions after about 350 years (Section 5.9.2.6). • The current base case for closure of OB29/30/35 is that voids be left open post mining. The current preliminary mine plan for Western Ridge includes backfill of below water table pits through productive movement, however, this may be subject to change (Section 7.3.1.2). • Impacts to riparian vegetation are considered unlikely given the pre-mining depth to groundwater (Section 7.3.1.3). • Impacts to borefields and Ethel Gorge are considered unlikely due to limited connection with OB29/30/35 (Section 7.3.1.3).	4	Unlikely	Moderate	• Conceptual and numerical groundwater modelling inform pit closure strategy and assessment of impacts on ecohydrological receptors • Pits will be backfilled to above the water table if unacceptable impacts are identified from groundwater modelling • Eastern Pilbara Water Resource Management Plan • Newman Potable Source Protection Plan • Pre-closure monitoring including monitoring of groundwater enables groundwater modelling to be refined (Sections 10.1.5 and 10.1.8).	4	Highly Unlikely	Low	• Refinement of conceptual and numerical groundwater models based on monitoring of the drawdown pathway during operations. • Refinement of mine void closure strategies based on updated groundwater modelling and mine plans.

Risk ID	Risk Event (Source & Pathway)	Domain & features	Indicator / criteria	Causes	Impact to Receptors	Inherent Risk			Controls (Treatment)	Residual Risk			Improvement Activity
						Consequences	Likelihood	Risk		Consequences	Likelihood	Risk	
6.	Impact to groundwater quality from pit that becomes a temporary through flow system.	Voids	C3.2 C5.1 C5.4	• Failure of creek diversions or pit walls captures creek and results in surface water runoff events that cause pit lake levels to rise to the level of surrounding groundwater and allow temporary through flow. • Temporary through flow systems may release salinity and metals from evapo-concentration of solutes in pit lake water to surrounding groundwater.	• In the event that pit lakes become temporary through flow systems, there is the potential for localised impact to groundwater quality. However, there is limited connection to receptors (Section 7.3.1.3) and the effect would be temporary (as the pits are sinks) so the impacts would be expected to be very low.	1	Likely	Low	• Pit wall and land bridge stability assessments inform closure designs • Creek diversions will be designed for closure conditions to prevent uncontrolled release of surface water to mine voids • Surface water assessment and modelling to inform closure strategy, including sensitivity testing • Geochemical testing and AMD risk assessment conducted	1	Unlikely	Very low	• Upgrade OB30 creek diversion to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments • Conduct detailed mine void stability analysis to determine whether stability controls such as backfilling or buttressing need to be incorporated to prevent failure of creek diversions post-closure
7.	Surface water flow off-site does not meet acceptable limits.	Creek Diversions	C3.2 C5.1	• Inadequate flood protection results in creek capture. • Final creek diversion design is inadequate to manage flows post-closure. • Creek diversions fail due to erosion caused by selection of inappropriate construction materials or inadequate materials characterisation. • Inadequate modelling of post-closure surface water flows (e.g., regional cumulative influences poorly accounted for) or inadequate sensitivity testing (e.g., to accommodate climate change).	• Southern Creek or Whaleback Creek capture results in moderate decline of flora and fauna values downstream (including Ethel Gorge) and impacts to Traditional Owner values.	3	Probable	Moderate	• Surface water assessment and modelling to inform closure strategy, including sensitivity testing • The OB30 and Phase 2 Southern Creek (if constructed) diversions will be upgraded to accommodate closure conditions (1 in 10,000 AEP) to prevent uncontrolled release of surface water to mine voids • Materials characterisation informs construction materials selection • Stability controls for pit walls (such as buttressing or backfill) may be considered where there is the potential for pit wall stability to threaten the integrity of surface water control structures (creek diversions) • Stability modelling for the 'land bridge' section of the Phase 2 Southern Creek diversion shows that stability achieves a FoS of >1.5 • Internal Design Review Process to verify that closure design guidance has been incorporated	3	Highly unlikely	Very low	• Conduct studies to inform the operational creek diversion designs and requirements for closure upgrades including (Section 5.14.6): - Monitoring of rainfall and surface water flows. - Monitoring of diversion performance. - Confirming the location and suitability of construction materials. - Assessing the potential to intersect PAF during construction. - Investigating the foundations of flood bunds. - Investigating operations to improve channel morphology. • Review and revise surface water modelling as the site approaches closure to take account of changes due to the construction of creek diversions (and associated upgrades) and changes to drainage characteristics resulting from final landform designs and adjacent mining developments • Upgrade OB30 creek diversions to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments • Conduct detailed mine void stability analysis to determine whether stability controls such as backfilling or buttressing need to be incorporated to prevent failure of creek diversions post-closure (Section 5.5.2).

Risk ID	Risk Event (Source & Pathway)	Domain & features	Indicator / criteria	Causes	Impact to Receptors	Inherent Risk			Controls (Treatment)	Residual Risk			Improvement Activity
						Consequences	Likelihood	Risk		Consequences	Likelihood	Risk	
8.	Rehabilitation values do not achieve ecological criteria.	OSAs, Pits backfilled to surface	C4.1 C4.2 C4.3 C4.4 C4.5	• Lack of topsoil or suitable alternate growth medium for establishing and sustaining native vegetation. • Incorrect species selection or viable correct provenance seed unavailable for seeding at completion of earthworks. • Limited seed available in growth media applied to project area. • Poor or no germination / establishment following seeding. • Climate change and prolonged periods of drought during crucial growth phases. • Wildfire impacts during crucial growth phases or above average fire frequency post establishment. • Excessive weed infestation displaces native species. • Feral animals. • Return of fauna habitat is not considered in rehabilitation plans. • Rehabilitation earthworks are not executed to standard or as defined in the project work pack. • Landform failure (see Risks 1. and 2.). • Third party activities on the land are outside the closure design parameters.	• Impact to surrounding native vegetation communities through uncontrolled weed spread (invasive species). • Potential impact to post-mining land use. • Minor visual amenity impacts e.g., dust. • Return of fauna delayed due to lack of habitat.	3	Probable	Moderate	• Topsoil reconciliation and waste characterisation for use as growth media (Section 5.4). • Progressive rehabilitation and associated monitoring and feedback loops • Growth media trials (Appendix G). • Rehabilitation implemented in accordance with: - Rehabilitation Standard (WAIO, 2023f). - Rehabilitation Planning and Execution Procedure (WAIO, 2023d). - Management of Topsoil and Growth Media Procedure (WAIO, 2024a). - Seed Management Procedure (WAIO, 2022d). - Weed Management Procedure (WAIO, 2020). • Research by the Botanic Gardens and Park Authority and the University of Western Australia on rehabilitation (Appendix G). • Use of local provenance seed	2	Unlikely	Very low	• Investigate locations which may be available for rehabilitation / landform trials • Further assessment of the plant growth potential of alternate growth media (Sections 5.4.6
9.	Impact to visual amenity post-mining.	All	C3.1	• Key stakeholders are not identified and included in consultation program. • Post-mining visual performance objectives and completion criteria are not informed by key stakeholders or unrealistic completion criteria are agreed to. • Landform failure (see Risks 1. and 2.) • Vegetation fails (see Risk 8.) • Rehabilitation earthworks not executed to standard or as defined in the project work pack.	• Impact to community amenity. Visual impacts during operations have been assessed as low, but as the land use context changes, the perception of visual impacts may change (Section 5.11).	2	Likely	Moderate	• Where visual impact is a key concern, options for managing visual impacts post-closure will be incorporated into designs following consultation with stakeholders • WAIO Closure and Rehabilitation Management Strategy (WAIO, 2016). • WAIO Rehabilitation Standard (WAIO, 2023f).	2	Unlikely	Very Low	Consultation with stakeholders (Section 4.24.2). Consider the visual impacts of post-closure landforms during the detailed design phase (Section 5.11.1)

Risk ID	Risk Event (Source & Pathway)	Domain & features	Indicator / criteria	Causes	Impact to Receptors	Inherent Risk Consequences	Inherent Risk Likelihood	Inherent Risk Risk	Controls (Treatment)	Residual Risk Consequences	Residual Risk Likelihood	Residual Risk Risk	Improvement Activity
10.	Traditional Owner values not achieved post-mining.		C7.1	• Key Traditional Owners are not identified or consulted. • Earthworks on closure landforms impact heritage sites. • Visual aspects of landforms or other aspects of closure designs impact on cultural values. • Access to key areas of country post-mining, including to significant sites, is not possible or has not been adequately considered in closure designs. • Landform failure (see Risks 1. and 2.). • Excessive weed infestation displaces native species (see Risk 8.). • Cultural Heritage Management Plan commitments (e.g., repatriation of cultural artefacts) are not adequately met at closure.	• Impact to Traditional owner values.	3	Probable	Moderate	• Consultation with Traditional Owners to develop closure strategies to address heritage and cultural values which could include, but not necessarily be limited to (Sections 4.2, and 9.1.6): - Closure landform designs. - Maintaining access to sites of significance. - Repatriation of artefacts. • Archaeological and ethnographic surveys (Sections 5.12). • Consultation program (Sections 4.2) • Closure execution activities to be approved through PEAHR process (Section 9.1.6).	2	Unlikely	Very low	Consultation with Traditional Owners (Section 4.2).
11.	Site safety measures fail or are inadequate at closed site or pit.		C2.1	• Public curiosity / interest in closed mine sites results in the deliberate breach of well controlled security measures. • Security measures are not in place (fence, gate, signage, abandonment bunds) or are not inspected and maintained. • Security measures are inadequate or ineffective. • Inadequate community engagement. • Inadequate infrastructure removal planning and / or execution to plan. • Leaving behind attractive features (pit lakes, high walls, tyre dumps, scrap metal yards) not planned for public access. • Abandonment bund failure caused by: - Incorrect location (e.g., near pit wall unconsolidated material) which is inconsistent with DEMIRS Guidelines. - Inappropriate design (e.g., climate change or closure time frames not considered, or pit wall not geotechnically stable due to a negative influence of the pit lake water level). - Final pit wall and abandonment bund not built to design or plan. • Uncontrolled access to potential hazards such as fibrous material (e.g., fibrous materials are released due to erosion).	• Minor environment impacts from illegal dumping of materials / items (i.e., abandoned vehicles etc). • Community injury or fatality arising from uncontrolled access to mine void or other hazardous area.	4	Probable	High	• Design and install reasonable duty of care control measures including abandonment bunds conforming to DEMIRS guidance (DoIR, 1997) and the outcomes of recent consultation with DEMIRS on abandonment bunds (Sections and 9.2.2). • Materials characterisation information is incorporated into mining models (Section 5.3.2) • Pit wall stability assessments inform abandonment bund locations (Sections 5.5.2) • Geological model (highlights fault zones) • Geotechnical pit model informs pit design • Residual mine voids will be left in a geotechnically stable state and, where pit walls do not achieve stability completion criteria (static FoS ≥1.5) or will not allow abandonment bunds to be located outside the zone of instability, buttressing may be considered. • Regular monitoring and maintenance of security measures during the post-closure monitoring and maintenance period (Section 10.1.10). • Infrastructure not being transferred to a third-party post-closure will be removed (Section 9.2.4). • Final landform design engineering to allow for sustainable safe access to places of agreed Traditional Owner significance and to accommodate the post-mining land use. • Mines Closure Design Guidance Procedure (WAIO, 2022f) includes guidance on abandonment bunds). • Internal Design Review Process. • Assessment of compliance to plan. • Fibrous material will be covered by 1 m of inert (non-fibrous) waste.	4	Very unlikely	Low	• Detailed slope stability analysis and assessment of potential interactions with surface water diversions to inform final abandonment bund locations for mine voids remaining at closure (Sections 5.5.2). • Consultation with stakeholders on post-closure land use requirements and safe access (Section 4.2). Within 5 years of site closure, develop detailed decommissioning and demolition plans for site infrastructure not required to be transferred to third parties (Section 9.2.4)

Risk ID	Risk Event (Source & Pathway)	Domain & features	Indicator / criteria	Causes	Impact to Receptors	Inherent Risk			Controls (Treatment)	Residual Risk			Improvement Activity
						Consequences	Likelihood	Risk		Consequences	Likelihood	Risk	
12.	Land condition is not suited to the post-closure land use.		C1.1 C1.2 C1.3	• Key stakeholders are not identified or included in the consultation program. • Performance criteria for post-closure land use are not agreed with key stakeholders or unrealistic criteria are agreed to. • Infrastructure transferred to third parties does not meet agreed condition. • The long-term active management requirements for the site are beyond those required to manage adjacent land with a similar land use.	• Potential impact to agreed post-closure land use. *Note: risks above identify risks to specific closure objectives (e.g., revegetation, stability, water quality). This risk is specifically focused on impacts likely to arise as a result of failing to consult, remaining infrastructure condition and post-relinquishment active management requirements.*	3	Probable	Moderate	• Consultation with key stakeholders to inform post-mining land use performance objectives and completion criteria (Section 4.2). • Assessment of infrastructure condition prior to transfer. • Identification of land management requirements through post-closure monitoring and maintenance program (Section 10).	2	Unlikely	Very low	Consultation with post-mining landowners / managers (Sections 4.2)
13.	Identified areas of contamination are not remediated during operations.		C6.1	• Contaminated sites are not identified, assessed and remediated during operations. • Incomplete recovery of known contamination or ineffective remedial measures. • Poor hydrocarbon / chemical management during closure execution	• Potential for localised groundwater contamination. • Regionally groundwater would not be expected to show an increase in contaminants due to attenuation and dilution. • Potential impacts to Newman potable water supply and Ethel Gorge aquifers considered unlikely due to the Whaleback Creek flow barrier, constrained flow to the east of OB29 and distance of bores (>15 km) from the OB29/30/35 closure planning area).	2	Probable	Low	• WAIO Contaminated Sites Register and risk-based schedule for investigation (Sections 5.10 and 9.1.8). • Remediation of known contamination (including PFAS) as required (Sections 5.10 and 9.1.8).	2	Unlikely	Very low	Investigation of suspected contaminated sites (Section 5.10.1). Remediate known contamination (including PFAS) as required (Section 5.10.1).

8 Closure outcomes and completion criteria

In line with BHP's Charter, we demonstrate environmental responsibility by minimising environmental impacts and contributing to enduring benefits to biodiversity, ecosystems and other environmental resources.

8.1 Closure and rehabilitation standards

BHP employs its Closure and Rehabilitation Standards (WAIO, 2023f; BHP, 2021b) to provide a consistent approach for closure and rehabilitation across its Pilbara sites. The Closure Standard provides the overarching framework for the development of the mine closure strategy and supporting closure provision. The Rehabilitation Standard provides the overarching framework for successful rehabilitation of areas impacted by BHP's operations in the Pilbara.

8.2 Closure outcomes and guiding principles

BHP's closure and rehabilitation objective is to:

> *Develop a safe, stable, non-polluting and sustainable landscape that is consistent with key stakeholder[22] agreed social and environmental values and aligned with creating optimal business value.*

To guide the development and implementation of mine closure and rehabilitation for the Pilbara operations, BHP has established a set of guiding closure principles which are applied to the OB29/30/35 mining operations:

- **Informed planning and design**: rehabilitation and decommissioning requirements are considered at a mine deposit and regional scale, upfront and integrated into mine plans to achieve optimal business value and a sustainable post-closure land use.
- **Sustainable post-closure land use**: post-closure land use and rehabilitated areas meet stakeholder expectations and consider the following:
  - Local land management practices;
  - Ongoing management requirements (e.g., roads and tracks);
  - Closure landform integration, including visual impacts, landform stability (physical and geochemical) and hydrological regimes;
  - Local baseline conditions (e.g., flora, vegetation, fauna and fauna habitat);
  - Ecosystem resilience in terms of flora, vegetation, fauna, and surface and groundwater hydrology;
  - Infrastructure transfer or decommissioning;
  - Management or remediation of contaminated sites; and
  - Amenity.
- **Safety**: All mine rehabilitation and decommissioning is planned so that the risks to health and safety of people within BHP's area of influence are minimised. Unauthorised public access risk will be managed through the implementation of controls in accordance with regulatory requirements and consideration of industry guidance.
- **Effective stakeholder engagement**: transparent and proactive stakeholder engagement occurs for all planned activities that may impact surrounding communities, including consideration of communities impacted by closure.

Rehabilitation and revegetation activities undertaken at OB29/30/35 will be targeted at the post closure land uses described in Section 6 and developed to function in line with the two or three star outcomes as described in the National Standards for Ecological Restoration (SERA) (2021), meaning the rehabilitation outcomes will: reinstate a level of ecosystem functionality on degraded sites where ecological restoration is not the aspiration, as a means of enabling ongoing provision of ecosystem goods and services. This is consistent with the SERA (2021) definition of a rehabilitated outcome and the level of landscape disturbance at OB29/30/35.

The closure objective and guiding closure principles provide the foundation for developing site specific completion criteria for the OB29/30/35 mining operations as outlined in Section 8.3.

8.3 Completion criteria

Completion criteria are defined in the DEMIRS (2021) Mine Closure Completion Guideline as *providing the basis on which successful rehabilitation and mine closure are determined and so enable formal acceptance that rehabilitation and closure obligations agreed to in an approved MCP have been met.* The DEMIRS guideline has been developed for rehabilitation and closure obligations under the *Mining Act 1978 (WA)*.

[22] Key stakeholders refers to post-mining landowners or managers and relevant regulators (DMIRS, 2020a; 2020b)

The process of 'completion' is a pre-cursor to, but separate from, the process to relinquish or surrender tenure (discussed further in Section 10.4). Once completion has been achieved, monitoring, inspection and any maintenance activities can be reduced from those necessary to achieve and demonstrate completion and would be commensurate with those required post-relinquishment. Following completion or withdrawal of a Ministerial Statement under the EP Act, DEMIRS / DWER can also determine that submission of AERs and MCPs is no longer required. The DEMIRS (2021) guideline provides for progressive completion reporting and sign-off as portions of mine disturbance are rehabilitated and completion criteria achieved. Given the long life of OB29/30/35 within the Newman Hub, the timeframe between completion of certain areas and relinquishment of tenure may be significant if mining activities are still occurring on parts of the tenure. Section 10.4 deals with completion reporting and relinquishment and the intervening period (referred to as post-completion).

Several terms have been used in this section to define the time between operations and completion as follows:

- Operations refers to the time when active mining or processing operations are occurring. Most of the planning for closure occurs during this time.
- Execution refers to the phase where closure and rehabilitation activities are conducted. Progressive closure execution may occur during the operational phase following cessation of mining / processing in a particular area.
- Post-closure refers to the time following execution of closure and rehabilitation where the success of closure and rehabilitation is being monitored and maintenance / rectification of areas not on track to meet completion criteria might occur.
- Completion refers to the time where achievement of completion criteria can be demonstrated and sign-off achieved.
- Post-completion refers to the period following completion but prior to relinquishment of tenure.

Completion criteria are the measures against which implementation of the closure objective and guiding principles can be assessed. BHP continues to actively review and improve its completion criteria based on new information and techniques. Recent studies informing completion criteria include a review of vegetation completion criteria by Syrinx Environmental (2019; 2023) and guidance on acceptable erosion rates for landforms in the Pilbara by Landloch (2018). The criteria developed by Syrinx and Landloch have been incorporated into those presented in Section 8.3. The full suite of criteria will be further refined based on new knowledge gathered during the life of the mine, and these refinements will be presented in future iterations of this plan.

In recognition that progressive closure is desirable to reduce the impacts of mining, BHP closes and rehabilitates landforms where this is practical and can be accommodated within mine plans. As discussed above, completion criteria will be refined over the life of mine. The completion criteria applicable to landforms rehabilitated at various times may, therefore, be different as criteria change in response to new knowledge.

8.3.1 Approach

BHP recognises that closure outcomes are controlled by planning, design and execution activities. BHP's criteria, therefore, include both leading indicators describing the activities and designs necessary to achieve desired outcomes (e.g., landforms have been designed and constructed to take account of waste characteristics affecting stability), as well as lagging indicators (completion criteria) which describe closure outcomes to be achieved (e.g., total hummock grass cover to be 14-25%).

Closure and rehabilitation objectives and criteria are based on the land uses applicable to a particular area, in recognition of the fact that the land is altered fundamentally from its pre-existing condition. The completion criteria for the OB29/30/35 mining operations are based on the provisional post-mining land use of *natural environment for managed resource protection* in line with the underlying tenure.

The purpose of the completion criteria is to ensure areas will display self-sustaining characteristics suitable to the post-mining land use and give government regulators confidence that, to the maximum possible extent, they can be managed in the long term according to the intended land use (or uses), using normal management practices without the input of additional resources.

The criteria outlined in Section 8.3.2 apply to the most common rehabilitated landforms. They do not apply in some specific or unusual circumstances, or where post-closure land uses other than natural environments for managed resource protection and / or grazing are required. Circumstances may arise whereby unusual landforms are restored that may require additional completion criteria or different thresholds. These include instances where impacts encroach on unique vegetation and hydrologic systems (e.g., riparian areas, mulga woodlands) or specially valued ecological communities (e.g., TECs, PECs). The vast majority of impacts by BHP's mining operations avoid these requirements. The completion criteria outlined in this document are foundation completion criteria, which should form the minimum applicable completion criteria to all BHP rehabilitated land.

The criteria outlined in Section 8.3.2 have been divided into three stages. The first two stages are performance indicators that are aimed at providing assurance that completion criteria will be met and guide appropriate planning and execution of closure:

- **Stage 1 Planning**: Describes criteria that must be met to confirm that the necessary planning and operating procedures have been developed and agreed with regulators and other stakeholders.
- **Stage 2 Execution**: Describes criteria that must be met to confirm that rehabilitation operations have been implemented according to the above agreed planning and operating procedures. The assessment method for this will be by reviewing and auditing closure execution records, and site inspections as required.

The **Stage 3 Completion Criteria** are the criteria which, when met, indicate that closure and rehabilitation has achieved an acceptable standard and is suitable for the agreed post-closure land use. These are the criteria that will be measured to support an application for relinquishment.

It should be noted that for older rehabilitation, it may not be possible to assess some (perhaps many) of the planning and execution criteria.

In line with the WABSI completion criteria framework (Young, et al., 2019), BHP has correlated the inherent risk ratings relevant to each set of criteria to assist in prioritising focus on those criteria of most importance.

8.3.2 Completion criteria and performance indicators

The completion criteria for the OB29/30/35 mining operations are presented in Table 8-1. For clarity, column headings are designed to broadly align with WABSI guidelines (Young, et al., 2019) for completion criteria and are defined as follows:

- **Aspect:** A key theme or element of rehabilitation that needs to be addressed in order to meet closure objectives.
- **Criterion objective:** The purpose or objective of the particular criterion. As defined in Young et. al, (2019), the closure objective provides a clear indication on what the proponent commits to achieve at closure.
- **Risk ID:** Refers to the Risk ID in Table 7-3, Section 7.4. Where more than one risk relates to a particular set of criteria, this has been shown in the Risk ID column, and the specific domains to which each risk relates are outlined in the adjacent domain column. The colour coding relates to the colour coding used in Table 7-3 for the inherent risk rating, i.e.,

High	Moderate	Low	Very Low

- **Domain:** Areas of similar operational land uses and closure requirements. Additional information relating to closure implementation for each closure domain is provided in Section 9.2.
- **Performance Indicator**: A level of performance through planning and execution that provides assurance that completion criteria will be met.
- **Completion Criteria:** A defined standard or level of performance that can be objectively verified and demonstrates successful closure of a site for a particular objective.
- **Verification Procedure:** The method used to confirm that the identified standard for the criterion has been achieved. As outlined by DEMIRS (2021), verification may rely on quantitative measurements or could be a process of certification, for example, compliance with an approved design. Verification processes have been identified for the planning, execution and completion phases of closure. The completion phase is the phase during which a completion report would be developed to support sign-off against completion criteria in accordance with DEMIRS (2021).
- **Monitoring Method:** The monitoring method column cross references the relevant section of the MCP that describes the monitoring methods that will be applied to assess achievement of each completion criterion.

Consistent with the WABSI completion criteria guidance (Young, et al., 2019), completion criteria can incorporate qualitative measures as well as quantitative numerical targets. Young et. al (2019), identifies three types of criteria which have been used in the development of the criteria outlined in Table 8-1:

- P - installed / built as planned. For example, habitat features have been installed / constructed as planned / designed.
- C - categorical - a feature is present or absent, or an activity has been achieved or not. For example, overburden materials with adverse geochemical properties are not exposed on OSAs.
- Q - quantitative - the attribute can be measured and compared against a numerical target. For example, total hummock grass cover to be 14-25%.

The qualitative categorical and installed / built as planned criteria can be measured by audit, inspection or survey whereas quantitative criteria would typically be measured through a specific environmental monitoring program. These monitoring and measurement / verification programs are described in Section 10.

8.3.3 Progressive sign-off

The principle of progressive signoff will be adopted where appropriate, to recognise areas where the development of rehabilitation has reached acceptable standards and facilitate the transition to a post-mining land use. In these instances, criteria that change over time will not be applied retrospectively.

Table 8-1 OB29/30/35 closure criteria

Aspect	Criterion Objective	Risk ID	Domain	Performance indicators[23]		Completion (Stage 3)[23]	Verification procedure	MCP section
				Planning (Stage1)	Execution (Stage 2)			
1. Post-closure land use								
C1.1 Post-mining land use	Post-mining land use has been informed by consultation with relevant stakeholders.	12.	All	Post completion land use has been informed by consultation with key stakeholders (C). Specific rehabilitation objectives, including requirements for safe access, have been developed so that, when met, areas will fulfil the post-mining land use requirements (C). Rehabilitation objectives have been informed by consultation with post-mining land users / owners (C). Mine closure designs have been developed to meet rehabilitation objectives (C).	Mine closure execution is conducted substantially in accordance with designs (P).	Monitoring, inspection and / or survey reports demonstrate that the rehabilitation objectives have been substantially met. These are the measures that the post-mining land use has been met (C). The current assumed post-mining land use is related to underlying tenure (unallocated crown land and pastoral) and achievement of the criteria for land management (C1.3), stability (C3.2 to C3.4), revegetation (4) and hydrology (5) will indicate that this criterion has been met (C).	**Planning** Documented approval of land use performance objectives from end landowners / managers and administering authority. Mine closure design review. **Execution** As-constructed report, or post-construction survey or inspection report. **Completion** Post-closure monitoring and survey reports. Landowner / manager provides written acknowledgement that rehabilitation objectives and completion criteria have been met.	4.2 Consultation program 6 Post-closure land use 5.12 Cultural values 10.1.1 Closure completion audit and inspection.
C1.2 Infrastructure	Infrastructure has been decommissioned and removed where transfer to a third party is not agreed.	12.	All where infrastructure exists	Agreement has been reached with government and other stakeholders (including post mining landowner / land manager) regarding the infrastructure to remain post-mining (C). The agreement includes condition of infrastructure at transfer (C). The depth of removal of in-ground infrastructure has been informed by the risks to post-mining land uses and consultation with the landowner / land manager and is specified in demolition plans (C). Waste disposal requirements and locations have been informed by consultation with key stakeholders and incorporated into decommissioning and demolition programs (C).	Unless otherwise agreed with stakeholders, infrastructure has been removed to 0.6 m bgl (C). Infrastructure removal is generally in accordance with demolition specifications (P). Remaining infrastructure condition has been assessed and referenced in stakeholder agreements (P). Waste disposal plans have been implemented (P).	Stakeholders agree to the transfer of infrastructure ownership and accept ongoing responsibility for maintenance of the infrastructure (C). In-ground infrastructure has been removed to 0.6 m bgl unless (C): • An alternate standard has been agreed with the post-mining landowner / manager. • Risk assessment indicates that a different specification is required.	**Planning** Demolition plan outlining infrastructure to be removed and standard of demolition (including extent to which concrete foundations and buried services will be removed). Documented agreement on infrastructure to remain and condition of infrastructure at transfer. **Execution** Demolition contractor's report against agreed standard. Condition assessment report of remaining infrastructure. Waste disposal records. **Completion** Completion audit of demolition contractor's report against agreed standard. Site inspection report following demolition. Documented transfer of infrastructure to stakeholders.	9.1.10 Site safety and security 9.2.4 Infrastructure and roads 10.1.1 Closure completion audit and inspection
C1.3 Land Management	Long-term management requirements have been addressed.	12.	All	The long-term management requirements of the closure strategy and alignment with the post-mining land use have been considered (C). Post-completion land management requirements have been defined through the post-closure monitoring and maintenance program and contaminated sites assessment (C). Where active management is likely to be required, land use representatives agree on the level of effort required to actively manage the site post-completion (C).	Post-relinquishment land management plan has been developed (C).	At the time mine closure is considered complete, site land management requirements are aligned to the post-completion land use and / or approved closure strategy (C). If additional management actions are required post-completion, these will have been agreed with the landowner / manager (C).	**Planning** The final closure strategy has been informed by consultation with post-mining land managers / owners. Report of the monitoring and maintenance activities required during the post-closure phase. **Execution and Completion** Closure strategy achieved as demonstrated by achievement of post-mining land use criterion C1.1 Post-completion land use management plan. Documented agreement of additional active management measures required post-completion.	10.1.1 Closure completion audit and inspection 10.4 Completion and relinquishment
2. Safety								

[23] Letters in brackets refer to the attribute types identified in Young et al. (2019): P (installed / built as planned); C (categorical – the feature is present or absent or the activity has been achieved or not); Q (quantitative, the attribute can be measured and compared against a numerical target).

Aspect	Criterion Objective	Risk ID	Domain	Performance indicators[23]		Completion (Stage 3)[23]	Verification procedure	MCP section
				Planning (Stage1)	Execution (Stage 2)			
C2.1 Safety	There are no unsafe areas where members of the general public could gain inadvertent access.	11.	All	**All** A hazard assessment of aspects of the closed site that could endanger the safety of any person or animal has been conducted (C). Designs have been developed to eliminate or mitigate identified hazards (C). Decommissioning and demolition plans have been developed for all infrastructure not required by third parties post-mining (C). **Mine void** Pit wall stability assessments inform the location of abandonment bunds (C). **OSAs / ISAs** Materials characterisation has been conducted and any PAF or fibrous materials identified (C).	Abandonment bunding which meets the DEMIRS guidelines (DoIR, 1997) is in place to prevent inadvertent access to voids (P). All infrastructure is de-energised and inadvertent access controlled following closure, and prior to demolition (P). Mine closure and demolition execution is conducted in accordance with designs / plans (P). Fibrous material has been covered with 1 m of non-fibrous inert material (C / P). The geochemical execution performance indicators (C3.3) have been met (C).	Residual safety and health hazards have been identified and controlled in accordance with regulatory requirements and consideration of industry guidance and are acceptable to the District Mines Inspector (C). The geotechnical and geochemical stability criteria (C3.2 and C3.3) have been met (C).	**Planning** Mine closure design hazard assessment. Decommissioning and demolition plans. Fibrous materials identified in mining models. DEMIRS endorsement via MCP updates. **Execution** As-constructed report, or post-construction / demolition survey or inspection report. Survey reports / mining records of fibrous and PAF material placement. Audit showing that the geotechnical and geochemical stability execution performance indicators (C3.2 and C3.3) have been met. **Completion** All sites are assessed as acceptable with regards to safety by the District Mines Inspector following execution. Audit showing that the geotechnical and geochemical stability criteria (C3.2 and C3.3) have been met.	9.1.10 Site safety and security 10.1.1 Closure completion and inspection 10.1.10 Public safety monitoring
3. Landforms								
C3.1 Visual amenity	Visual amenity of constructed landforms is compatible with that of local Pilbara landforms.	9.	All	Within the constraints imposed by aspects such as the physical nature of the materials available, tenement boundaries, and proximity to water courses, landforms have been designed to blend into the surrounding landscape (C). Visual impacts, design constraints and solutions have been discussed with stakeholders, where visual impact is a key concern (C).	Mine closure execution is conducted in accordance with designs (P).	Landforms meet visual design criteria (C).	**Planning** Mine closure design review. Stakeholder consultation records where visual impact is a key concern. **Execution** Report on rehabilitation works confirms landform has been substantially constructed according to design. **Completion** Rehabilitation inspections following execution confirm earthworks have substantially met visual impact design criteria.	4.2. Consultation program 9.1.4 Landforms 9.1 Standard closure and rehabilitation strategies 9.2.1 Overburden storage areas 10.1.1 Closure completion audit and inspection
C3.2 Geotechnical stability	Constructed landforms are safe and geotechnically stable.	2. 6. 7.	OSAs Mine voids (impact to groundwater) Mine voids / creek diversion (impact to surface water)	**OSAs** Post-mining landforms have been designed to: • Account for overburden characteristics affecting stability (physical and chemical) and the Zone of Instability (ZOI) of the void (C). • Achieve a Static FoS of ≥1.5 (C). **ISAs** • The stability of ISAs has been designed according to the risk posed by that ISA (C). **Mine voids** • Pit walls have been designed to achieve a static FoS of ≥1.5 where failure to meet this criterion could impact infrastructure designed to remain post-mining (e.g., surface water controls, abandonment bunds) (C). **Surface water infrastructure** • Flood bunds / diversions have been designed to fall outside the ZOI of the pit(s) (C).	Mine closure execution is conducted substantially in accordance with designs (P).	OSAs and mine voids conform to DEMIRS (2019) guidelines for structural stability and achieve design FoS criteria (C). Unless otherwise designed, there is no significant slumping or failure of accessible ex-pit constructed slopes or berms (C).	**Planning** Mine closure design review against DEMIRS (2019) guidelines. Overburden characterisation and OSA landform design shows target FoS will be achieved. Pit wall stability modelling reports show that the target FoS will be met where post-mining landforms and infrastructure may be impacted by the ZOI of the pit. DEMIRS endorsement via MCP updates. **Execution** Report on landform construction methods following execution confirms construction has substantially met relevant design criteria. **Completion** Results of inspections of the rehabilitated landforms conducted to completion. Report on performance in relation to design criteria and DEMIRS guidelines.	9.1.4 Landforms 9.1.4.2 Mine voids 9.1.4.1 OSAs 10.1.1 Closure completion audit and inspection 10.1.9 Landform and erosion monitoring

Aspect	Criterion Objective	Risk ID	Domain	Performance indicators[23]		Completion (Stage 3)[23]	Verification procedure	MCP section
				Planning (Stage1)	Execution (Stage 2)			
C3.3 Geochemical stability	Materials with poor chemical properties do not compromise rehabilitation (landform stability and revegetation) or water quality.	3.	OSAs / ISAs	**All** Geochemical overburden characterisation and an AMD risk assessment have been conducted (C). **OSAs and ISAs** PAF material placement practices within OSAs / ISAs have been developed to control the risk of AMD (C). **Mine voids** Closure designs have been developed to manage PAF wall rock exposures on the basis of risk (C). Where there is potential for the quality of pit lakes to be impacted, a pit lake assessment will be conducted to identify potential impacts and requirements for mitigation measures (C).	**OSAs and ISAs** All PAF material placement has been undertaken generally in accordance with the mine plan, Mines Closure Design Guidance Procedure and landform designs to control the risk of AMD (P). **Mine voids** Overburden or wall rock exposures likely to give rise to AMD have been appropriately managed in accordance with designs (P). **All** Mine closure execution is substantially in accordance with designs (P).	**OSAs and ISAs** No evidence of mineral scalds within rehabilitation areas (C). No exposed waste materials with adverse geochemical properties (C). Surface water and groundwater quality completion criteria (C5.2 and C5.4) are met (C). **Mine voids** Groundwater quality completion criteria are met. Pit lake water quality aligns with modelling trajectory, where modelling is required (C).	**Planning** Geochemical waste characterisation and risk assessment reports are available for review. OSA and ISA design guidance defines management of AMD 2 and AMD 3 waste types. Pit lake assessments where required. **Execution** Operational survey reports and mining records show waste has been substantially placed in designated locations in accordance with PAF management guidance. **Completion** Visual inspections identify no adverse materials at the surface of OSAs / ISAs. Surface water and groundwater quality completion criteria (C5.2 and C5.4) are met. Pit lake monitoring to validation of modelled quality.	9.1.1 Acid and metalliferous drainage 9.1.4.2 Mine voids 10.1.7 Surface water monitoring 10.1.8 Groundwater monitoring 10.1.9 Landform and erosion monitoring
		4.	Mine voids					
C3.4 Surface stability	The constructed surface is stable and showing no signs of significant erosion or release of sediment causing adverse impacts to drainage lines.	1.	OSAs	Post-mining landform designs have been informed by, and take account of, the following, as appropriate to the landform: • Overburden characteristics (physical and chemical) (C). • Erosion modelling. Modelled average annual erosion rates for OSAs are ≤6 t/ha/yr and maximum erosion rates ≤12 t/ha/yr (Q). • Design rainfall events. OSA landforms are designed to retain the 1 in 200-year rainfall event on the landform and allow the controlled discharge of higher rainfall events to erosion resistant areas (C). • Flood modelling. OSAs are located outside the 1 in 10,000-year flood plain, or designs include appropriate erosion protection (C). Surface water infrastructure has been designed on the basis of hydraulic modelling (C). Appropriate surface treatments have been identified given landform design, post-closure hydrology and available construction materials (C).	Mine closure execution is substantially in accordance with designs (P). Surface treatments (including ripping) have been undertaken to rehabilitated surfaces, if required, to maximise water infiltration, reduce erosion potential, and support establishment of vegetation (P). Overburden likely to provide a poor growth medium (e.g., dispersive and incompetent material), has been placed appropriately in OSAs or backfilled pits (P). Rock armouring is present as required, and no areas are exposed to the risk of significant unplanned erosion (P).	OSA slope surfaces do not show significant unplanned erosion which may be defined as having (C): • Channelised flow resulting in extensive active gullies; • Failure of banks, berms or bunds; and • Evidence of ongoing significant sheet erosion (including large accumulation of silt at base of slope, exposed subsoil, poor seedling establishment). By completion: • The annual average rate of erosion of slopes, flats and crests of OSAs is ≤6t/ha/yr (Q). • The erosion rate at any point on an OSA slope does not exceed the target threshold average rate by more than 100% (Q). Surface water management structures are performing as designed (P). Geotechnical stability completion criterion (C3.2) is met (C).	**Planning** Mine closure design review. DEMIRS endorsement via MCP updates. Overburden characterisation and erosion modelling reports. Surface water modelling reports. Surface water management infrastructure design reports including hydraulic modelling and construction material characterisation. **Execution** Report on landform construction, and any additional maintenance works confirm earthworks have substantially met final landform designs. **Completion** Visual assessment and rehabilitation monitoring to completion indicate: • Gullies and rills have stabilised. • There is no evidence of significant sheet erosion. • Average and maximum erosion rates have been achieved. Surface water management structures are performing as designed.	9.1.4 Landforms 9.1.5 Rehabilitation 10.1.1 Closure completion audit and inspection 10.1.2 Rehabilitation monitoring 10.1.9 Landform and erosion monitoring 10.1.7 Surface water monitoring
		7.	Creek diversions					
4. Revegetation								
C4.1 Growth Media	A suitable growth medium has been identified to facilitate plant establishment and growth.	8.	All where revegetation is planned	Topsoil stockpiles have been mapped, volumes calculated, and the relevant plans and databases have been prepared, updated and maintained (C). Available topsoil is assessed against topsoil required for rehabilitation and alternate sources of growth media have been identified where there is a deficit of topsoil (C). Material identified for placement on the outer surface of landforms has been assessed for its suitability as a growth medium and takes into consideration characteristics required to support sustainable vegetation development including structure, water holding capacity, and elements that might affect plant growth or survival (C).	Soil stripping and management have been undertaken generally in accordance with the relevant WAIO Rehabilitation Standards and Procedures (P). Where available and appropriate to meet the landform design requirements, topsoil has been used to provide a suitable medium for plant establishment and a source of propagules (P). Topsoil / growth medium has substantially been placed in accordance with rehabilitation plans (P).	Achievement of vegetation development criterion (C4.2) (C).	**Planning** Topsoil reconciliation information. Growth media characterisation reports. Rehabilitation monitoring results and / or trials provide feedback to determine the suitability of growth medium. **Execution** Report on landform construction. Rehabilitation inspections confirm earthworks have met final landform designs. **Completion** Rehabilitation monitoring results to completion.	9.1 Standard closure and rehabilitation strategies 10.1.2 Rehabilitation monitoring

Aspect	Criterion Objective	Risk ID	Domain	Performance indicators[23]		Completion (Stage 3)[23]	Verification procedure	MCP section
				Planning (Stage1)	Execution (Stage 2)			
C4.2 Vegetation Development	Vegetation is suited to the final landform and post-mining land use.	8.	All where revegetation is planned in areas of unallocated crown land (infrastructure footprints, OSAs, pits backfilled to surface)	Rehabilitation plans and target seed mixes are designed to return target vegetation communities (C).	Rehabilitation is substantially executed in accordance with plans (P).	**Land use: Natural environments for managed resource protection** • % bare ground (Q): - Hills, slopes, dry plains ≤50%. - Drainage lines and floodplains (excluding channel bed) ≤20%. • Perennial native species richness recorded in aggregated 50 x 50 m plot achieves target % for each target vegetation type (see Appendix C) (Q). • At least one dominant species from each stratum present (see Appendix C) (Q). • >70% of species present in rehabilitation areas are common to the Target Vegetation Type (Q). Plant cover achieves target % for each stratum and vegetation type (see Appendix C) (Q).	**Planning** Review of rehabilitation monitoring results, and related rehabilitation monitoring procedures. Research reports and findings from trials. **Execution** Rehabilitation execution completion report. Site inspection to confirm rehabilitation has been substantially conducted in accordance with the plan. **Completion** Monitoring of vegetation re-establishment using WAIO rehabilitation monitoring procedures until monitoring shows that the vegetation is on trajectory towards meeting completion criteria.	9.1.5.4 Revegetation 10.1.2 Rehabilitation monitoring
C4.3 Resilience	Demonstrated capacity of the site to recover from fire, drought and other disturbances.	8.	All where revegetation is planned (infrastructure footprints, OSAs, pits backfilled to surface)	Seeds to be used in rehabilitation reflect a range of species found in the bioregion (C). Seed requirements for rehabilitation have been identified and appropriate quantities of seed collected from local provenance areas, within the Pilbara IBRA region, to support the five-year rehabilitation plan (C). Rehabilitation techniques are informed by trials, research and monitoring of rehabilitated areas (C).	Rehabilitation is substantially executed in accordance with plans (P). Revegetation has used local provenance native seed from the Pilbara IBRA region (C).	• Flowering and seed production observed in more than one native lifeform (Q). • Different aged plants observed for more than one native species and for all lifeforms (Q).	**Planning** Review of progress and performance from rehabilitation monitoring results, and related rehabilitation monitoring procedures. Research findings from trials on representative rehabilitated areas investigating post-disturbance recovery of revegetation. **Execution** Rehabilitation execution completion report. **Completion** Monitoring of vegetation re-establishment using WAIO rehabilitation monitoring procedures until monitoring shows that the vegetation is on trajectory towards meeting completion criteria.	9.1.5.4 Revegetation 10.1.2 Rehabilitation monitoring
C4.4 Weeds	DBCA priority list weed species to be managed so as not to cause unacceptable risk to surrounding environments.	8.	All where revegetation is planned	Weeds have been monitored and risk-based control plans developed which are compatible with the agreed end land use (C).	The requirements of the WAIO Weed Management Procedure have been substantially implemented (P). Populations of weeds have been monitored and controlled based on risk (P).	Priority alert weed species are not present (C), or if present, cover is less than or equal to the surrounding areas (regional baseline) (Q). No new priority alert weed species introduced (C).	**Planning** Review of weed monitoring and control. **Execution** Report on weed monitoring and control records. **Completion** Measurement of weed abundance to completion. Surveys and comparison of priority weed species with regional baseline data.	10.1.3 Weed monitoring
	Total weed cover to be typical for each site and landform and reflect post-mining land use.	8.	All where revegetation is planned in areas of unallocated crown land (OB29/30/35 mining area)			**Land use: Natural environment for managed resource protection** Total weed cover: • Drainage lines, floodplains <15%. • Upland hills, slopes and flats <5%. Buffel grass cover: • Drainage lines, floodplains <10%. • Crests, slopes, flats <5%.		
C4.5 Fauna Habitat	Vegetated areas provide fauna habitat	8.	All where revegetation is planned (infrastructure footprints, OSAs, pits backfilled to surface)	Rehabilitation plans consider return of fauna habitat through selection of target vegetation communities and / or constructed habitat features (C). Constructed fauna habitat designs are based on the results of research and trials (C).	Rehabilitation is substantially executed in accordance with plans (P).	Achievement of vegetation development criterion (C4.2)	**Planning** Rehabilitation plans incorporate creation of fauna habitat. Review of research and trials. **Execution** Report on habitat construction. **Completion** Monitoring of vegetation re-establishment using WAIO rehabilitation monitoring procedures until monitoring shows that the vegetation is on trajectory towards meeting completion criteria.	9.2.1 Overburden storage areas 10.1.1 Closure completion audit and inspection

Aspect	Criterion Objective	Risk ID	Domain	Performance indicators[23]		Completion (Stage 3)[23]	Verification procedure	MCP section
				Planning (Stage1)	Execution (Stage 2)			
C4.6 Impact to Fauna	No significant adverse impact to fauna from pit lakes	8	Mine voids	The planning criteria have been met for geochemical stability (C3.3) (C). Pit lake quality assessments have been conducted (C). A pit lake risk assessment has been conducted and mitigation measures identified, if required (C).	Identified mitigation measures are substantially implemented in accordance with designs (P).	The pit lake risk assessment shows no significant impact to native terrestrial fauna (C). Monitoring shows that pit lake quality aligns with closure risk assessment assumptions (Q).	**Planning** Refer to geochemical stability criteria (3.3). Pit lake quality and risk assessment reports. Risk mitigation design review. **Execution** Refer to geochemical stability criteria (3.3). **Completion** Post completion report on pit lake monitoring and validation of risk assessment assumptions.	9.1.4.2 Mine voids 10.1.4 Fauna inspection of rehabilitation areas
5. Hydrology								
C5.1 Surface Water Flows	Rehabilitation drainage patterns have been established and impacts on natural surface water flows are acceptable at key receptors.	7.	Creek diversions and OSAs	Diversions have been provided around mine infrastructure (OSAs, mine voids) that may capture or significantly impede flow (C). Surface water modelling shows downstream flows are within parameters accepted via project approvals, following implementation of surface water management measures for closure (Q). Hydraulic modelling shows that surface water management infrastructure designs can withstand selected closure design flood events (C).	Mine closure execution is substantially in accordance with designs (P).	Flows at downstream environmental receptors are within model predictions and the parameters accepted via project approvals (Q). Impacts to downstream environmental receptors are within the parameters accepted via project approvals (Q).	**Planning** Surface water assessment and modelling reports. Design review. **Execution** Report on landform construction. **Completion** Surface water flow monitoring to calibration of model predictions. Calibration reports for model predictions. Monitoring of ecohydrological receptor condition to calibration of model. Site inspection to verify no unplanned impacts on surrounding natural drainage patterns or landform failures.	9.1.2 Surface water 9.1.4 Landforms 9.2.1 Overburden storage areas 9.2.2 Mine voids 10.1.7 Surface water monitoring
C5.2 Surface Water Quality	Surface water quality is acceptable at key receptors	1.	OSA / creek diversions	The planning criteria for surface and geochemical stability (C3.3 and C3.4) have been met (C). The planning criteria for OSA geochemical stability (C3.3) have been met (C).	Mine closure execution is substantially in accordance with designs (P).	Water quality (sediment and chemical) at downstream environmental receptors (Southern and Whaleback creeks) is within acceptable ranges (Q): • Defined, through the detailed analysis of pre-closure monitoring data from appropriate reference sites, to represent no significant impact to downstream ecohydrological receptors; and / or • Accepted via project approvals or other regulatory processes.	**Planning** Refer to surface and geochemical stability criteria (C3.3 and C3.4). **Execution** Refer to surface and geochemical stability criteria (C3.3 and C3.4). **Completion** Surface water quality monitoring to completion. Site inspection to verify that there have been no unplanned impacts associated with sediment transport. Audit of the achievement of contaminated sites criterion C6.1.	9.1.1 Acid and metalliferous drainage 9.1.2 Surface water 9.1.4 Landforms 9.1.4.2 Mine voids 9.2.1 Overburden storage areas 9.2.3 Creek diversions 10.1.7 Surface water monitoring
C5.3 Groundwater Levels	Groundwater levels are acceptable at key receptors.	5.	Mine voids	Groundwater modelling has been conducted to identify impacts to groundwater levels post-mining (C). Where unacceptable impacts have been identified at key receptors, closure designs, including backfilling if required, have been developed to mitigate these impacts (C).	Mine closure execution is conducted in accordance with designs (P).	Groundwater levels at key receptors are at acceptable levels, defined as closure thresholds in the Eastern Pilbara Water Resource Management Plan[24], and meet land use criteria supported by key stakeholders (Q).	**Planning** Groundwater assessment and modelling reports. Design review **Execution** Report on landform construction. **Completion** Groundwater monitoring to validation of groundwater model and groundwater model validation report.	9.1.3 Groundwater 9.2.2 Mine voids 10.1.8 Groundwater monitoring

24 Current thresholds are:
- Trigger > 6 m or a rate of > 4 m/year - interpreted as the statistically significant aquifer response and change to water level in the Ethel Gorge primary habitat monitoring zone. Water level responses greater than the above thresholds may result from localised bore abstraction and these localised responses shall not bias the overall criteria.
- Response >12 m or a rate of > 8 m/year.

Thresholds may be revised as the Eastern Pilbara Water Resources Management Plan is revised and where there is a difference in the criteria presented in this MCP and the Eastern Pilbara Water Resources Management Plan, the criteria in the Eastern Pilbara Water Resources Management Plan take precedence.

Aspect	Criterion Objective	Risk ID	Domain	Performance indicators[23]		Completion (Stage 3)[23]	Verification procedure	MCP section
				Planning (Stage1)	Execution (Stage 2)			
C5.4 Groundwater Quality	Groundwater quality is acceptable at key receptors	6.	Mine void	The planning criteria for geotechnical stability (C3.2) and surface water flows (C5.1) have been met	Mine closure execution is conducted in accordance with designs (P).	Groundwater quality is within limits (Q): • Defined, through the detailed analysis of pre-closure monitoring data from appropriate reference sites, to represent no significant impact to downgradient ecohydrological receptors; and / or • Accepted via project approvals or other regulatory processes.	**Planning** Refer to geochemical stability criteria (3.3) **Execution** Refer to geochemical stability criteria (3.3) **Completion** Groundwater quality monitoring to completion. Audit of the achievement of contaminated sites criterion C6.1.	9.1.2 Surface water 9.2.2 Mine voids 9.2.3 Creek diversions 10.1.7 Surface water monitoring 9.1.1 Acid and metalliferous drainage 10.1.8 Groundwater monitoring
		3.	OSA	The planning criteria have been met for geochemical stability (C3.3) (C).				
6. Contaminated sites								
C6.1 Contaminated Sites	Contaminated sites have been documented and managed to achieve a classification commensurate with the post-mining land use	13.	All where relevant	Contaminated sites have been identified and, where required, remediation action plans developed (C). Remediation action plans have been approved by a contaminated sites auditor, where required (C).	Implementation of the approved remediation action plan (P). x	Validation sampling shows remediation has achieved remediation criteria (Q).	**Planning** Preliminary Site Investigation (PSI), Sampling and Analysis Plan (SAP), Detailed Site Investigation (DSI) and Remediation Action Plan (RAP) – produced by a contaminated site consultant and reviewed by an independent auditor. **Execution** Reports produced by remediation contractor including validation sampling and waste disposal records. **Completion** Contaminated sites auditor produces Voluntary Audit Report (VAR) or Mandatory Audit Report (MAR).	9.1.8 Site contamination 10.1.1 Closure completion audit and inspection
7. Cultural Heritage								
C7.1 Cultural Heritage & Values	Protection of, and access to, heritage sites has been incorporated into mine closure planning.	10.	All where relevant	In consultation with the Nyiyaparli people: • Cultural values associated with final landforms have been identified and addressed in designs (C). • Provisions for safe access to sites of importance have been incorporated into closure designs (C). • Requirements for repatriation of cultural artifacts have been identified (C).	Mine closure execution is substantially in accordance with designs for the protection of cultural values (P). Cultural artifacts have been repatriated generally in accordance with stakeholder requirements (P).	Performance indicators for Execution (Stage 2) have been met.	**Planning** Mine closure designs have addressed cultural values and incorporated safe access to sites of cultural importance identified during consultation. Documented agreement regarding the repatriation of cultural artefacts. **Execution and Completion** As constructed report. Confirmation by Nyiyaparli people representative that artefacts have been repatriated.	9.1.6 Cultural heritage 9.1.10 Site security 10.1.1 Closure completion audit and inspection

9 Closure implementation

This section outlines:

- The procedures and processes that BHP progressively implements during operations and when planning for closure to manage key closure risks (Section 9.1).
- The proposed closure and rehabilitation strategies for each domain based on the studies conducted to date by acknowledging that further studies, investigations and design work are required before a final design can be developed (Section 9.2 to 9.3).
- Actions to be taken in the event of unplanned or unexpected closure (Section 9.5).

Taking into account the identified closure issues and acknowledging the further studies, investigations and design work that will occur during the life of the mine, this section describes how the OB29/30/35 mining operations will be rehabilitated and closed in a manner that satisfies the mine closure objectives, guiding principles and completion criteria outlined in Section 8.3, and addresses the DEMIRS guidelines (2020a; 2020b).

The closure implementation strategies defined below are based on experience across BHP's Pilbara Operations and will be conducted progressively during the mine life.

9.1 Standard closure and rehabilitation strategies

BHP will implement its Rehabilitation Standard 0001074 (WAIO, 2023f) which covers all procedures relevant to rehabilitation works including rehabilitation planning, growth media, earthworks, audit and inspection, seed management, rehabilitation data management and rehabilitation monitoring. The rehabilitation standard is used across BHP's Pilbara mine sites and other areas where appropriate. A description of each area of the standard is provided in the subsections below.

The internal procedures and standards referenced may be amended or replaced from time to time in accordance with BHP's adaptive management approach (Section 7.1).

9.1.1 Acid, metalliferous and / or saline drainage

AMD is a consideration for mine closure if concentrated levels of acidic, metalliferous or saline drainage enter waterways. Drainage that contains elevated concentrations of sulphuric acid, salts or toxic metals can present a risk to aquatic life, riparian vegetation, ground and surface water or users of these e.g., stock and humans. If the AMD risk is not managed during the life of the mine, it may arise post closure. In BHP's operations, potential sources of AMD include OSAs, exposed pit walls and other disturbances.

BHP is committed to managing and mitigating AMD risk using a structured approach, consistent with global leading practice guidelines including those developed by the International Network for Acid Prevention (INAP, 2014) and Department of Industry, Science, Energy and Resources (DISER, 2016c). Management of geochemical risk across BHP's Pilbara sites is outlined in several procedures including:

- BHP's Global Mined Management Standard (BHP, 2021e) which sets company-wide standards for geochemical risk management.
- WAIO's suite of procedures that outline how geochemical risk is identified, assessed and managed across BHP's Pilbara operations. These procedures include:
  - Acid and Metalliferous Drainage Management Technical Process Instruction (WAIO, 2022a).
  - Reactive Ground and AMD Potential: Mining Design and Dumping Procedure (WAIO, 2022c).
  - Reactive Ground and Associated Gases Procedure 0129611 (WAIO, 2024b).
  - Mines Closure Design Guidance TPI (WAIO, 2022f).
  - Preliminary AMD Risk Assessment Procedure 0132980 (WAIO, 2022b).

The Acid and Metalliferous Drainage Management Technical Process Instruction (WAIO, 2022a) outlines the overall strategy for management of geochemical risk (Figure 9-1) and considers the full mine life cycle.

The approach shown in Figure 9-1 is a risk-based approach which is refined with increasing knowledge of the geochemical characteristics of overburden material. Specifically, the characterisation stage (Stage 1) informs Stages 2 through 5 which results in OSA designs and mine void management practices aimed at minimising the potential risks associated with acid, metalliferous and / or saline drainage.

Characterisation of mined material commences at the exploration stage and is progressively refined through subsequent resource definition, short term geological drilling and grade control drilling, as applicable (Figure 9-1 and Figure 9-2). Based on geochemical characterisation test work across BHP's mining operation, BHP has developed an algorithm that is used to classify materials within the resource model as either NAF (AMD0) or PAF (AMD1, AMD2 and AMD3) (refer to Section 5.3.2). This enables mine planners to identify materials that require management, and to determine their placement according to their geochemical risk. The geochemical risk of materials generated at each site is confirmed through site-specific targeted geochemical testing and risk assessment (Section 5.3.2.3). This work informs the management requirements for geochemically problematic materials and, depending on risk, can include predictive hydrogeochemical modelling.

Further to the geochemical characterisation work, geochemical classifications in the resource model are confirmed though analysis and inspection of blast cone chips prior to mining and the results of this analysis are integrated into the short term mine plan and communicated to the production team (Figure 9-2).

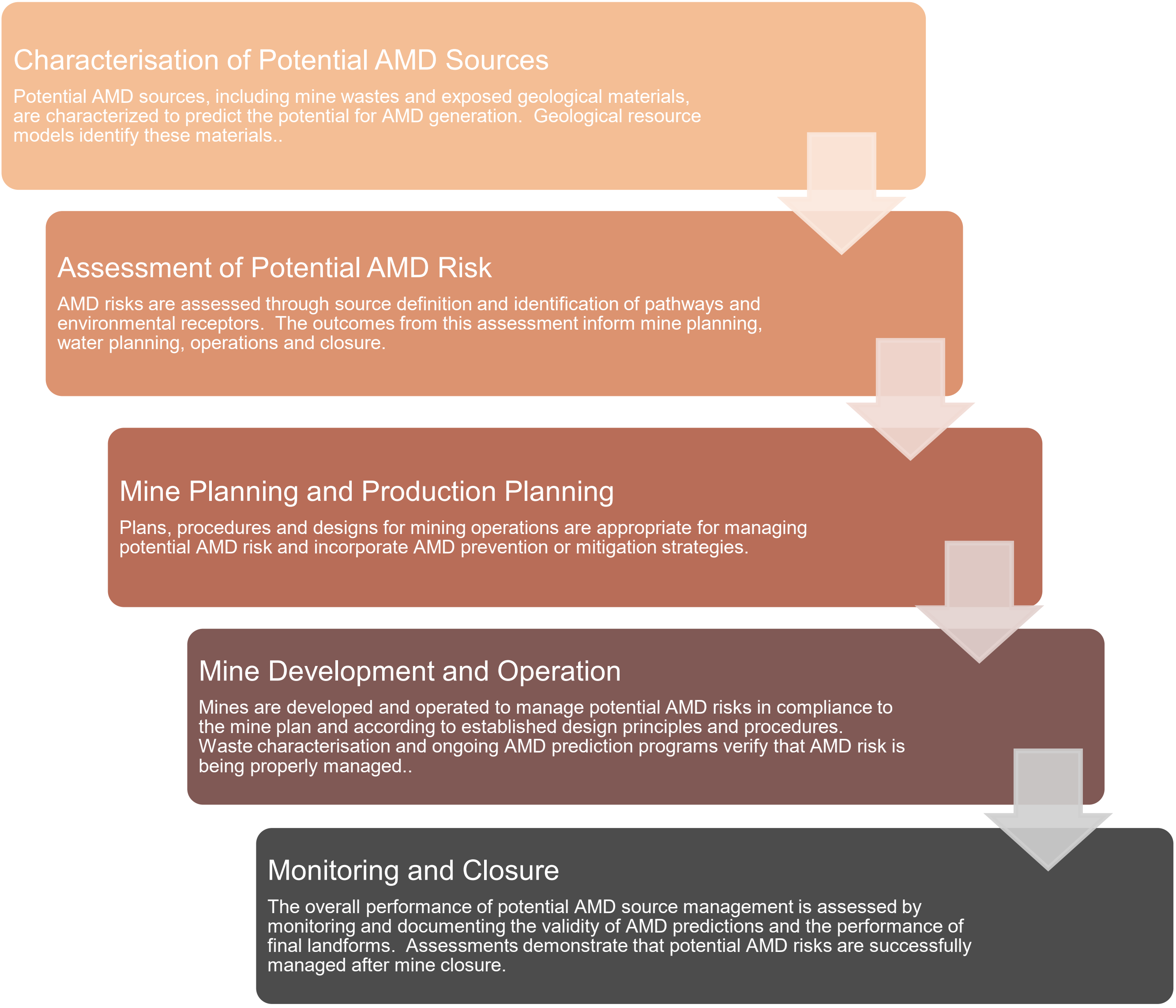


Figure 9-1 BHP's AMD management process

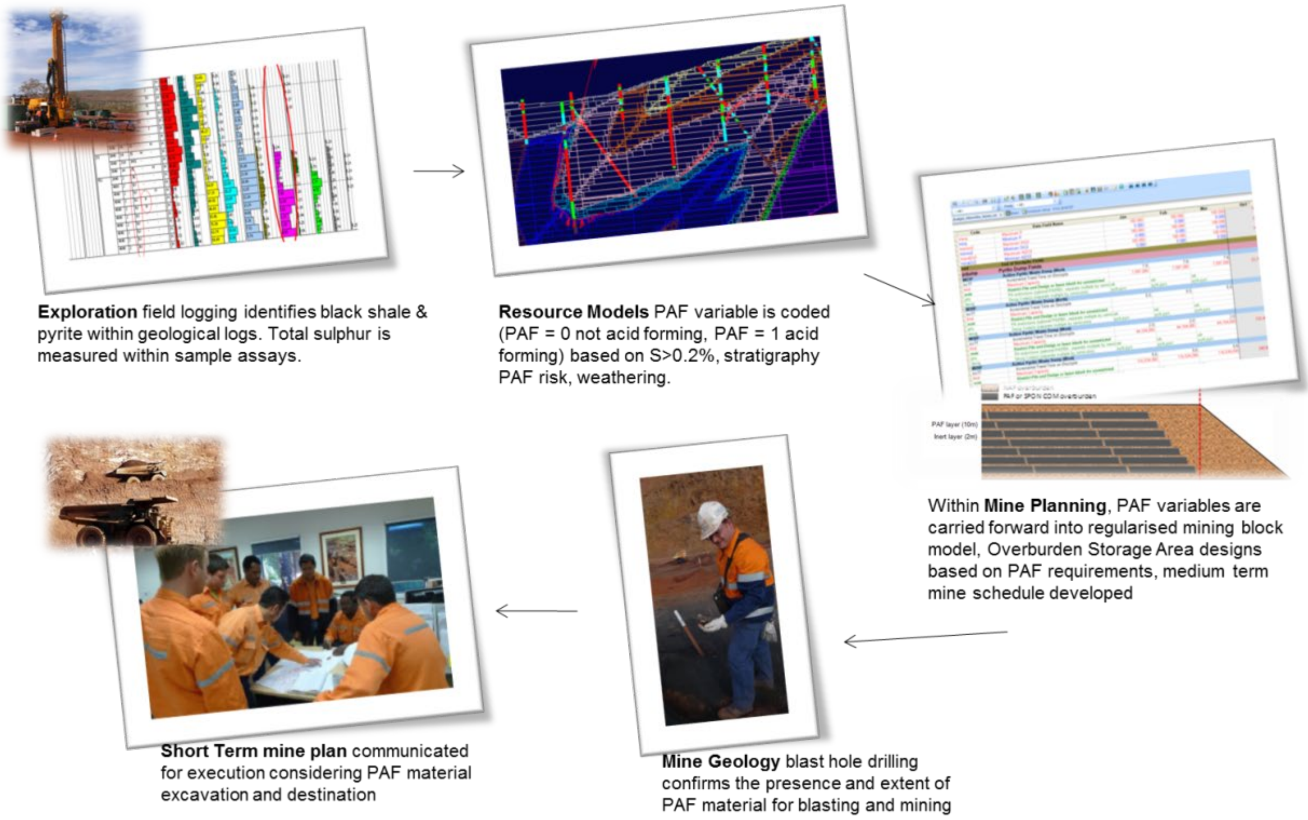


Figure 9-2 PAF management process flow (BHP's eLearning tool)

There are a variety of overburden management and mitigation options available for higher risk stratigraphies that have AMD generation potential (Figure 9-3). Material can be encapsulated, co-disposed with inert or acid neutralising material, disposed sub-aqueously or a combination of options can be applied. These options are evaluated on a site-specific basis following the completion of appropriate material characterisation, risk assessment and modelling.

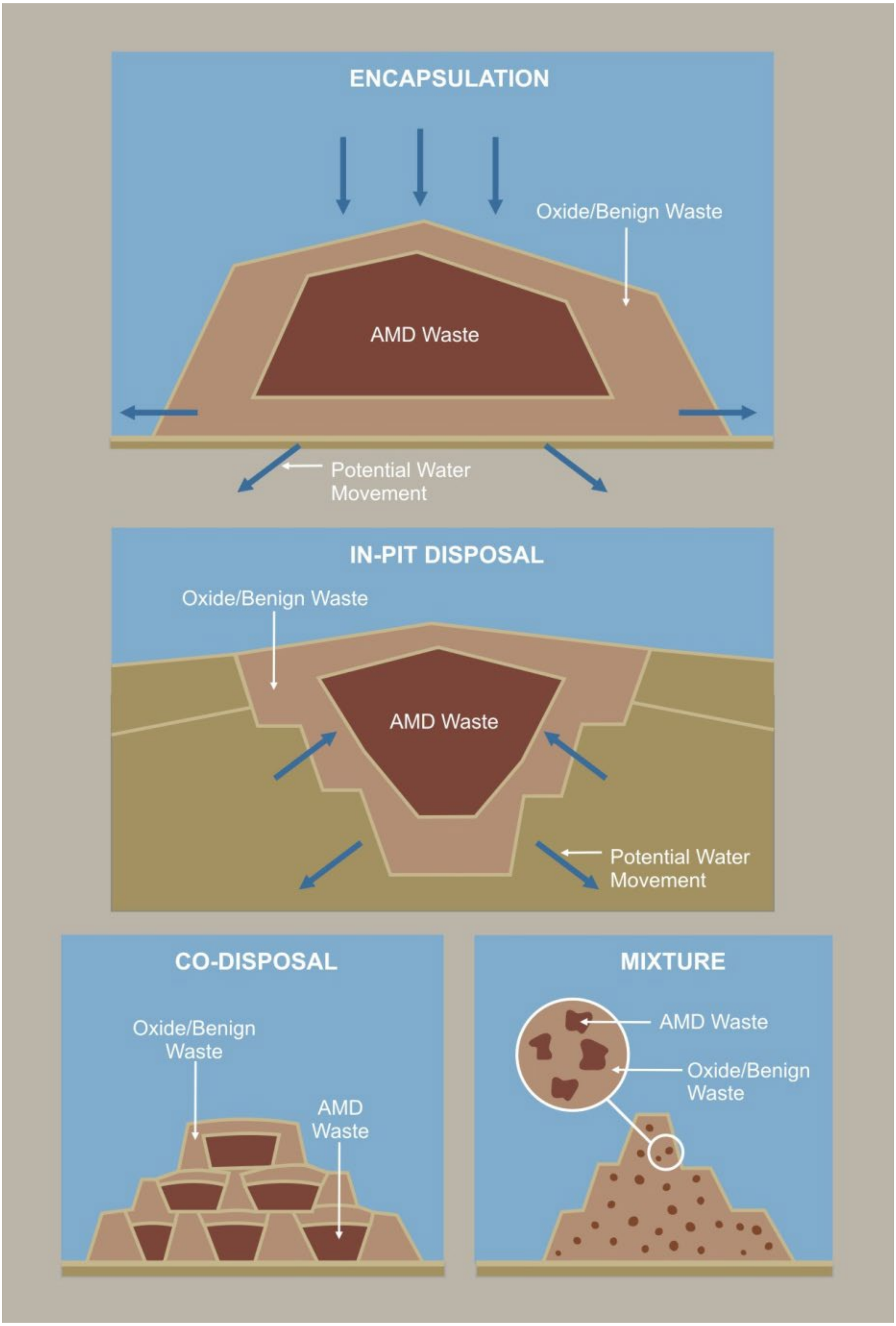


Figure 9-3 BHP's PAF waste management strategies (following DIISR (2016c))

Based on the findings of the AMD risk assessment conducted for OB29/30/35 (Section 5.3.2.3), the AMD hazard associated with waste rock / low grade ore and pit wall exposures at OB29/30/35 is low.

AMD 2 and 3 waste materials are managed according to risk but are generally placed within OSAs such that there is 10 m of inert waste between these materials and the surface of the OSA. This depth of inert waste is designed to prevent exposure of the AMD 2 / 3 materials during re-profiling of the OSA.

Given the negligible exposures of PAF on pit walls, no specific management measures are considered necessary.

9.1.2 Surface water

The surface water system at closure will be designed to meet the closure principle of no significant impact on surface water quality and flow regimes, in nearby waterways, beyond those permitted via project approvals as part of regional cumulative mining impacts. Key considerations will include an assessment of the likelihood that mine voids will 'capture' creek lines, or that major climatic events will result in damage to surface water controls (including those on constructed landforms) that may in turn impact long-term water balances.

The flood protection works required for closure will be designed and constructed to achieve stable, maintenance free draining landforms and may be different to operational flood protection works. Options, which would be considered for closure include additional rock armouring, changes to the elevation and slope of flood protection bunds and stream management to locally reduce velocities at critical locations.

The design of surface water management controls to meet operational needs includes consideration of the conceptual upgrades to the designs that may be required to accommodate closure requirements so that appropriate planning can be integrated into closure plans. The executed operational designs will then be revisited 5 years prior to the closure of the site when a detailed closure design will be developed. The development of this design near to the end of the pit life will permit the closure design to benefit from the data captured through the operational period as well as the increased certainty around final landforms.

Surface water closure designs will focus on maintaining the long-term stability of OSAs, creek diversions and pit walls adjacent to natural creek sections. The closure design will consider:

- Surface water runoff from OSAs;
- Natural creek sections adjacent to pits and OSAs;
- Design of diversion and flood bunds; and
- The potential impacts of climate change on flood events and closure designs.

9.1.2.1 Creek diversions

Surface water closure designs are based on modelled 1 in 10,000-year AEP events. Probable Maximum Floods have been calculated for comparison, however, are not used by BHP as a basis of design. This is due to the very large extrapolation and uncertainties involved in their estimates. Furthermore, the PMF method produces flood estimates significantly larger when adjusted for catchment area than any contained in the paleo record of any Australian River (Appendix E). The 10,000-year event estimates generally result in a flow rate several times larger than the 100-year AEP event and are considered an appropriately conservative basis for a closure design.

As discussed in Section 5.14.6, a permanent diversion of the Whaleback Creek has been constructed to the south of the OB30 pit to facilitate mining of the southern section of the pit and prevent creek capture post-closure. A number of operational constraints prevent the creek diversion from being constructed for closure conditions in the first instance, however, consideration has been given to the flood plain required to accommodate post-closure conditions (Section 7.3.1.1). The 1 in 10,000-year flood plain for this conceptual design intersects the toe of the OSA 1. Portions of this OSA may be rehandled so that the toe of the OSA sits outside the 1 in 10,000-year flood plain, or the creek diversion closure design may be modified to accommodate this landform. The closure flood bund would fall inside the current pit set-back, and if required at closure, additional pit wall stability controls, such as buttressing or partial backfill, may be implemented to maintain the long-term stability of this flood bund.

With regard to the OB35 Creek diversion, it has been assumed that it would remain and be upgraded for closure, (Section 5.14.5). At this stage, the Phase 2 diversion has been designed for 1 in 100 AEP operational flows (assuming no reduction in flow from the potential Western Ridge development) and further studies are required to determine the modifications required to accommodate closure requirements for this diversion once the impact of the proposed Western Ridge development on surface water flows has been confirmed. The stability assessment for the land bridge portion of the Phase 2 Southern Creek diversion shows that this section exceeds the closure stability criterion of FoS $\geq$1.5.

The permanent diversions will be designed to achieve comparable hydraulic and geomorphological characteristics to the original creek systems.

9.1.2.2 OSA stability

Drainage from OSAs and any upstream catchments will be managed to maintain long-term stability of landforms. OSAs will generally be designed so that the footprint lies 10 m outside of the 1 in 10,000-year AEP flood extent of named creeks or drainage lines, or where this is not possible, measures such as rock armouring of the toes of OSAs, modification of diversions, or the construction of flood bunds will be considered to reduce the potential for erosion of OSAs. The closure design for OSAs is further discussed in Section 9.2.1.

9.1.3 Groundwater

BHP uses hydrogeological conceptual and predictive modelling to inform closure planning. Groundwater flow modelling is undertaken to predict the range of possible outcomes for mine voids post-closure, which guides further technical studies and site-specific closure plans to focus on key uncertainties. Groundwater flow models provide predictions for water level recovery rates and equilibrium levels for the mine void options available at closure.

The initial conceptual model is updated and validated throughout the life of mine as more data becomes available. Updates and validations inform closure strategies and landform design from conceptual through to detailed, thereby reducing risk and increasing confidence.

The current mine plan assumes that there will be residual mine voids at closure which will result in the formation of pit lakes. Hydrogeological assessments predict that the OB29/30/35 pit lakes will remain sinks and will gradually become saline at rates defined by the salinity of groundwater and surface water inflows, the volumes of the pits and evaporation rates. However, since pit wall exposures of PAF material are negligible, the risk to pit lake quality from AMD is low. Risks to surrounding groundwater quality due to increases in pit lake salinity are low as the pits are predicted to be sinks and would only become temporary through flow systems in the event that a creek diversion or pit wall fails and results in capture of significant surface water flows. As discussed in Section 9.2.2 and 9.2.3, the likelihood of creek capture is minimised through:

- Pit wall stability assessments for closure and implementation of management measures (such as buttressing) if stability criteria (Factor of Safety (FoS) ≥1.5) are not met.
- Design of creek diversions for closure (1 in 10,000-year AEP events).

Based on the assumption that the mine voids remain open, there will be a permanent change to groundwater levels in the vicinity of the pits. Impacts to riparian vegetation are considered unlikely given the pre-mining depth to groundwater (Section 7.3.1.3) and Impacts to potable groundwater borefields and Ethel Gorge are considered unlikely due to limited connection with the OB29/30/35 aquifers (Section 7.3.1.3 and 5.9.2).

The Newman Potable Source Protection Plan (BHP Billiton, 2015) describes a catchment management strategy which focuses on the main drinking water supplies of Homestead and Ophthalmia Borefield and is based on the adaptive management approach outlined in the Eastern Pilbara Water Resources Management Plan (WAIO, 2018b). This plan includes the establishment of a number of management and monitoring zones to manage the range of potential hydrological changes resulting from BHP's operations and ensure proactive management of potential impacts to an acceptable level. Should pre-determined management thresholds or triggers be exceeded, action is taken to investigate causes and appropriate management actions. The Ethel Gorge TEC is also managed by the Eastern Pilbara Water Resources Management Plan (WAIO, 2018b).

Hydrocarbon and other contamination that is not remediated during operations can impact on groundwater quality. There are currently four identified contaminated sites at OB29/30/35 and a site of PFAS contamination at Whaleback that has the potential to impact on the OB29 dewatering bores. These areas will be managed in accordance with the CS Act.

9.1.4 Landforms

The development of the post mining landform design is an iterative process, integrating all the closure domains. Critical to the transfer of the operational domains, particularly OSAs, to a successful and sustainable landform design is a fundamental understanding of the chemical and physical properties of the soil and / or waste material used to construct the final landform (Section 5.3.2.4). In particular, the surface materials must be appropriate to withstand erosive forces and sustain vegetation growth in the long term. Inherent in this consideration is the water and nutrient holding capability of the growing media (Section 5.4). Similarly, its chemical properties must have low AMD (Section 5.3.2.3) and dispersivity / sodicity risk (Section 5.3.2.4).

BHP follows the adaptive management framework, with the mine plan and closure landform designs evolving over the life of mine as knowledge of constraints and opportunities become available over time.

To achieve our closure objective, slopes are created to minimise rilling, as this minimises the opportunity for accelerated erosional forces to develop within channel flows. Such slopes will have minor potential to become heavily gullied, and any inter-rill erosion that occurs will be insignificant relative to potential rates of erosion by rilling that could develop on long, steep, slopes. If rilling and gullying is avoided, the slope should be stable. BHP undertakes a suite of work to inform and guide the landform design process including:

- **Resource sterilisation assessment**: which is an assessment of resource or potential mineralisation beneath an area typically selected for proposed OSA construction. This assessment also applies to pit voids where backfill is proposed as part of the operations and / or closure strategy. It adds to the spatial dataset to assist with OSA positioning at the conceptual stage.
- **The resource block model**: which contains geological resource information for planned and operational mines. The model contains, amongst other things, the relevant stratigraphies, physical and geochemical properties of the rock mass allowing for the identification of ore and appropriate classification of waste material.
- **Waste characterisation** identifies material suitable for use on final slopes and problematic material (e.g., PAF, sodic) which should be buried within an OSA or mine void as appropriate.
- **Mine plan optimiser**: mine planning software is used to assist in generating an optimal pit design based on financial and geotechnical parameters, assuming an appropriate risk level. The mine planning software is also used to schedule multiple deposits based on optimal net present value (in consideration of operational and environmental constraints). Schedules

provide the necessary information to develop optimal waste strategies and are an iterative process. Scheduling outcomes influence OSA designs and backfill strategies.
- **Numerical erosion potential modelling**: surface erosion modelling can be undertaken as part of the detailed OSA design stage to evaluate the predicted rates and locations of erosion on a final landform. This process is supported by numerical inputs obtained from the material characterisation programs. This activity supports planning considerations around final landform design and waste scheduling objectives.
- **Physical erosion potential modelling**: an examination of mine waste that forms the outer surfaces of OSA landforms is undertaken to determine the key erosion characteristics of the waste material. This is conducted under laboratory conditions using predicted rainfall events from local rainfall data. It provides validated data for the numerical modelling on how well a specific waste rock type behaves in surface flow conditions and informs detailed OSA design such as stable slope angles and material use. In addition, field trials are utilised where appropriate, to validate laboratory findings.

The final landform design for the OB29/30/35 mining operations will require integration of all the domains listed in Table 2-1 and summarised below:
- OSAs;
- Infrastructure;
- Mine voids (above and below water table); and
- Creek diversions and flood protection works.

There are a number of ongoing studies that may impact the size and form of OSAs at OB29/30/35 (including consideration of a potential in-pit tailings facility and development of adjacent Western Ridge deposits). The final shape of OSAs will be designed to maintain surface stability and minimise erosion by managing surface water runoff. Where berms are deemed necessary in design due to overall landform geometry, berm cross-sectional water holding storage is based on 200-year 72 hr event with 300 mm freeboard from top of crest embankment.

Conceptual landform designs for existing and potential future OSAs are presented in Section 9.2.1, but these are likely to evolve over time in response to mine planning decisions. For example, the OB29 pit extends beyond an existing OSA. As part of rehandling waste material from this OSA to enable the mining of the pit area, the landform will be adjusted to fall outside of the Zone of Instability. If this is not feasible, material will be backfilled into the pit void to buttress the OSA landform, as advised through geotechnical review.

There is expected to be sufficient competent waste to close the OB29/30/35 landforms based on hard cap waste already stockpiled at OB29/30/35, additional hard cap waste to be sourced during the construction of future pit pushbacks and competent waste volumes located at Whaleback (Section 5.3.3).

Geotechnical and hydrological assessments will be used to inform the pit design and reduce stability issues, with surveys being undertaken to check final pit walls against designs. If pit walls do not meet stability completion criteria (for example to enable abandonment bunds or surface water diversion infrastructure to be located outside the zone of instability), buttressing may be considered. Creek diversions and flood protection works will be implemented to prevent creek capture and associated impacts to pit wall stability. As discussed in Section 9.1.2, where these structures have been designed for operational conditions, they will be upgraded at closure to accommodate extreme rainfall conditions that could occur post-closure.

At closure, abandonment bunds would be located outside the zone of instability of the pits in accordance with DEMIRS guidelines (DoIR, 1997) and designs would take into account the outcomes of recent consultation with DEMIRS (Section 4.3). Consideration would also need to be given to how the abandonment bunds interact with surface water management infrastructure remaining post-closure (e.g., flood bunds and diversions).

Provisions for safe access to the closed mine would be made, following consultation with key stakeholders, to accommodate the post-mining land use and enable Traditional Owners to access places of importance.

Visual impacts, design constraints and solutions will be discussed with key stakeholders, where visual impact is a key concern.

The decision-making process to determine how all domains will be integrated into a closure final landform design will take into consideration the full suite of potential closure impacts utilising tools discussed above. The final landform design for OB29/30/35 will develop over the life of mine based upon multi-disciplinary inputs including for example:
- Exploration data;
- Mine waste characterisation;
- Hydrology, hydrogeology, and hydro-geochemistry information;
- Post-mining land use and tenure considerations;
- The physical footprint;
- Cumulative impacts;
- Visual impact considerations;
- Mine planning, scheduling, and waste volumes;
- Flora, fauna and heritage issues; and
- Stakeholder inputs.

All of these factors interact over the life of mine in an iterative process such that the evolving mine closure strategy may progress from conceptual to detailed and include the specifics on landform design

9.1.4.1 Design of OSAs and ISAs

Potential requirements for OSA designs are integrated into the master area design for a mine and are refined throughout the mine planning process (Figure 9-4). During the early stages of mine planning (see 'Range Analysis' and 'Development Strategy' on Figure 9-4), conceptual OSA landform designs are used to delineate OSA locations and disturbance extents for approval purposes. In these strategic planning stages, the overall landform extent and conservative assessment of slope angle is used to estimate a final disturbance area. As more localised information becomes available and knowledge improves, a final landform design will be developed (see 'Engineering' stage on Figure 9-4) which will transition into an executable design. During construction, assessments are undertaken of compliance to plans based on survey data.

Erodible overburden may be backfilled into pits (sometimes as constructed ISA landforms) or placed in ex-pit OSAs which have appropriate geometries and are sheeted with competent material defined through materials characterisation studies. OSAs are generally located outside the Zone of Instability (ZOI) of pits, but where this is not possible, pit walls will be buttressed or pits backfilled to increase stability, or the ex-pit overburden material will be transferred to an alternative location. OSAs will also typically be located outside the 1 in 10,000-year floodplain. However, where the 1:10,000 floodplain intersects OSAs, consideration will be given to additional rock armouring or toe protection bunds or diversions to minimise the potential for erosion in a post-closure flood event.

The final shape of OSAs and ISAs will be designed to maintain surface stability. Erosion of OSAs is minimised by managing surface water run-off and designing slopes that will result in minimal rilling as this minimises the opportunity for accelerated erosional forces to develop within channel flows. Such slopes will have minor potential to become heavily gullied, and any inter-rill erosion that occurs will be insignificant relative to potential rates of erosion by rilling that could develop on long, steep, slopes. If rilling and gullying is avoided, the slope should be stable.

Where berms are deemed necessary in design due to overall landform geometry, berm cross-sectional water holding storage is based on 200-year 72 hr event with 300 mm freeboard from top of crest embankment.

Opportunities to minimise the size of the OSAs by increasing the amount of overburden material used to infill final voids are explored as part of ongoing operational planning.

Final OSA landform designs are informed by:

- Final contours of an 'as tipped' OSA;
- Surface water assessments including an assessment of the catchments that impact on the OSA and potential for run-off from the OSA;
- Materials characterisation (Section 5.3.2); and
- Modelling of erosion (Section 5.3.2.4).

There are several standard design elements that are typically integrated into most landform designs. These comprise:

- Frontal crest bunds to control surface water run-off down slopes (Figure 9-5). A typical cross section is shown in Figure 9-6.
- Inter-bunds to control surface water movement across landform surfaces (Figure 9-7). Cells generally run perpendicular to the frontal crest bunds. A typical cross section is shown in Figure 9-8. Finished cell surfaces are deep ripped. The top Reduced Level (RL) of inter-bunds is required to be a minimum of 300 mm below the frontal crest bunds.

Waste Resource Planning Knowledge Map

Purpose: To layout the waste planning activities and study levels during the various stages of project development, from early Range Analysis to execution by Operations. By detailing the study/management level, risks can be identified and separate management plans to manage the risks can be developed.

Scope: This document covers the management of waste material at WAIO sites. Waste generated at WAIO sites includes:
1. Non-mineralised waste rock (mining overburden).
2. Mineralised waste rock (Low/Blend Grade).
3. Quarried rock used for construction.

LoA Waste Knowledge Understanding

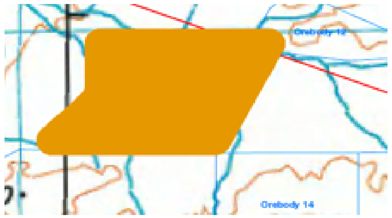
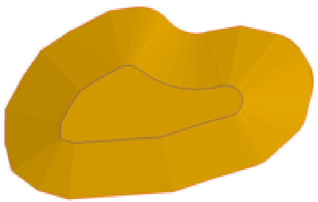
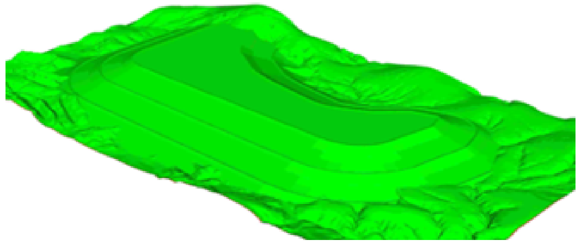
	Range Analysis	Development Strategy	Engineering	Implementation
OVERVIEW	The waste and landform considerations will generally be at a high level due to a limited waste understanding caused by the model maturity.	A conceptual 9 degree OSA final design with no ramps developed for extents that considers preliminary geochemistry and landform requirements. Assumes all waste/LG/BG dumped ex-pit.	Executable rehabilitated designs are developed to inform the as-tipped designs. The design is to consider the material properties of the waste and physical environmental conditions of the area.	Mine Operations execute the OSA and landform structure in accordance with the approved as-tipped design. Waste schedule optimises waste placement objectives to minimise haulage and rehabilitation costs.
OSA LANDFORM REQUIREMENT				
KNOWLEDGE LIMITATIONS	*Initial drilling program that has broadly defined a known mineral deposit. Footprint of conceptual OSA should consider drainage alignments and future pit and infrastructure footprints.*	*Infill drilling has allowed for the development of resource models that consider the waste risks of the deposit.*	*Infill drilling completed, resource and mining models available with a good understanding of lithologies and PAF potential. Site specific material characterisation work may not yet have been completed but reviews of adjacent studies has been undertaken.*	*Monthly review of compliance to plan undertaken to ensure compliance with design during execution of landforms. As material competency investigations are completed, mine plans are amended to optimise waste placement objectives if possible.*

Figure 9-4 OSA landform development stages during mine planning

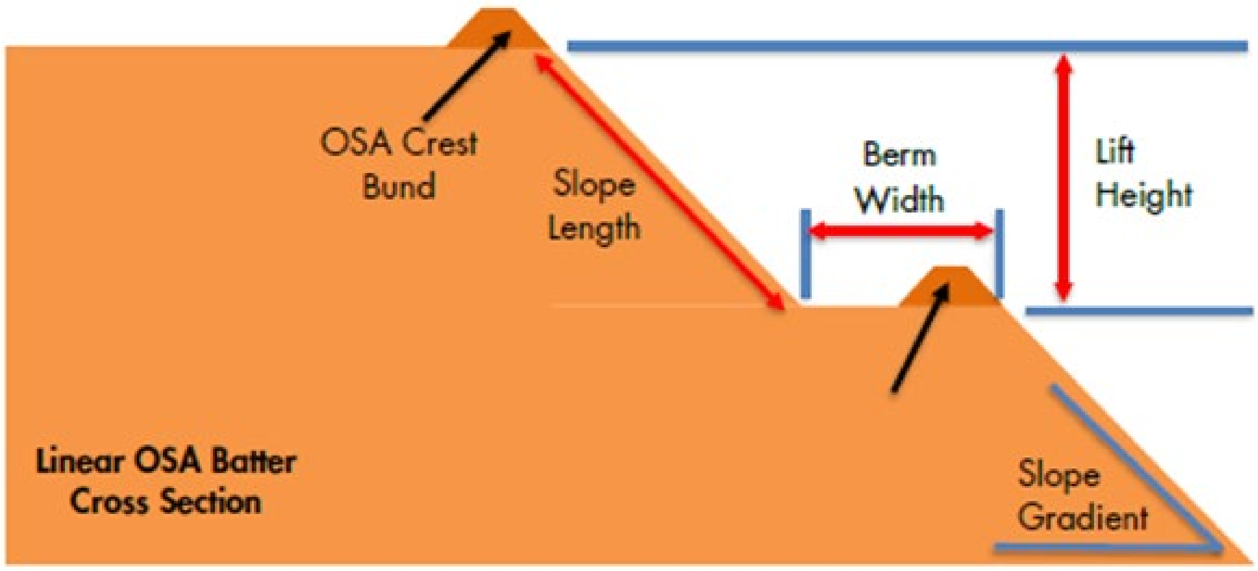


Figure 9-5 Linear OSA batter cross section showing location of crest bunds

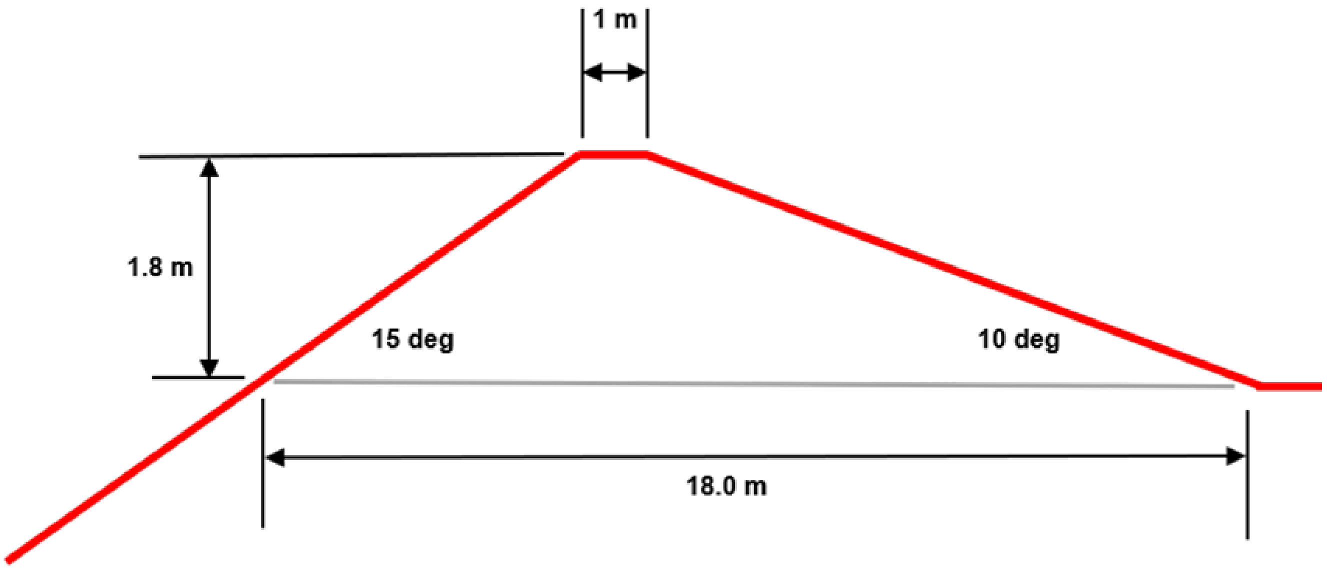


Figure 9-6 Typical frontal crest bund cross section

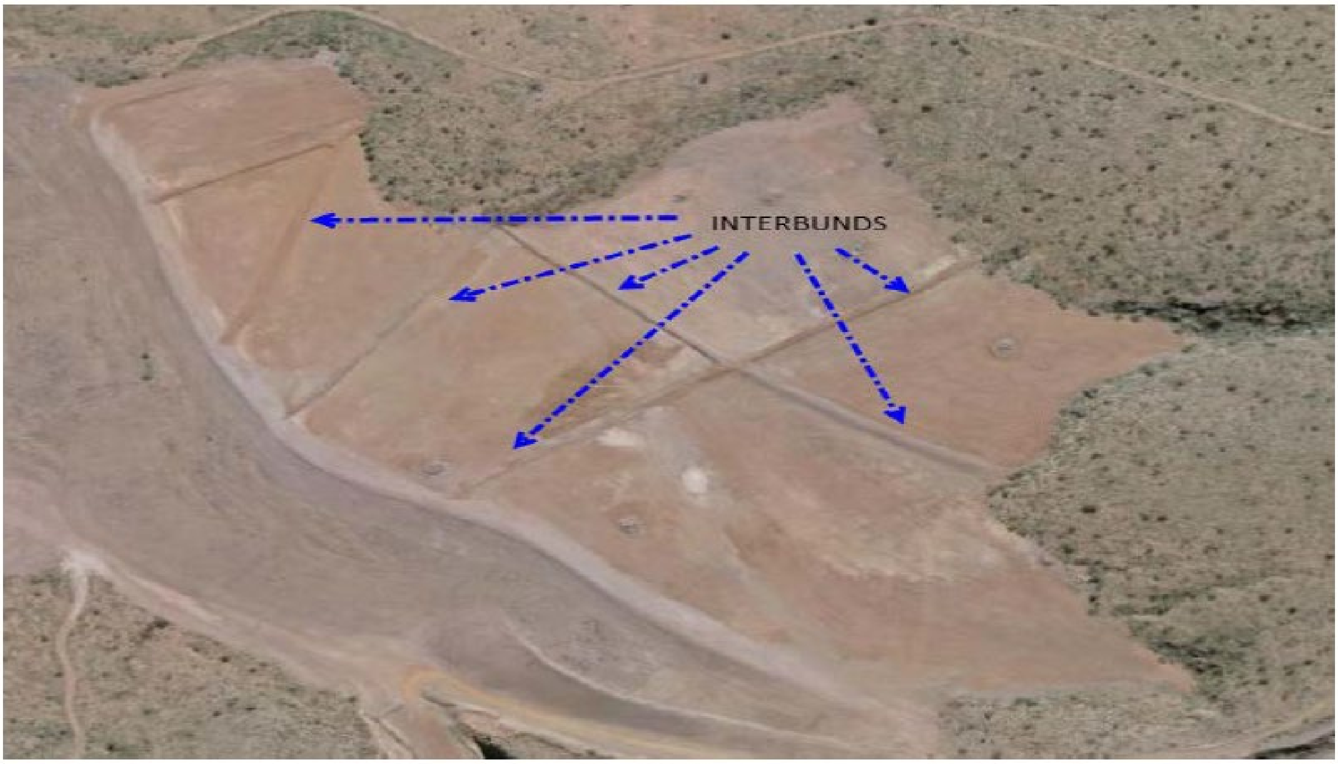


Figure 9-7 Example inter-bund configuration

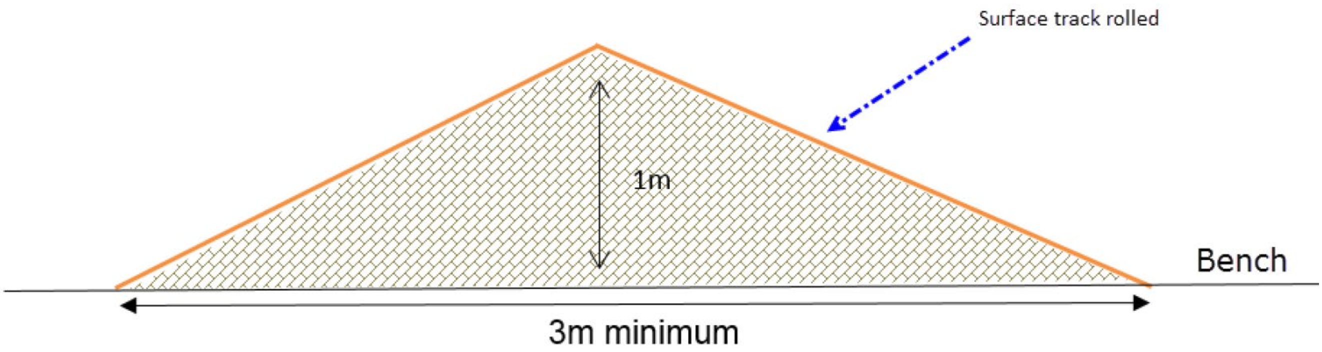


Figure 9-8 Typical cell bund cross section

9.1.4.2 Mine Voids

Mine void closure strategies consider the post-closure influence of mining areas on groundwater and associated receptors, as well as opportunities for reducing the ex-pit footprint of OSAs and management of physically or geochemically problematic materials. Following the confirmation of the preferred mine void closure strategy (e.g., whether they will be backfilled) and final pit shells, pit wall stability is assessed and the potential for the ZOI of the pits to impact on infrastructure (such as safety bunds and surface water management infrastructure) determined. Where post-closure infrastructure falls within the ZOI of pits (determined in accordance with DEMIRS guidelines (DMIRS, 2019) on the basis of risk, but typically using a FoS of ≥1.5), pit walls may be designed to achieve a lower slope angle or buttressed or backfilled to improve stability.

Geological and geotechnical models are produced for each pit which are used as the basis for geotechnical assessments. Geotechnical, hydrological and hydrogeological assessments are used to inform pit designs and pit wall stabilities and BHP's Internal Design Review Process checks that geotechnical guidance has been incorporated into designs. Following construction, surveys are undertaken as part of BHP's compliance to plan processes to check final pit walls against designs.

At closure, safety bunds will be located outside the ZOI of the pits in line with DEMIRS guidelines (DoIR, 1997), and designs will consider the outcomes of recent consultation with DEMIRS. Consideration will also need to be given to how the safety bunds interact with surface water management infrastructure remaining post-closure (e.g., flood bunds and diversions).

9.1.5 Standard rehabilitation strategies

BHP implements its Rehabilitation Standard (0001074) (WAIO, 2023f) and associated procedures relevant to rehabilitation works including rehabilitation planning, growth media management, earthworks for rehabilitation, audit and inspection, seed management, rehabilitation data management and rehabilitation monitoring. These procedures have been developed based on previous rehabilitation success and to manage identified issues. The results of rehabilitation monitoring are used to adjust and refine the methodology in accordance with BHP's adaptive management approach (Section 7.1). The rehabilitation standard and associated procedures are used across BHP's Pilbara mine sites and other areas, where appropriate. Further details of various aspects of the standard and procedures are provided in the subsections below.

9.1.5.1 Rehabilitation planning

Rehabilitation planning is conducted generally in accordance with BHP's Rehabilitation Planning and Execution Technical Process Instruction (WAIO, 2023d). This requires that a 5-year rehabilitation plan be developed in consultation with the mine planning and production scheduling teams. The plan is updated as part of the financial closure provision process and is used as the basis of a five-year seed supply plan which guides seed purchases (species and volumes).

For each area of rehabilitation, a work pack (and / or scope of work if rehabilitation is to be executed by an external contractor) is developed. Work packs typically outline the key tasks for the project with appropriate stages, which require sign-off by all relevant parties, validating that the work conforms to BHP's rehabilitation and closure standards and objectives.

9.1.5.2 Earthworks

The Earthworks for Rehabilitation Procedure (WAIO, 2023e) has been prepared to provide a consistent methodology for rehabilitation earthworks across the Pilbara operations including:

- Relocating materials (e.g. backfilling pits).
- Re-profiling the land surface to create landforms that are consistent with the surrounding landscape, within the constraints imposed by the physical nature of the materials.
- Reshaping slopes to a profile suited to the nature of the material used (determined by overburden characterisation studies and modelling of erosion potential).
- Constructing surface water controls.
- Application of rock armour.
- Implementing the surface treatments outlined in Section 9.1.5.3.
- Constructing fauna habitats as outlined in Section 9.1.5.5.

At the end of each earthworks phase, a rehabilitation inspection is conducted generally in accordance with WAIO's Rehabilitation Inspection and Sign-off procedure (WAIO, 2023c) to confirm conformance to the work pack / scope of work for that area.

9.1.5.3 Surface treatment

Several surface treatments may be used, depending on the size and nature of the rehabilitated area. The proposed surface treatments for rehabilitation areas at OB29/30/35 have been developed to satisfy the stated closure objectives and may consist of one or more of the following:

- Deep ripping of compacted surfaces, and cross ripping if clod size is greater than 150 mm.
- Selective application of topsoil material (or alternative growth media) to provide a medium to support plant growth.
- Application of inorganic or organic amendments informed by assessment of the growth media and research findings (refer to Appendix G).
- Surveyed contour ripping or scarifying of surfaces following the application of soils to maximise water infiltration and enhance revegetation success (Figure 9-9). When scarifying on the contour is not appropriate due to physical constraints (such as narrow areas or areas constrained by infrastructure or natural features), a herringbone technique may be used (Figure 9-10). Where there is high rock content and natural surface roughness of the final designed surface, contour ripping may not be required. Based on the outcomes of research and trials across BHP's operations, a no-rip approach is the preferred approach, where possible. This can be achieved through deep ripping to treat compacted areas being undertaken prior to the spread of armouring material / growth media.
- Selective placement of logs or smaller woody debris across the re-profiled surface (Figure 9-11) and / or constructing rocky cliff features (where potential exists) to provide additional habitat areas for fauna species recorded prior to mining.

Figure 9-9 Contour ripping

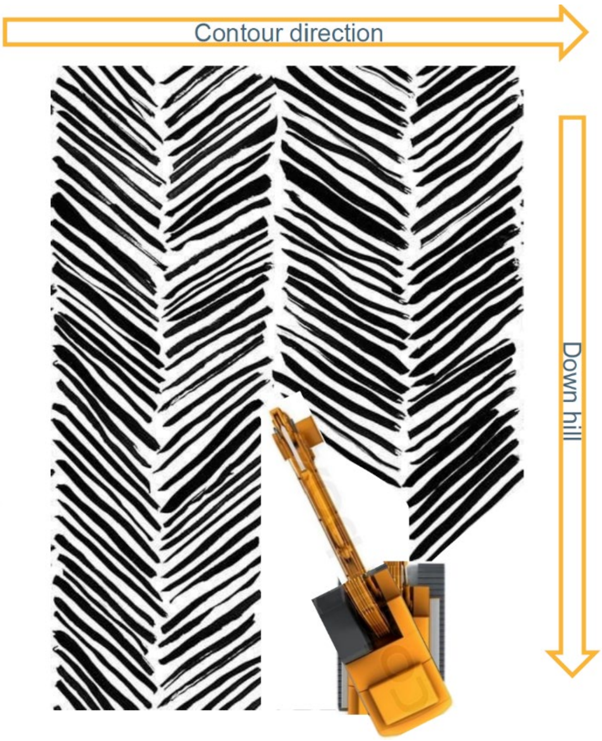


Figure 9-10 Herringbone scarification

Figure 9-11 Example of placement of logs & branches as fauna habitat

The Management of Growth Media for Rehabilitation TPI (WAIO, 2024a) provides general information on soils of the Pilbara region and methods for soil stripping, stockpiling and use in rehabilitation, and has been informed by the results of the research partnership with the Botanic Gardens and Parks Authority and the University of Western Australia (as discussed in Section 5.14.1).

Direct placement of topsoil onto rehabilitation areas is preferable. If direct placement is not possible, soil will be stockpiled in single mounds, ideally no more than 3 m high to maintain biological activity. Compaction of the topsoil stockpiles should be minimised by building from the edge (rather than the top of the stockpile), deep ripping and spreading stripped plant material to encourage revegetation. Revegetating the stockpiles will also minimise dust, erosion and weed establishment.

9.1.5.4 Revegetation

Revegetation programs are typically designed to establish native vegetation that blends with surrounding areas and provides habitat and foraging areas for native fauna, while taking into consideration the constructed landform design and overburden material characteristics within the potential root zone.

The Rehabilitation Standard (WAIO, 2023f) requires that revegetation be conducted to establish plant species that will support the approved post-mining land use(s). Plant species lists for different domains are generated, using baseline vegetation data, to include a range of typical vegetation assemblages suited to the post-mining landform (Appendix K). While selected plant species will typically be consistent with vegetation associations and native species recorded in the mine area prior to mining, some domains (e.g. backfilled pits) or post-mining land uses, may require the return of novel ecosystems. Where a novel ecosystem is proposed, research / studies are conducted to define appropriate species for use in revegetation of these areas. Seed used in rehabilitation is of local provenance and sourced from the local area (but as a minimum from within the Pilbara Biogeographic Region and 100 km of the site), unless novel ecosystems require seed sourced from elsewhere.

Based on the available climate change predictions, BHP considers that the most appropriate revegetation approach is to select native species based on the current climatic conditions. If there were to be an effect on revegetation from climate change, those changes would reasonably be expected to be gradual and would be experienced across the entire region, including adjoining unmined areas. Major differences between regional and post-mined vegetation will be managed by planning for diversity of species within rehabilitated sites, so that the natural adjustments to a changing climate will be accommodated within the local species pool. However, BHP will maintain a watching brief on emerging research associated with the use of out of provenance seed sources to increase genetic diversity to provide resilience to climate change.

The Seed Management Procedure (WAIO, 2022d) describes the types of seed species mixes and seeding rates that BHP uses at its Pilbara mining operations. This mix can be adapted to suit the particular characteristics of the site through BHP's adaptive management approach (refer Section 7.1).

All seed collections are recorded in BHP's seed collection database (developed as part of the Restoration Seedbank Initiative). This database records information for each seed batch such as provenance zone, seed test data, and landform position, preferred by each species.

Where monitoring results indicate vegetation establishment may not meet required standards, (vegetation density, species diversity and plant age heterogeneity), additional seeding (in subsequent years) may be undertaken.

Two rainfall periods characterise the OB29/30/35 region – one from January to March and the other from May to August. The most reliable rainfall period occurs from January to March. Accordingly, revegetation activities will be completed between October and December, where practicable. Work completed as part of the research partnership with Botanic Gardens and Parks Authority and the University of Western Australia has highlighted the significance of sowing time (in relation to expected rainfall events) to the success of seed germination.

Weeds will be monitored and controlled in accordance with the Weed Management Procedure (WAIO, 2020).

9.1.5.5 Fauna habitats

Rehabilitation plans address the return of fauna habitat through selection of target vegetation communities and / or specialised constructed habitat features. Establishment of specialised fauna habitats is considered during the development of landform designs and associated work packs for execution.

Where available, large rocks (with a minimum of 500 mm diameter) may be used to create fauna habitats. The rock habitats are formed with a wide base, often sunk into the ground, with multiple layers of rocks to 2.5 m high (Figure 9-12). Topsoil is pushed back in / around the lower section of the rock stack. These rock habitat structures provide gaps and voids to allow species such as quolls and pebble mound mice to gain entry.

Landform designs typically require a higher percentage of rock on slopes for stability, but the surfaces of OSAs may contain less rock and, therefore, are of greater suitability for species that require less rocky habitat.

BHP is in the process of planning a research program on fauna habitat, including consideration of key species of importance to Traditional Owners, and the return of fauna to rehabilitated areas. This will inform future rehabilitation practices

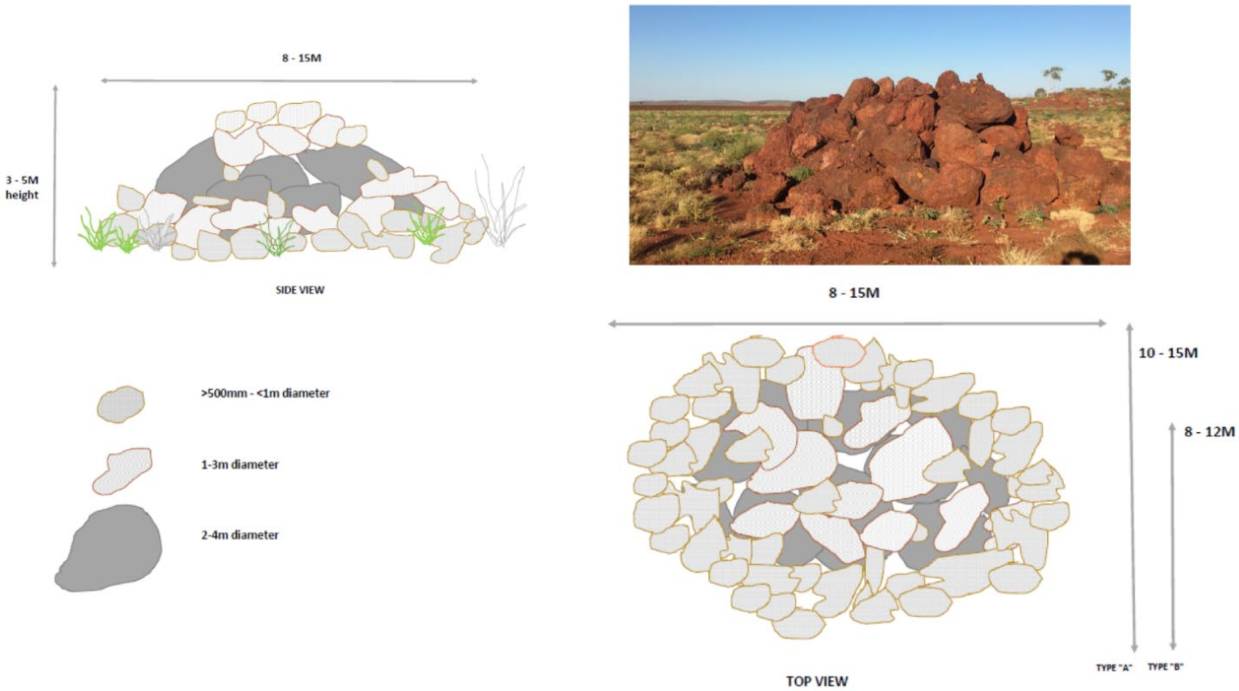


Figure 9-12 Fauna habitat

9.1.6 Cultural values and heritage

Comprehensive archaeological and ethnographic surveys are undertaken to identify sites of cultural significance prior to ground disturbing activities. In general, closure activities are unlikely to impact these sites as these activities usually occur in areas that have already been disturbed. However, where new disturbance is required to execute closure designs, BHP reviews and authorises the disturbance (currently via its Project Environmental and Aboriginal Heritage Review (PEAHR) procedure (WAIO, 2023a)) prior to work commencing. For each planned disturbance area, the following details are addressed in the PEAHR form:

- A summary of the proposed disturbance activities;
- A plan showing the location of the proposed works;
- The anticipated environmental, land access and Aboriginal heritage impacts; and
- Specific management measures where necessary.

The primary mechanism for protection of cultural heritage sites identified as being significant, is the development of closure plans and designs to avoid identified sites. Any post-closure issues (including ongoing management) relevant to these sites will be discussed with the relevant Traditional Owners through the stakeholder engagement process (Section 4).

Discussions will also include:

- The opportunity to repatriate artefacts that have been collected and stored during the mining process, if required.
- Options for closure designs to provide safe access to sites of importance post-closure.
- Cultural values and potential closure designs to incorporate / retain these values.

A number of sites of cultural value have been identified at OB29/30/35 in consultation with the Nyiyaparli People. Consultation with the Nyiyaparli People will be conducted to inform final landform designs (including requirements for safe access to sites of significance) and management of cultural artefacts post-closure.

All work will be conducted in compliance with the *Aboriginal Heritage Act 1972* or any replacement legislation and in accordance with BHP's comprehensive agreement with the Nyiyaparli People.

9.1.7 Post-closure land use

Stakeholder views (including those of Traditional Owners) and the appropriateness / feasibility of different land uses changes over time. BHP's ongoing stakeholder consultation program will enable future land use options to be identified and studied in further detail throughout a mine's life, and detailed land use-specific performance objectives and completion criteria to be developed.

As a site approaches closure, discussions will be held with key stakeholders to determine whether they have a requirement for site infrastructure post-closure. If infrastructure is to be transferred to third parties, a condition assessment of the infrastructure will be conducted, and the infrastructure (including responsibilities for ongoing management and maintenance) will be formally transferred to its new owner.

Post-closure monitoring will be used to gain an understanding of any long-term land maintenance requirements. Where specific long-term management actions are required, which are above those expected for the post-closure land use, an agreement will be made to provide for these actions prior to relinquishment.

9.1.8 Site contamination

In areas where the potential for soil, and groundwater / surface water contamination has been identified, assessment and remediation are managed in accordance with the CS Act and DWER requirements (including sampling / analysis and remediation / management) during a site's operational life and not left unresolved at the time of closure. As a site approaches closure, investigation and remediation of any remaining contamination is considered during BHP's closure study phases[25]. This includes consideration of whether the contamination land use classification of sites previously investigated / remediated is commensurate with the agreed post-mining land use.

Remaining surfaces will be reshaped to conform to surrounding landforms, with surface treatment and revegetation implemented as outlined in Section 9.1.5.3 and 9.1.5.4.

9.1.9 Dust emissions

Dust has the potential to be emitted during decommissioning and bulk earthworks activities during closure. Dust control measures will be implemented during closure, e.g. regular watering of unsealed roads, exposed surfaces and active earthwork areas. Upon closure, dust generation from the rehabilitated surfaces is expected to be similar to other nearby natural landforms.

9.1.10 Site safety and security

Safety considerations for closure include:

- The post-mining land use and associated requirements for safe access.

[25] *Closure approaches and designs will be refined over the coming years through further assessments and design studies. For major capital projects, which include closure projects, BHP has a defined study process that starts with an Identification Phase Study (IPS) that looks at possible closure options and then conducts sufficient technical work to enable these options to be refined to a list of viable alternatives and selection of a preferred alternative. Following selection of a preferred alternative, a Selection Phase Study (SPS) is conducted to refine and optimise the preferred designs / approaches. A Definition Phase Study (DPS) follows the SPS and develops detailed designs and execution plans.*

- Safe access to sites of significance for Traditional Owners.
- Measures to prevent inadvertent access to hazardous areas.
- Management of hazardous materials.
- Decommissioning and removal of above ground infrastructure that will not be transferred to a third-party post-mining.

Safety hazards are identified during risk assessments conducted during appropriate design phases, and where practicable, are eliminated through a range of measures including, but not necessarily limited to:

- Placement of fibrous overburden encountered during mining, 1 m below the surface of an OSA / ISA / backfill. Where, due to historic practices, there may be an absence of detailed destination information for materials placed in OSAs, any potentially fibrous materials encountered during regrading or recovery for mine void backfill will be placed at least 1 m below inert non-fibrous overburden.
- Removal of infrastructure, filling of voids left after infrastructure removal and capping of bores.

Where hazards cannot be eliminated, designs are developed to prevent inadvertent access. In defining appropriate site safety and security measures to prevent inadvertent access, consideration is given to the accessibility of a site (such as proximity to public access routes). Consultation is also conducted with post-mining land managers and Traditional Owners to identify safe access requirements to accommodate the post-mining land use and access to sites of importance to Traditional Owners. Inadvertent access is typically controlled using safety bunds which are designed to be located outside the zone of instability of the pits in accordance with DEMIRS guidelines (DoIR, 1997) and include consideration of matters raised during consultation with DEMIRS (Section 4.3). However, for some sites near population centres, fencing, signage and locked gates may also be required. In these instances, provision would need to be made for ongoing inspection and maintenance post-closure.

At sites where flood bunds and creek diversions remain post-closure, the interaction of safety bunds with these features will be factored into designs.

9.2 Closure strategies for specific domains

This section outlines the closure design based on studies and mine planning conducted to date. The designs presented in this section will be updated as consultation with stakeholders and the Nyiyaparli people is progressed and as design studies are completed.

Details about the closure of individual designs is provided in Sections 9.2.1 to 9.2.5.

9.2.1 Overburden storage areas

Final landform designs (including location) of the ex-pit OSAs are informed by surface water assessments, waste characterisation and modelling of erosion potential. Any low-grade ore that is encountered will be placed adjacent to the OSAs, as it is likely that low-grade ore will be both added and removed depending on ore blending requirements. Market demand will determine how much, and when it is viable to process the low-grade material. In the event that this material is not blended with the high-grade ore, BHP will re-profile these areas into the OSAs.

The final landform design will be developed in accordance with the Mines Closure Design Procedure (WAIO, 2022f) and executed in accordance with the earthworks strategies outlined in the Rehabilitation Standard (WAIO, 2023f). Landforms are generally designed on the principle of store and controlled release of water. Landforms are designed to store a 1 in 200-year 72-hour event on the landform and release water from larger events to engineered spillways, or suitable adjacent natural features that are resistant to erosion such as rocky outcrops, or natural gullies which transport drainage from natural slopes. The speed of water movement on the OSA (and hence the potential for erosion) is controlled by appropriate slopes, guided by material characterisation data, and inter-bunds on the surface of the landform (see below for further detail).

Final landform designs would be informed by:

- Final contours of an as-constructed OSA;
- Surface water assessments including an assessment of the catchments that impact on the OSA and potential for run-off from the OSA;
- Materials characterisation; and
- Modelling of erosion.

There are currently four OSAs located at the site with an additional two proposed. These include:

- Existing
  - OB29 OSA North
  - OB29 OSA South (which is proposed to be expanded as part of the Significant Amendment and will be renamed OB29 OSA West)
  - OSA 1
  - OSA 2
- New proposed OSA
  - OB29 OSA East

Conceptual designs are provided in Figure 9-13, Figure 9-14 and Figure 9-15 to give an indication of possible post-mining landforms. The landform concept designs have been based on the erosion studies outlined in Section 5.3.2.4, and assume that landforms will be sheeted with hard cap waste extracted and separately stored at OB29/30/35, or competent Brockman waste types extracted from Whaleback.

Figure 9-13 shows a conceptual landform design for OB29. The figures shows that the OB29 North OSA has been relocated to enable mining of the northern part of the OB29 pit. However, rehandling of OB29 North OSA is under review, and it may be re-profiled in situ to avoid creating more disturbance associated with gaining access for hauling material back into the pit. Section FF' shows where the East OSA extends into the pit as partial backfill. The material shown in the aerial photograph immediately to the east of Section FF' is hard cap material that will be used in the rehabilitation of the OSAs.

Figure 9-13 Figure 9-14 and Figure 9-15 shows the landform concepts for OB30 and OB35, including the OB30 and the OB35 creek diversions. Section BB' shows where the OSA 2 interfaces with the OB35 creek diversion across the backfilled area of the pit. Section BB' shows how OSA 1 interfaces with the pit and the OB30 creek diversion. The concept design assumes that the OSA 1 landform will be adjusted to fall outside of the 10,000-year flood plain for Whaleback Creek. Some backfill may be required in OB30 to stabilise the pit wall adjacent to the closure flood bund for the OB30 creek diversion (Figure 9-15). This will be dependent on the final closure design for the diversion. Section FF' shows a possible partial backfill profile in OB35 pit. This profile is highly dependent on future mine plans.

Final closure designs will be confirmed following updates to the mine plan and through 3D landform evolution modelling, if required once the detailed design has been completed. The designs shown do not include details of the crest, frontal and inter-bunds. These details are usually added in closer to execution, as the final landform designs will need minor adjustments in any case, to account for slight differences in plan vs. as-dumped surface for various reasons such as, but not limited to, operational geotechnical requirements, over/undertipping and temporary LV accesses.

Table 9-1 OSA Status

OSA/ISA Name	Status	Design Comment
OB29 North	Planned OSA was not tipped out due to heritage site nearby. Design of rehab area was postponed pending pit and backfill optimisation for OB29, which may change access strategy as it currently limited by active power and dewatering infrastructure at along the eastern toe.	Marra mamba waste forming the pads for old stockpile areas are planned to be rehabbed. Design and construction methodology yet to be finalised, with consideration on having minimal impact on nearby heritage site. Conceptual design is to be based on maximum 43m-high concave slope on the east, with 20m-high slopes of 16° from the crest, followed by 10m-high sections of 10° and 8° and 6° slope at the toe to integrate the landform to the surrounding terrain.
OB29 South (which will be renamed to OB29 West)	Final landform design is currently being adjusted to account for new Western Ridge conveyor being constructed along the western toe. The option of expanding the last lift of this OSA is also being considered, due to decreased dumping capacity in the other OB29 OSAs.	Marra mamba OSA has been tipped to enable a 15-degree stacked linear design with 18m berms separating three 20m-high lifts. Additional width of competent waste rock armouring is planned for the west-facing slope of the bottom lift. The eastern slopes of this landform will also be adjusted and re-assessed once the OB29 pit and backfill scenarios are finalised.
OB29 East (proposed)	Tip-to design is for planning only, pending approval regarding heritage sites nearby.	Inert Marra Mamba waste, with footprint heavily constrained as to not impact the heritage sites. Conceptual design has a maximum height of 57m on the eastern-facing slope. Concave slope recommended with 20m high slopes of 16° near the crest, then a total of 20m-high slopes of 10° and 8° and, 6° applied near the toe.
OB29 ISA	Active. Opportune pit back-filling.	All slopes are contained within the pit void, hence no reprofiling is intended for this ISA, apart from rehabilitation of open areas used for access near the pit crest. Additional back-filling options are still being sought in conjunction with haulage optimisation.
OB35 ISA	Tipping to 552RL has been approved. Stage 2 tipping to 592RL is pending completion of sterilisation drilling on the mined-out berms.	All slopes fall inside the OB35 pit void; hence no reprofiling is intended for this ISA. Ground control requirements from the active mining area on the western side of the pit is currently limiting the expansion of this in-pit dump. Additional back-filling options are still being sought in conjunction with haulage optimisation.
OSA 1	OSA already tipped out to design. The top of the OSA is currently being used as a park-up area. Dewatering pipeline on the east and a major haul road on the west also need to be diverted before rehabilitation can commence.	40m high Marra Mamba waste. Conceptual design will be updated to incorporate additional pads that were added around this OSA since it was tipped out.
OSA 2	Active, with a footprint expansion being considered towards the north-west, within the Western Ridge development envelope. Erodibility testing required for the 3m-high waste pad that will be left at the toe in the southeast quadrant, to inform decision on whether it can stay in place or be rehandled into the pit.	60m-high Marra mamba waste dump, with final landform toe located offset at least 10m away from the 10,000-year ARI flood extents. All the slopes are designed to have a linear 16° section at the top 20m section, followed by a 60m berm, and then a continuous concave profile all the way to the toe. Landform design considers closure of OB35 creek diversion.

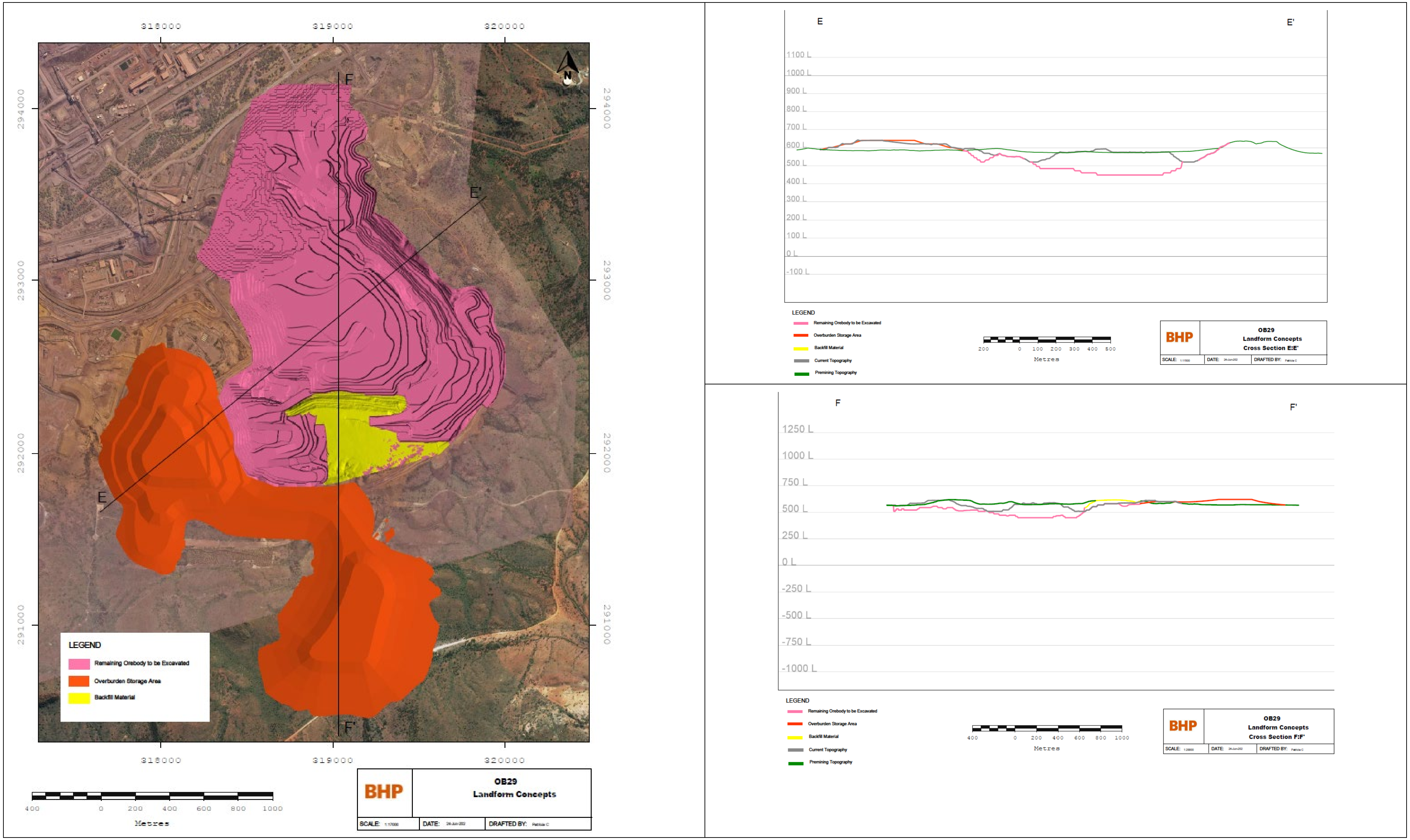


Figure 9-13 OB29 Landform concept

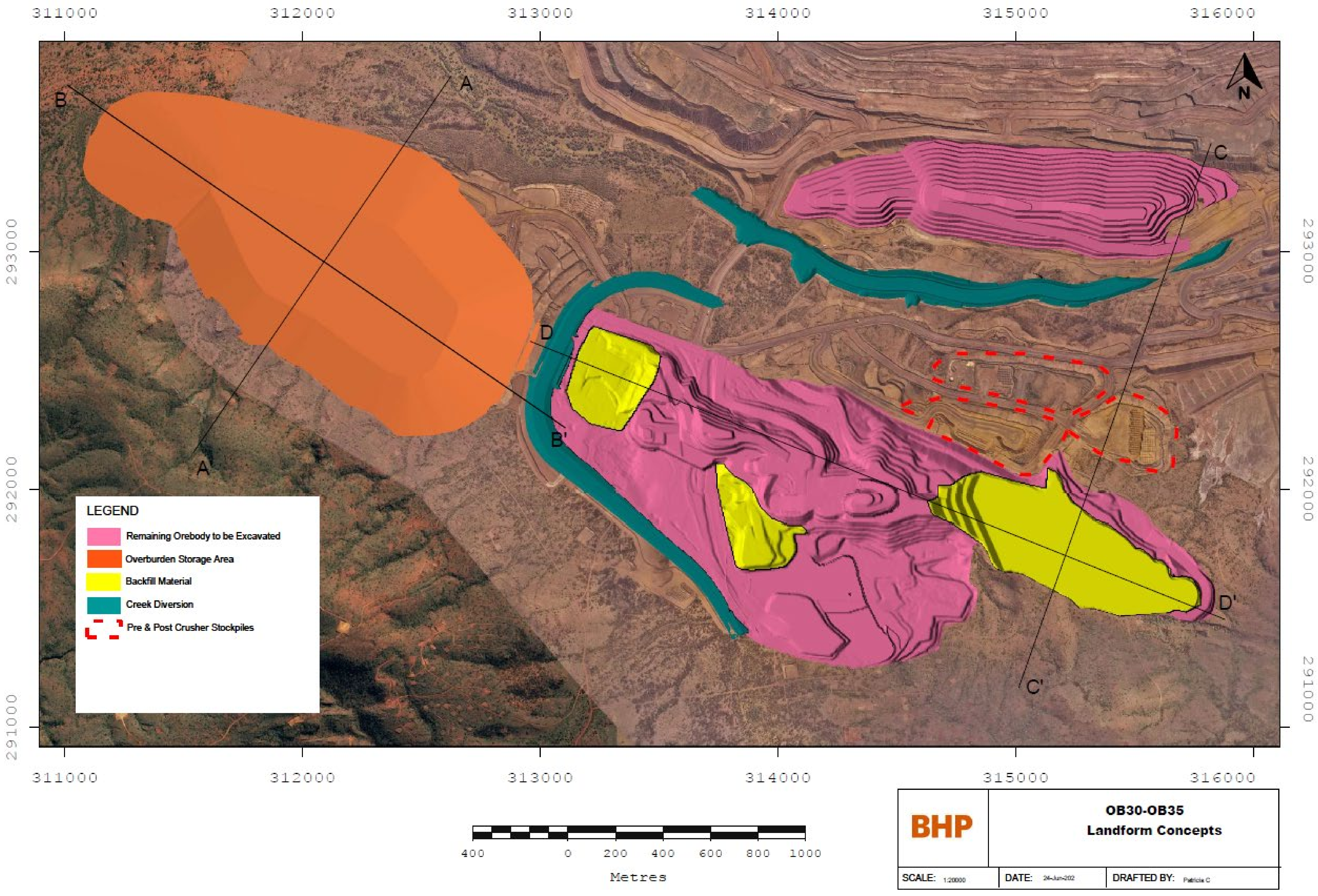


Figure 9-14 OB30 and OB35 landform concepts (a)

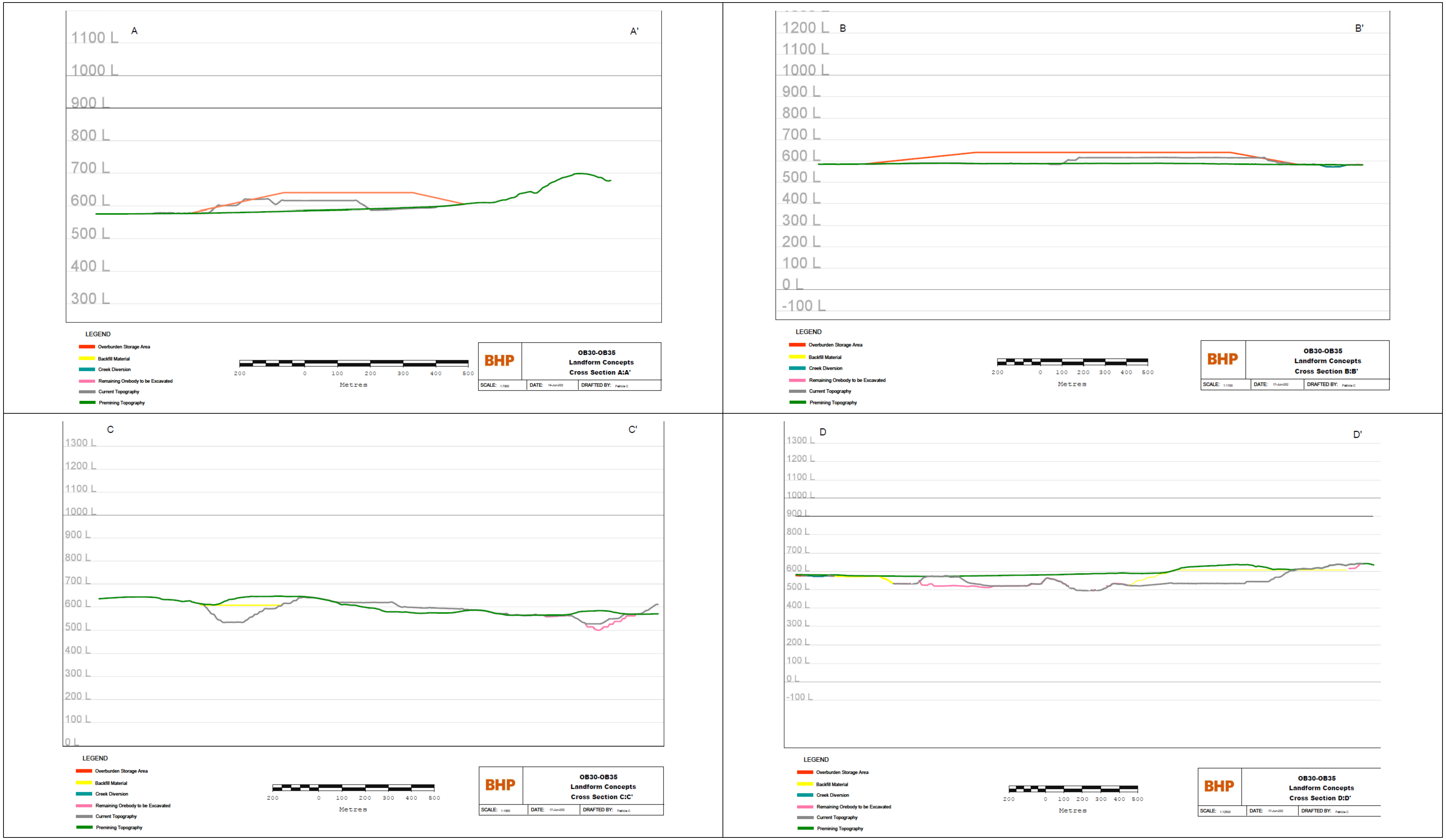


Figure 9-15 OB30 and OB35 landform concepts (b)

9.2.2 Mine voids

Three mine voids will remain at closure. The backfill strategy for OB293035 is that there will be no backfill at OB30, partial backfill in the south of the OB29 void and partial backfill into the OB35 void. This would result in pit lakes forming at OB29 and OB30, with a smaller pit lake at OB35 in the residual void below the water table. Backfill options are currently under review and are dependent on waste rock availability.

Safety bunds will be constructed around residual voids in accordance with the DEMIRS recommended practice (DoIR, 1997). The bunds will be a minimum 2 m high with a base width of minimum 5 m and constructed at least 10 m away from the edge of the area known to contain potentially unstable rock mass as per recommended practice (DoIR, 1997).

Where safety bunds, creek diversion structures (e.g., OB30 closure flood bund; see Sections 9.2.1 and 9.2.3.2 for discussion) or OSAs are located within the pit zones of instability due to spatial constraints, pit wall stability will be improved (e.g., by buttressing).

Current blasting practices used to reduce the potential for pit wall failure post-closure include the use of trim shots.

9.2.3 Surface water management infrastructure

Surface water management structures that will remain post-closure and may require upgrade for closure are the:

- Southern creek diversion (Section 9.2.3.1)
- OB30 creek diversion (9.2.3.2).

The arrangements of the two diversions are shown in Figure 9-16.

Creek alignments prior to installation of diversion | **Creek alignments after installation of diversions**

Figure 9-16 OB29/30/35 Creek Diversions

9.2.3.1 OB35 creek diversion

There are two creek diversions associated with the Southern Creek (Figure 9-17); the Phase 1 Southern Creek diversion and the OB35 creek diversion, formally known as the Phase 2 creek diversion. A Mine Closure Plan for Small Mining Operations was developed for the Phase 1 Southern Creek diversion (BHP, 2020a) and closure of this infrastructure falls within the closure planning boundary for another MCP (BHP, 2023m). This section provides a description of the OB35 creek diversion, which was constructed in 2023.

The current mine plan assumes that the OB35 creek diversion would remain post-closure. The diversion was designed for 1% AEP operational flows (assuming no reduction in flow from the Western Ridge development). However, current mine plans for the Western Ridge development forecast that most of the catchment will be mined and that the future peak flows will be less than the current design flows. Features such as low flow channels have been incorporated into the design to allow the diversion to evolve into a natural system over time. It is therefore assumed that the current configuration of the OB35 creek diversion is suitable for closure.

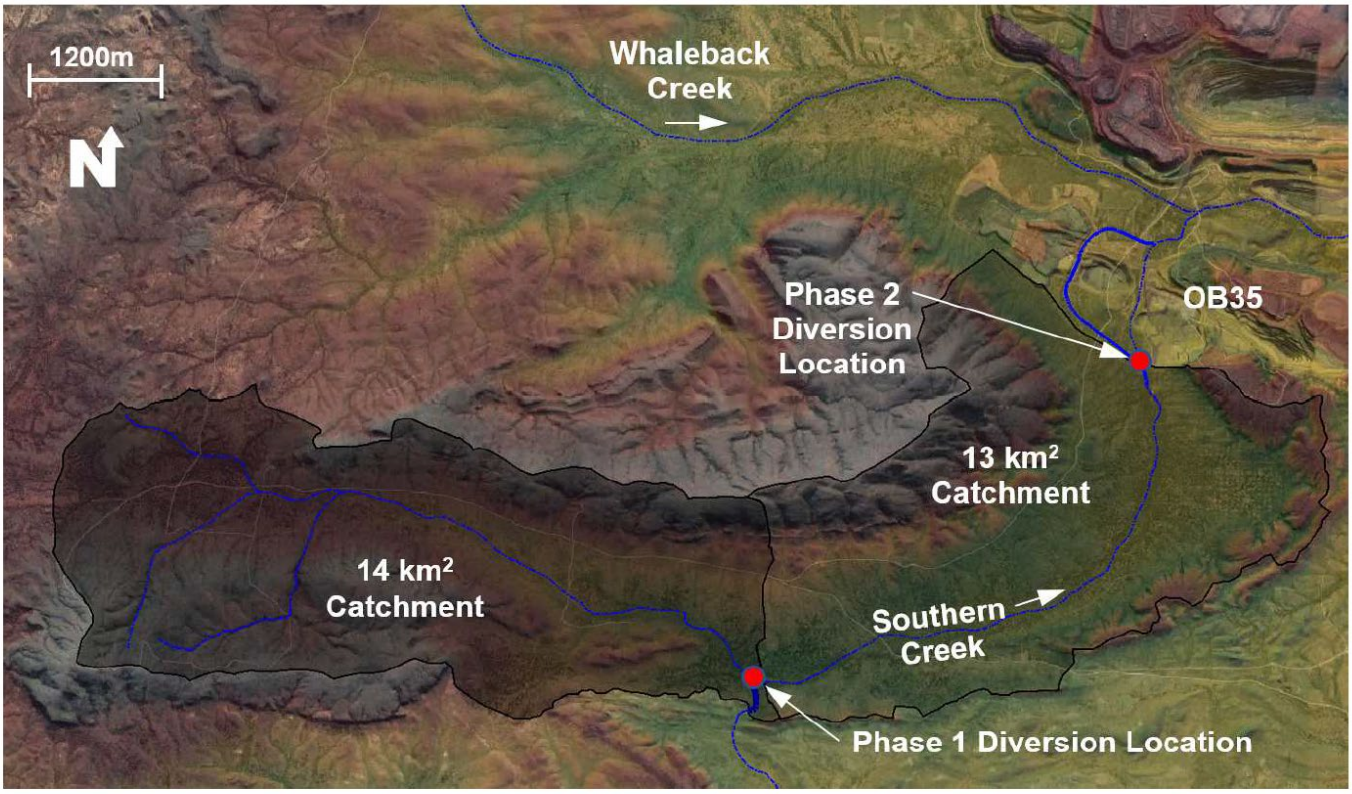


Figure 9-17 Location of Southern Creek Phase 1 and Phase 2 (OB35) diversions

The OB35 creek diversion diverts flow around the western edge of the OB35 pit to facilitate mining. A small portion of the western end of the OB35 pit has been backfilled with overburden, to allow the OB35 diversion to traverse the 'land bridge' in this section of the pit (Figure 9-20). Two flood bunds also form part of the design. The diversion channel has been designed as a composite channel (Figure 9-18) with a:

- Base width of 50 m and a trapezoidal cross section with 3H:1V embankment side slopes.
- 10-m low flow channel that is 500 mm deep, with 2.5H:1V side slopes.

The composite channel shape transitions to a flat-bed channel across the "land bridge" portion of the alignment (Figure 9-19). This portion of the channel is lined with a geosynthetic liner to reduce seepage.

Key studies which have informed the design of the OB35 creek diversion include hydraulic modelling of the proposed diversion channel (Tetra Tech Proteus, 2020) and a stability assessment of the OB35 ISA which forms the 'land bridge' section of the diversion (AMC, 2020). The findings of these two studies are summarised in Appendix H.

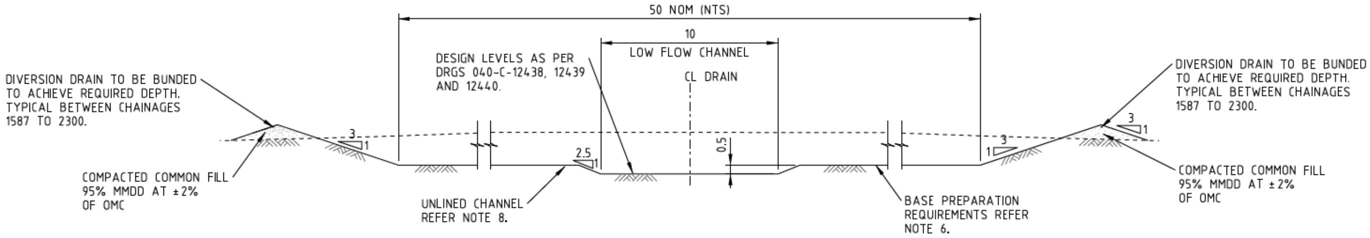


Figure 9-18 OB35 Phase 2 diversion drain section with low flow channel

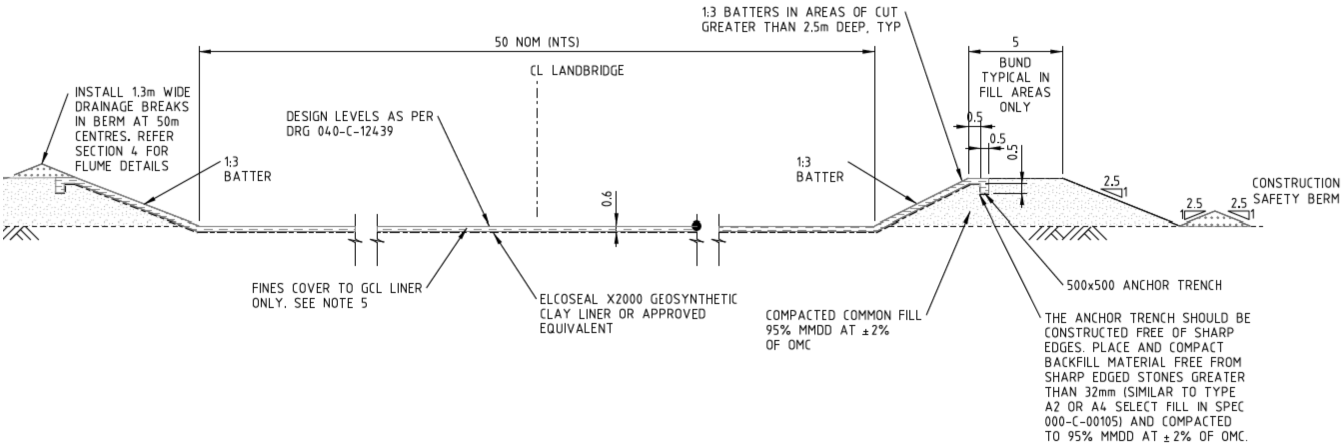


Figure 9-19 OB35 Phase 2 diversion drain typical section across land bridge

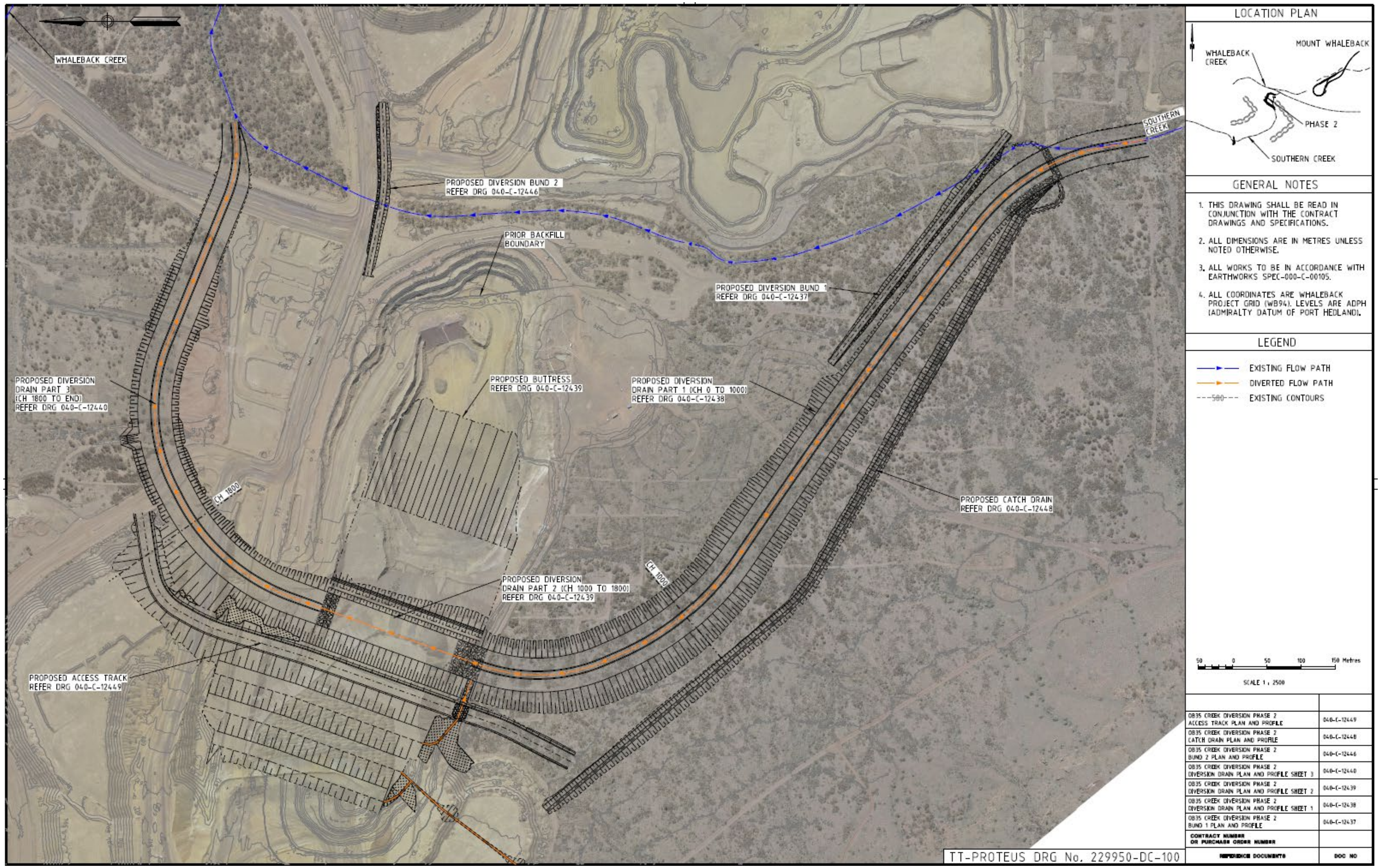


Figure 9-20 OB35 creek diversion

9.2.3.2 OB30 creek diversion

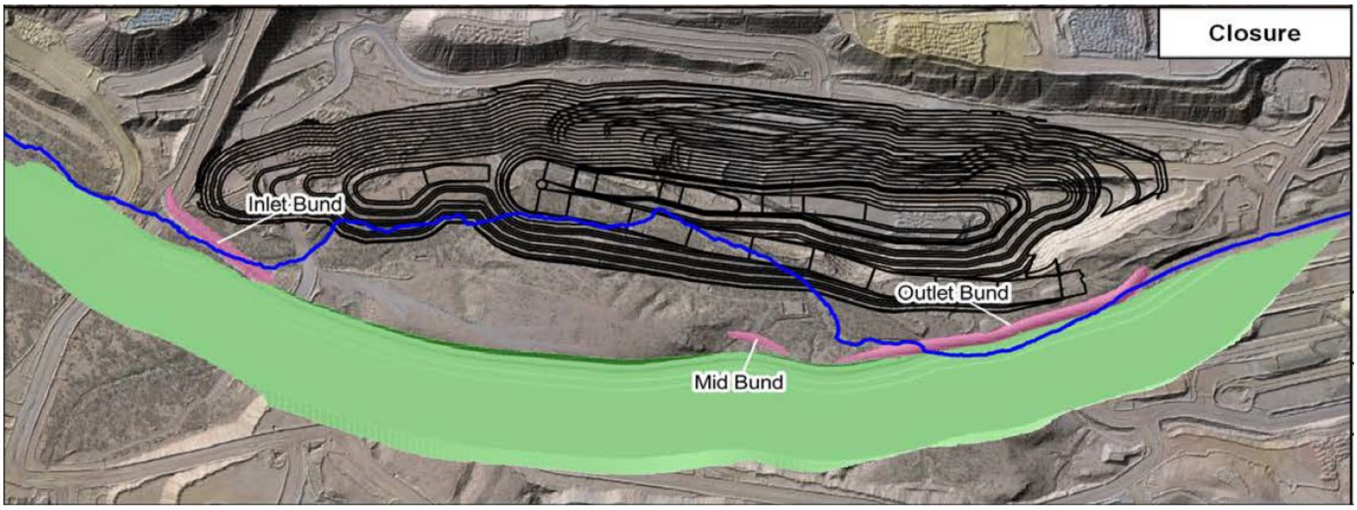
The OB30 creek diversion will remain post-closure, and the drainage system will be upgraded to accommodate a 1 in 10,000-year flood event. A preliminary review of closure requirements has been conducted by Advisian (2021a; 2021b) who concluded that to accommodate a 1 in 10,000-year flood event:

- A constructed floodplain of approximately 200 m may be required for closure (Figure 9-21) so that the channel behaviour reflects that seen in the analogues. As shown on Figure 9-21, this flood plain impacts on the current footprint of the OSA 1. It is currently assumed that the portion of the OSA within the flood plain will be relocated.
- Closure bunds (Figure 9-22) would need to be 1 - 1.5 m higher than operational bunds. Current spatial constraints at the diversion outlet suggests that it may not be possible to locate the bunds outside of closure setbacks. As discussed in Sections 9.2.1 and 9.2.2, measures to increase pit wall stability (such as buttressing) will be considered, if required.
- Rock armour size does not need to increase compared to operations design.

Studies undertaken to determine the requirements for upgrade of the diversion for closure are outlined in Section 5.14.6.

Source: Advisian (2020)

Figure 9-21 OB30 diversion concept closure design



Source: Advisian (2020)

Figure 9-22 OB30 diversion bund locations

9.2.4 Infrastructure and roads

In accordance with the State Agreement Act, prior to removing equipment and removable buildings, BHP will notify the State in writing giving the option for the State to purchase the infrastructure subject to valuation. Other stakeholders including adjacent landholders will also be consulted regarding infrastructure decommissioning as part of the post mining land use consultation. In the event that the State or other stakeholders do not take up the infrastructure ownership, decommissioning plans will be prepared to guide the decommissioning, demolition and removal of all fixed site assets. Plans will include provisions for:

- Safe removal of residual hydrocarbons and chemicals, and de-energising and cleaning equipment prior to demolition.
- Demolition / removal of:
- Ore processing facilities.
- BHP's office buildings and minor equipment.
- All above-ground power generation and supply infrastructure.
- Break up and removal of concrete slabs, foundations and footings to a depth of 600 mm below ground surface (to a maximum of 1000 mm below ground surface), to allow for grading of the site to a self-draining condition.
- Removal of underground services to a depth of 600 mm below ground surface unless a risk assessment indicates otherwise, or a different agreement is made with the post-mining landholder.
- Removal of bitumen from sealed roads and disposal to an appropriate landfill.
- Removal of rail infrastructure, including lines and sleepers in accordance with the Rail Safety National Law WA (2015) Act and associated regulations:
- Waste management facilities including the putrescible landfills, inert landfills and tyre dumps will be closed and rehabilitated. Details of the closure treatments (e.g., depth of cover material) will be developed over the life of mine.

At closure, the infrastructure associated with dewatering of the OB29/30/35 pits ahead of mining will be removed and the water bores will be capped in accordance with the decommissioning requirements of the relevant government administering authority and the National Uniform Drillers Licencing Committee Minimum Construction Requirements for Water Bores in Australia (NUDLC, 2012).

Following the removal of infrastructure and roads the land surface will be reprofiled, and additional surface treatments and revegetation works will be implemented in accordance with the standard rehabilitation procedures described in the Rehabilitation Standard 0001074 (WAIO, 2023f).

9.2.5 Waste management facilities

Management requirements for waste management facilities are governed by environmental licence L4503/1975/14 (see Section 3.2.2) and are set out in the WAIO waste management strategy including managing contamination and rehabilitation during operations. Post-closure land use will align with design requirements for general land disturbance areas.

Detailed closure designs for waste facilities at OB29/30/35 will comply with relevant environmental licence conditions (refer to Section 3.2.2) and:

- Putrescible waste facilities will be covered with 1,000 mm of clean fill.
- The final tipping surface of landfills containing anthropogenic asbestos will be 2,000 mm above asbestos waste.
- Inert Type 2 waste will be covered with 1,000 mm clean fill.

Asbestos waste is managed in accordance with the Environmental Protection (Controlled Waste) Regulations 2004, the Code of Practice for the Management and Control of Asbestos in Workplaces, Code of Practice for the Safe Removal of Asbestos, Australian Standard 2601 – The Demolition of Structure. Environmental licence L4503/1975/14 requires that asbestos waste is covered by at least 1,000 mm of fill material. Current practice exceeds this requirement. However, the thickness of the cover will be reviewed based on risk to determine whether the current practice of a 2,000 mm cover is still appropriate. The review has been included in the forward work program (Table 13-3).

In cases where a waste disposal site is covered by an OSA, the closure requirements would be considered to have been met and rehabilitation of the OSA would fall under the standard closure requirements.

9.3 Progressive rehabilitation

Progressive rehabilitation and ongoing performance assessment will be carried out in areas where mining operations have been completed and further disturbance is unlikely.

The main components of the progressive rehabilitation program are described in the Rehabilitation Standard 0001074 and are reported annually within the AER.

9.3.1 Existing rehabilitation

Map 2-1 (Section 2.2) shows the areas that have been rehabilitated to date at OB29/30/35. The areas comprise a flat landform covering approximately 15 ha at OB35 and flat / flat undulating landforms covering an area of approximately 44 ha to the east of OB29. The area to the east of OB29 formerly comprised old borrow pits and tracks. The flat analogue sites relevant to these areas are BWB33 and BWB34 (refer to Map 9-1). Table 9-2 provides a summary of the results of the most recent on-ground monitoring of these sites. The OB35 rehabilitation area is represented by monitoring site BWB46 and the OB29 area is represented by monitoring sites BWB39 to BWB41 and BWB49 and BWB50 (Table 9-2 and Map 9-1).

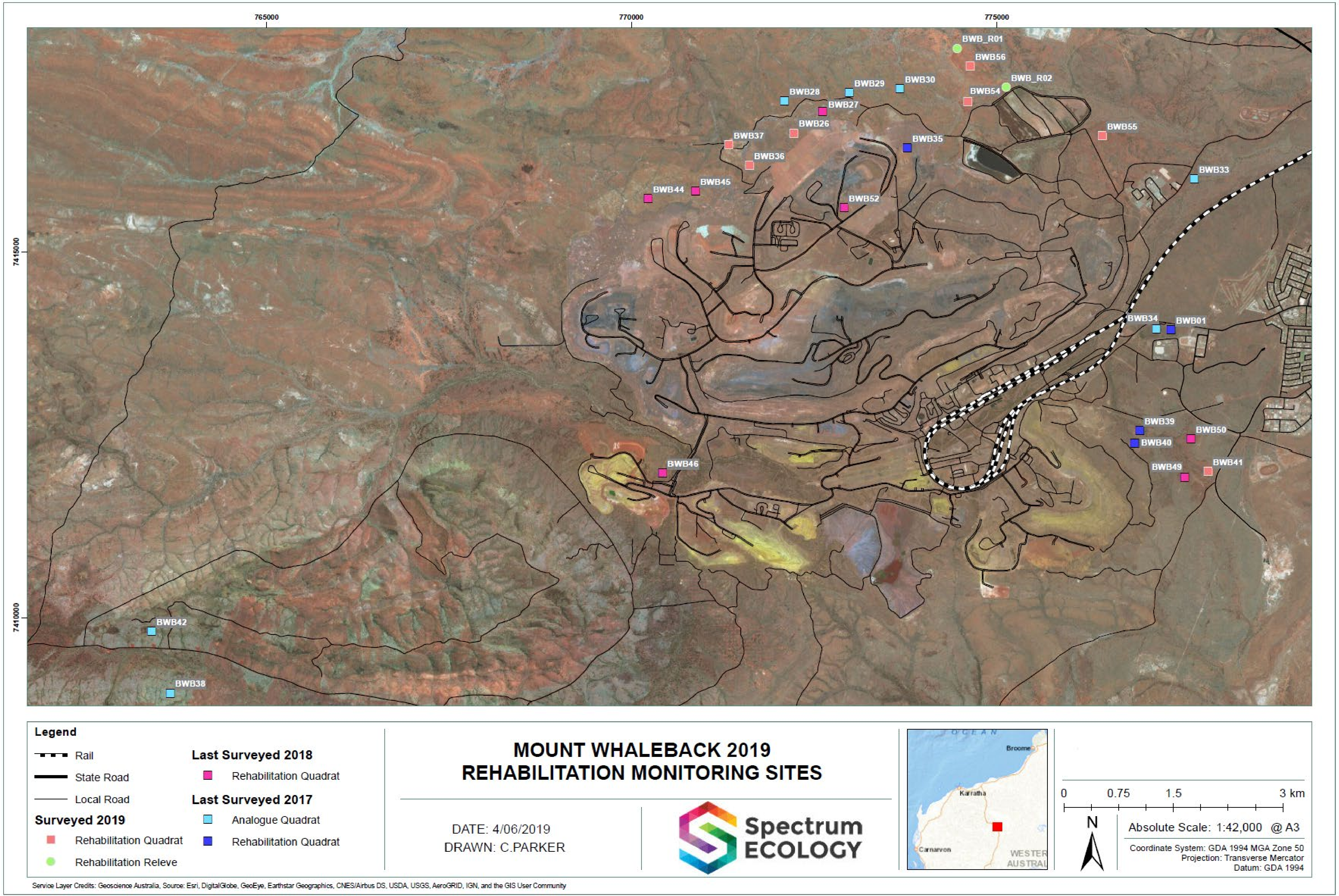
In 2020, remote sensing was used for the first time to assess rehabilitation performance against the completion criteria developed by Syrinx (2019) (see Section 8.3.2). The accuracy of this technique was assessed by comparing remote sensing results to results obtained for known sample sites assessed using ultra-high-resolution imagery in conjunction with ground-truthed data. An overall accuracy of 84% was achieved across the central and eastern Pilbara mines. The accuracy of the identification of tussock grasses was lower at 40% due to the poor condition and small size of this lifeform after low seasonal rainfall conditions (leading to incorrect classification as ground in some instances) during this monitoring period. For this sampling event, herb and weed species classification was also not possible (again due to low rainfall) (Spectrum Ecology, 2020).

Across the monitoring area (which included Whaleback as well as OB29/30/35), only 10.7% of flats between 5 and 15 years old (this category applies to the OB29/30/35 rehabilitation sites) met all completion criteria. The hummock grass / native cover ratio prevented approximately 85% of rehabilitated flats from meeting all completion criteria. Further ground truthing is recommended to complement the remote sensing metrics, particularly for hummock grass density in rehabilitation areas 5 to 15 years old (Spectrum Ecology, 2020).

Table 9-2 Summary of rehabilitation monitoring results

Location	Monitoring Site	Landform	Rehabilitation Year	Rehabilitation Treatment	Monitoring commenced	Date of last survey	Observations
OB35	BWB46	Flat	2014	Seeded and ripped	2018	2018	The vegetation was described as: *Acacia citrinoviridis*, *Acacia pruinocarpa* and *Acacia aptaneura* low open woodland, over **Cenchrus ciliaris* grassland and *Triodia pungens* sparse hummock grassland. Native vegetation cover was very low 9.7% (9.7% perennial and 0.01% annuals) compared to the analogue mean (30%). Weeds were the dominant lifeform including **Cenchrus ciliaris* (60.0%) followed by *Triodia pungens* (3.0% cover), followed by shrubs (6.5% cover) and hummock grasses (3.1% cover). Species richness was lower (23 species, 21 perennials and 2 annuals) than the mean of the analogue sites (40 species, 32 perennials and 8 annuals). Of the 23 species recorded, 13 (57%) were common to the analogue site. There was no erosion recorded at the site or within the wider rehabilitation area. A large drainage area was recorded. Vegetation structure showed similarities to the analogue site with a tall shrub layer with a similar species composition. But weeds formed a dominant structural component and there was little hummock grass cover. The success of rehabilitation may be impeded by weeds.
OB29	BWB39	Flat	2014	As reported in the 2014 AER, rehabilitation comprised: Reprofiling to blend in with the surrounding landform. Construction of fauna habitats Scarifying to reduce compaction and provide a friable seed bed. Seeding across all scarified areas from a dozer mounted air seeder at a rate of ~5kg/ha while scarifying was undertaken. Seed from the local provenance region and included three *Triodia* species only. Only spinifex seed was utilised as there was already evidence of natural colonisation of native species with mature vegetation (e.g., Acacia aneura) scattered across the project area.	2017	2017	The vegetation was described as: *Corchorus lasiocarpus* isolated shrubs over *Triodia epactia* and *Triodia lanigera* open hummock grassland. Total vegetation cover in the quadrat was 26%, lower than the associated analogues and with less than 1% coverage of annuals. Hummock grasses were the most dominant lifeform with 14% cover, with *Triodia epactia* and *Triodia lanigera* accounting for 10% and 4% cover, respectively. Weed species were the next most dominant lifeform, with **Cenchrus ciliaris, *Cenchrus setiger,* and **Solanum nigrum,* recorded within the quadrat at 5%, 1%, and 0.1% cover, respectively. Species richness (49) was equivalent to that recorded in the analogues. Of these, twenty-eight species (54%) were common to the analogue site. Numerous *Triodia* recruits were observed during the site traverse and are expected to have a positive impact on the site's recovery trajectory over time.
	BWB40	Flat			2017	2017	The vegetation was described as: *Acacia bivenosa*, *Acacia victoriae* and *Acacia ancistrocarpa* sparse shrubland over *Eriachne mucronata* sparse tussock grassland. Total vegetation cover (31%) was within the range of associated analogues and contained less than 1% cover of annuals. Woody shrubs were the dominant lifeform (20%), with *Acacia bivenosa* accounting for 10% cover, followed by tussock grasses (7.5%), with *Eriachne mucronata* accounting for 5% cover. Total *Triodia* cover was 2.5%. Native species richness (49 species) was high in comparison to the other rehabilitated flat sites, and equivalent species richness to the flat analogues. Thirty-one species (65%) were common to this site and the analogue sites. Weed species cover was, **Cenchrus ciliaris* (0.1%) and **Aerva javanica*, (0.01%) was recorded. High density of Acacias with variable patches of good *Triodia* cover were noted during the site traverse.
	BWB41	Flat			2017	2019	The vegetation was described as *Acacia tetragonophylla* mid isolated shrubs, over **Cenchrus ciliaris* sparse tussock grassland. Native vegetation cover was very low 0.8% (all perennial species) compared to the analogue mean (30% cover). Introduced cover (1.0%) was slightly lower than the analogue mean (1.6%) and made up exclusively of **Cenchrus ciliaris*. Weed was the most dominant lifeform, followed by shrub (0.4% cover), which was made up of a mix of species including *Senna artemisioides* subsp. *oligophylla, Solanum lasiophyllum* and *Senna symonii*. Herb and other grass were the only other native lifeforms recorded at the site (both with 0.2% cover). This structure differs to the analogue site where hummock grass or tree was the most dominant lifeforms. Native species richness (14 species, 13 perennials, one annual) was significantly lower than the analogue mean (39 species, 31 perennials and eight annuals). Introduced species richness was one (**Cenchrus ciliaris*). Compared to analogue sites, the rehabilitation area was almost devoid of any native or introduced cover. The cover reduced considerably between 2017 and 2019, likely as a result of the poor seasonal conditions and increased grazing in the area. The overall success of the rehabilitation could be improved by restricting cattle into the area. There was no evidence of fire at this site.
OB29	BWB49	Flat	2012	Topsoil applied, ripped and seeded.	2018	2018	The vegetation was described as: *Acacia pteraneura*, *Acacia aptaneura* and *Acacia ayersiana* low open woodland, over *Acacia synchronicia* tall sparse shrubland, over *Senna glutinosa* subsp. x *luerssenii*, *Eremophila*? platycalyx and *Acacia tetragonophylla* mid isolated shrubs, over *Triodia epactia* and *Triodia angusta* sparse hummock grassland and **Cenchrus ciliaris* (±**Cenchrus setiger*) sparse tussock grassland. Native vegetation cover for this site was 24.9% (24.7% perennial and 0.3% annuals) and was low compared to the analogue mean (30%) and slightly lower than the lowest analogue value (28.1% to 31.9% cover). Introduced cover was 8.0%, including **Cenchrus ciliaris, *Cenchrus setiger* and **Bidens bipinnata*. Shrubs were the dominant lifeform (15.8% cover), followed by hummock grasses and weeds (both with 8.0% cover). *Acacia synchronicia*, *Triodia epactia* and **Cenchrus ciliaris* were species with the greatest cover (all with 5.0%), followed by *Acacia pteraneura* (4.0% cover). Species richness was similar (45 species, 37 perennials and 8 annuals) to the mean of the analogue sites (40 species, 32 perennials and 8 annuals). Of the 45 species recorded, 19 (42%) were common to analogue sites. Vegetation structure showed similarities to the analogue sites, where hummock grasses were common and there were outcropping shrubs and trees with a similar species composition. Field observations indicate that there was no evidence of fire.
	BWB50	Flat	2012		2018	2018	The vegetation was described as: *Acacia pteraneura* and *Acacia?ayersiana* low open woodland, over *Senna glutinosa* subsp. x *luerssenii*, *Eremophila forrestii* subsp. *forrestii* and *Acacia tetragonophylla* mid isolated shrubs, over *Triodia angusta* sparse hummock grassland and **Cenchrus ciliaris* open tussock grassland. Native vegetation cover (22.4% perennial and 0.01% annuals) was low compared to the analogue mean (30.0%) and lower than the lowest analogue value (28.1% to 31.9% cover). Introduced cover was 15.5%, including **Cenchrus ciliaris* (15.0%), **Cenchrus setiger* (0.5%) and **Bidens bipinnata* (0.01%). Shrubs were the dominant lifeform (20.1% cover), followed by weeds (15.5% cover) and hummock grasses (2.1% cover). *Acacia pteraneura* was the species with the greatest cover (17.0%), followed by **Cenchrus ciliaris* (15.0% cover). Species richness was lower (30 species, 27 perennials and three annuals) than the mean of the analogue sites (40 species, 32 perennials and 8 annuals). Of the 30 species recorded, 13 (43%) were common to analogue sites. Vegetation structure was similar to the analogue sites, where shrubs formed a dominant structural component, however, it lacked a hummock grass layer and was dominated by weeds. There was no erosion at the site or wider rehabilitation area. Field observations indicate that there was no evidence of fire.

Source: Spectrum Ecology (2017; 2018; 2019)



Source: Spectrum Ecology (2019)

Map 9-1 OB29/30/35 rehabilitation and analogue monitoring sites

9.3.2 Planned rehabilitation

Areas available for progressive rehabilitation within the OB29/30/35 closure planning footprint in the next five years are limited. Some minor rehabilitation may occur on small areas if access allows.

9.4 Implementation schedule

The implementation schedule for OB29/30/35 is currently under review and is subject to change with updates to mine plans. There is potential for material from OSAs to be used in closure works at OB29/30/35 (for example, as cover material for a possible in-pit storage facility at OB35) or adjacent mining areas (e.g., Whaleback). The predicted mining completion dates for each orebody are outlined in Table 9-3. Opportunities for progressive rehabilitation of ex-pit areas will be reviewed annually in line with the Corporate Alignment Planning process (BHP, 2023a).

Table 9-3 OB29/30/35 closure implementation schedule

Orebody	Indicative mining completion
OB29	2055
OB30	2065
OB35	2026
ES PB1	2045

9.5 Unplanned or unexpected closure

BHP is required to review a range of risks associated with the closure of its facilities annually as assessed using the risk processes described in the Risk Management Global Standard (BHP, 2023f). One of these risks is unexpected or unplanned closure. In the event that unplanned or unexpected closure occurs, the site will be decommissioned and rehabilitated in line with the objectives and strategies outlined in this document. In the absence of more detailed information the overall objective under this scenario will be to make landforms such as OSAs secure and non-polluting following decommissioning and decontamination activities, with application of topsoil prioritised for these areas.

In the rare event of unplanned closure, existing OSAs would be assessed on a case-by-case basis to develop a final design commensurate with the incomplete geometry and available waste rock on site to re-contour within acceptable erosion requirements. Existing stockpiles of competent waste will be used to stabilise landforms to acceptable levels. Where there is a shortfall, additional competent waste may be sourced from Whaleback, or portions of OSAs may be rehandled into mined-out voids subject to approval from DEMIRS via the Sterilisation Report Submission Form for In-Pit Waste / Tailings Disposal Proposals (DMIRS, 2018).

Annual cost provisioning for closure in line with the closure cost estimating methodology outlined in Section 11 provides an understanding of the current closure liability, with present closure obligation costs representing an unplanned or unexpected closure scenario.

10 Closure monitoring and maintenance

10.1 Monitoring program overview

Across its Pilbara mining operations, BHP has implemented monitoring programs to evaluate the performance of rehabilitated mine landforms and to assess whether they have met the site completion criteria or are showing satisfactory progress towards meeting these criteria. These programs will be expanded as new areas of the mine are rehabilitated and will be refined based on monitoring results and rehabilitation success.

Monitoring events will be undertaken in line with the processes outlined in this section, with the outcomes informing rehabilitation strategies, facilitating refinement of completion criteria and directing maintenance and remedial action plans consistent with the adaptive management approach (Section 7.1), and demonstrating performance against completion criteria in preparation for rehabilitation sign-off.

In some instances, achievement of completion criteria would be verified by audit or inspection rather than by monitoring over a period. Section 10.1.1 provides further details of the means to verify achievement of these criteria.

10.1.1 Closure completion audit and inspection

Table 10-1 outlines those completion criteria (Section 8.3.2) that would be verified through a completion audit and inspection, rather from the monitoring processes discussed in Sections 10.1.2 to 10.1.10. This section focuses only on completion criteria. Other interim audits and inspections would be conducted to confirm that planning and execution criteria were met.

Table 10-1 Completion audits and inspections

Category	Completion Criteria	Means of Verification
C1.1 Post-closure land use	Monitoring, inspection and / or survey reports demonstrate that the rehabilitation objectives have been substantially met. The current assumed land use is related to underlying tenure (pastoral) and achievement of the criteria for land management, stability, revegetation and water will indicate that this criterion has been met.	Completion audit of: • Post-closure monitoring and survey reports. • Post-closure land user / owner's written acknowledgement that rehabilitation objectives and completion criteria have been met.
C1.2 Infrastructure	Stakeholders agree to the transfer of infrastructure ownership and accept ongoing responsibility for maintenance of the infrastructure. In-ground infrastructure has been removed to 0.6 m bgl unless: • The post-closure landowner / manager requires infrastructure to remain. • Risk assessment indicates that a different specification is required.	Completion audit of: • Demolition contractor's report against agreed standard. • Site inspection report following demolition. • Documented transfer of infrastructure to stakeholders.
C1.3 Land management	At the time mine closure is considered complete, site land management requirements are aligned to the post-completion land use and / or approved closure strategy. If additional management actions are required post-completion, these will have been agreed with the landowner / manager.	Completion audit of: • Achievement of the closure strategy, as demonstrated by achievement of post-mining land use criterion C1.1 • The post-completion land use management plan. The documented agreement of additional active management measures required post-completion.
C2.1 Safety	Residual safety and health hazards have been identified and controlled in accordance with regulatory requirements and consideration of industry guidance, and are acceptable to the District Mines Inspector The geotechnical and geochemical stability criteria (C3.2 and C3.3) have been met.	Site inspection by the District Mines Inspector following execution and all sites are assessed as acceptable. Completion audit of the achievement of the geotechnical and geochemical stability criteria (C3.2 and C3.3).
C3.1 Visual amenity	Landforms meet visual design criteria.	Rehabilitation inspections / surveys confirm final landform has substantially met landform visual design criteria.

Category	Completion Criteria	Means of Verification
C3.2 Geotechnical stability	OSAs conform to DEMIRS guidelines for structural stability (DMIRS, 2019) and achieve design FoS criteria. Unless otherwise designed, there is no significant slumping or failure of accessible ex-pit constructed slopes or berms.	Completion audit of: • Construction records against designs. • Landform inspection reports.
C4.6 Impact to fauna	The pit lake risk assessment shows no significant impact to native terrestrial fauna.	Completion audit of report on pit lake monitoring and validation of risk assessment assumptions.
C6.1 Contaminated sites	Validation sampling shows remediation has achieved remediation criteria.	Completion audit of contaminated sites auditor VAR or MAR.
C7.1 Cultural values	Performance indicators for Execution (Stage 2) have been met.	Completion audit of: • As constructed report of designs developed to protect cultural values. • Confirmation by Nyiyaparli people representative that artefacts have been repatriated.

10.1.2 Rehabilitation monitoring

10.1.2.1 Monitoring objective

Monitoring will be used to assess whether initial vegetation establishment has been successful, rehabilitation is developing satisfactorily and is ready for signoff. Rehabilitation monitoring will be used to assess achievement of completion criteria outlined in Table 10-2.

Table 10-2 Rehabilitation completion criteria

Criteria	Domain	Completion criteria
C4.1 Growth media C4.2 Vegetation development	All where revegetation is planned in areas of unallocated crown land (OB29/30/35 mining area)	**Land use: Natural environments for managed resource protection** • % bare ground (Q): - Hills, slopes, dry plains ≤50%. - Drainage lines and floodplains (excluding channel bed) ≤20%. • Perennial native species richness recorded in aggregated 50 x 50 m plot achieves target % for each target vegetation type (see Appendix C) (Q). • At least one dominant species from each stratum present (see Appendix C) (Q). • >70% of species present in rehabilitation areas are common to the Target Vegetation Type (Q). Plant cover achieves target % for each stratum and vegetation type (see Appendix C) (Q).
C4.3 Resilience	All where revegetation is planned	• Flowering and seed production observed in more than one native lifeform (Q). • Different aged plants observed for more than one native species and for all lifeforms (Q).

10.1.2.2 Monitoring method and frequency

Progressive rehabilitation and ongoing performance assessment will be carried out in areas where mining and related operations have been completed and further disturbance is unlikely. Monitoring procedures will be used to assess whether initial establishment has been successful, rehabilitation is developing satisfactorily and is ready for signoff. Ecological monitoring post closure will be in accordance with the Rehabilitation Standard (0001074) and the Rehabilitation Monitoring Procedure (SPR-IEN-LAND-012) (Appendix L). This procedure was updated in March 2024 to incorporate the remote sensing techniques that BHP has been trialling since 2020.

Remote sensing is conducted every two years. Plot based ground sampling is also conducted biennially to collect data that cannot be captured by remote sensing. A brief description of each method is provided below.

Remote sensing

Four band (RGBI) aerial imagery is captured at the end of the Pilbara wet season at 0.1 m ground sample distance. An orthorectified, mosaiced, and colour balanced image is then produced and assessed using machine learning algorithms. Following classification of the data via the machine learning algorithms, a thorough, visual quality assessment is carried out to identify any classification errors. Identified errors are manually corrected and used to retrain and improve the machine learning algorithms. Remote sensing currently captures the following data:

- Bare ground.
- *Triodia* cover.
- Shrub cover.
- Tree cover.
- Herb cover.
- Tussock grass cover.
- *Cenchrus* cover (*C. ciliaris* and *C. setiger*).
- *Aerva javanica* cover.
- *Calotropis procera* cover.
- *Acacia aneura* complex cover.
- Total area of weeds identified.
- Total area of vegetation cover.

Plot based sampling

Plot based sampling is aligned with the guidelines set out by the EPA for Level 2 Flora and Vegetation Surveys (EPA, 2016), and comprises assessment of the following attributes within a 50 m x 50 m plot:

- Species richness.
- Evidence of flowering and seed production and variable aged plants.

Photographs are also taken from the corner of each plot.

Permanent plots are sampled every two years, generally six to eight weeks after the wet season (during April to June).

The location of quadrats is decided by random stratified sampling, and plots are placed at representative locations throughout the survey area to cover a mixture of landforms, geology, elevation, slope, aspect, surface or groundwater expressions, and soil types. The number of 50 m x 50 m quadrats is determined by the area of rehabilitation (Table 10-3). The total quadrat area (1 quadrat = 0.25 ha) must be equal or greater than 1 % of the sum total of all rehabilitated areas.

Table 10-3 Number of plots required for each rehabilitated area

Size of rehabilitated area	Number of quadrats required
< 10 ha	0 plots
10-25 ha	1 plot
25-50 ha	2 plots
50-75 ha	3 plots
>75 ha	4 plots

10.1.2.3 Corrective action

Should ongoing monitoring indicate that completion criteria cannot be met, the appropriate maintenance and / or remedial work will be undertaken. Depending on the cause of the deficiency, remedial actions could include, but not be limited to, reseeding, application of ameliorants / fertiliser and / or rework of an area. Further monitoring would be subsequently undertaken on repaired areas to demonstrate achievement of relevant criteria.

10.1.3 Weed Monitoring

10.1.3.1 Monitoring objective

To assess weed populations in relation to completion criterion C4.4 (Table 10-4) and the effectiveness of weed control measures.

Table 10-4 Weed completion criteria

Criterion	Domain	Completion criteria
C4.4 Weeds	All where revegetation is planned in areas of unallocated crown land (OB29/30/35 mining area)	**Land use: Natural environment for managed resource protection** Total weed cover: • Drainage lines, floodplains <15%. • Upland hills, slopes and flats <5%. Buffel grass cover:

Criterion	Domain	Completion criteria
		• Drainage lines, floodplains <10%. • Crests, slopes, flats <5%.
	All where revegetation is planned	Priority alert weed species are not present (C), or if present, cover is less than or equal to the surrounding areas (regional baseline) (Q). No new priority alert weed species introduced (C).

10.1.3.2 Monitoring method and frequency

BHP's weed management procedure (WAIO, 2020) describes the monitoring to be conducted to assess the ongoing effectiveness of weed control measures, in addition to measures used to prevent the introduction and spread of weeds. Site inspections are conducted annually and weed monitoring via remote sensing and quadrats and is conducted during rehabilitation monitoring.

10.1.3.3 Corrective action

Post-mining control measures and monitoring programs will be developed and / or refined during the mine life in consultation with the relevant authorities. Approved changes to the monitoring programs and control measures will be documented in the AER and revisions of the weed management procedure (WAIO, 2020).

10.1.4 Fauna inspection of rehabilitation areas

10.1.4.1 Monitoring objectives

We recognise that fauna have an intrinsic value to key stakeholders and natural processes within rehabilitation, however, the transient nature of fauna makes it difficult to consistently capture data that can be compared to a quantitative target. The objectives of fauna monitoring are, therefore, to:

- Provide information to key stakeholders on observed use of rehabilitation areas by fauna; and
- Inform management of the impacts of feral animals and pests on rehabilitation.

10.1.4.2 Monitoring method and frequency

Damage to rehabilitation from feral animals / pests is currently recorded during on-ground rehabilitation monitoring and inspections. BHP is in the process of reviewing its rehabilitation monitoring procedures to determine how fauna use of rehabilitated areas can be integrated into the monitoring program.

10.1.4.3 Corrective action

Implement feral animal and pest controls, if required.

10.1.5 Regional water monitoring network

From a closure perspective, it is necessary to understand:

- Pre-mining conditions and acceptable levels of change so that appropriate completion criteria can be developed.
- The changes that occur during mining so that conceptual and numerical models can be refined to facilitate:
  - Prediction of impacts at closure; and
  - The development of a post-closure monitoring regime that will enable model predictions to be validated over time.
- The changes that occur post-closure to enable models to be calibrated and provide an acceptable level of certainty in model predictions.

A Regional Monitoring Network has been installed at an operational and catchment scale to collect important information for compliance reporting and to improve the capacity to estimate receptor response to changing hydrological conditions and natural climatic variations and stresses (Figure 10-1). It is used to develop an understanding of the baseline conditions (prior to BHP's operations) and current conditions (with BHP's operations), to:

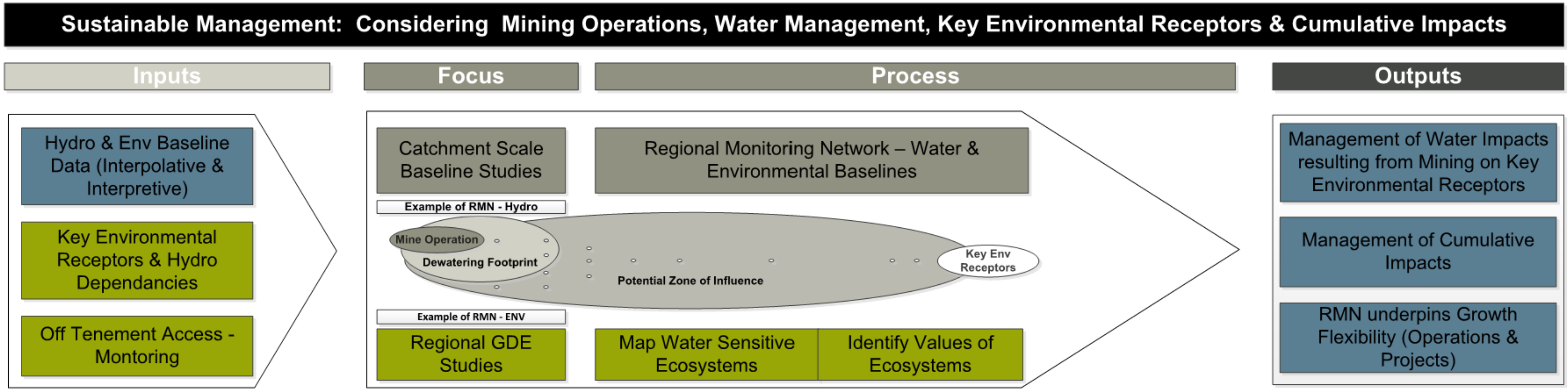
- Define the natural variance in hydrological conditions;
- Underpin adaptive management and modelling processes; and
- Be consistent with the threshold variables being used to assess significance of impacts to receiving receptors.

The Regional Monitoring network and monitoring of the OB29/30/35 mining operations will continue to be used to support and inform closure assessments, enabling progressive improvement in understanding and confidence in the achievement of the stated closure objectives related to the hydrological regime.

The Regional Monitoring Network – Hydrological enables time-variant data collection from various hydrological systems, including:

- Groundwater aquifer water levels and quality within the Priority 1 Public Drinking Water Source Area, Ethel Gorge aquifer and groundwater reference sites;

- AMD from PAF storage locations (both groundwater and surface water monitoring may be required to detect seepage);
- Surface water drainage features water quality and creek flow volumes;
- Pit lake quality and levels;
- Spring discharges, seepages, waterholes and marsh zones; and
- Weather and climatic conditions.



Note: GDE – Groundwater Dependent Ecosystem

Figure 10-1 WAIO's regional groundwater monitoring network approach

10.1.6 AMD monitoring

10.1.6.1 Monitoring objective

To assess the effectiveness of PAF management measures and achievement of completion criterion 3.3 (Table 10-5).

Table 10-5 Geochemical stability completion criteria

Criterion	Domain	Completion criteria
C3.3 Geochemical stability	OSAs / ISAs	No evidence of mineral scalds within rehabilitation areas (C). No exposed waste materials with adverse geochemical properties (C). Surface water and groundwater quality completion criteria (C5.2 and C5.4) are met (C).
	Mine voids	Groundwater quality completion criteria are met. Pit lake water quality aligns with modelling trajectory, where modelling is required (C).

10.1.6.2 Monitoring method and frequency

AMD monitoring will be integrated with the regional monitoring network (Section 10.1.5) as required, based on progressive refinement of the assessment of AMD risk following mine closure.

Surface water and groundwater monitoring (Sections 10.1.7 and 10.1.8) are the primary methods for assessing water quality impacts from AMD. In addition, visual inspections will be conducted to confirm that there is no evidence of mineral scalds in rehabilitation areas and no exposed materials with adverse geochemical properties. These inspections will be conducted in conjunction with the landform inspections discussed in Section 10.1.9.

10.1.6.3 Corrective action

Where PAF materials are identified, they are managed as described in Section 9.1.1. Where AMD is detected in the receiving environment, an investigation into the cause of the release will be conducted, and remedial measures defined in consultation with appropriate regulatory authorities.

10.1.7 Surface water monitoring

10.1.7.1 Monitoring objectives

The objectives of surface water monitoring are to:

- Assess the quality of water in drainage lines to inform completion criteria and enable achievement of completion criteria to be demonstrated.
- Measure flow rates to assist in the validation of surface water modelling.
- Assess achievement of completion criteria C5.1 and C5.2 (Table 10-6).

Table 10-6 Surface water completion criteria

Criterion	Domain	Completion criteria
C5.1 Surface water flows	Creek diversions and OSAs	Flows at downstream environmental receptors are within model predictions and the parameters accepted via project approvals (Q). Impacts to downstream environmental receptors are within the parameters accepted via project approvals (Q).
C5.2 Surface water quality		Water quality (sediment and chemical) at downstream environmental receptors (Southern and Whaleback creeks) is within acceptable ranges (Q): • Defined, through the detailed analysis of pre-closure monitoring data from appropriate reference sites, to represent no significant impact to downstream ecohydrological receptors; and / or • Accepted via project approvals or other regulatory processes.

10.1.7.2 Monitoring method and frequency

Data collected during operations helps to refine and calibrate surface water models which will in-turn inform the locations and frequencies of a post-closure surface water monitoring program designed to validate model predictions of:

- The potential effects of peak floods on post-closure infrastructure (OSAs, flood bunds, creek diversions) and subsequent impacts on downstream receptors; and
- The potential impacts of post-closure infrastructure on downstream flows.

Several automatic flow gauging stations have been installed within Southern Creek and Whaleback Creek (Map 5-9) to enable data to be collected to validate models.

Pre-closure ambient surface water quality is monitored in accordance with the OB29/30/35 Environmental Licence (Table 10-7) at the locations shown on Map 5-9 (Section 5.9.1). This pre-closure monitoring will inform the development of appropriate quantitative completion criteria.

Table 10-7 Surface water quality monitoring program

Monitoring point reference and location	Parameter	Unit	Averaging period	Frequency
Whaleback Creek upstream (WBSW042) Whaleback Creek downstream (WBSW043)	pH[1]	-	Spot sample	Quarterly when flowing
	TDS, TSS, Total Recoverable Hydrocarbons (TRH), Ag, Al, As, B, Ca, Cd, Cl-, CO_3, COD, Cr, Cu, Fe, HCO_3, Hg, K, Mg, Mn, Mo, Na, Ni, NO_3, Pb, Se, SO_4, Total N, Total P, Zn	mg/L		

[1]In-field non-NATA accredited analysis permitted.

Post-mining monitoring programs will be developed and / or refined during the mine life in consultation with the relevant authorities. Approved changes to the monitoring programs and control measures will be documented in the AER and this MCP.

10.1.7.3 Corrective action

If monitoring indicates that completion criteria will not be achieved, an investigation into the cause of the exceedance will be conducted, and remedial measures defined in consultation with appropriate regulatory authorities.

10.1.8 Groundwater monitoring

10.1.8.1 Monitoring objective

The monitoring objectives are to:

- Detect unacceptable impacts during operations that require remediation in closure (completion criterion C6.1; Table 10-8);
- Confirm conceptual and numerical model assumptions; and
- Assess achievement of completion criteria C5.3 and C5.4 (Table 10-8).

Table 10-8 Groundwater and contaminated sites completion criteria

Criteria	Domain	Completion criteria
C5.3 Groundwater levels	Mine voids	Groundwater levels at key receptors are at acceptable levels, defined as closure thresholds in the Eastern Pilbara Water Resource Management Plan[26], and meet land use criteria supported by key stakeholders (Q).
C5.4 Groundwater quality	Mine void OSA	Groundwater quality is within limits (Q): • Defined, through the detailed analysis of pre-closure monitoring data from appropriate reference sites, to represent no significant impact to downgradient ecohydrological receptors; and / or • Accepted via project approvals or other regulatory processes.
C6.1 Contaminated sites	All where relevant	Validation sampling shows remediation has achieved remediation criteria (Q).

10.1.8.2 Monitoring method and frequency

In addition to the Regional Monitoring Network (Section 10.1.5), ambient groundwater monitoring[27] is currently conducted in accordance with the:

- Groundwater Operating Strategy for OB29/30/35 which outlines the management and monitoring of groundwater abstraction at the operations; and
- Eastern Pilbara Water Resources Management Plan (WAIO, 2018b).

26 Current thresholds are:
- Trigger > 6 m or a rate of > 4 m/year - interpreted as the statistically significant aquifer response and change to water level in the Ethel Gorge primary habitat monitoring zone. Water level responses greater than the above thresholds may result from localised bore abstraction and these localised responses shall not bias the overall criteria.
- Response >12 m or a rate of > 8 m/year.

Thresholds may be revised as the Eastern Pilbara Water Resources Management Plan is revised and where there is a difference in the criteria presented in this MCP and the Eastern Pilbara Water Resources Management Plan, the criteria in the Eastern Pilbara Water Resources Management Plan take precedence.

27 Note: there are currently no ambient sites relevant to the OB29/30/35 operations identified in the Whaleback Environmental Licence (L4503/1975/14) (Section 3.2.2).

Post-mining monitoring programs will be developed and / or refined during the mine life in consultation with the relevant authorities. Approved changes to the monitoring programs and control measures will be documented in the AER and this MCP.

In addition to these programs, contaminated sites monitoring is conducted during operations in accordance with approved sampling and analysis plans developed in accordance with the CS Act. These are programs are regulated separately to mine closure and consequently have not been outlined in this MCP.

Groundwater Operating Strategy

The Groundwater Operating Strategy (WAIO, 2019b) forms part of the conditions of Groundwater Licence (GWL160418(8)) and is approved by DWER. The strategy is periodically reviewed and revised to incorporate changes in operations and / or knowledge of groundwater responses to dewatering stresses. It also specifies internal water quality trigger levels that will be used to manage potential impacts from dewatering during operations.

A number of the monitoring locations within the Groundwater Operating Strategy are designed to test conceptual and numerical model assumptions. Water level data are collected monthly, and groundwater quality data are collected quarterly (Table 10-9). The data collected through the monitoring program help to refine and calibrate the conceptual and numerical groundwater models for the OB29/30/35 operations. These models will be used to identify the locations and frequencies of monitoring post-closure to enable predictions of groundwater recoveries and final pit lake levels to be validated.

Table 10-9 Groundwater Operating Strategy (Version 3) groundwater monitoring relevant to OB29/30/35[28]

Monitoring Type	Borefield or Source	Bores[1]	Monitoring Parameters	Minimum Monitoring Frequency[2]
Regional / ex- pit water levels	Mt Whaleback (pit North and South), OB29, OB30 and OB35	EEX0745, HWHB1518, HWHB0652	Water level	Monthly
In-pit water levels	OB29, OB30 and OB35	Any 2 representative monitoring bores per pit	Water level	Monthly
Dewatering and water supply	OB29, OB30 and OB35	All active production bores and active sumps	Cumulative output	Monthly
		Any 2 active production bores and active sumps	Field EC and pH	Monthly
			Hydrochemistry: pH, EC, TDS, TSS, $CaCO_3$, alkalinity, Cl, SO_4, SiO_2, F, Na, K, Ca, Mg, Al, Fe, Mn, Zn, Cu, Cd, B, Pb, As, Hg, Se, Ba, Cr, Ni, Mo.	Biannually

Source: BHP (2019b)

Notes:

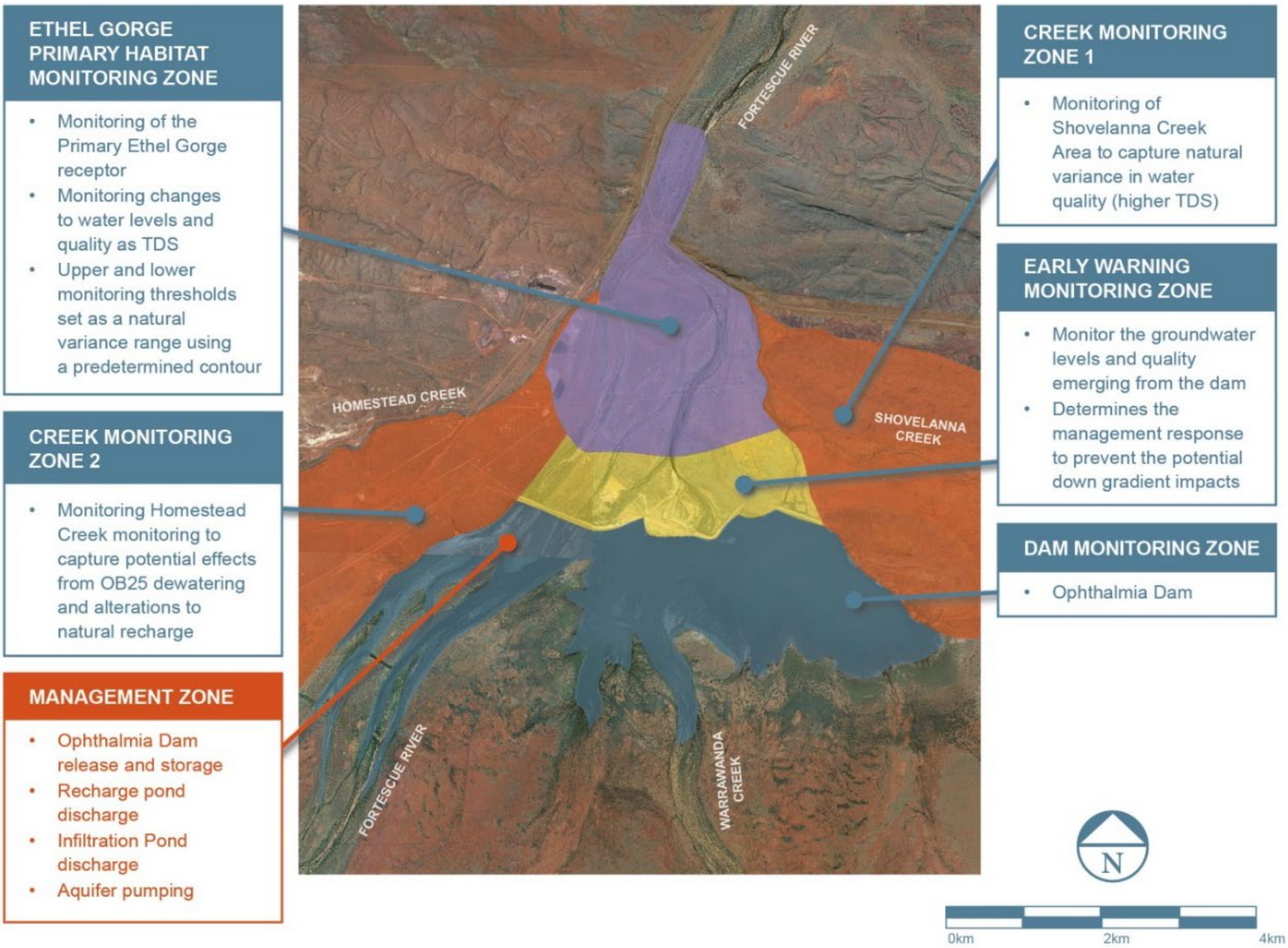
[1] Individual in-pit monitoring bores for compliance monitoring may change as access and bores are lost.

[2] Indicates minimum requirement – frequency may be increased to support operational planning.

Eastern Pilbara Water Resources Management Plan

The Eastern Pilbara Water Resources Management Plan (WAIO, 2018b) provides an overarching monitoring and management program that is focused on the protection of the Ethel Gorge TEC. Monitoring zones have been established that reflect the main sources of influence on the Ethel Gorge aquifer (Figure 10-2) which include inflows from adjacent river valleys, Ophthalmia Dam, and surplus water inputs from surrounding mines and any closure related activities. Monitoring associated with the Eastern Pilbara Water Resources Management Plan is designed to compare changes in the water level and quality against thresholds that protect key receptors in the system, namely the Ethel Gorge Aquifer Stygobiont Community and riparian vegetation associated with the creeks (refer to Section 7.3.1.3). Under the Eastern Pilbara Water Resources Management Plan, changes in aquifer condition outside the nominated ranges will trigger management responses designed to mitigate impacts at key receptors.

28 The pre-closure monitoring program will be governed by the Groundwater Operating Strategy for OB29/30/35. Where there are differences in the monitoring program presented in this MCP and the OB29/30/35 Ridge Groundwater Operating Strategy, the Groundwater Operating Strategy will take precedence.



Source: BHP (2018b)

Figure 10-2 Ethel Gorge monitoring zones

10.1.8.3 Corrective actions

If monitoring indicates that completion criteria C5.3, C5.4 or C6.1 will not be achieved, an investigation into the cause of the exceedance will be conducted, and remedial measures defined in consultation with appropriate regulatory authorities.

10.1.9 Landform and erosion monitoring

10.1.9.1 Monitoring objective

The monitoring objectives are to:

- Assess landform geotechnical and surface stability against completion criteria C3.2 and C3.4 (Table 10-10).
- Identify any obvious sources of off-site impact.

Table 10-10 Surface stability and geotechnical completion criteria

Criteria	Domain	Completion criteria
C3.2 Geotechnical stability	OSAs Creek diversions Voids	OSAs and mine voids conform to DEMIRS (2019) guidelines for structural stability and achieve design FoS criteria (C). Unless otherwise designed, there is no significant slumping or failure of accessible ex-pit constructed slopes or berms (C).

Criteria	Domain	Completion criteria
C3.4 Surface stability		OSA slope surfaces do not show significant unplanned erosion which may be defined as having (C): • Channelised flow resulting in extensive active gullies; • Failure of banks, berms or bunds; and • Evidence of ongoing significant sheet erosion (including large accumulation of silt at base of slope, exposed subsoil, poor seedling establishment). By completion: • The annual average rate of erosion of slopes, flats and crests of OSAs is ≤6t/ha/yr (Q). • The erosion rate at any point on an OSA slope does not exceed the target threshold average rate by more than 100% (Q). Surface water management structures are performing as designed (P). • Geotechnical stability completion criterion (C3.2) is met (C).

10.1.9.2 Monitoring method and frequency

As part of the general monitoring of the site, visual inspections will be conducted to identify obvious off-site impacts. Visual inspections will be undertaken in conjunction with the public safety inspections.

Rehabilitated landforms will be inspected after significant rainfall to assess stability and identify areas where unacceptable erosion has occurred. Monitoring methods may include:

- Visual inspections and / or photographic review of rehabilitated landforms including surface water management structures.
- LiDAR, INSAR data, photogrammetry surveys and / or comparative assessment at established survey points.

10.1.9.3 Corrective action

Where unacceptable erosion or threats to geotechnical stability have occurred, maintenance works will be undertaken to improve performance.

10.1.10 Public safety monitoring

10.1.10.1 Monitoring objective

To confirm the integrity of public safety measures during operations and the post-closure monitoring and maintenance period.

10.1.10.2 Monitoring method and frequency

During operations and the post closure management phase, periodic inspections will be conducted to determine the condition of the safety bunds (and any other safety measures) erected around the open pits and a record will be kept of these inspections.

10.1.10.3 Corrective action

Where the integrity of the bunds or other safety measure has been compromised to the extent that inadvertent public access could occur, maintenance will be conducted.

10.1.11 Dust

Dust monitoring is only applicable to operations and the closure execution phase. Given the proximity of the mining operation to Newman, the dust monitoring requirements of the Environmental Licence have been included in this section for reference.

10.1.11.1 Monitoring objective

To maintain acceptable dust levels in Newman during closure execution.

10.1.11.2 Monitoring method and frequency

Dust monitoring during operations is specified in Environmental Licence L4503/1975/14 and outlined in Table 10-11. This monitoring will only be relevant to the closure execution phase.

Table 10-11 Closure execution air quality monitoring program

Monitoring point reference and location	Parameter	Target	Units[1]	Averaging period	Frequency	Method
Newman 1 Town Centre (WBAQRT010)	Particulates as PM_{10}	<70	µg/m^3	24 hours	Continuous	AS 3580.9.11
Newman 3 (WBAQRT006) McLennan Drive						

[1]Note: all units are referenced to standard temperature and pressure (STP) dry.

10.1.11.3 Corrective action

In the event that particulate targets are exceeded during execution, an investigation will be conducted into the cause, and remedial actions identified and implemented.

10.2 Reporting

The following information will be reported in the AER which covers all of BHP's operations:

- Progress and performance of rehabilitation including a summary of the rehabilitation monitoring results for the reporting period and maintenance / remedial actions completed or planned;
- New rehabilitation activities conducted including the area and nature of the rehabilitation; and
- Rehabilitation activities planned for the future reporting period which will continue to be reported as environmental initiatives on an annual basis.

Reporting results will be made available to the relevant authorities on request.

10.3 Maintenance

The monitoring program will provide feedback on the performance of the site rehabilitation to identify any issues and inform maintenance activities. Examples of remedial maintenance activities that may occur during the post-closure phase include:

- Minor earthworks
  - Repair erosion or stability issues identified during landform monitoring.
- Infill planting or reseeding
  - Based on failing to maintain development trajectory, additional tube stock may be planted, or reseeding undertaken to improve density or species diversity.
- Weed control
  - Weed control may be required to manage weed species that may compete with planted rehabilitation species, increase fire risk, or as required under regulation.
- Fire management
  - Fire is part of traditional land management practices but is a risk to initial development of rehabilitation, and therefore, will be controlled.
  - Fire will be excluded from rehabilitation areas for a nominal period until framework species have achieved the required parameters (to be determined from research).
- Application of fertiliser
  - Some growth media used in rehabilitation may require fertiliser to create optimal growing conditions, however, due to losses from volatilisation (from heat) and leaching (from rainfall) much of the fertiliser is unavailable to plants. Based on monitoring results for plant health and nutrient cycling, reapplication of fertilisers may be required.
- Pest control
  - Insect damage and grazing by native and feral vertebrate fauna can impact rehabilitation success. Monitoring results will be used to determine impact vectors and appropriate management actions.
- Water management
  - Irrigation established to support rehabilitation growth, if required, will be removed when no longer required.
  - If passive water / sediment structures are established for closure, these structures will be removed when no longer required.

Triggers for maintenance activities will be developed via the adaptive management process and will be based on measured deviation away from the completion criteria.

10.4 Completion and Relinquishment

As discussed in Section 8.3, the DEMIRS (2021) guideline provides for progressive completion and, given the long life of OB29/30/35 and the broader Newman Hub, there may be a considerable time between completion of some areas, and completion and relinquishment of the whole site. During the time between completion and relinquishment, completed areas may still be managed by BHP, but differently to areas that are still subject to the post-closure monitoring and maintenance phase. This section outlines key steps in completion reporting, post-completion management and relinquishment.

10.4.1 Completion reporting

As areas of OB29/30/35 approach completion, BHP will prepare completion reports in accordance with the Mine Closure Completion Guideline (DMIRS, 2021). With reference to the guideline requirements, BHP will consult with DEMIRS and DJTSI regarding the eligibility of the area for evaluation prior to submission of a completion report.

Completion reports will collate evidence that the completion criteria, outlined in Section 8.3, have been achieved using the data collected from the monitoring programs outlined in Section 10. The reports will also include:

- Details of how the closure risks identified in the MCP have been managed and an assessment of any residual post-closure risks requiring management by the post-mining land manager.
- A post-completion land management plan where there are residual post-closure risks that require management.
- Relevant information on consultation with stakeholders including:
  - Documented acknowledgement of landowners / managers that rehabilitation objectives and completion criteria have been met.
  - Documented infrastructure transfer agreements where infrastructure has been transferred.
  - Documented agreements with post-mining land managers on implementation of any post-closure management activities (including the post-relinquishment land management plan).

10.4.2 Post-completion management

Following completion and prior to relinquishment, BHP will maintain tenure over the OB29/30/35 area. During this period, the land will be managed in accordance with the post-completion management plan, either by BHP, or by arrangement with the landowner / manager. As detailed in the completion criteria in Section 8.3, land management requirements will be typical for the agreed post-completion land use unless otherwise specified in the post-completion management plan agreed with the landowner / manager.

10.4.3 Relinquishment

At relinquishment, land management responsibilities will be transferred to the landowner / manager, with adequate provisions for management requirements beyond those normally associated with the agreed post-completion land use.

11 Financial provisioning for closure

BHP considers specifics of the closure cost estimate (provision) to be commercially sensitive information. This section outlines the general process used to develop the closure cost estimate.

11.1 BHP principles for closure cost estimation

The financial provision preparation is undertaken in accordance with Our Requirements Closure (BHP, 2023c), and the associated BHP accounting and cost estimation standards. Closure cost estimates are updated annually.

BHP ensures costs included in the provision encompass all closure and rehabilitation activities (for areas disturbed as at balance sheet reporting date) expected to occur progressively over the life of the operation, at the time of closure and during the post-closure period (e.g., monitoring). This includes all expected indirect costs, such as project management costs, statutory reporting fees and technical support costs.

In some cases, substantial judgements and estimates are involved in forming expectations of future activities and the amount and timing of the associated cash flows. These expectations are based on existing environmental and regulatory requirements and or company standards or policies as outlined in this MCP.

Adjustments to the estimated amount and timing of future closure and rehabilitation cash flows are a normal occurrence in light of the substantial judgements and estimates involved. Factors influencing those changes include:

- Revisions to estimated site life;
- Developments in technology or improvements to existing practices;
- Regulatory requirements and environmental management strategies;
- Changes in the estimated extent and costs of anticipated activities; and
- Movement in economic input assumptions (interest rates, inflation).

For OB29/30/35, the closure cost estimate is made up of:

- Three phases of closure studies.
- Landform earthworks and general land disturbance rehabilitation including:
  - Reshaping of OSAs and sheeting with competent material, including a contingency for hauling competent waste from other Newman hub operations, if required.
  - Topsoil / growth media haulage and spreading.
  - Ripping / scarifying (as required) and seeding.
  - Upgrade of the OB30 and Phase 2 Southern Creek diversions (if constructed) for closure, including contingencies for rehandling of OSA material from the flood plain, and buttressing of OB30 and OB35 if required.
  - Construction of abandonment bunds.
- Decommissioning and demolition of infrastructure (based on independent engineering contractor estimate) including:
  - Removal of all buildings and structures.
  - Removal of in-ground infrastructure and services to 0.6 m bgl, or otherwise agreed based on risk or stakeholder requirements.
  - Waste management.
- A provision for remediation of contamination.
- Post closure monitoring and maintenance costs for up to 20 years.
- Stakeholder engagement.
- Allowance for failed rehabilitation.
- A contingency factor.
- Human resources allowances.

11.2 Closure cost estimation methods

The closure cost estimation process is conducted in accordance with BHP Our Requirements: Closure (BHP, 2023c) and the associated BHP accounting and cost estimation standards. The level of accuracy increases as the site approaches closure. The closure cost estimate is:

- An expected cost, based on best available information at a point in time
- Reflective of the class of estimates appropriate for the proximity in time to the commencement of closure activities, and
- Inclusive of uncertainty and reflective of the maturity of the estimate using methods such as sensitivity analysis, weighted scenarios, range analysis, risk events and / or contingency.

Closure cost estimates are developed within the BHP business and include input from specialists in closure planning, rehabilitation, contamination, risk, finance, engineering (mining, civil, mechanical), water planning, and, where necessary, external consultants.

The closure cost estimate is developed from the activities required to close each domain. The closure cost estimate uses internal BHP costs and / or external third-party rates, as appropriate for the activity. Selected costs are benchmarked against third party rates to provide confidence in the quantum of the estimate. The cost estimate for each activity is developed using the method that is considered by BHP to provide the most reasonable estimate. Methods include cost estimates built up by BHP from first principles, factorisation based on BHP's experience at its WAIO sites, or cost estimates provided by specialist third-party consultants for specific studies such as engineering studies, demolition studies and / or detailed execution planning. BHP maintains sufficient closure input assumption documentation to support the closure model financial provision outcomes. The closure cost estimate is updated annually to account for incremental changes to disturbance during the year and to capture changes to the cost basis for execution activities. The provision process and outcomes are subject to internal and external audit on an annual basis.

For commercial reasons BHP does not document the actual estimate in this Closure Plan.

12 Data management

BHP will collect, store and manage closure data in line with its existing data management procedures, including the WAIO-wide Rehabilitation Data Capture Work Instruction (001006) (WAIO, 2023b).

The MCP and related information will be managed by BHP. All data will be stored in a central and readily accessible location in accordance with existing BHP standards and procedures. After lease relinquishment BHP will transfer the MCP and all associated completion relevant information to the DEMIRS for its files.

BHP will progressively update this MCP over time to capture and summarise current closure planning information associated with:

- Closure planning prior to cessation of operations;
- Implementation of the closure program of works; and
- The post closure monitoring and reporting period.

BHP will communicate closure planning progress to the regulators via existing AER channels and will update the MCP as knowledge gaps are filled and closure plans are refined.

13 Reviewed MCPs

This section outlines the key changes to this closure plan from the 2018 revision submitted to government:

- Section 13.1 provides a summary of the key changes between this revision of the plan and the last;
- Section 13.2 summarises regulator comments provided on the 2021 MCP (Revision 6) and BHP's response in this MCP (Revision 7); and
- Section 13.3 outlines progress made to address knowledge gaps and implement improvement activities. It also summarises the new knowledge gaps identified during the development of this MCP.

13.1 Summary of changes to this revision of the MCP

The key changes between this revision of the MCP (Revision 7) and Revision 6 are summarised below with further detail provided in Table 13-1.

Table 13-1 Summary of key changes between the 2021 MCP (Revision 6) and this revision (Revision 7)

MCP checklist		Y / N / NA	Section No.	Comments	Changes from previous version (Y / N)	Section No.	Summary
1	Has the Checklist been endorsed by a senior representative within the tenement holder/operating company?	N/A	N/A	No longer a requirement			
Public Availability							
2	Are you aware that all approved MCPs will be made publicly available?	Y	N/A				
3	Is there any information in this MCP that should not be publicly available?	Y	N/A	Commercially sensitive information.			
4	If "Yes" to Q3, has confidential information been submitted in a separate document/section?	Y	Appendix B Appendix G Appendix I-1 Appendix M	Commercially sensitive information.			
Cover Page, Table of Contents							
5	Does the cover page include; • Project Title. • Company name\ Contact details (including telephone numbers and email addresses) • Document ID and version number • Date of submission (needs to match the date of this checklist)	Y	Page ii				
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 requirements)	Y	Section 1.1		N		

MCP checklist		Y / N / NA	Section No.	Comments	Changes from previous version (Y / N)	Section No.	Summary
Project Overview							
7	Does the project summary include; • Land ownership details (include any and management agency responsible for the land/reserve and the purpose for which the land/ reserve [including surrounding land] is being managed). • Location of the project. • Comprehensive site plan(s). • Background information on the history and status of the project.	Y	Sections 1 & 2		Y	Section 2	The project summary incorporates: • Expansion of OB29 pit • Minor expansion of OB35 to incorporate a new ramp • Renaming of OSA South to become OSA West • Addition of a new OSA called OSA East.
Legal Obligations and Commitments							
8	Does the MCP include a consolidated summary or register of closure obligations and commitments?	Y	Section 3 & Appendix A		Y	Section 3 & Appendix A	Updated to include relevant tenement conditions.
Stakeholder Consultation							
9	Have all stakeholders involved in closure been identified?	Y	Section 4.2		N		
10	Does the MCP include a summary or register of historic stakeholder engagement with details on who has been consulted and the outcomes?	Y	Section 4.3		Y	Section 4.3	Summary has been provided of consultation that has occurred since the last MCP update.
11	Does the MCP include a stakeholder consultation strategy to be implemented in the future?	Y	Section 4.2		N		
Post-Mining Land Use(s) and Closure Objectives							
12	Does the MCP include agreed post-mining land use(s), closure objectives and conceptual landform design diagram?	Y	Sections 6 & 9.2.1		Y	Section 9.2.1	Landform concept designs and visualisations have been updated to reflect updated mine plans / designs and potential future options.
13	Does the MCP identify all potential (or pre-existing) environmental legacies, which may restrict the post-mining land use (including contaminated sites)?	Y	Section 5.10		Y	Section 5.10	Section has been revised to reflect assessments / studies that have been conducted since the last MCP.

MCP checklist		Y / N / NA	Section No.	Comments	Changes from previous version (Y / N)	Section No.	Summary
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*?	Y	Section 5.10	There is regular consultation between DWER and BPH regarding the status of contaminated sites at OB29/30/35 and Whaleback and sites have been formally reported under the CS Act.	Y	Section 5.10	Updated information has been added.
Development of Completion Criteria							
15	Does the MCP include an appropriate set of specific closure criteria and closure performance indicators?	Y	Section 8.3		Y	Section 8.3	Vegetation criteria have been updated to incorporate outcomes of a revised completion criteria study completed by Syrinx Environmental (2023).
16	Does the MCP include baseline data (including pre-mining studies and environmental data)?	Y	Section 5		Y	Section 5	Section has been updated to accommodate new / additional information on: • waste materials and topsoil balances • surface water • groundwater • flora and fauna
17	Has materials characterisation been carried out consistent with applicable standards and guidelines (e.g., GARD Guide)?	Y	Section 5.3.2		Y	Section 5.3.2	Section has been updated to include an account of potentially fibrous materials.
18	Does the MCP identify applicable closure learnings from benchmarking against other comparable mine sites?	Y	Appendix G		Y	Appendix G	Information on WAIO's closure rehabilitation research and trials has been updated.
19	Does the MCP identify all key issues impacting mine closure objectives and outcomes (including potential contamination impacts)?	Y	Section 7		Y	Section 7	The risk register has been updated to reflect the current knowledge base and the amended completion criteria. Controls have been updated to reflect current practice.
20	Does the MCP include information relevant to mine closure for each domain or feature?	Y	Section 9.2		Y	Section 9.2	Conceptual landform designs have been updated to reflect changes to the mine plan.
Identification of 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	Sections 5 & 7		Y	Sections 5, 7 and 13.3.	Updated to reflect updated mine plans and new studies conducted since the last MCP update. New knowledge gaps and improvement activities have been incorporated into the forward works plan in Section 13.3.

MCP checklist		Y / N / NA	Section No.	Comments	Changes from previous version (Y / N)	Section No.	Summary
22	Does the MCP include the process, methodology, and has the rationale been provided to justify identification and management of the issues?	Y	Section 7 & Appendix I		N		
Closure Implementation							
23	Does the reviewed MCP include a summary of the closure implementation strategies and activities for the proposed operations or for the whole site?	Y	Section 9		Y	Section 9	The closure implementation section has been updated to include additional information developed since the previous MCP.
24	Does the MCP include a closure work programme for each domain or feature?	Y	Section 9.4		Y	Section 9.4	The implementation schedule has been updated to reflect current mine plans.
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	Section 2.2		Y	Section 2.2	The plan has been updated to reflect current disturbance and mine plans.
26	Does the MCP contain a schedule of research and trial activities?	Y	Appendix G		Y	Appendix G	Updated to reflect current research and trials.
27	Does the MCP contain a schedule of progressive rehabilitation activities?	Y	Section 9.3		N		
28	Does the MCP include details of how unexpected closure and care and maintenance will be handled?	Y	Section 9.5		N		
29	Does the MCP contain a schedule of decommissioning activities?	Y	Section 9.4		Y	Section 9.4	Schedule updated to reflect current mine plans.
30	Does the MCP contain a schedule of closure performance monitoring and maintenance activities?	Y	Section 10		Y	Section 10	The monitoring and maintenance programs have been updated to reflect current information.
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?	Y	Section 10		Y	Section 10	The monitoring and maintenance programs have been updated to reflect current information.
Closure Financial Provisioning							
32	Does the MCP include costing methodology, assumptions and financial provision to resource closure implementation and monitoring?	Y	Section 11		N		

MCP checklist		Y / N / NA	Section No.	Comments	Changes from previous version (Y / N)	Section No.	Summary
33	Does the MCP include a process for regular review of the financial provision?	Y	Section 11		N		
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	Section 12		N		

13.2 Response to regulator feedback

Table 13-2 summarises the feedback provided by DWER January 2024 on the 2021 OB29/30/25 MCP Rev 6

Table 13-2 Feedback on 2021 MCP

Item No.	CMP section	DWER comments	Response[29]	Section addressed
1	Throughout.	**Issue:** Several references within the mine closure plan (MCP) require updates, and where to locate them is unclear. Some references have been notes as 'in prep' as they were not able to be provided in this revision of the MCP. **Actions:** • Correct and clarify references within text and provide updates of those 'in prep'.	Within the OB29/30/35 Mine closure Plan Rev 6 November 2021 (OB293035 MCP) the following references are "in prep": • BHP. (in prep a). *Western Ridge Mine Closure Plan.* • BHP. (in prep b). *Whaleback Mine Closure Plan.* • BHP. (in prep c). *Western Ridge and OB29/30/35 Detailed Hydrogeological Assessment.* • *WB25 site management plan in prep.* These documents have been provided to the Department of Water and Environmental Regulation (DWER) and the Department of Mining, Industry Regulation and Safety (DMIRS) (now the Department of Energy, Mines, Industry Regulation and Safety (DEMIRS)) on the following dates: • Western Ridge Mine Closure Plan Rev 0 – 31 January 2023. • Whaleback Mine Closure Plan Rev 1 31 August 2023. • Western Ridge and OB29/30/35 Detailed Hydrogeological Assessment (as part of Western Ridge Mine Closure Plan Rev 0 appendices – 31 January 2023). *WB25 site management plan* is referenced in section 5.10 contamination. This section will be updated in the next iteration of the OB293035 MCP.	Documents that were in preparation during the previous review have now been finalised and outcomes of the final versions have been incorporated into Section 5 of this MCP. The final Western Ridge and OB29/30/35 Detailed Hydrogeological Assessment has been included in Appendix M.
2	Section 5.3.2	**Issue:** Where mine scheduling allows, backfilling of erodible waste into below ground level pits is recommended as a primary management strategy to ensure problematic waste materials are not dispersed in the catchment over the long-term, and rehandling of overburden storage area (OSA) materials is minimised. Fibrous materials require further information regarding occurrence, identification, and risk analysis. **Actions:** • Where possible, it is recommended that below ground level pits are backfilled with erodible waste and OSA material handling is minimised. Where this is not possible, provide a justification of alternative management. • Provide further information on the identification and occurrence of fibrous materials and clarify the risk analysis for how they are being managed during operations to ensure long-term stability and minimal exposure risk post-closure.	BHP understands that fundamental to a successful and sustainable landform designs is an understanding of the chemical and physical properties of the soil and / or waste material used to construct the final landform(s). Characterisation of waste is covered in Section 5.3.2 and Management activities in sections 7.5 and 9. Erosion protection is based on the modelling discussed in section 5.3.2.3 and operationalised via the WAIO Mine Closure Design procedure (internal operational document not supplied with MCP) – the fundamental aspects are covered in Table 7.6 of the MCP. The placement and depth of rock armour will vary based on the material type as described in section 5.3.2 BHP acknowledges that backfilling of pits remains the preferred method of managing mined materials and that the 2021 MCP contained commitments to detailing further mine planning to optimise progressive backfill. This work remains ongoing as mine planning optimises and adjusts pushback sequences to long term mine plans (action in 5.3.4). At the time of drafting the MCP in 2021, mining at OB29/30/35 was slowed during FY21/22/23 to enable the contaminated sites investigation into PFAS (as reported to DWER), and mine development sequences were subject to uncertainty due to the need to understand PFAS issues. As ore from OB29/30/35 is part of the broader WAIO supply chain, mining strategy is subject to further change as dewatering efforts restart. BHP notes DWERs recommendation on placement of erodible waste and will continue to provide details on material placement and final landform designs within future iterations of the OB293035 MCP. Fibrous materials are identified in the processes described in Section 5.3.2 and based on this WAIO is able to describe the volume of fibrous materials to be managed in Section 5.3.3. Management actions relating to mined materials are described in section 7.5.6 (min 1 meter of cover), and closure execution activities are described in 9.2 in relation to anthropogenic asbestos waste with a minimum of 2m of fill cover. The final waste destination planning is guided by the WAIO Mines Closure Design procedure, The Mines Closure Design procedure provides guidance on minimum inputs for safe, stable and sustainable final landforms. BHP notes the risks and controls on final landforms and waste material within Section 7, Assessment and Management of Risk. Completion Criteria are proposed within Section 8, Closure Outcomes, detailing performance indicators for safe, stable and sustainable final landforms within which are references to treatments for Fibrous and erosive material. BHP notes the request for further information on the identification and occurrence of fibrous materials and the risk analysis on operational waste management planning and therefore closure management of the material. This detail will be included in future iterations of the OB293035 MCP.	Pit backfill strategy is discussed in Section 9.2.2. Potentially fibrous material is discussed in Section 5.3.2.2 and Section 5.3.3. Review of anthropogenic asbestos waste cover thickness has been included in the forward work program (Table 13-3).
3	Section 5.7 and 5.8	**Issue:** As mentioned above, several references to require updating in this MCP. This also includes studies that have been used to develop closure targets and management techniques. A summary of historical work and feral animal baseline information would be beneficial to provide context, especially during monitoring. This would be further complemented by a discussion regarding closure issues such as invasive species, and how they inform management.	BHP understands the risk of feral fauna and invasive weeds against the ability to achieve ecological criteria as described in Section 7.4 Risk Assessment R8 "Rehabilitation values do not achieve ecological criteria". Section 10, Closure and Monitoring and Maintenance, describes the management of feral fauna and invasive flora. BHP will continue to review this issue in ongoing monitoring assessments and appropriately update to incorporate new management actions via adaptive management as described in OB293035 MCP Section 7.1. BHP can provide relevant studies referenced in an appendix in future iterations of the OB293035 MCP, however please note, BHP requests that appendices that contain sensitive information are not made publicly available. The appendices which BHP requests are not to be made publicly available will be attached as a separate PDF copy with submissions of the OB293035 MCP. BHP, in future iterations of the OB293035 MCP, will provide further context, history and site-specific survey data as available and relevant to closure.	Assessments including surveys of feral species are discussed in Section 5.8.2. Monitoring of feral species during the post closure monitoring period is discussed in Section 10.1.4. Previous studies including Onshore Environmental 2013, Bennelongia, 2013 have been included in Appendix M.

[29] Note that Sections referenced in this column refer to OB293035 2021 Rev 6 not this version 7

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		Actions: • Provide a summary of historical work and current understanding to provide context. • Include site-specific feral animal baseline information, including historical, changes during mining, and outline key issues requiring management for closure. • Provide a discussion on issues relating to closure, including for weeds and feral species. This will inform management requirements and needs to be included in the risk assessment. • Provide relevant studies (e.g. Onshore Environmental 2013, Bennelongia, 2013) as they are required to support the MCP.		
4	Section 5.9.1	**Issue:** For future MCPs, a discussion of stream flow measurement / monitoring within the relevant catchments (Whaleback and Sothern Creeks) would be highly beneficial to inform closure designs. This may include influences of upstream (future) mining operations. Hydrological modelling presented in the MCP for closure design purposes must consider rare to extreme rainfall events when planning permanent diversions for Whaleback and Southern Creeks. These closure design requirements ideally would inform design and construction of pit voids and OSAs during operations to minimise future rehandling of materials. **Actions:** • Include a discussion of stream flow measurement and monitoring within the Whaleback and Southern Creek catchments, including creek diversion performance over the life of the mine. This discussion will be used to inform closure design. External impacts upstream also need to be considered as they arise, and conditions change. • Update hydrogeological modelling to consider rare and extreme rainfall events and incorporate this information into planned creek diversions within the above catchments.	BHP acknowledges that hydrological information including stream flow is important for informing closure designs. Within section 5.9.1 table 5-32 the existing conditions peak flow rates for Whaleback and Southern Creeks are displayed from 1:2 – 1:10,000 AEP (peak event), this data has formed the baseline for hydraulic modelling and used to inform the constructed creek diversions at OB30 and OB35. Section 7.3.2.1 details how BHP has considered AEP flood events in the design of operational and closure creek diversions and impacts to ecological receptors. The overarching closure and rehabilitation philosophy stated in the basis of design for Whaleback Creek diversion at OB30 is - to recreate the pre-development creek system's hydraulic and sediment transport characteristics. Closure design requirements are preferentially constructed at the time of project execution, if operational space allows, to reduce the volume of material rehandling at closure. As upstream proposed mining areas are developed (for example Western Ridge) BHP will continue to model the cumulative impact to catchment and stream flow data and adjust design criteria, if required, via adaptive management. Discussion of any design changes will be discussed in future iterations of the OB293035 MCP. BHP will update future iterations of the OB293035 MCP with current relevant information pertinent to the creek diversions impacting on the site including stream flow monitoring, hydrogeological modelling and ongoing design and material handling, as required.	Stream flow modelling used to inform design of the diversions is discussed in Appendix F and Appendix H. Catchment modelling to inform risks associated with the Significant Amendment approval is provided discussed in Section 7.3.1.1. Discussion about geomorphology of the Whaleback Creek is provided in Section 5.9.1.3.
5	Section 5.9.2	**Issue:** A synthesis of new knowledge and information on the conceptual hydrogeological understanding of the project area and numerical modelling has been provided in Section 5.9.2 of the MCP. The hydrogeological conceptual model and numerical model report(s) were in preparation at the time of writing and have not been provided to support this new information. For example, a hydrogeological review of a Report by RPS Aquaterra, 2012 in support of the original proposal was referenced, but not provided. **Action:** • Provide any new modelling, studies and surveys that have been used to develop this MCP. The updated conceptual model and numerical model reports need to be provided to assess the adequacy of the studies conducted.	As discussed in response to item 1, the Western Ridge and OB29/30/35 Detailed Hydrogeological Assessment was submitted to DWER/*EPA* and DEMIRS as part of Western Ridge Mine Closure Plan Rev 0 appendices on the 31st of January 2023. At the time of drafting the 2021 OB293035 MCP this report was not available in a final form. The updated detailed hydrological assessment (referenced, not supplied) contained a newer interpretation of the system and differed from the 2012 report. Reviewing the 2012 report would have confused the assessing officer. BHP will review the references within the next iteration of the OB293035 MCP and provide relevant studies referenced, however please note, BHP requests that appendices that contain sensitive information are not made publicly available. The appendices which BHP requests are not to be made publicly available will be attached as a separate PDF copy with submissions of the OB293035 MCP.	The hydrogeology knowledge base in Section 5.9.2 has been revised to include the most recent modelling. Copies of the most recent hydrogeology assessments are provided in Appendix M.
6	Section 5.9.2.3 and Section 5.9.4	**Issue:** The MCP assumes the western side of the Whaleback fault to be a groundwater flow barrier base on the present geological information (Jeerinah Formation) in this area, but no further confirmation is provided to support this (Section 5.9.2.3). BHP recognises that groundwater monitoring is required along the western side of the Whaleback fault to confirm this assumed flow barrier (Section 5.9.4). Hydrographs / bores presented in Figure 5-24 are hard to discern. **Actions:** • Undertake monitoring of the western side of the Whaleback fault to confirm if it is a groundwater flow base and utilise results to update future management. • Improve the readability of graphs, figures and data provided in the MCP, specifically Figure 2-24. • Provide a hydrogeological cross section through the aquifers underlying Whaleback Creek towards Ophthalmia Dam and Ethel Gorge TEC to further describe hydrogeological conceptualisation.	BHP has used observations from current groundwater monitoring locations and local hydrogeology models to develop the Whaleback, OB293035 and Western Ridge conceptual groundwater flow model(s). An output this conceptual model, as described in *Western Ridge and OB29/30/35 Detailed Hydrogeological Assessment*, is that throughflow is minimal from western side of the Whaleback Fault due to presence of low permeability Jeerinah Formation. BHP has, since the publishing of the OB293035 MCP Rev 6, installed monitoring on the western side of the Whaleback fault. BHP will continue to refine the conceptual groundwater flow model(s) via calibrating the models against operational and monitoring data and infilling areas of groundwater flow knowledge gaps, via appropriate mechanisms. As updated information is collected and models refined BHP will present this in future iterations of the OB293035 MCP. BHP notes DWER request for an updated figure 5-24 and request for a hydrogeological cross section through the aquifers underlying Whaleback Creek towards Ophthalmia Dam and Ethel Gorge TEC. BHP requests that DWER details their area of focus for the request for a hydrogeological cross section to enable BHP to focus the response adequately. BHP will present updated requested figures in future iterations of the OB293035 MCP.	The hydrogeology knowledge base in Section 5.9.2 has been revised to include the most data and modelling including an assessment of the groundwater 'leaky barrier'. Copies of the most recent hydrogeology assessments are provided in Appendix M.
7	Section 5.12	**Issue:** Consideration of Heritage places, cultural and site values, post-mining access needs to be discussed in the MCP. Additionally, the MCP doesn't clearly address site specific risk assessments for potential impacts to heritage during decommissioning/ rehabilitation/ closure. Closure-related stakeholder engagement with Traditional Owners is expected to support ongoing refinement of closure outcomes and completion criteria. **Actions:**	BHP does not agree with the recommendation to detail site heritage places and post mining access beyond what is discussed in Sections 5.12, 7.4, 7.5.7, 9.1 and table 8.1 in the MCP, as this is managed confidentially under the Aboriginal Heritage Act and remains separate to the OB293035 MCP. BHP is committed to working with Traditional Owners under our Comprehensive Agreements and Heritage Protocols to ensure that cultural heritage is protected and managed as far as possible. BHP notes that prior to the OB293035 MCP Rev 6 consultations with Traditional Owners were less formal than in the current day. BHP is committed to ongoing consultation with the Nyiyaparli people as documented in Section 4, and OB293035 MCP	BHPs approach to the identification and management of heritage places is outlined in Section 5.12 and Section 9.1. A discussion about how the Nyiyaparli People are engaged in closure planning is provided in Section 4.2 and Section 5.12.

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		• Include a discussion of heritage places (noting confidentiality limitations), cultural and site values, post-mining access (safety, rehabilitation of access tracks) and with regards to post closure land uses. • Following the above, include a site-specific risk assessment of how the above values and receptors during decommissioning/rehabilitation/closure. • Further discussion on how Aboriginal stakeholders, such as the Nyiyaparli Traditional Owners, are engaged in closure planning is required in the MCP.	Rev 6 was provided to KNAC for review and comment. Nyiyaparli Closure Principles were communicated to BHP via KNAC, but which were received after submission to government will be acknowledged in future iterations of the OB293035 MCP.	
8	Section 5.14.1.1 and section 5.14.1.2	**Issue:** Two void closure scenarios at OB29/30/35 are currently under review for potential implementation during closure: • leaving the residual voids open at closure • partial backfill of one or more voids with waste rock or tailings. The MCP acknowledges the need for the plan to be updated to include information relevant to the closure of in-pit tailings facilities, should one or more pits be used to store tailings. However, closure scenarios and strategies need to be refined based on the numerical models and studies that are identified in Table E1. **Actions:** • Incorporate additional monitoring data, studies and updated numerical models to refine closure scenarios and strategies. • Closure scenarios need to be considered as part of preliminary planning for diversion alignment (ideally prior to removal of original creek lines) to ensure design is appropriate for closure. • Conduct geochemical testing of Tertiary Detritals and long-term leaching tests. This testing is required to inform landform design with other geochemical information for the rest of the stratigraphic units. • Implement consultant engineers' recommendations (e.g. Tetra Tech Proteus 2021; AMC 2020a etc.) along with ongoing monitoring and review of performance and stability of constructed landforms to demonstrate closure landforms are "safe, stable, non-polluting and self-sustaining". • The MCP focus needs to shift from operations to closure, particularly where permanent creek diversions are built upon constructed landforms. • Where required, discuss proposed diversions with DEMIRS geotechnical engineers during planning to ensure closure designs meet DEMIRS requirements for geotechnical stability. Stakeholder acceptance of design criteria will be required for BHP to meet closure obligations.	The OB293035 mine is a long-lived mine (estimated completion date for mining is 2069). The knowledge base of the MCPs is continually updated over time. The new knowledge incorporated into this MCP is summarised in Section 13 and includes several closure design studies. The knowledge base associated with areas approaching closure / rehabilitation is more mature than newer areas. As areas progress through operations to closure, additional studies will be conducted to help inform the closure and rehabilitation of these areas, this includes ongoing incorporation of numerical models as described in Table E1 and OB293035 Forward work Plan Table 7-10. BHP will continue to refine and present the OB293035 closure strategy in future iterations of the OB293035 MCP. BHP acknowledges that further geochemistry testing is required for the Tertiary Detritals. Further environmental geochemical testing, including leach tests, are currently underway for analogous detrital material; sequential or kinetic leach tests will be considered for appropriate samples classified as AMD2 or AMD3 to address gaps in the current knowledge base. BHP will present relevant results in future iterations OB293035 MCP of the results become available and ensure, via adaptive management to inform OB293035 closure strategy. The Creek Diversions for OB30 and OB35 (discussed in the OB293035 MCP as "Phase 2") were approved by DMIRS (now DEMIRS). The conceptual closure designs associated with the approvals are based on pre diversion geomorphology of the original respective catchments to recreate the pre-development creek system's hydraulic and sediment transport characteristics. As discussed above in response to this item (8) BHP will progress through the forward work plan to inform final closure designs, this includes implementing third party engineering recommendations, where relevant, and consultation with relevant stakeholders listed in section 4.2 of the OB293035 MCP. BHP will update future iterations of the OB293035 MCP as studies are completed.	Closure studies and how new data is incorporated into closure designs is described in Section 5.14.
9.	Section 7	**Issue:** All risks included in the risk assessment, including those identified as "low", need to be comprehensively analysed. Fibrous material requires further risk analysis and structured approach to managing this waste to ensure the risk is as low as reasonably practicable and risk is managed using the hierarchy of controls. **Actions:** • Ensure that the risk assessment analysis is demonstrably comprehensive. • Fibrous material management for closure needs to use the hierarchy of controls to demonstrate the closure objective "safe, stable, non-polluting" can be achieved.	BHP agrees that all risks presented in table 7-10 are required to be comprehensively analysed. In future iterations of the OB293035 MCP BHP will revise the risk assessment structure to provide a greater level of granularity on the risk assessments with references to knowledge base and risk management sections (where more detailed data / analysis can be found) provided within the table. BHP notes that while the risk table will be updated to include a greater level of risk granularity, the splitting out multiple low inherent risks (e.g., one risk per causal factor) does not add value when each causal factor contributes to a higher-level amalgamated risk (i.e. this approach can result in a false picture of risk across the site as each risk in its own right may be low, but when the causal factors are considered cumulatively, the overall risk is likely to be higher). Please refer to item 2 response for discussion on fibrous waste.	Section 7.
10.	Section 8	**Issues:** The terminology BHP use to define closure outcomes and completion criteria requires further improvement so it is clear what the outcomes and criteria are for closure. All outcomes and completion criteria will require ongoing review and development throughout life of mine. **Actions:** • Clarify terminology used to define closure outcomes and completion criteria (e.g. use terminology consistent with DEMIRS guidance OR identify and justify which parameters BHP propose for stakeholder/regulator acceptance upon closure). • Further refinement of closure outcomes with regard to key environmental values (e.g. Ethel Gorge TEC, hydrological flows/water quality at receptors) need to confirm (at or post-closure) that there are no impacts arising from this operation (i.e. impacts are as predicted). • Specific actions from Table 8-1:	The terms that BHP used in Section 8.3 of the OB293035 MCP are consistent with those used in the WABSI guidance on completion criteria. As defined in Young et. al (2019): • The closure objective provides a clear indication on what the proponent commits to achieve at closure (in other words, outcomes). Completion criteria are defined standards or level of performance that can be objectively verified and demonstrates successful closure of a site for a particular objective. Criterion objective in Section 8 describes the purpose or objective (i.e., the outcomes to be achieved) of a particular criterion. Each criterion in Table 8-1 is linked to a specific risk number and domain. Completion is assessed in three stages with the first two stages (Planning and Execution) measured via internal performance indicators and the third stage, Completion, measured via *Completion Criteria*. Timing is built in via the 3-stage process. Completion is not defined as 1 year or 10 years etc. as, based on historical experiences within BHP in the Pilbara, trajectories of rehabilitation success are variable, and it would be erroneous to predict when rehabilitation meets all completion outcomes. BHP's point of view is that when we apply for surrender or	Section 8.

Item No.	CMP section	DWER comments	Response[29]	Section addressed
		• 2.1 Safety: performance indicators for fibrous materials require review when updating risk analysis and baseline data. • 4.3 Vegetation development / 4.5 Weeds: acceptance of bare ground/species richness/weed cover values will require sufficient justification in baseline data and be comparable with reference /analogue sites. • 7.1 Cultural heritage: Closure completion criteria need to be included demonstrating stakeholders are accepting of the final MCP and specific aspects relating to cultural heritage have been addressed to stakeholder's satisfaction.	relinquishment, all criteria must be met. Some criteria may be met earlier in the post closure phase, however many, especially the vegetation criteria, may take 15-30 years to achieve success, based on historical performance. OB293035 is a long-lived mine and completion criteria are being refined based on collection of data and interpretation during the life of mine via the adaptive management process as described in section 7.1 of the OB293035 MCP BHP does note the potential confusion on the terminology used and the structure of table 8.1 and will further clarify in future iterations of the OB293035 MCP, this includes clarifying current links within the MCP to key environmental values, safety, vegetation development and cultural heritage.	
11.	Section 9	**Issues:** As discussed above, closure implementation is acceptable at this time, however future MCP revisions are expected to progressively refine the planned approach to closure implementation. **Actions:** • Include indicative landform designs, such as: o final site configuration (where pits/OSAs will remain) o maximum height, o slope angle(s)/profile(s) shape (including crest berm design details), o disturbance area, o materials and methods used in rehabilitation of the final landform surface, armoring requirements, and o plans for revegetation. • Provide supporting studies (design reports, geotechnical assessments, materials characterisation and erosion assessments etc.). • It is unclear where the final storage of acid and metalliferous drainage material, fibrous material, and other potentially hazardous/contaminating waste will be; final locations need to be included. Management strategies for these materials need to be developed in closure implementation as soon as possible to ensure efficient handling during mine operation.	The OB293035 mine is a long-lived mine (estimated completion date for mining is 2069). The knowledge base, closure designs and strategy are continually updated over time. The new knowledge incorporated into Rev 6 and, future OB293035 MCPs, is/will be summarised in Section 13 and includes several closure design studies. Section 5.14 describes closure design studies, current at the time of OB293035 MCP Rev 6 publish date and Sections 7.5 and 9 the associated closure strategies. Future iterations of the OB293035 MCP will be progressively updated with landform design parameters, as listed by DWER item 11, and supporting relevant studies provided within the technical appendices. BHP will update future iterations of the OB293035 MCP with further detail on the final storage locations of AMD (Acid and Metalliferous Drainage), hazardous and fibrous materials noting that: • Within Section 5.3.2 AMD and hazardous materials risk assessments have been conducted and determined that the risk for this area is low. • Within sections 7.5, 9.2 and 10 closure strategies and management procedures for OB293035 are documented.	Preliminary landform designs are provided in Section 9.2. New studies, undertaken since the previous MCP submission, to support the closure designs are summarised in Section 5.14, and the outcomes incorporated into the knowledge base (Section 5). Copies of technical reports are provided in Appendix M.
12	Section 9.2.5	**Issues:** Cover thicknesses specified in section 9.2.5 are likely to be insufficient for closure. Closure cover designs for landfill waste, asbestos, tyre disposal areas, and other potentially hazardous materials must ensure long-term erosion does not expose materials at the surface. **Actions:** • Refine cover thickness, using recent monitoring data and study data to justify and demonstrate how contained hazardous materials will not be impacted by long term erosion. • There is an assumed typo in this section for putrescible waste cover of 1,000 m (metres) and requires correction.	BHP notes the typo in section 9.2.5 this should read: *Putrescible waste facilities will be covered with 1,000 mm of clean fill.* BHP will correct this typo in future iterations of the OB293035 MCP. BHP maintains a WAIO wide Waste Management Standard which is developed to mitigate risk of future erosional exposure and is aligned to current operational licence conditions for waste cover. BHP will review and assess the cover thicknesses for waste management facilities and provide justification for stated cover thickness in future iterations of the OB293035 MCP.	Discussion provided in Section 9.1.1. Review of anthropogenic asbestos waste cover thickness has been included in the forward work program (Table 13-3).
13	Section 13.3	**Issues:** The future improvement program, risk assessment / improvement activity, knowledge gaps are generally aligned, however duplication and some inconsistency exists between tables and other references. **Actions:** • Update the following tables to reduce duplication and ensure consistency: • Table 7-10 (forward work plan) • Table 13-4 (progress against improvement activity) • 13-5 (new knowledge gaps)	BHP notes the future improvement opportunity and will review and update the structure of tables 7-10, 13-4 and 13-5 in future iterations of the OB293035 MCP.	New table created to replace the previous Tables 7-10, 13-4 and 13-5. The new table is Table 13-3.
14	Summary	Provide DWER with the updated surveys, studies, conceptual and numerical model reports when available.	Noted	Provided in Appendix M

13.3 Forward work program & progress to address knowledge gaps

Table 13-3 outlines:

- The data gaps and improvement activities incorporated into the 2021 MCP and provides commentary on the current status of those activities.
- New knowledge gaps identified in the completion of this plan.

The table is structured as follows:

- Column 1 identifies the technical area to which a knowledge gap and improvement pertains.
- Column 2 outlines the knowledge gap that needs to be filled.
- Columns 3 to 5 (shaded grey) reproduce the forward work program in the 2021 MCP and provide commentary on the progress made against each activity in the 2021 program.
- Columns 6 to 7 outline the forward work program identified for this MCP following work completed since 2021. Column 6 identifies whether:
  - An action has been carried forward from the 2021 MCP. In some instances, activities have been carried forward as they were scheduled for completion at a later date or require further work.
  - An action has been carried forward from the 2021 MCP but has been reworded. In these cases, an activity may be broadly similar to one in the 2021 MCP but needs to be refocused based on work done since the 2021 MCP.
  - An action is new and has arisen as a result of the investigations conducted since 2021.
  - An action was completed in 2021.

Table 13-3 Forward Works Program

Technical area	Knowledge gap / improvement	2021 proposed activities and progress			2024 revised forward work program	
		Proposed improvement activity	Indicative timing	Progress since 2021 MCP	Revised / new activity	Indicative timing
Consultation						
Government and other stakeholder consultation	Stakeholder views	Consultation will continue to be undertaken with identified stakeholders in line with the broader Stakeholder Consultation Programme. Information sought will include, over time: • Post mining land use performance objectives and requirements for safe access. • Requirements for infrastructure post-closure and condition of any infrastructure to be transferred post-closure. • Visual amenity.	Ongoing	See Section 4.2 and Section 4.3.	**CONTINUE** Consultation will continue to be undertaken with identified stakeholders in line with the broader stakeholder consultation program. Information sought will include over time: • Post mining land use performance objectives and requirements for safe access. • Requirements for infrastructure post-closure. • Visual amenity.	Ongoing with an update to be provided in the next review of the MCP.
Traditional Owner engagement	Nyiyaparli People views	Consultation will continue with Traditional Owners in accordance with the broader Stakeholder Consultation Program. Information sought will include, over time: • Requirements for protection, management and post-closure access to sites of cultural significance. • Management of cultural artefacts. • Nyiyaparli people views of rehabilitation of OB29/30/35. • Landform and rehabilitation designs.	Ongoing	See Section 4.2, Section 4.3 and Section 5.12.	**CONTINUE** Consultation will continue with Traditional Owners as part of the broader Stakeholder Consultation Program. Information sought will include over time: • Cultural values. • Requirements for protection, management and post-closure access to sites of cultural significance. • Management of cultural artefacts. • Nyiyaparli people's views of rehabilitation and post-mining land use. • Landform and rehabilitation designs including creation of special places.	Ongoing with an update to be provided in the next review of the MCP.
Landforms						
Waste characterisation	Waste characterisation modelling and analysis	Gap analysis of existing knowledge of waste characteristics and ongoing characterisation of waste to address gaps and inform final landform designs, with a focus on confirming the competent waste balance.	Next scheduled statutory MCP update	The AMD risk assessment completed in 2021 (see Section 5.3) and reported in the previous MCP indicated the waste material that will be placed in OSAs has low risk of generating AMD. Additional classification of potentially fibrous materials was undertaken to inform management requirements (see Section 5.3.2). No additional physical characterisation of waste has been completed in the previous review cycle.	**CONTINUE** Gap analysis of existing knowledge of waste characteristics and ongoing characterisation of waste to address gaps and inform final landform designs, with a focus on confirming the competent waste balance.	Next scheduled statutory MCP update.
	Waste balance	Ongoing review of competent waste balance taking into account Whaleback and OB29/30/35 deposits.	Next scheduled statutory MCP update	See Section 5.3.3	**CONTINUE** Ongoing review of competent waste balance taking into account Whaleback and OB29/30/35 deposits.	Ongoing with an update to be provided in the next review of the MCP.
	Fibrous material	-	-	-	**NEW** Undertake a review of capping over stored fibrous material to confirm the adequacy of the cap.	Within 5 years of domain closure.
Stability	Slope stability of residual voids remaining post-closure.	Detailed slope stability analysis to inform final abandonment bund location for mine voids remaining post-closure. Abandonment bund design will also take into account potential interactions with surface water management infrastructure (e.g., creek diversions and flood bunds) and will conform to DEMIRS guidance (DoIR, 1997) and the outcomes of recent consultation with DEMIRS.	Less than 5 years to domain closure	See Section 9.1.4.2 and Section 9.2.2.	**CONTINUE** Detailed slope stability analysis to inform final abandonment bund location for mine voids remaining post-closure. Abandonment bund design will also take into account potential interactions with surface water management infrastructure (e.g., creek diversions and flood bunds) and will conform to DEMIRS guidance (DoIR, 1997) and the outcomes of recent consultation with DEMIRS.	Less than 5 years to domain closure
Landform design	Mine void closure strategy	Refine mine void closure strategy based on updated mine plans and groundwater modelling.	Next MCP update	See Section 9.1.4.2 and Section 9.2.2. Studies completed to date have informed BHP's understanding of risks associated with the pit void strategy and have informed decision making. Modelling completed to date is sufficient to meet requirements of planning for closure of the current mine plan. Additional investigation may be undertaken in the event that the mine plan changes in the future.	**COMPLETE** The works completed to date are sufficient to meet the closure planning requirements for the current mine plan. Additional investigations may be undertaken if future changes to mine plan result in potential changes to the closure risk profile of the site.	

Technical area	Knowledge gap / improvement	2021 proposed activities and progress			2024 revised forward work program	
		Proposed improvement activity	Indicative timing	Progress since 2021 MCP	Revised / new activity	Indicative timing
Landform design	Closure landform designs.	Review and revision of landform designs following changes to OB29/30/35 mine plans, adjacent mining developments, and construction of creek diversions. Landform designs to consider: • Provisions for safe access post-closure. • Visual impacts where visual impact has been identified as a key concern.	Conceptual designs next MCP update	See Section 9.1.4.1 and Section 9.2.1 for current strategies. Further refinement of designs will be undertaken as the mine life progresses.	**CONTINUE** Review and revision of landform designs following changes to OB29/30/35 mine plans, adjacent mining developments, and construction of creek diversions. Landform designs to consider: • Provisions for safe access post-closure. Visual impacts where visual impact has been identified as a key concern.	Ongoing with an update to be provided in the next review of the MCP.
AMD						
AMD	Improved knowledge of geochemical characteristics of key lithologies and the hazards associated with high sulphur NAF waste	Further geochemical characterisation (as required) including: • Geochemical testing of Tertiary Detritals. • Leach testing of key stratigraphies. • Assessment of the geochemical hazard of high sulphur NAF waste to gain a better understanding of the potential for neutral metalliferous drainage.	Next scheduled statutory update	See Section 5.3.2 for current understanding of geochemical characteristics of the key lithologies. Potentially fibrous materials have been defined (see Section 5.3.2.3).	**CONTINUE** Further geochemical characterisation (as required) including: • Geochemical testing of Tertiary Detritals. • Leach testing of key stratigraphies. • Assessment of the geochemical hazard of high sulphur NAF waste to gain a better understanding of the potential for neutral metalliferous drainage.	Ongoing with an update to be provided in future versions of the MCP.
Hydrology						
Hydrogeology	Improved understanding of groundwater response	Refine conceptual and numerical groundwater models based on monitoring of the drawdown pathway during operations.	In accordance with Groundwater Licence requirements and nominally within 5 years of commencing dewatering at Western Ridge (if approved)	Groundwater model revised based on the most recent groundwater monitoring data and review of historic groundwater level data (see Section 5.9.2.3).	**NEW** Develop a groundwater monitoring network that supports refinement of source-pathway-receptor modelling for closure (see Section 5.14.7).	Ongoing with an update to be provided in the next review of the MCP.
		Improve understanding of source-pathway-receptor linkages with regards to geochemical characterisation and risk assessment of pit lakes.	-	-		
Surface Water Hydrology and Water Quality	Closure designs to manage surface water.	Review and revise surface water modelling as the site approaches closure to take account of changes due to the construction of creek diversions (and associated upgrades) and changes to drainage characteristics resulting from final landform designs and adjacent mining developments.	5 years prior to closure	See Section 5.9.1 Surface water diversions have been constructed at OB35 and OB30. Surface water modelling undertaken in 2024 for the Significant Approval (see Section 7.3.1.1) included consideration of the diversions and makes recommendations for forward works determine alterations to the diversions that will be required for closure.	**CONTINUE** Review and revise surface water modelling as the site approaches closure to take account of changes due to the construction of creek diversions (and associated upgrades) and changes to drainage characteristics resulting from final landform designs and adjacent mining developments.	5 years prior to closure
	Closure designs to manage surface water.	Upgrade permanent creek diversions to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments.	5 years prior to closure	No additional studies completed in this review cycle. OB35 creek diversion has been constructed and is suitable for closure. Future studies apply to OB30 creek diversion only.	**CONTINUE** Upgrade OB30 permanent creek diversions to accommodate conditions that could occur post-closure, taking into account the changes arising from adjacent mining developments.	5 years prior to closure
Rehabilitation						
Progressive rehabilitation	There is a topsoil deficit.	Continued investigation of the suitability of various waste types for use as growth media.	Ongoing	No additional studies completed in this review cycle.	**CONTINUE** Continued investigation of the suitability of various waste types for use as growth media and improve the level of certainty around the final topsoil balance. .	Ongoing
	Available topsoil	-	-	-	**NEW** The topsoil balance shows a significant deficit in topsoil availability for rehabilitation however, there is some uncertainty around how much topsoil is currently stored. Additional survey effort is required to verify topsoil volumes.	Update to be provided in the next review of the MCP.
	Progressive rehabilitation	Investigate locations which may be available for rehabilitation / landform trials.	Ongoing	Given the limited activity undertaken at the site over the previous review cycle, no additional rehabilitation was completed.	**CONTINUE** Continued investigation of the suitability of various waste types for use as growth media.	Ongoing

Technical area	Knowledge gap / improvement	2021 proposed activities and progress			2024 revised forward work program	
		Proposed improvement activity	Indicative timing	Progress since 2021 MCP	Revised / new activity	Indicative timing
Contaminated sites						
Contaminated sites	Contamination investigations are incomplete. Further extent delineation and severity assessment required.	Contamination assessments will be undertaken as per BHP's contaminated site management strategy including assessment and remediation of known contamination (including PFAS).	Ongoing	See Section 5.10.	**CONTINUE** Contamination assessments will be undertaken as per BHP's contaminated site management strategy including assessment and remediation of known contamination (including PFAS).	Ongoing
					NEW Landfill disposal of asbestos material currently assumes a cover thickness of 2 m. Review the proposed cover thickness based on risk and confirm whether the specification needs to be changed.	Update to be provided in the next review of the MCP.
Post-closure land use and decommissioning						
Post-closure land use	Final-land use yet to be confirmed (provisional use is currently low-intensity grazing).	Final land use planning study to be undertaken. Stakeholders to inform the final land use for OB29/30/35 operations.	Ongoing	See Section 6 for land use planning activities. See Section 4.3 and Section 5.12 for discussion on recent consultation. Consultation will continue throughout the mine life.	**CONTINUE** Final land use planning study to be undertaken. Stakeholders to inform the final land use for OB29/30/35 operations.	Ongoing
Decommissioning Plans	No detailed decommissioning plans.	Develop detailed decommissioning and demolition plans for site infrastructure not required to be transferred to third parties.	Within 5 years of closure	No activity completed in the last review cycle.	**CONTINUE** Develop detailed decommissioning and demolition plans for site infrastructure not required to be transferred to third parties.	Within 5 years of closure

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Appendix A. OB29/30/35 closure and rehabilitation obligations and commitments

A-1. Obligations register

Location	Type	Closure Commitment	Reference
OB29	Notice of Intent May 1999. Expansion of the Mt Whaleback and Satellite Orebodies Overburden Storage Areas General Purpose Leases 52/19 to 52/274	**Pyritic waste management** Segregate acid generating waste from inert waste in the mining process and direct to specified sites where it can be encapsulated within the inert waste.	Section 4.4.3
		Final closure Existing extinct dumps will be reshaped to an overall face angle of less than 20° using fresh imported material. Future dumps will be constructed by placing overburden at the desired profile. New faces will have drainage terraces 7 m wide set in the face at 20 m vertical intervals to intercept runoff with a longitudinal gradient of 2 to 3% along the storage area face. The new terraces will lead into safe discharge points onto natural surface areas. The new terraces will be constructed using 35 m wide haul ramps with trucks tipping to the normal 37° repose angle. Once hauling is complete, the storage areas will be shaped to a 20° angle as shown in the schematic profile below. One final profile is achieved, the faces will be covered with topsoil, ripped and seeded to assist storage area stabilization.	Section 4.4.3
		Topsoil management Before major land disturbance occurs at the Mt Whaleback / OB29 operations, the topsoil resource and vegetation cover are stripped and stockpiled for future use. Topsoil stockpiles are created away from planned disturbance. Vegetation that is stripped in this process is generally placed onto or adjacent to these stockpiles for later use. As areas become available for rehabilitation, these stockpiles will be used as necessary to assist with revegetation activities.	Section 5.1.1
		Surface water Local drainage patterns will be altered by the development of the overburden stockpiles and is likely to result in localised impact over small areas (<50m^2 through water starvation / inundation).	Section 5.2
		Overburden storage areas Overburden storage area (OSA) have been designed to minimise haulage distances and to address a variety of operational and environmental concerns. Ongoing designs and trials are being used to refine methods for constructing final OSA configurations. These designs will continue to evolve as more areas are rehabilitated. Currently, BHPIO are utilising the following criteria for construction of the final rehabilitated slope: • Bench heights of 25 m have been adopted in preference to the suggested 10 m heights (DME guidelines) as it is expected that control of erosion and discharge of runoff can be achieved in a more stable and efficient manner with the materials present at Mt. Whaleback. Ten metre benches will lead to excessive lengths of terracing without discharge points onto natural surfaces necessitating the use of artificial drop drains. These have proven to be subject to instability on larger OSA's; • Terraces will be angled back into the face to ensure that runoff is concentrated along the toe of the drain rather than on the outer berm. This will ensure that the integrity of the terrace is maintained. The designs and hydraulic calculations for the terraces are designed to safely pass the 1 in 100-year events at a minimum; • Dump faces will be contour ripped as necessary and topsoil spread where available to enhance revegetation; and • Sediment traps will be constructed at discharge points from dump faces onto natural surface. As further refinements of these techniques are made, they will be implemented as standard operating practices for the BHPIO operations.	Section 5.5

Location	Type	Closure Commitment	Reference
OB29	*Notice of Intent May 1999.* *Expansion of the Mt Whaleback and Satellite Orebodies Overburden Storage Areas General Purpose Leases 52/19 to 52/274 continued*	**Rehabilitation and post-mining land use** Conceptual designs have been prepared to show how rehabilitation generally will be accomplished on the OSAs. Detailed designs for each storage area have not been completed as most designs have a 25-year time frame and will be subject to change as further data and information becomes available. The overall objectives of rehabilitation are to create stable landforms, supporting a diverse mixture of native species appropriate to the post mining land use. To the extent possible, progressive rehabilitation will be undertaken. Long term plans continue to be developed for the Mt Whaleback mining operations and as components of the plan are finalised, rehabilitation will be undertaken. Mine and overburden storage area design is an ongoing process. Modelling is used to predict when areas will no longer be needed for mine development and then rehabilitation is undertaken. These areas are identified as early as possible to effect final landforms that meet rehabilitation objectives and reduce costs. Further research will be conducted on rehabilitation technologies, pit design and overburden storage areas to meet final objectives. The planned post mining land use is for a combination of grazing and livestock management coupled with wildlife habitat. The above-mentioned design principles will ensure the construction of stable, non-polluting landforms that are compatible with adjacent ecological processes and anticipated post-mining land-use.	Section 5.9
OB30/35	State Agreement Proposal September 1999	**Rehabilitation and Decommissioning** BHPIO has developed rehabilitation procedures through its experience in the Pilbara region. The overall objectives of the rehabilitation program are to return disturbed surfaces to a stable condition, with flora and fauna approaching that which occurred in the area prior to mining. Where available and practicable, topsoil and vegetation are stripped and stored for later use in rehabilitation. At the end of mining activities, areas will be contoured as necessary, topsoiled and surface treated by ripping or other techniques. Where necessary, the area will be seeded with a mixture of local species. 4.8 Commitments BHPIO will comply with existing GPL and DEP licence conditions with respect to the management of the environment.	Clause 4.7 - MN16

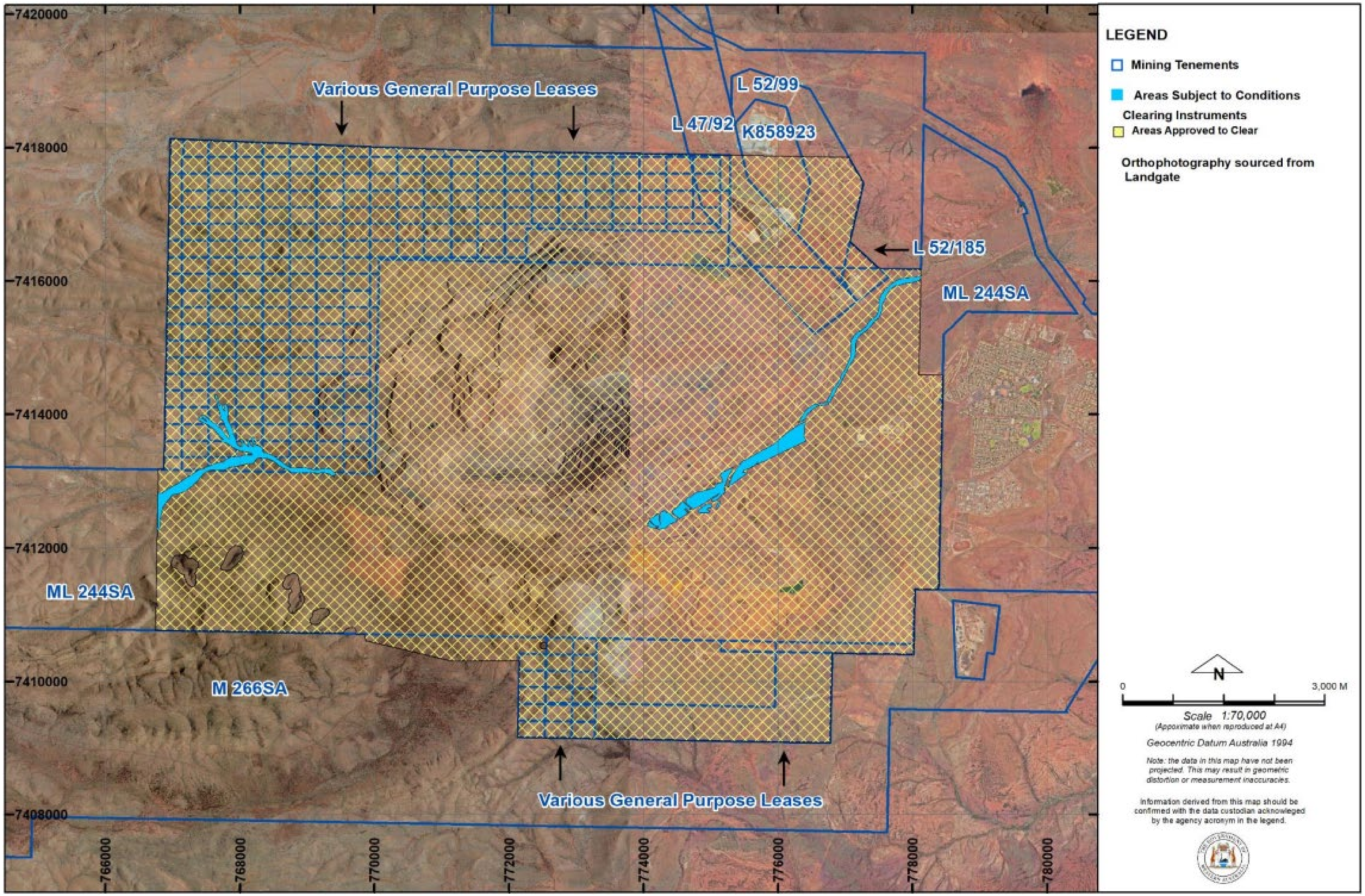
<table>
<tr><th>Location</th><th>Type</th><th>Closure Commitment</th><th>Reference</th></tr>
<tr><td rowspan="3">OB30/35</td><td rowspan="3">Environmental Management Plan
(Attached to State Agreement Proposal September 1999)</td><td>Rehabilitation
Re-establishment of an erosionally stable landform with land uses similar to those existing prior to mining.
To monitor changes following mining.
To undertake infilling where practicable.
To undertake research to continually improve rehabilitation techniques.
To develop a plan which addresses rehabilitation during the mining phase, outlines how disturbed areas will be rehabilitated and considers future decommissioning alternatives, including:
• how topsoil and vegetation materials will be utilized for rehabilitation;
• slopes will be progressively battered to an overall angle of 20º or less, spread with stored topsoil and vegetation (where available) and stabilized to prevent erosion and encourage vegetation establishment and fauna re-colonisation;
• how water management techniques will be applied;
• how disturbed areas will be seeded; and
• safety bunds will be constructed around the decommissioned pits and their design will comply with guidelines established by the DME (now DMIRS) (1991).
During the mining operation:
• disturbed areas will be progressively rehabilitated throughout the Project's life; and
• completed pit berms that protrude above the plain level will be progressively rehabilitated.
To minimise erosion in ensuing years, pre-existing drainage networks will be re-established where practicable.
Revegetation activities will continue beyond the mine closure to enable final overburden storage areas to be contoured and stabilized.</td><td>Sections 17.1 to 17.3</td></tr>
<tr><td>Performance Indicators
Procedures developed by BHP in the Pilbara will be applied to rehabilitation. The object of the rehabilitation will be to ensure that, at the end of the project, all disturbed surfaces (with the exception of the mined pits) are returned to a stable condition with a flora and fauna which approaches the natural condition of the site. Areas no longer in use will be progressively rehabilitated during the life of the project. All exposed overburden surfaces will be battered to an angle of 20° or less. Topsoil, where available, will be replaced and the surface shaped for water harvesting and stability. If necessary, seeding using local species will occur. With respect to the mined pit,
seeding of the berms will be undertaken to minimise the remaining visual impact.
Following completion of mining, rehabilitation of the overburden will be finalised. All bare or compacted areas will be contoured, ripped and seeded, if required. Monitoring of the rehabilitated areas will be undertaken to gauge success.
A closure plan will be prepared for the OB30/35 operations detailing specific management plans and final void strategies.</td><td>Section 17.4</td></tr>
<tr><td>Critical Dates
Prior to the commencement of closure activities, an end land use plan will be agreed upon.
A progressive rehabilitation plan will be developed and implemented.
At least 12 months prior to the cessation of mining at any location the existing and approved Decommissioning Plan will be revisited and revised in consultation with the DEP and implemented.
Annual audits will be undertaken.</td><td>Section 17.5</td></tr>
</table>

<table>
<tr><th>Location</th><th>Type</th><th>Closure Commitment</th><th>Reference</th></tr>
<tr><td>OB30/35 Continued</td><td>Environmental Management Plan
(Attached to State Agreement Proposal September 1999) Continued</td><td>Monitoring
Regular inspections will be carried out during operations and following the completion of mining to assess the progress of rehabilitation.
Table 17—1 presents the rehabilitation criteria which have been developed for the OB30/35 development.
TABLE 17-1 REHABILITATION CRITERIA
<table>
<tr><th>Site Element</th><th>Final Landform</th><th>Final Vegetation</th></tr>
<tr><td>Overburden storage areas</td><td>Flat topped spurs, 20° scree outslopes, stabilised; blends with natural topography.</td><td>Early successional species first, final objective is grasses with scattered shrubs.</td></tr>
<tr><td>Open pit</td><td>Open pit to DME safety standards, possibly with occasional open water or partially filled with overburden.</td><td>Accessible internal benches and pit floors will be ripped and seeded, as necessary.</td></tr>
<tr><td>Road</td><td>Consistent with existing topography.
All infrastructure removed.</td><td>Site topsoiled, ripped and seeded consistent with the vegetation on adjacent areas, as necessary, to achieve a grassland of scattered shrubs.</td></tr>
</table>
</td><td>Section 17.6</td></tr>
<tr><td>OB30/35</td><td>State Agreement Proposal October 2012</td><td>BHPIO has made the commitment to the OEPA [now DWER] that it will prepare and submit a Closure Plan for OB35 within three years of commencement of mining at 0835. The Closure Plan will be prepared in accordance with the DMP Guidelines for Preparing Mine Closure Plans (DMP & EPA, 2011). The Closure Plan will be site specific and limited to the 0835 operations.
No potentially acid forming material (“PAF”) has been identified at OB35.
OB35 is included in the BHPIO Annual Environmental Report which is lodged annually to relevant government agencies for the 12-month period ending in June each year.</td><td>Clause 6 -MN54</td></tr>
<tr><td rowspan="2">OB29/30/35</td><td rowspan="2">OB29/30/35. Below Water Table Mining
Environmental Referral Supporting Information Document, August 2013</td><td>Rehabilitation and closure
The range of closure options available for the OB29/30/35 pits includes:
• in-filling of pit voids to above water table;
• partial in-filling of pit voids to reduce pit lake surface area; and
• leaving the pits as fully open voids allowing pit lake formation.
The in-filling of pits with waste rock and other material to above the pre-mining water table is unlikely to present any long-term impacts and would enable groundwater levels to recover to regional levels. The option of retaining open voids, can present changes to groundwater inflow and evaporative losses during the groundwater recovery in the pit void, however this impact is expected to be localised. Partial backfill scenarios would be investigated further during the life of operations.</td><td>Section 5.6.5</td></tr>
<tr><td>Rehabilitation and closure
The OB29/30/35 Mine Closure Plan (draft) provides for an adaptive management approach to closure and rehabilitation, which involves BHP Iron Ore regularly assessing performance and adjusting management practices to facilitate continuous improvement. Closure and rehabilitation strategies have been identified in the OB29/30/35 Mine Closure Plan (draft), for specific domain types including pit voids. Additionally, groundwater and surface water monitoring and maintenance programmes have also been incorporated to meet the site completion criteria and objectives.</td><td>Section 5.6.6</td></tr>
</table>

Location	Type	Closure Commitment	Reference
OB29/30/35	*OB29/30/35. Below Water Table Mining* *Environmental Referral Supporting Information Document, August 2013 continued*	**Landforms** BHP Iron Ore will endeavour to ensure that the integrity, ecological functions and environmental values of landforms are considered, and measures are adopted to reduce impacts to landforms to as low as reasonably practicable. Management measures that may be used to mitigate potential visual impacts include: • Designing OSAs to integrate and blend in with the surrounding topography as far as practicable. • Rehabilitating mine landforms when they are not required. • Conserving topsoil resources where practicable.	Section 5.8.6
OB29/30/35	State Agreement Proposal March 2014	**Closure** OB29/30/35 is located within the Whaleback Creek catchment area, which forms part of the greater Fortescue River Upper Catchment. This constitutes the main environmental receptor for the project area. No Threatened or Declared Rare Flora species or priority species were recorded within the closure boundary of the project. There are no areas of groundwater dependent vegetation were identified to be at high risk from groundwater drawdown associated with proposed mining below the water table at OB29/30/35. In the EP Act Part IV referral, BHPIO made the commitment that it will prepare and submit a Closure Plan for below water table mining at OB29, 30 and 35 within calendar year 2014. The Closure Plan will be implemented within 12 months of commissioning of the first below water table mine pit. The Closure Plan will be prepared in accordance with the DMP Guidelines for Preparing Mine Closure Plans (DMP & EPA, 2011). The Closure Plan will be site specific and limited to the OB29, 30 and 35 operations. In the referral, BHPIO included a preliminary assessment by SRK Consulting that the potential for AMD (Acid and Metalliferous Drainage) formation from the overburden stockpile areas, and pit walls is considered to be low. It will be further assessed to better understand the potential for AMD over the life of the project. AMD was not specifically referred to in the Ministerial Statement for the project, however there was the requirement for a Mine Closure Plan to be approved, in accordance with the DMP Guidelines. The Guidelines require Mine Closure Plans to address AMD potential and management. BHP Iron Ore is committed to managing and mitigating AMD risk using a structured approach, consistent with global leading practice guidelines including INAP (2012) and DITR (2007). Management for AMD materials across BHP Iron Ore's Pilbara sites is outlined at a high-level in the WAIO AMD Management Standard. Below water table mining of OB29, 30 and 35 will be included in the BHPIO Annual Environmental Report which is lodged annually to relevant government agencies for the 12-month period ending in June each year	Clause 5 - MN71
OB35	OB35 State Agreement Proposal Project Proposal for OB35 Pit Extension, 9 September 2016	**Closure** The Mine Closure Plan that applies to the OB29/30/35 Closure Plan Area will be applied to the Proposal. A draft of the Mine Closure Plan was provided with the referral to the OEPA [now DWER] of the 0829/30/35 Project on 30 August 2013. The draft Plan was prepared in accordance with the Guidelines for Preparing Mine Closure Plans, June 2011 (Department of Mines and Petroleum and Environmental Protection Authority), including consultation with Government Regulators. Ongoing technical studies (and DMP/EPA Guideline updates) will inform updates to the Mine Closure plan over the life of the mine. The Mine Closure Plan is scheduled for further submission in September 2016. This updated plan will be in accordance with the 2015 Guidelines for Preparing Mine Closure Plans. This proposal is considered low risk for closure and rehabilitation. Final land use, land management, safety, landform, water and sustainability aspects can be managed through standard BHP Iron Ore management practices for closure. Based on the Preliminary Acid and Metalliferous Drainage (AMD) Risk Assessment (SRK, 2013) carried out, the majority of material to be encountered during mining AWT has a low to negligible potential to generate acidity. Within the overburden, the estimated proportion of Potentially Acid Forming (PAF) classed materials is approximately 5% using a conservatively low 0.1% sulphur threshold. The estimated proportion of PAF classed materials that will be exposed on pit walls is approximately 3% using a 0.1% sulphur threshold	Section 5.0

Location	Type	Closure Commitment	Reference
OB35	Pit Optimisation Proposal September 2016	BHPIO (in its capacity as manager and agent for both MNJV and BHPIOJ) will operate this proposal and the OB35 Pit Extension proposal as a single mining operation that straddles both Leases. Works carried out within ML244SA will be performed by BHPIO on behalf of the MNJV in accordance with the Newman Agreement, as contemplated by this proposal. Works carried out within M266SA will be performed by BHPIO on behalf of BHPIOJ in accordance with the McCamey's Agreement, as contemplated by the OB35 Pit Extension Proposal.	Paragraph seven of correspondence
Eastern Syncline	DRAFT State Agreement Proposal (Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972) November 2002	Overburden will be stockpiled in existing or approved OSA's on ML244SA. Where practicable, overburden may also be placed back into pit voids to assist in achieving closure objectives for the site. No overburden will be located on M266SA, other than any backfilling of the pit. Topsoil, where recoverable, will first be removed and placed into stockpile areas for later use in rehabilitation. Approximately 6 million cubic metres of overburden is required to be mined from OB35 through this proposal.	3.2
		The OB29/30/35 Mine Closure Plan (MCP) Version 5, approved 14 November 2018, will apply to the Proposal. The MCP was prepared in accordance with the Guidelines for Preparing Mine Closure Plans, 2015 (Department of Mines and Petroleum and Environmental Protection Authority), including consultation with Government Regulators. Ongoing technical studies (and DMP/EPA Guideline updates) will inform updates to the MCP over the life of mine with the next MCP submission due in November 2021. This proposal to mine the extension of Orebody 35 is considered low risk for closure and rehabilitation. Final land use, land management, safety, landform, water and sustainability aspects can be managed through standard BHP Iron Ore management practices for closure. Based on the Preliminary Acid and Metalliferous Drainage (AMD) Risk Assessment (SRK, 2013) carried out, the majority of material to be encountered during mining AWT at Orebody 35 has low to negligible potential to generate acidity. Within the overburden, the estimated proportion of Potentially Acid Forming (PAF) classed materials is approximately 5% using a conservatively low 0.1% sulphur threshold. The estimated proportion of PAF classed materials that will be exposed on pit walls is approximately 3% using a 0.1% sulphur threshold.	5

A-2. CPS 5167/6 clearing permit plan



Appendix B. Syrinx review of vegetation completion criteria

This appendix is supplied separately – the information is commercially sensitive and not for public release

Appendix C. Indicator species and plant cover criteria

Indicator species and plant cover targets for the land use of natural environments for managed resource protection

Target Vegetation Types			Grass Steppe	Shrub Steppe	Low Tree Steppe	Low Woodland	Riparian Woodland
Indicator Species	Presence of dominant and common species from each Target Vegetation Type *Note, if more than one type is applicable, choose the most representative for each rehabilitated area*	At least one dominant species from each strata present >70% of common species present	Dominant Trees -	Dominant Trees *Corymbia hamersleyana*	Dominant Trees *Corymbia hamersleyana* *Eucalyptus leucophloia subsp. leucophloia* *E. gamophylla*	Dominant Trees *Acacia aneura* *A. ayersiana* *A. minyura* *A. paraneura* *Corymbia hamersleyana* *Eucalyptus leucophloia subsp. leucophloia*	Dominant Trees *Eucalyptus camaldulensis var. obtusa* *E. victrix* *Melaleuca glomerata* *M. argentea*
			Dominant Shrubs *Acacia tumida var. pilbarensis* *A. eriopoda* *A. ptychophylla* *Grevillea wickhamii*	Dominant Shrubs *Acacia bivenosa* *A. aneura* *A. inaequilatera* *A. pyrifolia* *Grevillea pyramidalis subsp. Leucadendron* *G. wickhamii* *Hybanthus aurantiacus* *Senna notabilis* *S. glutinosa subsp. glutinosa*	Dominant Shrubs *Acacia ancistrocarpa* *A. atkinsiana* *A. bivenosa* *A. aneura* *A. hiliana* *Hakea lorea* *H. chordophylla* *Senna artemisioides* *S. glutinosa subsp. glutinosa* *S. pleurocarpa var. pleurocarpa* *Solanum lasiophyllum*	Dominant Shrubs *Acacia adoxa var. adoxa* *A. pruinocarpa* *A. tenuissima* *Eremophila spp.* *Grevillea wickhamii* *Hakea chordophylla* *Hybanthus aurantiacus* *Indigofera monophyla* *Senna artemisioides subsp. Oligophylla* *S. glutinosa subsp. glutinosa*	Dominant Shrubs *Acacia ampliceps* *A. pyrifolia var. pyrifolia* *Atalaya hemiglauca* *Crotalaria novae-hollandiae subsp. novae-hollandiae* *Cymbopogon ambiguous* *Cyperus vaginatus* *Gossypium robinsonii* *Indigofera monophyla* *Petalostylis labicheoides*
			Dominant Grasses: *Triodia basedowii* *T. epactia* *T. pungens* *T. schinzii*	Dominant Grasses: *Triodia wiseana* *T. basedowii* *T. pungens* *T. vanleeuwenii* *T. epactia*	Dominant Grasses: *Triodia wiseana* *T. basedowii* *T. schinzii* *T. vanleeuwenii* *Eriachne pulchella subsp. pulchella*	Dominant Grasses: *Triodia basedowii* *T. pungens* *T. wiseana* *Aristida spp.* *Cymbopogon spp.* *Eriachne pulchella subsp. Pulchella*	Dominant Grasses/Sedges: *Aristida spp.* *Enneapogon spp.* *Eragrostis spp.* *Eriachne mucronate* *Eriachne tenuiculmis* *Themeda triandra*
Species Richness	Presence of perennial species	No perennial species recorded in aggregated 50 x 50 m plots	8 - 16.5	15 - 19	16 - 29	28 - 30	14 - 30

Target Vegetation Types			Grass Steppe	Shrub Steppe	Low Tree Steppe	Low Woodland	Riparian Woodland
Plant Cover	% cover for each stratum and each Vegetation Type to be	Trees	0 - 1	1 - 10	1 -10	2 - 10	10 - 70
		Shrubs	0.2 - 7	3 - 7	2 - 10	2.6 - 6.8	2 -10
		Hummock Grasses	15 - 34	19 - 33	20 - 30	17 - 33	
		Other Grasses	0.01 - 0.4	0.02 - 0.16	0.04 - 0.62	0.2 - 1	
		Herbs	0.1 - 0.2	0.1 - 1	0.05 - 0.4	0.06 - 0.27	

Source: Syrinx (2023)

Indicator Species and Cover Targets for Pastoral Grazing Land uses

Target Vegetation Types			Grass Steppe	Shrub Steppe	Low Tree Steppe	Low Woodland	Riparian Woodland
Indicator Species	Presence of dominant and common species from each Target Vegetation Type *Note, if more than one type is applicable, choose the most representative for each rehabilitated area*	At least one dominant species from each strata present >50% of common species present	Dominant Trees -	Dominant Trees *Corymbia hamersleyana*	Dominant Trees *Corymbia hamersleyana* *Eucalyptus leucophloia subsp. leucophloia* *E. gamophylla*	Dominant Trees *Acacia aneura* *A. ayersiana* *A. minyura* *A. paraneura* *Corymbia hamersleyana* *Eucalyptus leucophloia subsp. leucophloia*	Dominant Trees *Eucalyptus camaldulensis var. obtusa* *E. victrix* *Melaleuca glomerata* *M. argentea*
			Dominant Shrubs *Acacia tumida var. pilbarensis* *A. eriopoda* *A. ptychophylla* *Grevillea wickhamii*	Dominant Shrubs *Acacia bivenosa* *A. aneura* *A. inaequilatera* *A. pyrifolia* *Grevillea pyramidalis subsp. Leucadendron* *G. wickhamii* *Hybanthus aurantiacus* *Senna notabilis*	Dominant Shrubs *Acacia ancistrocarpa* *A. atkinsiana* *A. bivenosa* *A. aneura* *A. hiliana* *Hakea lorea* *H. chordophylla* *Senna artemisioides* *S. glutinosa subsp. glutinosa*	Dominant Shrubs *Acacia adoxa var. adoxa* *A. pruinocarpa* *A. tenuissima* *Eremophila spp.* *Grevillea wickhamii* *Hakea chordophylla* *Hybanthus aurantiacus* *Indigofera monophyla* *Senna artemisioides subsp. Oligophylla*	Dominant Shrubs *Acacia ampliceps* *A. pyrifolia var. pyrifolia* *Atalaya hemiglauca* *Crotalaria novae-hollandiae subsp. novae-hollandiae* *Cymbopogon ambiguous* *Cyperus vaginatus* *Gossypium robinsonii* *Indigofera monophyla*

Target Vegetation Types			Grass Steppe	Shrub Steppe	Low Tree Steppe	Low Woodland	Riparian Woodland
				S. glutinosa subsp. glutinosa	*S. pleurocarpa var. pleurocarpa* *Solanum lasiophyllum*	*S. glutinosa subsp. glutinosa*	*Petalostylis labicheoides*
			Dominant Grasses: *Triodia basedowii* *T. epactia* *T. pungens* *T. schinzii*	Dominant Grasses: *Triodia wiseana* *T. basedowii* *T. pungens* *T. vanleeuwenii* *T. epactia*	Dominant Grasses: *Triodia wiseana* *T. basedowii* *T. schinzii* *T. vanleeuwenii* *Eriachne pulchella subsp. pulchella*	Dominant Grasses: *Triodia basedowii* *T. pungens* *T. wiseana* *Aristida spp.* *Cymbopogon spp.* *Eriachne pulchella subsp. Pulchella*	Dominant Grasses/Sedges: *Aristida spp.* *Enneapogon spp.* *Eragrostis spp.* *Eriachne mucronate* *Eriachne tenuiculmis* *Themeda triandra*
Species Richness	Presence of perennial species	Number of perennial species recorded in aggregated 50 x 50 m plots	>8	>15	>16	>28	>14
Plant Cover	% cover for each stratum and each Vegetation Type to be > Q1 for relevant reference sites	Trees	>0	>1	>1	>2	>10
		Shrubs	>0.2	>3	>2	>2.6	>2
		Hummock Grasses	>15	>19	>20	>17	
		Other Grasses	>0.01	>0.02	>0.04	>0.2	
		Herbs	>0.1	>0.1	>0.05	>0.06	

Source: Syrinx (2023)

Appendix D. Materials characterisation

D-1. Overburden characterisation

Physico-chemical analyses

Outback Ecology (2006) characterisation of stability of waste

Material	% Coarse material (>2mm)	% Clay	Org C (%)	EC (1:5) (mS/m)	pH (H_2O)	CEC (meq/100g)	ESP (%)	MOR (kPa)
Beneficiation waste	71	3	0.26	16.2	6.8	2.7	3	64.3
Wittenoom dolomite	45	22	0.3	11.4	8.1	4.9	0.7	162.7
Joffre - BIF	64	9	0.12	5.5	7.0	0.9	3.5	67.7

Outback Ecology (2006)

Outback Ecology (2005) chemical analyses of wastes

Analyte	WB3	WB6	WB7	WB8	WB9
	Wittenoom Dolomite	BIF, Joffre	BIF, Joffre	Coarse rejects	Coarse rejects
NO_3 (mg/kg)	12	3	13	3	4
NH_4 (mg/kg)	6	3	23	1	1
Extractable P (mg/kg)	28	8	5	12	15
Extractable K (mg/kg)	53	15	16	32	18
Extractable S (mg/kg)	11.7	27.4	9.7	108	72.2
Organic C (%)	0.3	0.13	0.11	0.27	0.26
EC (mS/m)	11.4	5.9	5.1	18.4	14.8
pH ($CaCl_2$)	7.6	6.5	6.5	6.5	6.7
pH (H_2O)	8.1	7.2	6.8	6.6	6.9
Exchangeable Ca (meq/100g)	2.32	0.29	0.41	1.07	1.08
Exchangeable K (meq/100g)	0.14	0.07	0.09	0.14	0.13
Exchangeable Mg (meq/100g)	2.44	0.6	0.33	1.52	1.4
Exchangeable Na (meq/100g)	0.03	0.01	0.05	0.08	0.08
CEC (sum of bases) meq/100g	4.93	0.98	0.88	2.82	2.69
ESP%	0.7	1.1	6	3	3.1

Source: Outback Ecology (2005)

Description of small samples taken from OB29 and OB30 by Landloch (2013)

Sample ID	Orebody	Easting (m)+	Northing (m)+	Description
MM1	30	770996	7412423	W23 Marra Mamba waste
MM2	30	770945	7412395	W23 Marra Mamba waste
MM3	29	-	-	Yellow Marra Mamba waste on tip head
MM4	30	770565	7412466	W23 Marra Mamba waste
MM5	30	770497	7412504	W23 Marra Mamba waste
MM6	29	-	-	Tip head Black shale
MM7	29	-	-	Mustard Marra Mamba waste on tip head
MM8	29	-	-	Mustard Marra Mamba waste on tip head
MM9	30	770426	7412541	W23 SE end, fine detritals
MM10	29	-	-	Mixed Mustard White waste on tip head
MM11	29	-	-	Beneficiation coarse rejects on tip head

Sample ID	Orebody	Easting (m)+	Northing (m)+	Description
MM12	29	-	-	Marra Mamba waste
MM13	29	776522	7410865	Rocky Hard Cap
MM14	29	776287	7410715	Mustard coloured Marra Mamba waste
MM15	29	-	-	White waste on tip head
MM16	29	-	-	Mustard coloured waste on tip head
MM17	29	776281	7410778	Mustard coloured Marra Mamba waste
MM18	29	776042	7410737	Red rocky material
MM19	30	770565	7412466	W23 Marra Mamba waste (Rocks)
MM20	30	770702	7412394	W23 Marra Mamba waste
MM21	30	770426	7412541	W23 SE end
MM22	30	770515	7412495	W23 detritals
MM23	29	776061	7410823	Yellow Marra Mamba waste

Notes: Coordinates are in the GDA94 coordinate system. The Pilbara area generally lies within zone 50, bounded on the east and west by and 114- and 120-degree longitudes respectively.

Cells shaded orange denote classic mustard coloured Marra Mamba shales wastes.

Source: Landloch (2013)

Landloch characterisation of OB29 & OB30 Marra Mamba materials

Property		Unit	Min	Max	Mean	Median	n
$pH_{1:5}$		pH Units	6.2	8.7	8.1	8.3	13
$EC_{1:5}$		dS/m	0.02	1.61	0.33	0.25	13
Exchangeable cations	Calcium	meq/100g	0.5	10.5	3.7	3.7	13
	Magnesium	meq/100g	0.5	7.1	2.2	1.3	13
	Potassium	meq/100g	0.02	0.50	0.18	0.21	13
	Sodium	meq/100g	0.05	2.48	0.57	0.30	13
	Aluminium	meq/100g	0.0	0.01	0.0	0.0	13
	ECEC	meq/100g	1.1	16.1	6.6	5.4	13
	ESP	%	1.1	23.0	8.3	6.4	13
Fertility	Total N	mg/kg	244	531	298	285	13
	Total P	mg/kg	198	665	336	347	13
	Available P	mg/kg	16	33.6	22	21.1	13
	Available K	mg/kg	72.5	367	168	168	13
	Available S	mg/kg	5.3	1188	145	62.5	13
	Organic carbon	%	0.01	0.07	0.02	0.01	13
	Available Cu	mg/kg	0.05	0.17	0.09	0.08	13
	Available Mn	mg/kg	0.24	28.4	6.8	1.51	13
	Available Zn	mg/kg	0.17	0.57	0.35	0.35	13
Particle size distribution of coarse fraction	Rock (>45mm)	%	0.0	10.0	0.9	0.0	13
	Coarse gravel (25-45mm)	%	3.0	23.0	8.8	8.0	13
	Gravel (6-25mm)	%	0.0	51.0	28.5	29.0	13
	Fine gravel (2-6mm)	%	10.0	24.0	14.3	14.0	13
	Fine fraction (<2mm)	%	30.0	66.0	47.9	49.0	13
Particle size distribution of fine fraction	Coarse Sand (0.2-2mm)	%	18.9	60.7	34.7	34.6	13
	Fine Sand (0.02-0.2mm)	%	19.5	50.5	36.9	35.5	13
	Silt (0.002-0.02mm)	%	0.6	15.4	5.7	4.8	13
	Clay (<0.002mm)	%	13.5	26.0	21.8	22.6	13

Property	Unit	Min	Max	Mean	Median	n
Coarse fraction (>25mm)	%	3.0	23.0	9.7	9.0	13
Soil texture class	-	LS	CL	-	L	13
Plant Available Water	cm/m soil	4	15	9	9	13
Colour	-	Yellowish red-Dark brown				
Rock Particle Density	g/cm³	-	-	1.8	-	1
Rock Water absorption	%	-	-	31.6	-	1

Notes: Plant Available Water: Adjusted for rock, assuming particles >2mm is diameter do not hold water available to plants. Soil texture class: LS, Loamy sand; SL, Sandy loam; L, Loam; ZL, Silty loam; SCL, Sand clay loam; CL, Clay loam.
Source: Landloch (2013)

Landloch characterisation of OB29 hard cap waste

Property		Unit	OB29 Hard Cap
$pH_{1:5}$		pH Units	7.48
$EC_{1:5}$		dS/m	0.58
Exchangeable cations	Calcium	meq/100g	3.1
	Magnesium	meq/100g	1.4
	Potassium	meq/100g	0.09
	Sodium	meq/100g	0.32
	Aluminium	meq/100g	0.0
	ECEC	meq/100g	4.8
	ESP	%	6.6
Particle size distribution of coarse fraction	Rock (>45mm)	%	16
	Coarse gravel (25-45mm)	%	23
	Gravel (6-25mm)	%	31
	Fine gravel (2-6mm)	%	12
	Fine fraction (<2mm)	%	18
Particle size distribution of fine fraction	Coarse Sand (0.2-2mm)	%	22.6
	Fine Sand (0.02-0.2mm)	%	44.6
	Silt (0.002-0.02mm)	%	9.1
	Clay (<0.002mm)	%	23.7
Coarse fraction (>25mm)		%	39

Notes: Plant Available Water: Adjusted for rock, assuming particles >2mm is diameter do not hold water available to plants. Soil texture class: LS, Loamy sand; SL, Sandy loam; L, Loam; ZL, Silty loam; SCL, Sand clay loam; CL, Clay loam.
Source: Landloch (2013)

Landloch characterisation data for other waste materials from OB29 & OB30

Property		Unit	Min	Max	Mean	Median	n
$pH_{1:5}$		pH Units	7.71	8.6	8.2	8.22	8
$EC_{1:5}$		dS/m	0.04	1.98	0.41	0.11	8
Exchangeable cations	Calcium	meq/100g	0.87	28.3	6.1	3.3	8
	Magnesium	meq/100g	0.3	2.3	1.4	1.2	8
	Potassium	meq/100g	0.06	0.25	0.15	0.14	8
	Sodium	meq/100g	0.07	0.38	0.18	0.16	8
	Aluminium	meq/100g	0	0.02	0.01	0	8
	ECEC	meq/100g	1.86	31.1	7.8	4.6	8
	ESP	%	1.2	10.7	3.6	3	8

Property		Unit	Min	Max	Mean	Median	n
Fertility	Total N	mg/kg	258	393	312	306	8
	Total P	mg/kg	35	734	388	440	8
	Available P	mg/kg	15.9	32.2	25.4	26.4	8
	Available K	mg/kg	94.9	285	157	142	8
	Available S	mg/kg	2.46	514	105	40.4	8
	Organic carbon	%	0.01	0.23	0.04	0.02	8
	Available Cu	mg/kg	0.05	0.21	0.10	0.08	8
	Available Mn	mg/kg	0.42	114	19.7	0.90	8
	Available Zn	mg/kg	0.21	0.98	0.48	0.39	8
Particle size distribution of coarse fraction	Rock (>45mm)	%	0.0	0.0	0.0	0.0	8
	Coarse gravel (25-45mm)	%	3.0	9.0	5.4	5.0	8
	Gravel (6-25mm)	%	24.0	54.0	33.6	30.5	8
	Fine gravel (2-6mm)	%	14.0	20.0	16.9	16.5	8
	Fine fraction (<2mm)	%	30.0	56.0	44.4	44.5	8
Particle size distribution of fine fraction	Coarse Sand (0.2-2mm)	%	12.8	63.1	41.3	46.4	8
	Fine Sand (0.02-0.2mm)	%	20.8	54.2	33.5	30.5	8
	Silt (0.002-0.02mm)	%	0.2	19.6	6.5	0.9	8
	Clay (<0.002mm)	%	12.9	20.8	17.5	18.9	8
Coarse fraction (>25mm)		%	3.0	9.0	5.4	5.0	8
Soil texture class		-	L	ZL	-	ZL	8
Plant Available Water		cm/m soil	2	12	6	4	8
Emerson Index		-	5	6	-	5	8
Colour		-	Brown-Reddish Brown-Black				
Rock Particle Density		g/cm³	-	-	1.6	-	1
Rock Water absorption		%	-	-	17.2	-	1

Notes: Plant Available Water: Adjusted for rock, assuming particles >2mm is diameter do not hold water available to plants. Soil texture class: LS, Loamy sand; SL, Sandy loam; L, Loam; ZL, Silty loam; SCL, Sand clay loam; CL, Clay loam.
Source: Landloch (2013)

Strength

Angle of repose for different material types across BHP's Pilbara operations

Material Type	Angle of Repose (°)
Very fine, leached and highly altered BIF, shales, dolerite and specific sill to clay dominated Detritals units (powder type)	27 - 30
Fine oxidised shale, majority of Tertiary Detritals (except thick clay units), weathered dolerite, denatured and I or lower channel iron deposit (LCID)	34 - 35
Fine and coarse black, fresh, unoxidised shale	35 - 36
Weathered BIF, upper channel Iron deposit (UCID), welded pisolitic Detritals waste	36 - 37
Coarse, angular, competent BIF / slightly weathered BIF and dolerite (waste or ore)	37

Source: AMC (2020)

Strength parameters, typical lift heights vs. FoS for various material types across BHP's Pilbara operations

Material Type	Non-linear shear strength envelope	Typical rock strength (MPa)	Rill Angle Assumption (°)	Approximate life height (m) @ FoS		
				1.20	1.10	1.00
Weathered BIF	$1.5124\sigma_n^{0.8715}$	25	37	55	110	200
		25	36	65	130	<200
Weathered (oxidised) Shale[1]	$1.3259\sigma_n^{0.8613}$	7.50	34	30	55	100
Weathered (oxidised) Shale / Dolerite[2]	$1.2817\sigma_n^{0.8573}$	5	34	20	50	75
Fresh Shale	$1.3986\sigma_n^{0.8663}$	26	36	30	50	110
Detritals Eastern Ridge	$1.2268\sigma_n^{0.8672}$	10	35	15	30	70
OB29 Marra Mamba (Newman and West Angela Members)	$1.2151\sigma_n^{0.8489}$	3	35	12	20	33
Yandi denatured dolerite, Jimblebar 'powder type' materials including oxidised Jeerinah shale, very fine Detritals, alluvium, colluvium	$1.0519\sigma_n^{0.8375}$	<1	<30	10	15	24[3]

Notes:
[1] Mainly Sylvia, Mt McRae, Whaleback Shale, Jeerinah dominated units.
[2] Mainly Yandicoogina Shale, Weeli Wolli Shale / dolerite dominated units.
[3] Based on precedent waste dump experience at Jimblebar.
Source: AMC (2020)

Appendix E. Comparison of PMF with 1 in 10,000-year flood

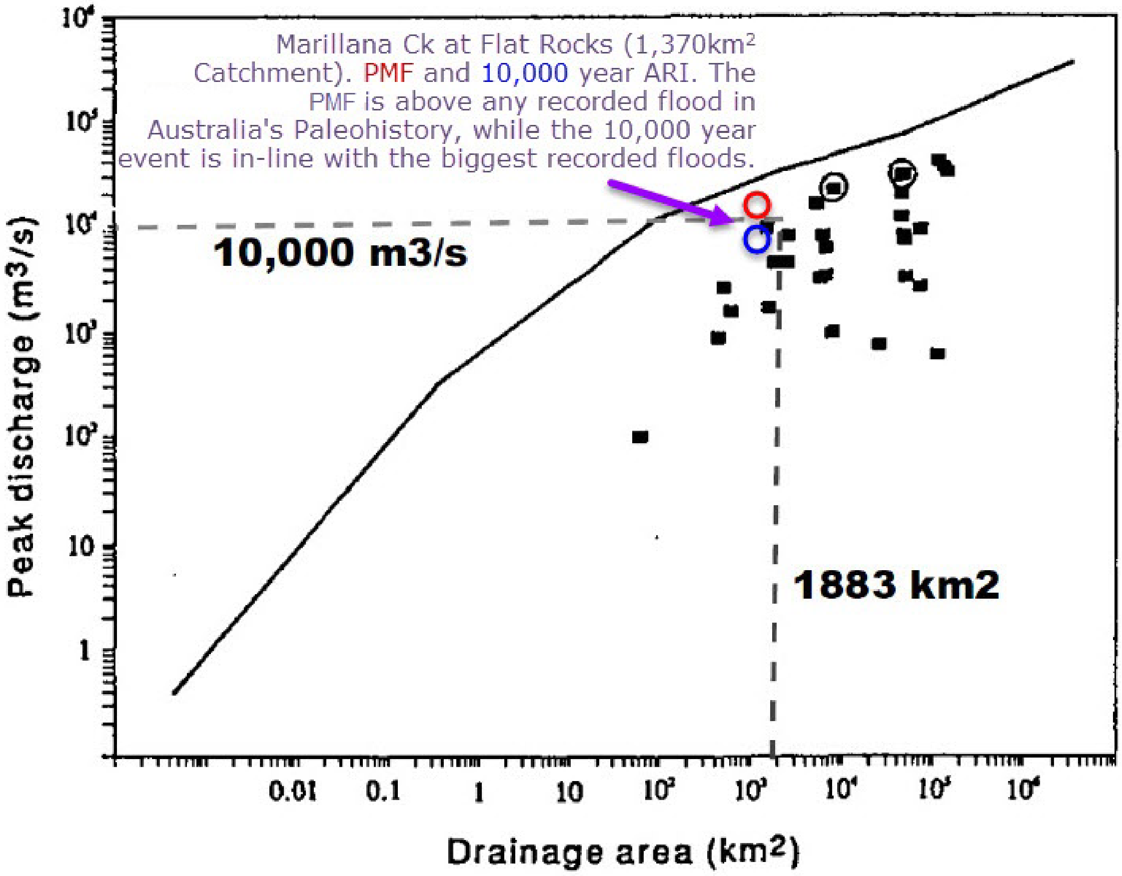


Figure 2.5: Plot of maximum rainfall-runoff floods measured world-wide and in Australia (reproduced from Fig. 5 Wohl et.al 1994). Envelope curve for world floods, shown as solid line, based on data from Costa (1987). Australian data points from Rodier and Roche (1984) and Finlayson and McMahon (1988) represent maximum floods measured in Australia north of 25° South. The largest palaeo-floods in the Fitzroy and Margaret River are circled. The peak discharge for the catchment area of Marillana Creek (1883 km^2) is estimated.

Appendix F. Hydraulic modelling results for Whaleback Creek

F-1. Existing conditions

Peak velocity values extracted from HEC-RAS models for Whaleback Creek

Velocity analysis for the channel cross sectional area (m/s)					
1 in "x" AEP	Maximum	75th Percentile	Average	25th Percentile	Minimum
Upstream Reach					
1 in 2	1.99	1.59	1.46	1.32	0.99
1 in 5	2.34	1.78	1.64	1.50	0.98
1 in 10	2.79	1.96	1.71	1.45	0.92
1 in 20	2.75	1.96	1.64	1.34	0.82
1 in 50	3.08	1.65	1.51	1.17	0.78
1 in 100	2.95	1.66	1.51	1.25	0.94
Pre-diversion (Existing) Reach					
1 in 2	1.90	1.65	1.43	1.25	0.63
1 in 5	2.14	1.86	1.57	1.29	0.75
1 in 10	2.51	1.98	1.59	1.31	0.73
1 in 20	2.93	1.80	1.56	1.13	0.91
1 in 50	2.73	1.79	1.55	1.28	1.03
1 in 100	2.82	1.81	1.62	1.35	1.07
Downstream Reach					
1 in 2	2.16	1.52	1.44	1.28	1.19
1 in 5	2.48	1.85	1.77	1.58	1.49
1 in 10	3.01	2.14	2.02	1.82	1.54
1 in 20	3.47	2.36	2.20	1.87	1.25
1 in 50	3.74	2.67	2.31	1.84	1.26
1 in 100	3.97	2.84	2.35	1.85	1.33

Source: Advisian (2021b)

Peak bed shear values extracted from the HEC-RAS model for Whaleback Creek

Shear analysis for the channel cross sectional area (N/m^2)					
1 in "x" AEP	Maximum	75th Percentile	Average	25th Percentile	Minimum
Upstream Reach					
1 in 2	50.14	29.96	25.36	19.40	12.52
1 in 5	61.27	30.03	26.26	19.36	8.76
1 in 10	74.15	32.47	27.31	19.76	9.18
1 in 20	53.60	29.49	25.11	16.57	9.46
1 in 50	75.08	32.39	25.38	16.71	8.54
1 in 100	82.82	31.60	28.55	19.95	13.40
Pre-diversion (Existing) Reach					
1 in 2	43.91	27.32	22.91	16.50	6.72
1 in 5	49.05	33.55	25.72	18.57	9.01
1 in 10	56.67	32.17	26.42	17.51	7.79

Shear analysis for the channel cross sectional area (N/m^2)					
1 in "x" AEP	Maximum	75th Percentile	Average	25th Percentile	Minimum
1 in 20	64.13	31.56	27.01	17.58	11.76
1 in 50	74.23	33.42	29.93	21.50	15.37
1 in 100	86.86	36.02	34.47	26.86	18.80
Downstream Reach					
1 in 2	72.20	27.59	26.93	20.30	16.93
1 in 5	86.98	40.55	36.75	27.74	21.61
1 in 10	103.28	48.14	43.69	30.70	23.31
1 in 20	102.81	57.74	45.99	29.28	14.90
1 in 50	126.65	71.39	52.13	28.13	18.11
1 in 100	151.64	77.67	55.40	29.24	20.69

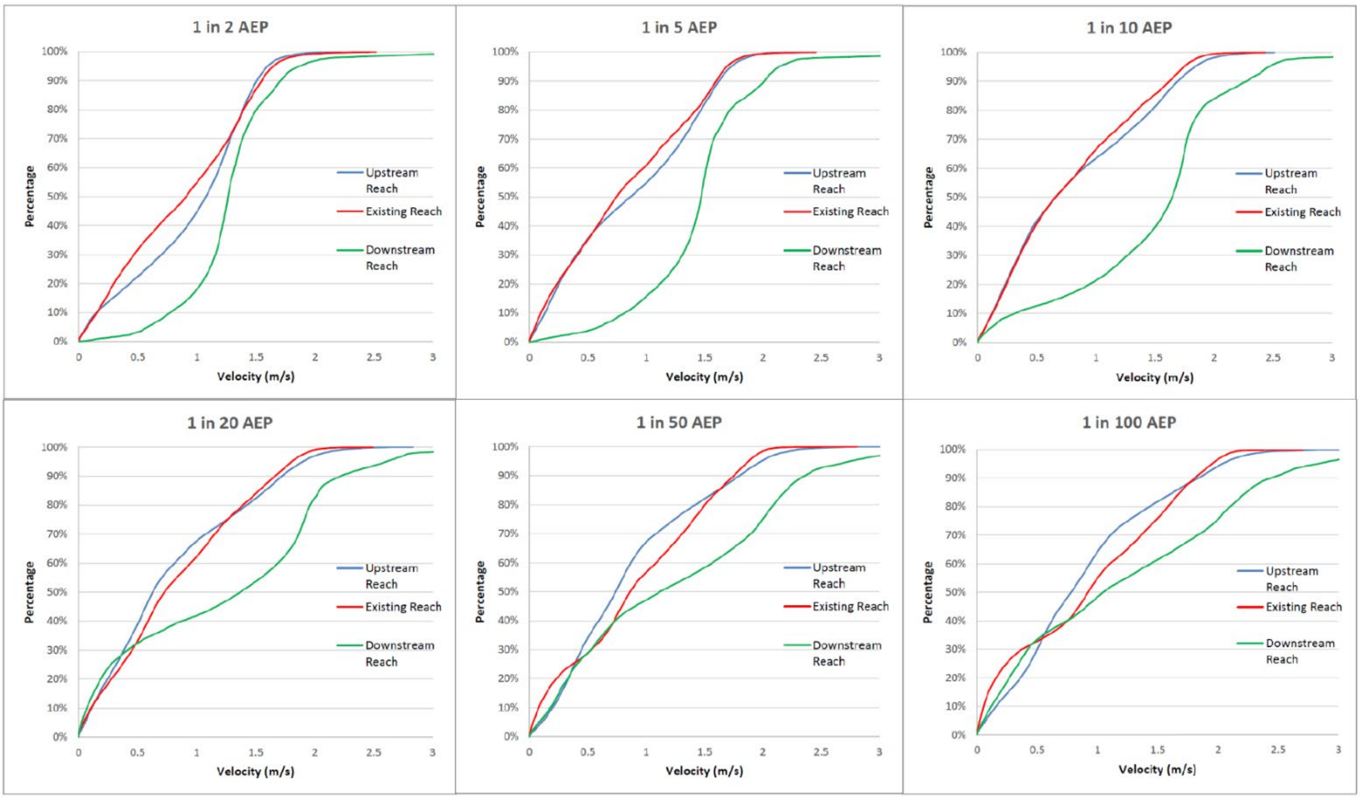
Source: Advisian (2021b)

Peak unit stream power values extracted from the HEC-RAS model for Whaleback Creek

Stream power analysis for the channel cross sectional area (Wm^{-2} or kgs^{-3})					
1 in "x" AEP	Maximum	75th Percentile	Average	25th Percentile	Minimum
Upstream Reach					
1 in 2	99.65	49.56	38.47	25.60	13.16
1 in 5	143.30	51.87	45.23	28.53	8.61
1 in 10	206.59	65.38	50.54	29.18	8.42
1 in 20	147.61	57.69	45.75	21.71	7.74
1 in 50	231.28	50.80	44.15	19.68	6.68
1 in 100	244.46	50.73	47.78	25.95	12.67
Pre-diversion (Existing) Reach					
1 in 2	83.34	44.99	34.92	20.63	4.26
1 in 5	103.66	59.18	43.66	25.50	6.71
1 in 10	139.48	57.66	46.78	25.13	5.68
1 in 20	160.06	60.64	47.34	19.72	10.96
1 in 50	202.29	56.35	50.89	27.84	15.96
1 in 100	245.05	65.57	61.09	36.93	21.57
Downstream Reach					
1 in 2	156.12	41.81	41.60	25.98	20.18
1 in 5	215.71	74.50	69.60	43.72	34.35
1 in 10	310.79	103.92	94.93	56.39	35.84
1 in 20	342.44	148.89	111.31	57.10	18.67
1 in 50	441.81	193.37	138.55	50.83	22.80
1 in 100	602.05	220.70	155.66	54.51	27.54

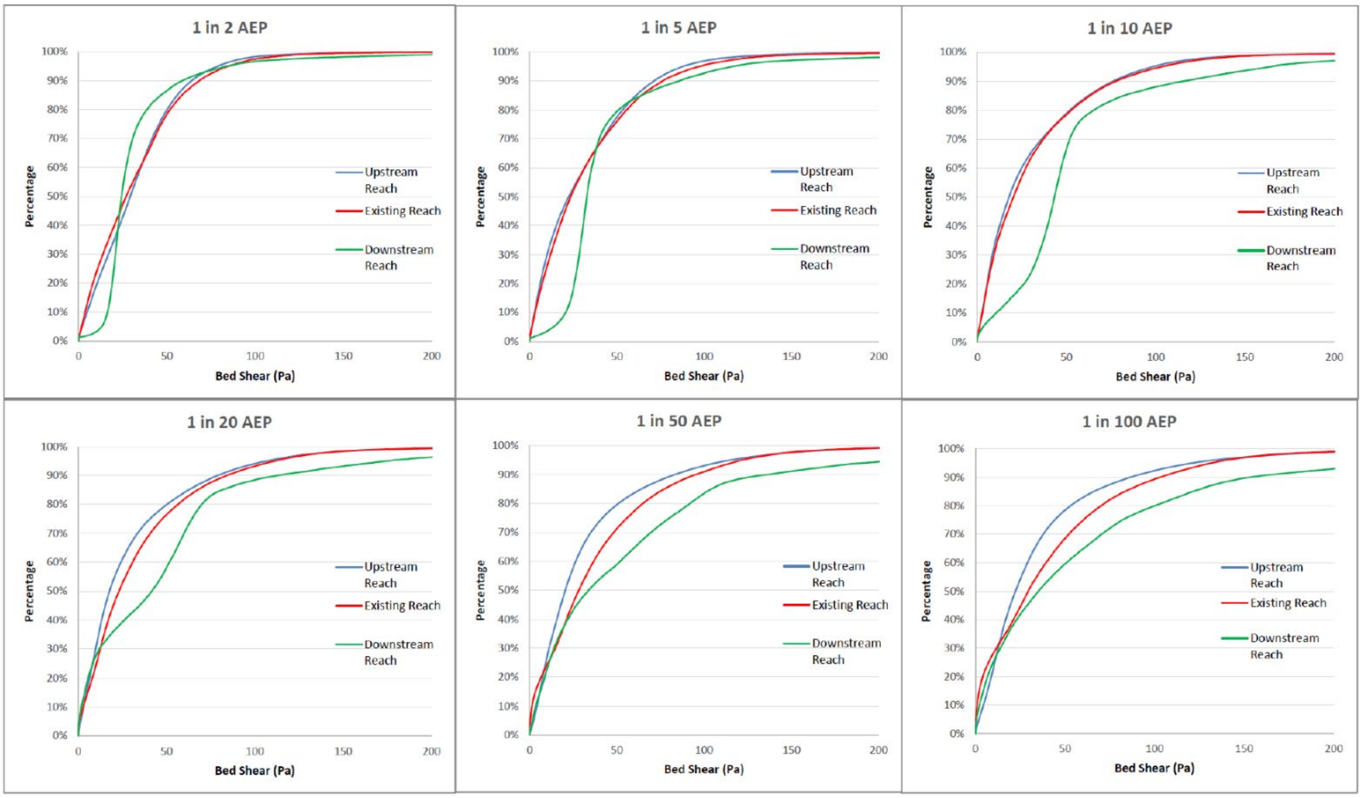
Source: Advisian (2021b)

Peak velocity S-curves derived from 2D hydraulic modelling



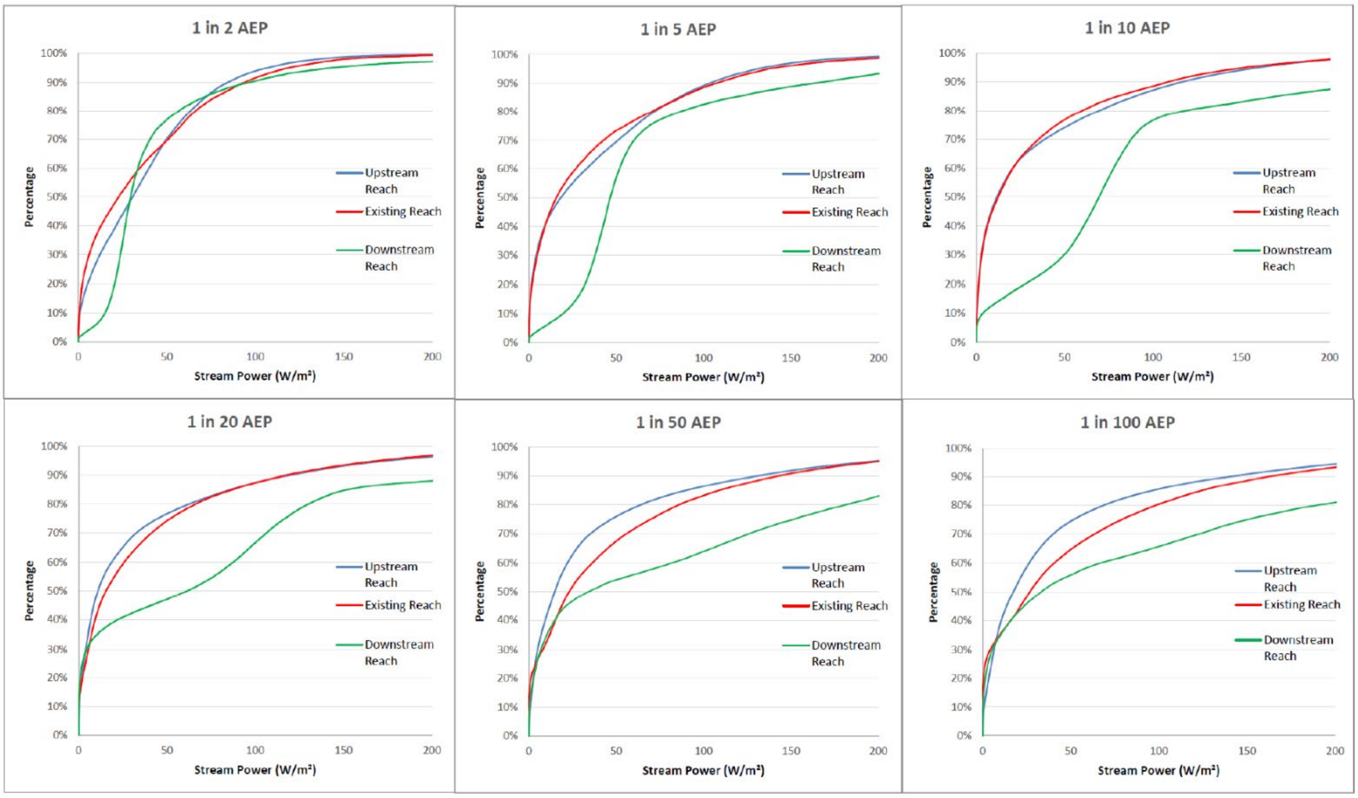
Source: Advisian (2021b)

Peak bed shear S-curves derived from 2D hydraulic modelling results



Source: Advisian (2021b)

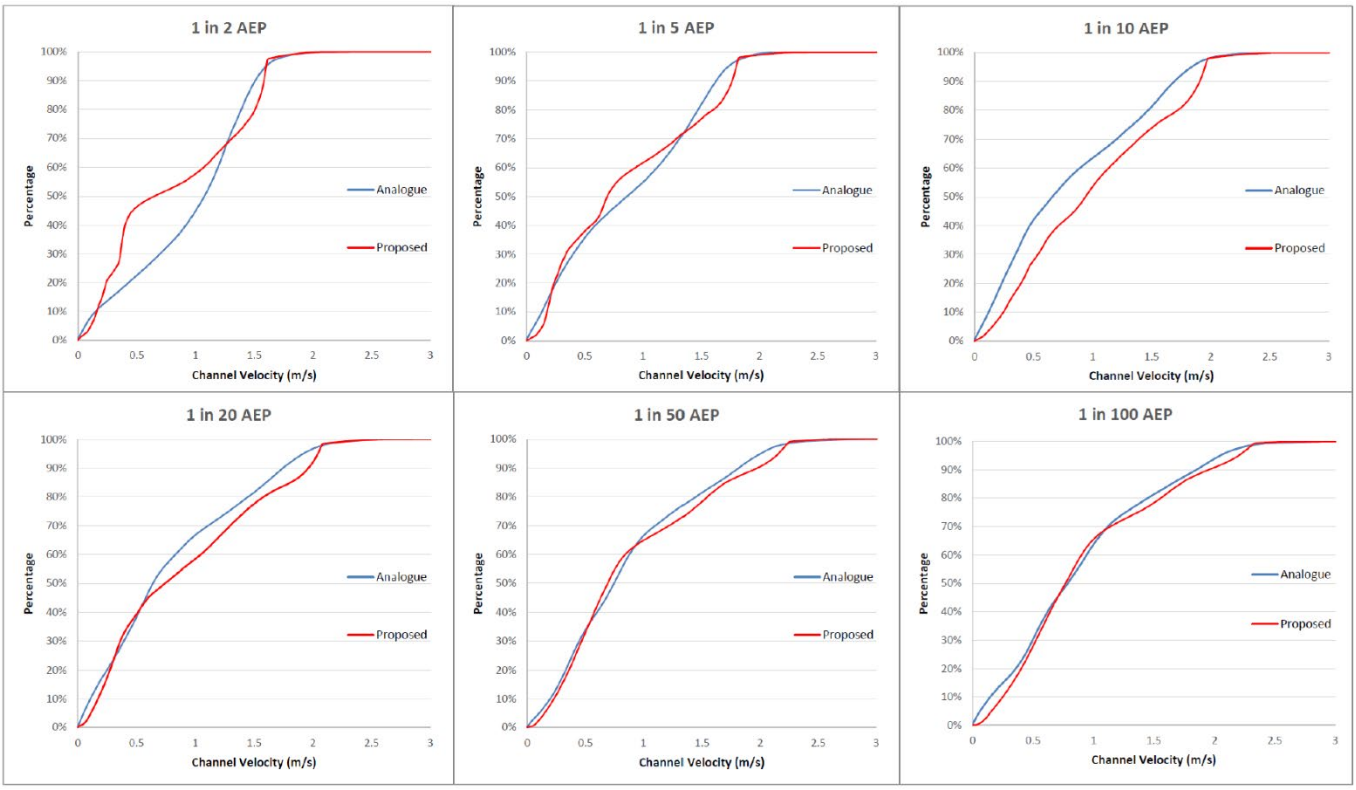
Peak stream power S-curves derived from 2D hydraulic modelling results



Source: Advisian (2021b)

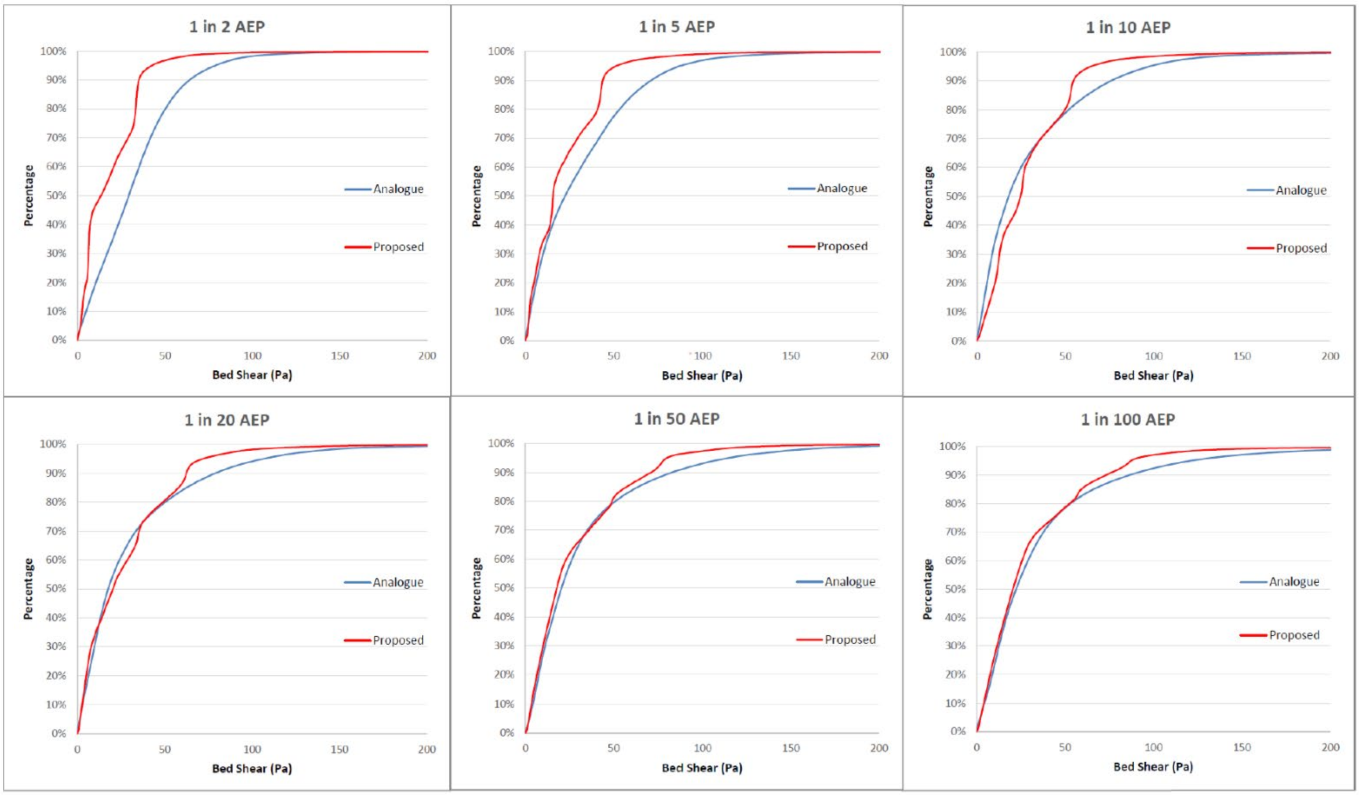
F-2. Performance of initial OB30 closure designs

Peak velocity S-curves derived from 2D hydraulic modelling



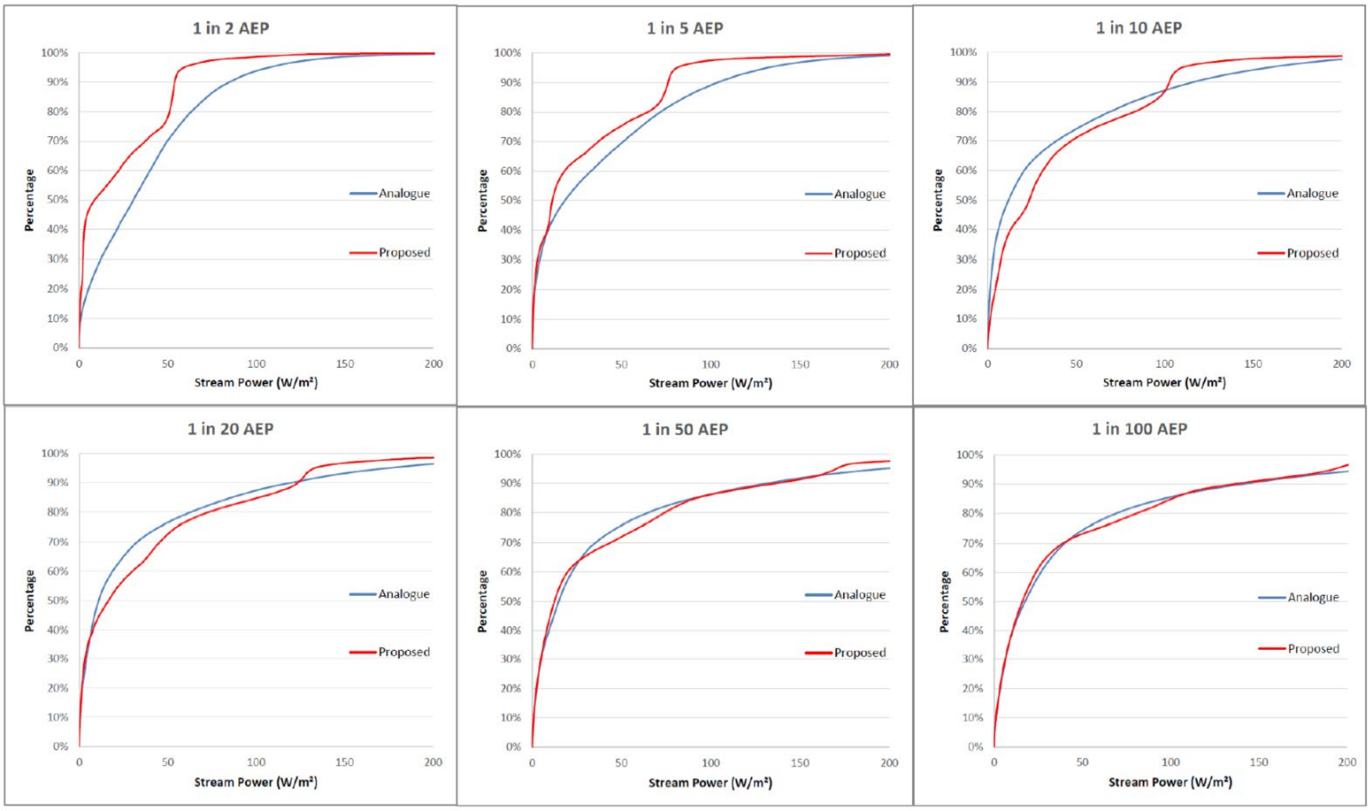
Source: Advisian (2021b)

Peak bed shear S-curves derived from 2D hydraulic modelling results



Source: Advisian (2021b)

Peak stream power S-curves derived from 2D hydraulic modelling results



Source: Advisian (2021b)

Appendix G. WAIO closure and rehabilitation research and trials

This appendix is supplied separately – the information is commercially sensitive and not for public release

Appendix H. Summary of OB35 Creek Diversion Studies

The assessments described below were conducted to support design of OB35 creek diversion, formally known as the Stage 2 of the Southern Creek diversion (see Section 9.2.3.1). Construction of this diversion is now complete.

Hydraulic Modelling

The results of the hydraulic modelling conducted by Tetra Tech Proteus (2020) showed that:

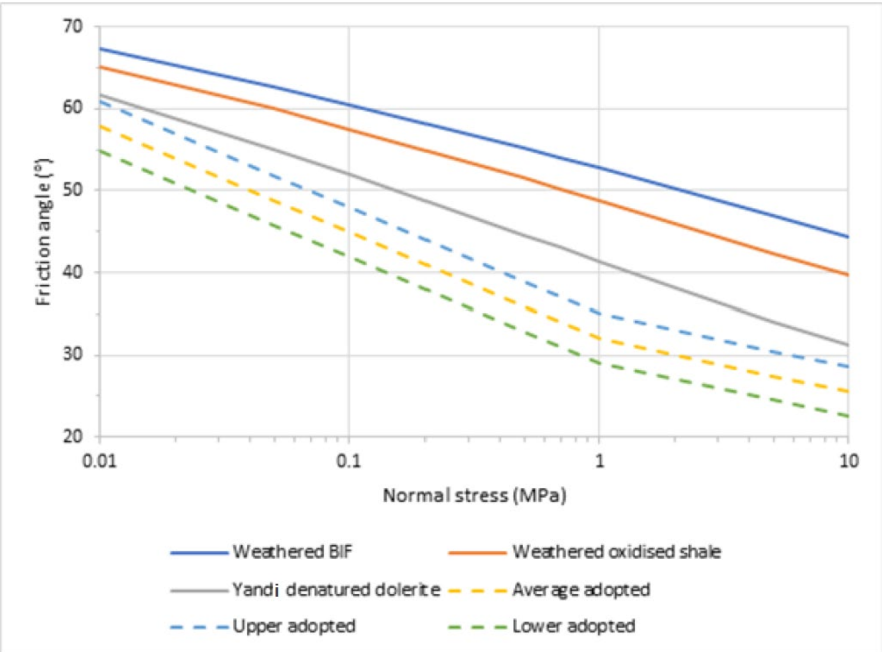
- The 100-year ARI would be conveyed within the channel banks with no breakout flows and a minimum freeboard of 500 mm.
- The maximum flood depth within the diversion channel would be approximately 2 m in a 100-year ARI event and the maximum depth against the bund would be approximately 0.5 m.
- In a 100-year ARI event:
  - Maximum velocities against Bund 1 would be less than 1 m/s and less than 0.5 m/s for Bund 2. Some ponding would occur against the southern side of the bund where the alignment crosses the former channel.
  - At the downstream extent of the diversion, flows would be influenced by backwater conditions in Whaleback Creek. Coincident peak flows would raise water surface elevations by approximately 300 mm at the downstream diversion extent and reduce velocities by approximately 50%.
  - Velocities along the channel approach 2.5 m/s at the channel entrance and in the main low flow channel just upstream of the “land bridge” portion of the alignment. These velocities exceed typical criteria for armour rock, and armour rock aprons have been included in the design to fix the horizontal cross-sectional shape of the channel as well as the longitudinal bed slope.

No planting is proposed within the low-flow channel in order to maintain hydraulic efficiency, however, the establishment of vegetation is encouraged along the floodplain terraces. Terraces are not included in the land bridge reach of the diversion in order to reduce the establishment of vegetation.

Stability & deformation assessment of OB35 ISA

AMC (2020) conducted a stability and deformation assessment of the OB35 ISA which will form the ‘land bridge’ section of the downstream Southern Creek diversion channel. The analysis was conducted using the 3D FE modelling software FLAC3D.

Rockfill materials have a strength envelope and elastic properties dependant on stress levels. The waste materials within the OB35 ISA comprise a mix of materials from different stratigraphic units intersected by the OB35 pit (refer to Section 5.3.1.2). To derive lower and upper bound shear strength envelopes for use in probabilistic analysis, AMC (2020) used recently published data by Ovalle et al (2020) on low to high strength rockfill material. A 10% spread was used. The strength parameters for different materials from BHP’s Pilbara operations are provided in Appendix D-1. A comparison of AMC's proposed strength envelopes with BHP's strength parameters is presented in Figure 14-1. AMC used the 'average' strength envelope, represented by the yellow dashed line, in the deterministic stability assessment. The adopted shear strength parameters for the analysis are lower and, therefore, more conservative than BHP's parameters (Figure 14-1) which was considered appropriate given the uncertainty of the precise mix of materials within the OB35 ISA (AMC, 2020).



Source: AMC (2020)

Figure 14-1 Comparison of strength parameters

The significant factors which may influence the deformation behaviour of the OB35 ISA include (AMC, 2020):

- Degree of compaction of the rockfill. The OB35 ISA has been end tipped with little traffic compaction. However, approximately 30 m of the ISA material must be removed for the diversion channel construction. The remaining in-pit fill thickness is also about 30 m. This material is, therefore, considered preloaded and, as a result, well-compacted with a reduced void ratio.
- Applied stress conditions and stress path.
- Geometric shape that could reduce deformation such as stress reduction due to arching. The narrow mine void might enhance some stress reduction.
- Particle shape and size distribution. The OB35 ISA is likely to consist of all ranges of particle sizes from silt to boulders in a uniform distribution. A low void ratio after initial settlements could, therefore, be expected.
- Intact strength of the rockfill (expected to consist of very weak to strong rocks).
- Wetting and saturation of the rockfill causing collapse deformation. The OB29/30/35 area is subjected to cyclonic rain events.
- Time-dependent creep type deformation.

Settlement

The diversion channel is planned more than 150 m away from the ISA slope face and, therefore, the freedom of lateral deformation will be highly restricted and is considered to be very small (close to zero). This restriction also influences the vertical settlement (AMC, 2020).

Published data indicates that 80% to 90% of the deformation of a rockfill occurs during construction and within three years after construction. The OB35 ISA is approximately three years old and, therefore, may be considered largely settled. In addition, given the pre-loading of the material on which the diversion will be constructed it could be expected that (AMC, 2020):

- There would be a decreased void ratio.
- Most of the perceived settlement would have already taken place.
- Some elastic rebound may occur upon unloading, but this would be negligible.

Time dependent vertical settlement is therefore likely to be very small over a long period of time and have no impact on the diversion channel (AMC, 2020).

Stability analysis

Slope stability assessments were conducted for the following scenarios:

- Reprofiled slope configuration (channel and buttress construction).
- A rise of water table 10 m within the ISA.
- Rapid drawdown of the water level from 566 mRL.

Stability modelling indicated that the reconfigured slope for the construction of the diversion channel would be stable with a Factor of Safety (FoS) of >1.5 and a probability of failure of <5%, for all of the environmental conditions assessed (Table 14-1).

Table 14-1 Stability analysis results

Model	FoS	POF (%)	Comment
Final slope configuration	2.43	0	
14 m rise of water table within ISA (556 mRL)	3.03	0	Passive support from water
Rapid drawdown of water table	1.92	0	Passive support removed, no dissipation of pore pressure

Source: AMC (2020)

Deformation analysis

The potential deformation of the channel along its axis, angular distortion (tilt), and the deflection of the channel gradients were analysed using FE models for the following:

- Rise of the water table to 566 mRL.
- Rapid drawdown of water table from 566 mRL.

Given the conservative design parameters used, the indicative deformations derived from the FE models are likely to be somewhat exaggerated (AMC, 2020) and are discussed below.

The deformations in the water table rise and rapid drawdown scenarios were up to 60 mm and 55 mm, respectively, and AMC (2020) concluded that they would have very little effect on the channel. There would be some potential for very small ponds to develop on the channel surface (permanent deformation) between chainages 150 m to 200 m. However, in AMC's opinion the expected deformation would not be large enough to influence the performance of the channel (obstruct the flow) (AMC, 2020).

Degradation of waste material can be expected over time. It can cause breakage of larger particles enhancing creep. This aspect was modelled by decreasing the deformation modulus by 50% and resulted in very little increase in the expected deformations. AMC (2020) concluded that degradation of waste material would be unlikely to have any adverse effects on the stability of the channel.

Appendix I. Closure risk matrices

Severity matrix (see I-1 for excerpt from BHP's guidance on severity levels)

Severity Level	Descriptor
5	6 or more fatalities or 6 or more life shortening illnesses; or Severe impact to the environment and where recovery of ecosystem function takes 10 years or more; or Severe impact on community lasting more than 12 months or a substantiated human rights violation impacting 6 or more people.
4	1-5 fatalities or 1-5 life shortening illnesses; or Serious impact to the environment, where recovery of ecosystem function takes between 3 and up to 10 years; or Serious impact on community lasting 6-12 months or a substantiated human rights violation impacting 1-5 persons.
3	Life altering or long term/permanent disabling injury or illness to one or more persons; or Substantial impact to the environment, where recovery of ecosystem function takes between 1 and up to 3 years; or Substantial impact on community lasting 2-6 months
2	Non-life altering or short-term disabling injury or illness to one or more persons; or Measurable but limited impact to the environment, where recovery of ecosystem function takes less than 1 year; or Measurable but limited community impact lasting less than one month.
1	Low level impact resulting in first aid only; or Minor, temporary impact to the environment, where the ecosystem recovers with little intervention; or Minor, temporary community impact that recovers with little intervention.

Likelihood Matrix

Uncertainty	Frequency	Likelihood Factor
Highly Likely	Likely to occur within a 1-year period.	3
Likely	Likely to occur within a 1 - 5-year period.	1
Probable	Likely to occur within a 5 - 20-year period.	0.3
Unlikely	Likely to occur within a 20 - 50-year period.	0.1
Highly Unlikely	Not likely to occur within a 50-year period.	0.03

Risk Matrix

I-1. Severity level guidance

This information is supplied separately – the information is commercially sensitive and not for public release

Appendix J. AMD Management TPI

BHP

Acid and Metalliferous Drainage Management

Technical Process Instruction

Document Number: 0096370
Version: 7:0

Document Control

APPROVER	DATE	CUSTODIAN	REVIEW DATE
Manager Closure Planning	July 2022	Specialist GeoEnvironmental – Closure Planning	July 2026

Contents

Electronic Approval Record

Business Role	Name
Author Role	**Name**
Principal GeoEnvironmental – Closure Planning	Marilena Stimpfl
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Document Amendment Record

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6.0		No change	10/08/2021
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Key Stakeholders

Department	Position
HSEC	Manager Environment A&I West Australia
HSEC Environment	Managers Business Partnering HSE
Resource Engineering	Manager Water Planning
Resource Engineering	Superintendents Mine Planning
IPRO	Manager Production Scheduling
Geoscience	Manager Planning and Technical
Geoscience	Manager Resource Delivery
Geoscience	Manager Mine Geology
Geoscience	Manager Heritage
Geoscience	Manager Exploration Operations
Mining	Managers Mining Production

1. Introduction

The BHP WAIO Technical Process Instructions are to enable efficient and consistent routines to be carried out at all WAIO Operations. They are to provide a formal platform to collectively improve upon, capture, endorse and replicate best practice.

1.1. Background

BHP Billiton Iron Ore (BHPBIO) operates mines in the Pilbara of Western Australia that generate mine waste and expose geological surfaces that could result in Acid and Metalliferous Drainage (AMD) if the operations and materials are not properly managed. The AMD Management Standard outlines minimum requirements for consistent and practicable AMD management across all BHPBIO's functions and operations.

AMD includes the release of low pH drainage waters otherwise described as Acid Rock Drainage (ARD) from potentially acid forming (PAF) mine waste or exposed surfaces. It can also include metals release or saline drainage in acidic or non-acidic waters. If improperly managed, AMD can cause environmental impact by altering the quality of surface and groundwater resources which support important environmental receptors.

1.2. Objective

This Technical Process Instruction outlines requirements to ensure that AMD is managed throughout the life of mine from exploration through mine planning, operations and closure to ensure that risks associated with AMD are identified and controlled.

It is acknowledged that BHPBIO is in a transition period to enable all sites (historical and current) to be fully compliant with this Document. However, many of the objectives and requirements are currently being met. This Technical Process Instruction represents a future state with the goal of fully meeting the objectives and requirements through developing and embedding procedures into business as usual activities.

1.3. Scope

This Technical Process Instruction describes AMD management objectives, requirements and supporting documents upon which this document is based.

This document applies to all BHPBIO mining and mining-related activities and facilities and all personnel who are involved with work affecting AMD management. This Technical Process Instruction applies to mine sites in all phases of development which include new mine projects, sustaining mine expansions and replacement ore bodies, and existing mines that have been in operation for many years.

A range of activities by BHPBIO functions and operations will enable effective AMD management. This Technical Process Instruction addresses work performed by HSEC and Planning functions as well as Mines operations. Elements addressed by this document range from waste rock sample collection during site exploration to environmental approvals and compliance, mine waste management planning and implementation, and mine closure. The AMD Management Technical Process Instruction does not preempt established strategies, accountabilities and responsibilities, but it supplements them by defining requirements that deliver consistent AMD management.

Unless otherwise stated, managers with principal responsibility for BHPBIO mining functions and operations are responsible for the communication and implementation of the performance requirements contained in this Technical Process Instruction. A Responsible, Accountable, Consulted and Informed (RACI) matrix is attached as Appendix 1 showing the roles of various functions and operations in complying with the Technical Process Instruction.

Verification of AMD management controls is led by Closure Planning as layered Audits and documented in the Field Leadership Database. The required schedule for completing AMD management control verification for each mining hub is attached as Appendix 2.

2. AMD Management Requirements

The conceptual AMD management process flow is illustrated in Figure 1. The following sections describe the critical objectives and requirements within major components of the process flow. The conceptual process flow consists of sequential requirements during mine planning, development and closure. However, in practice, AMD management (particularly for well-established operations) is iterative with a strong adaptive management approach. For example, the assessment of risks associated with potential AMD sources for a mine site can be revised as new information becomes available with outcomes incorporated into mine plan revisions.

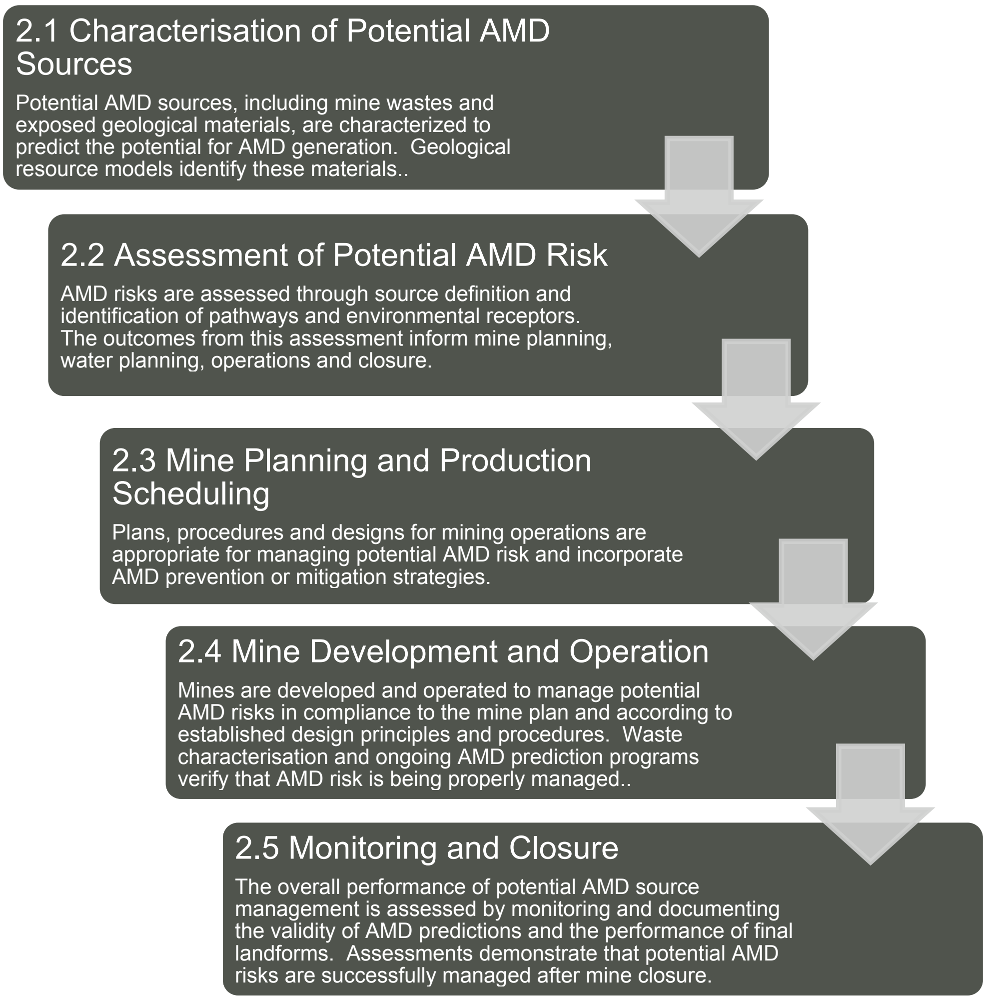


Figure 1: AMD Management process flow

2.1. Characterisation of Potential AMD Sources

Objectives: Planning for AMD management begins during early mine studies. Potential AMD sources, including mine wastes and exposed geological materials, are characterized by conducting appropriate geochemical studies aimed at predicting the potential for AMD generation. Geological resource models identify these materials.

Specific requirements to meet those objectives include:

- Requests for drilling program samples must be made during upfront drill planning and specify the locations and numbers of samples based on an assessment of the proposed drill programs, geological data and available pit shell designs.
- Geochemical baseline studies, including testing of mine waste rock and pit wall rock, must identify the short and long term potential for AMD generation.
- Long duration geochemical testing programs must be established and maintained to support predictions regarding potential AMD generation.
- A comprehensive AMD data management system must be maintained to supplement geological and assay data.
- Geological resource models must include coding for potential AMD source materials.

2.2. Assessment of Potential AMD Risk

Objectives: AMD risks are assessed through source definition (characterization of potential AMD sources), and identification of pathways and environmental receptors. The outcomes from this assessment inform mine planning, water planning, operations and closure.

Specific requirements to meet those objectives include:

- Conceptual site models and preliminary assessments of mine wastes and exposed geological surfaces must provide sufficient information to evaluate Overburden Storage Areas (OSA's) and pit voids as potential AMD sources.
- Formal reviews of risk from potential AMD sources must be conducted based on preliminary evaluations of AMD risk and revised as needed based on new information or changes to mine plans.
- Information and data regarding potential AMD sources (e.g. source terms and processes for potential acid, metals or saline drainage) must be considered in outcome based approaches to protecting environmental receptors and assessing risks to water resources.
- Assessments of risks from potential AMD sources must inform mine Water Planning and operational management and strategy.
- Detailed assessments and refinement of site AMD models, such as additional characterization studies and geochemical modeling, must be completed if warranted based on water management strategies and the potential severity of AMD risk.
- Environmental approval documents and conceptual site closure plans must account for potential AMD risk.

2.3. Mine Planning and Production Scheduling

Objectives: Plans, procedures and designs for mining operations are appropriate for managing potential AMD risk and incorporate AMD prevention or mitigation strategies.

Specific requirements to meet those objectives include:

- Mine plans must estimate the quantity of materials that present potential AMD risk and provide segregation of these materials based on AMD coding in geological resource models.
- Final landform designs for OSAs must be based on design principles that prevent or mitigate AMD risk. Mine pit designs and waste scheduling must consider avoidance of potential AMD sources.

- Plans for mine waste testing must be appropriate for the level of the potential AMD risk and the scale of the operation.

2.4. Mine Development and Operation

Objectives: Mines are developed and operated to manage potential AMD risks in compliance to the mine plan and according to established design principles and procedures. Waste characterisation and ongoing AMD prediction programs verify that AMD risk is being properly managed.

Specific requirements to meet those objectives include:

- Operational procedures must support the execution of AMD management according to the mine plans. This includes testing, tracking, verifying and reporting potential AMD source material classification, movement and placement.
- Mine waste testing results must inform medium and short term planning and provide input to change management if testing demonstrates that the current mine plan could result in unacceptable risks.

2.5. Monitoring and Closure

Objectives: The overall performance of potential AMD source management is assessed by monitoring and documenting the validity of AMD predictions and the performance of final landforms. Assessments demonstrate that potential AMD risks are successfully managed after mine closure.

Specific requirements to meet those objectives include:

- If AMD risks have been identified, surface and groundwater quality must be monitored according to water management strategies throughout mine operation and into the post closure period to assess the effectiveness of AMD source management.
- AMD assessment programs must continue throughout mine operation to confirm predictions regarding AMD potential, and the site AMD model must be updated as appropriate based on new information to inform operational and water management strategies.
- Where adaptive management is required due to unacceptable testing or monitoring results, AMD management procedures must be revised to address any changes in AMD risk.

3. Definitions and Abbreviations

Term	Description
ARD	Acid Rock Drainage; release of low pH drainage waters resulting from the oxidation of sulphide bearing rocks.
AMD	Acid & Metalliferous Drainage includes ARD, metals or saline drainage in low or neutral drainage waters from mining processes.
GARD	Guide for Acid Rock Drainage
HSEC	Health safety Environment and Community
INAP	International Network for Acid Prevention
OSA	Overburden Storage Area
PAF	Potential Acid Forming; sulphide bearing rock types (e.g., pyrite) having the potential to oxidise upon exposure to air/water and result in acid formation.

4. Supporting Documents

The BHPB Iron Ore AMD Management Standard is informed by and consistent with a set of internal corporate, regulatory and industry standards, principles and guidelines.

External

- Department of Industry Tourism and Resources (2007) Managing Acid and Metalliferous Drainage — Leading Practice Sustainable Development Program for the Mining Industry. Department of Industry, Tourism and Resources, Canberra.
- The Global Acid Rock Drainage (GARD) Guide, May 2012, developed by the International Network of Acid Prevention (INAP).
- Department of Mines and Petroleum/Environmental Protection Authority (2011) Guidelines for Preparing Mine Closure Plans 2011.
- ANZECC/ARMCANZ, 2000, Australian Water Quality Guidelines for Fresh and Marine Waters, Australia and New Zealand Environment and Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand, Canberra.
- Australian Government, 2000, Environment Protection and Biodiversity Conservation Act (EPBC Act).
- Other State and Federal Acts and Policy Statements.

Internal

BHP Billiton's commitments to effective management of mine waste to prevent or mitigate environmental impacts exist within the BHP Billiton Charter, the BHP Billiton Group Level Documents (GLD's), BHPB Billiton Iron Ore standards and the references cited in these documents.

- Our Requirements, specifically Closure, Environment and Climate Change, and Risk Management
- BHP Billiton Charter
- Minerals Australia Closure Planning Standard (August 2017)
- Mine Geology Standard (2014)
- Exploration Standard (2014)
- Mine Planning Standard (2011)
- Pilbara Water Resource Management Strategy (2014)
- Rehabilitation Standards (2016)
- Procedure for Completing Preliminary AMD Risk Assessments (2017)
- Prioritisation of AMD Research and Development Opportunities (2017)
- Standard Operating Procedure for AMD Sample Selection, Collection and Data Management
- Mines Closure Design Guidance (2017)

5. Appendices

5.1. AMD Management RACI

Geoscience & Exploration: [1] Planning & Technical, [2] Resource Delivery, [3] Mining Geology, [4] Heritage, [5] Exploration Operations

HSE: [6] Business Partnering WAIO, [7] Business Partnering Biodiversity, [8] A&I Environment

R Responsible
A Accountable
C Consulted
I Informed

	Resource Engineering	Resource Engineering	Resource Engineering	Geoscience & Exploration	IPRO	Mining Operations	HSE	Comments
AMD Standard Requirements and Process Activities	Closure Planning	Mine Planning	Water Planning	See teams listed above	Production Scheduling	Mining Production	See teams listed above	
Characterisation of Potential AMD Sources								**See SOP for AMD Sample Selection, Collection and Data Management (Controlled Document 0120105).**
Requirement 1: Collect Geological Samples								
Provide Guidance for AMD Sample Collection	A R			C [1,3]				
Plan for AMD Sample Collection, collect and assay Geological Samples including samples requested by Closure Planning	C			A [1,5] R [1,5]				**G&E Planning and Technical plan for sampling, Exploration Operations collects samples.**
Collect and assay Geological Samples including samples requested by Closure Planning, determine AMD classification	C			A [3] R [3]				
Coordinate AMD sample analysis and data reporting	A R			I [1,3]				**Data Management in G&E Planning & Technical**
Requirement 2: Conduct Geochemical Baseline Studies								
Prepare Geochemical Study Plans and complete studies.	A R	C I	C I	C [1] I [1]	I		C [6] I [6]	**Consultation and informing depends on the nature and scope of the study.**

	Resource Engineering	Resource Engineering	Resource Engineering	Geoscience & Exploration	IPRO	Mining Operations	HSE	Comments
AMD Standard Requirements and Process Activities	Closure Planning	Mine Planning	Water Planning	See teams listed above	Production Scheduling	Mining Production	See teams listed above	
Requirement 3: Conduct Advanced (Long Duration Kinetic, Detailed Static) Geochemical Testing								
Prepare Geochemical Study Plans and complete studies.	A R	C I	C I	C[1] I[1]	I		C[6] I[6]	Consultation and informing depends on the nature and scope of the study.
Requirement 4: Manage Geological Sample AMD Data								
Provide Guidance for AMD Data Management	A R			C[1]				
Manage Geological sample AMD Data in GBIS	C			A[1] R[1]				
Manage Data not compatible with GBIS	A R			C[3]				Currently, Mine Geology AMD data cannot be managed in GBIS or Blast Holes.
Requirement 5: Prepare Resource Models and STGMs with AMD Coding								
Provide guidance on waste coding for PAF and other potential AMD risk in Resource Models	A R	I		C[2] I[1]	I			
Prepare and document resource models with AMD coding	C	I		A[2] R[2] I[3]	I			Coding in Resource Models flows through Mining Models, STGMs and Grade Control

	Resource Engineering	Resource Engineering	Resource Engineering	Geoscience & Exploration	IPRO	Mining Operations	HSE	Comments
AMD Standard Requirements and Process Activities	Closure Planning	Mine Planning	Water Planning	See teams listed above	Production Scheduling	Mining Production	See teams listed above	
Assessment of Potential AMD Risk								
Requirement 1: Prepare Conceptual Site Models and Conduct Preliminary Risk Assessments for AMD								See Procedure for Conducting Preliminary AMD Risk assessments (Controlled Document in preparation).
Provide data and interpretations regarding: Geological data and resource models	C I			A [2] R [2]				
Provide data and interpretations regarding: Mine Planning data, models and designs	C I	A R						
Provide data and interpretations regarding: Water Resource Risks (Pathways and Receptors), hydrological data and models	C I		A R					
Provide data and interpretations regarding: Heritage Receptors	C I			A [4] R [4]			-	
Provide data and interpretations regarding: Ecological Receptors							A [7] R [7]	
Provide data and interpretations regarding: Environmental and monitoring data	C I						A [6] R [6]	
Complete AMD Source Assessment	A R			C [2]				
Participate in AMD Risk Assessment Workshop	A R	R	R	R [4]			R [6,7,8]	
Document Conceptual Site Models for AMD and Preliminary AMD Risk Assessments	A R	I	I		I		I [6,8]	
Requirement 2: Conduct Risk Reviews								
Conduct Risk Reviews and complete Risk Registers related to AMD for Closure Planning	A R	I	C		I		I [6]	Resource Engineering owns the overall WAIO risk for AMD
Conduct Risk Reviews and complete Risk Registers related to AMD for Mines Operations	C	I	C		C	A R	C [6,8]	Mines Operations owns the risk for AMD controls

	Resource Engineering	Resource Engineering	Resource Engineering	Geoscience & Exploration	IPRO	Mining Operations	HSE	Comments
AMD Standard Requirements and Process Activities	Closure Planning	Mine Planning	Water Planning	See teams listed above	Production Scheduling	Mining Production	See teams listed above	
Requirement 3: Use Outcome Based Approaches								
No specific tasks related to this requirement as the requirement is addressed in other tasks.								
Requirement 4: Prepare and Implement Water Management Strategies that Account for AMD Risk								
Provide guidance on potential AMD risks	A R		C		I		C [6]	
Prepare water management strategies that account for Potential AMD Risk	C		A R		C		C [6]	
Requirement 5: Complete Detailed AMD Assessments and Modelling								
Assess the need for Detailed AMD Risk Assessments and Modelling, prepare plans and conduct assessments.	A R		C		C		C [6]	Hydrology responsible for hydrological aspects of Hydro-Geochemical modelling
Prepare plans for detailed AMD Assessments, possibly including Hydro Geochemical modelling	A R		R		C		C [6]	Hydrology responsible for hydrological aspects of Hydro-Geochemical modelling
Conduct detailed assessments and prepare refined site AMD models	A R		R		C		C [6]	
Requirement 6: Prepare Environmental Approvals Documents and Closure Plans that Account for Potential AMD Risk								
Prepare Environmental Approvals documents that require assessment of AMD risk and management	C	C	C		C		A [8] R [8]	
Prepare Closure Plans that include assessment of AMD risk and management	A R	C	C		C		C [6,7,8]	

	Resource Engineering	Resource Engineering	Resource Engineering	Geoscience & Exploration	IPRO	Mining Operations	HSE	Comments
AMD Standard Requirements and Process Activities	Closure Planning	Mine Planning	Water Planning	See teams listed above	Production Scheduling	Mining Production	See teams listed above	
Mine Planning and Production Scheduling for AMD Management								See Mines Closure Design Guidance Procedure (Controlled Document 0128030).
Requirements 1 and 2: Prepare Mine Plans (schedule and designs) that Account for Potential AMD Risk								
Provide Resource Models and STGMs with AMD Coding	C	C		A [2] R [2]	C			
Prepare Mining Models with AMD coding	C	A R						
Prepare STGMs/STPMs with AMD coding	C			A [2] R [2]				
Prepare short term schedules with AMD coding	C				A R			
Provide guidance to address potential AMD Risks for OSA and pit designs and waste scheduling.	A R	C					I [6,7,8]	
Prepare mine designs and long term waste schedules consistent with guidance.	C	A R	C		C	C	I [6,7,8]	Waste scheduling and pit designs must consider avoidance of potential AMD sources, proper management of mined waste and water strategy.
Prepare short term scheduling for waste placement consistent with long term plans and schedules.	C	C			A R	C		Additional design work may be needed to comply with long term designs.
Prepare site specific AMD testing plans as required by operations	C	C		A [3] R [3]	C			Plans should include procedures for mine waste testing to verify potential AMD source material classification.
Requirement 2: Prepare Landform Designs that Account for Potential AMD Risk								
Provide design guidance to Mine Planning on designs to address potential AMD Risks.	A R	C	I		C		I [6,7,8]	
Prepare designs consistent with design guidance.	C	A R	I		C		I [6,7,8]	

	Resource Engineering	Resource Engineering	Resource Engineering	Geoscience & Exploration	IPRO	Mining Operations	HSE	Comments
AMD Standard Requirements and Process Activities	Closure Planning	Mine Planning	Water Planning	See teams listed above	Production Scheduling	Mining Production	See teams listed above	
Mine Development and Operation for AMD Management								
Requirement 1: Monitor compliance to plan for potential AMD source material								
Develop, implement and maintain process to execute required design and schedule with AMD control verification.	C	C		C [3]	C	A R		A and R sit with the Mining Managers as their teams execute the plan and schedule.
Requirement 2: Conduct testing and revise mine plans as needed								Mine waste testing results must inform Production Scheduling and provide input to change management if testing demonstrates that the current mine plan could result in unacceptable risks.
Conduct mine waste testing according to plan.	C	I		A [3] R [3]	C			Assay testing of grade control and blast hole samples of waste
Review mine waste testing results and inform Closure Planning if inconsistent with block modelling predictions.	I			A [3] R [3]	C			
Prepare revised mine plans and designs if warranted by AMD testing.	C	A R			C			

	Resource Engineering	Resource Engineering	Resource Engineering	Geoscience & Exploration	IPRO	Mining Operations	HSE	Comments
AMD Standard Requirements and Process Activities	Closure Planning	Mine Planning	Water Planning	See teams listed above	Production Scheduling	Mining Production	See teams listed above	
Monitoring and Closure for AMD Management								
Requirement 1: Monitor to assess the effectiveness of AMD source management								See Closure Planning memornadum dated 26 May 2016 for Guidance on AMD Water Quality Monitoring.
Conduct AMD Geochemical testing, as appropriate based on risk, as described for other requirements.	A R				I			
Prepare monitoring plans and conduct surface water and groundwater quality monitoring for AMD impacts.	C		A R		C		I	For montoring conducted under Water Planning programs.
Prepare monitoring plans and conduct surface water and groundwater quality monitoring for AMD impacts.			I		C		A[6] R[6]	For montoring conducted under HSE Business Partnering programs.
Requirement 2: Continue AMD assessments throughout operation and update the site AMD model as appropriate								
Review AMD testing data to assess the validity of predictions and effectiveness of AMD management.	A R		I	I[3]	I		I[6]	Assess whether results meet Closure Plan criteria.
Update Closure Risk Registers based on new information regarding AMD risk.	A R		C				C[6,8]	
Update site Risk Registers based on new information regarding AMD risk.	C		C	C[3]	C	A R	C[6]	
Requirement 3: Revise AMD management procedures in response to unacceptable testing and monitoring results								
Review mine plans, considering current AMD risk predictions, and recommend changes if appropriate.	A R	C	C		C			
Prepare recommendations to revise mine plans for operating mines, if warranted.	A R	C	C		C			
Revise Closure Plan if warranted based on changes in predicted AMD risk.	A R	C	C				C[6,8]	
Prepare revised mine plans if warranted based on AMD monitoring data and revised assessments of AMD risk.	C	A R			C			

5.2. Appendix 2 – Control Verification Schedule for AMD Management

Current Risk Ranking and Control Verification Schedule for BHP Billiton Iron Ore Mine Sites

Mine Area	Currently or within 1 year managing AMD 1 (PAF)?>	Currently or within 1 year managing AMD 2 or 3?	Currently or within 1 year generating acidic water requiring management?	Detailed PAF and AMD management plans in place?	Current overall relative AMD Risk	Frequency for AMD Management Control Verification
Mt Whaleback	Yes	Yes	Yes	Yes	High	12 months
Eastern Ridge	Yes	Yes	Yes	Yes	High	12 months
OB 18	Yes	Yes	Yes	Yes for PAF No for AMD	High	12 months
Jimblebar	Yes	Yes	No	Yes for PAF No for AMD	Moderate	18 months
Mining Area C	No	Yes	No	No	Moderate	18 months
Yandi	No	No	No	No	Low	24 months

Appendix K. Seed list

Common species used in rehabilitation at OB29/30/35

Derived from baseline surveys. Species planted in each rehabilitation area may vary according to seed availability and include other (less common) species identified during baseline surveys

Domain	OSA			Infrastructure	Road / rail / corridors	TSF	Mine Pit		
Landform	Lower Slope /Plains	Mid Slope	Crest/Mesa	Lower Slope /Plains	Lower Slope /Plains	Lowlying floodplain	Lowlying floodplain	Major drainage line / Creek	Escarpment / steep slope into pit
Community	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Themeda Tussock Grassland / Triodia Tusscok Grassland	Themeda Tussock Grassland / Triodia Tusscok Grassland	Themeda Tussock Grassland	Triodia Hummock / Open Hummock Grassland / Low Acacia Woodland
Species (Nyiyaparli name)									
Acacia acradenia		P (1-20)	P (1-20)						P (1-20)
Acacia adoxa var. adoxa	P	P		P	P				
Acacia aptaneura (Wirntamarra) (highlighted)		P (1-20)	P (1-20)			P (1-20)	P (1-20)	P (1-20)	
Acacia bivenosa (Morulba; Moorubah) (highlighted)	P (1-20)	P (1-20)	P	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)
Acacia citrinoviridis (Catagurra; Kootagurra) (highlighted)						P	P	P (1-20)	
Acacia dictyophleba			P						
Acacia hamersleyensis		P	P						
Acacia inaequilatera (Partirri) (highlighted)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)				P (1-20)
Acacia maitlandii	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)				P (1-20)
Acacia paraneura						P (1-20)	P (1-20)		
Acacia pruinocarpa (Pulartu) (highlighted)	P	P (1-20)	P (1-20)	P	P				P (1-20)
Acacia pyrifolia (Munturru) (highlighted)	P		P	P	P	P	P	P (1-20)	
Acacia rhodophloia (Marntarru) (highlighted)		P	P						P (1-20)
Acacia synchronicia (Yarrkurtu) (highlighted)	P (1-20)	P		P (1-20)	P (1-20)	P (1-20)	P (1-20)	P	
Acacia tenuissima	P (1-20)	P		P (1-20)	P (1-20)				
Acacia tetragonophylla (Kurarra) (highlighted)	P	P		P	P	P (1-20)	P (1-20)	P	
Aristida contorta	P	P	P	P	P				
Bonamia rosea	P			P	P				
Corchorus lasiocarpus subsp. lasiocarpus			P						
Corymbia hamersleyana (Parlkarri) (highlighted)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)
Cymbopogon ambiguus (Lemon Grass) (highlighted)	P	P		P	P			P	
Dodonaea coriacea	P	P	P	P	P				P
Enneapogon caerulescens	P	P	P	P	P				P
Enneapogon cylindricus	P	P		P	P				P
Enneapogon lindleyanus		P	P						
Eragrostis cumingii		P	P						P
Eremophila cuneifolia						P	P		
Eremophila fraseri subsp. Fraseri (Burra) (highlighted)	P	P (1-20)	P (1-20)	P	P				
Eremophila jucunda subsp. pulcherrima	P (1-20)	P (1-20)		P (1-20)	P (1-20)				
Eremophila longifolia						P (1-20)	P (1-20)	P (1-20)	
Eremophila platycalyx subsp. pardalota		P (1-20)	P (1-20)						
Eriachne helmsii		P	P						
Eriachne mucronata	P	P		P	P				P
Eriachne pulchella subsp. pulchella	P	P		P	P				P
Eriachne tenuiculmis								P (41-60)	
Eucalyptus camaldulensis subsp. Refulgens (Wurrangkura) (highlighted)								P (1-20)	
Eucalyptus gamophylla	P (1-20)			P (1-20)	P (1-20)				
Eucalyptus leucophloia subsp. Leucophloia (Malykan) (highlighted)	P (1-20)	P (1-20)	P (1-20)	P (1-20)	P (1-20)				P (1-20)
Eucalyptus socialis subsp. eucentrica	P (1-20)			P (1-20)	P (1-20)				

Highlighted species of significance to Nyiyaparli people*

Approx %Cover	
<1	P
1-20	P
21-40	P
41- 60	P
61-80	P
>80	P

Domain	OSA			Infrastructure	Road / rail / corridors	TSF	Mine Pit		
Landform	Lower Slope /Plains	Mid Slope	Crest/Mesa	Lower Slope /Plains	Lower Slope /Plains	Lowlying floodplain	Lowlying floodplain	Major drainage line / Creek	Escarpment / steep slope into pit
Community	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Triodia Hummock Grassland to Open Grassland	Themeda Tussock Grassland / Triodia Tusscok Grassland	Themeda Tussock Grassland / Triodia Tusscok Grassland	Themeda Tussock Grassland	Triodia Hummock / Open Hummock Grassland / Low Acacia Woodland
Species (Nyiyaparli name)									
Eucalyptus victrix (Piyarrpa)								P	
Euphorbia australis	P			P	P				
Evolvulus alsinoides var. decumbens	P			P	P				
Gompholobium oreophilum		P	P						
Goodenia stobbsiana	P			P	P				
Gossypium robinsonii (Ngurtaya)	P			P	P				
Hakea chordophylla		P	P						P
Hakea lorea subsp. Lorea (Kartanypa)		P	P			P	P		P
Indigofera monophylla	P	P	P	P	P				
Maireana georgei						P	P		
Maireana triptera						P	P		
Melaleuca glomerata (Jalkupurta)								P	
Paraneurachne muelleri	P	P	P	P	P				P
Petalostylis labicheoides	P			P	P			P	
Ptilotus astrolasius	P	P		P	P				
Ptilotus obovatus	P	P		P	P				
Ptilotus rotundifolius		P	P						P
Santalum lanceolatum (Nyumaru)								P	
Senna glutinosa subsp. glutinosa	P	P	P	P	P	P	P	P	P
Senna glutinosa subsp. pruinosa	P	P		P	P				
Senna glutinosa subsp. Luerssenii		P	P						P
Themeda triandra	P	P		P	P	P	P	P	
Tribulus suberosus (Gawiwarnda)	P	P		P	P				
Triodia sp. Shovelanna Hill (S. Leeuwen 3835) (Paru)		P	P						P
Triodia angusta (Paru)	P			P	P				
Triodia basedowii (Paru)									
Triodia brizoides (Paru)	P	P	P	P	P				P
Triodia epactia (Paru)	P	P		P	P				
Triodia pungens (Paru)	P	P	P	P	P	P	P		P
Triodia wiseana (Paru)	P	P	P	P	P				P

Highlighted species of significance to Nyiyaparli people*

Approx %Cover	
<1	P
1-20	P
21-40	P
41- 60	P
61-80	P
>80	P

*Sources KNAC (2023) Nyiyaparli People & Country Plan. Fortescue Marsh. 2023 - 2032; BHP Ethnobotanical Species Database (2023)

Appendix L. Rehabilitation Monitoring TPI

BHP

Rehabilitation Monitoring

Technical Process Instruction

Document number: SPR-IEN-LAND-012
Version: 7.0

Document Control

APPROVER	DATE	CUSTODIAN	REVIEW DATE
Manager Environment Sustainability	**March 2024**	**Superintendent Contamination and Rehabilitation**	**March 2028**

Contents

Electronic Approval Record

Business Role	Name
Author Role	**Name**
Principal Rehabilitation	Andrew Blackburn
Reviewer Role	**Name**
Specialist Rehabilitation	Emma Stock
Approver Role	**Name**
Superintendent Rehabilitation and Contaminated Sites	Tony Webster

Document Amendment Record

Version. No	Page Number	Change Effected	Date of Change
1.0	All	New document superseding WIN-ENV-LAND NW-03	21/01/2011
2.0	All	Revised document	01/10/2012
3.0	13-14	Revised document	02/09/2014
4.0	All	Document review & update	28/10/2017
5.0			December 2019
6.0	All	Document updated to new document type- TPI as per MOCWAIO025628	Aug 2022
7.0	All	New monitoring methodology and schedule	March 2024

Key Stakeholders

Department	Position
HSE	Manger Environment Sustainability
Improvement and Operational Readiness	Manager Improvement and Operational Readiness
HSE	Manager Environment Approvals and Biodiversity

1. Introduction

1.1. Background

This document outlines the rehabilitation monitoring procedures employed at BHP Western Australia Iron Ore (BHPWAIO) rehabilitation sites. It is to be provided to WAIO staff and external consultants engaged to conduct rehabilitation monitoring on behalf of WAIO.

1.2. Objective

The objective is to provide guidance on the methodologies and monitoring schedule to be used, and under which circumstances they apply. The results from this monitoring data will be compared against the WAIO Rehabilitation Criteria Workbook (2023) targets to determine when a rehabilitated site has reached acceptable levels of vegetation development. The results of the rehabilitation monitoring program are also to be used to identify sites which may be at risk of not achieving the Ecological Rehabilitation Criteria, and for which additional investigation and management intervention may be required.

1.3. Scope

This document provides an overview of the methods and monitoring schedule used to prepare and collect monitoring data on rehabilitated sites across BHPWAIO's operations. The process used to assess the data collected against Ecological Rehabilitation Criteria is currently under development and will be included in the next version of this document. BHP is in the process of reviewing its rehabilitation monitoring to determine how fauna use of rehabilitated areas can be integrated into the monitoring program.

2. Process

Rehabilitation monitoring at WAIO sites is completed using a combination of the following methods consistent with BHP WAIO Rehabilitation Criteria Workbook (Syrinx, 2023):

- Remote Sensing Analysis;
- Quantitative Plot-based Sampling (Ground); and
- Database comparison against Rehabilitation Criteria (in development) (Table 2).

The following sections provide a description of the remote sensing imagery capture and analysis, field procedures and reporting protocols. Rehabilitation metrics (Table 2) are measured against criteria for the relevant stage as per Table 1.

Table 1. Division of rehabilitation by age into three stages of rehabilitation with associated criteria.

REHABILITATION STAGE	AGE (Time since completion)
Young	**1 – 4 years**
Progressive	**5 – 14 years**
Completion	**15 + years**

Table 2. Rehabilitation Monitoring Metrics reported at Young, Progressive and Completion stages of rehabilitation, and source of data to derive metrics.

REHABILITATION MONITORING METRICS			
PROPERTY	METRIC REPORTED	DATA SOURCE	MONITORING STAGE
Total Native Vegetation Cover	• Area Triodia • Area Shrub • Area Trees • Area Herbs • Area Debris • Area Tussock • Area Mulga • Area Total Native Veg • Area Total Veg • Total Area • Total Bvol	Remote Sensing	Young, Progressive, Completion
Bare Ground	• Area Ground • Area Bare	Remote Sensing	Young, Progressive, Completion
Total Weed Cover	• Area Cenchrus • Area Kapok • Area Calotropis • Area Total Weeds	Remote Sensing	Young, Progressive, Completion
Triodia Relative Cover	•Perennial Weed Cover %/Hummock Grasses cover % • Hummock grasses cover %/Shrub cover % • Hummock Grasses cover %/Other Grasses + Herbs Cover % • Shrub Cover %/Total Native Cover %	Database calculation	Young, Progressive, Completion
Species Richness	• Number of Species	On-ground	Young, Progressive, Completion
Indicator Species	• % Species common to Target Veg Type	On-ground	Completion
Dominant Species	• Presence of Dominant Species from each Strata	On-ground	Completion
Reproductive Capacity	• Flowering and Seed Production	On-ground	Progressive, Completion

2.1. Remote Sensing Analysis

Remote sensing is the process of detecting and monitoring the physical characteristics of an area by measuring its reflected and emitted radiation. All BHPWAIO rehabilitation is periodically assessed via airborne aerial imagery at the end of the Pilbara wet season. Four band (RGBI) aerial imagery is currently captured from a manned aircraft at 0.10 m Ground Sample Distance (GSD) in conjunction with geodetic precise differential global positioning system (DGPS). Aerial imagery capture methods may change as this science evolves.

Orthomosaic and Digital Surface Model (DSM)

The assessor will produce an orthorectified, mosaiced, and colour balanced image for the area of influence (AOI) at 0.10 m GSD. Imagery will be provided in tiles, according to the specifications required by the BHP WAIO survey team. An associated DSM will also be produced for each AOI at 1 m GSD.

Remote Sensing Data Analysis

Areas captured in the AOIs and deemed to be suitable and representative training sites for rehabilitation will be assessed using machine learning (ML) algorithms. Once developed, ML algorithms are to be applied to all sites and the following metrics generated (Table 3). Note that all metrics are reported in m^2.

Table 3. Rehabilitation Monitoring Metrics to be generated from remotely sensed data (Area in m^2).

Required Metric	**Definition**
A_Ground	Area of bare ground
A_Triodia	Area of *Triodia* cover
A_Shrub	Area of Shrub cover
A_Trees	Area of Tree cover
A_Herbs	Area of Herb cover
A_Tussock	Area of Tussock grass cover
A_Cenchrus	Area of *Cenchrus* cover (*C. ciliaris and C. setiger*)
A_Kapok	Area of *Aerva javanica* cover
A_Calotropis	Area of *Calotropis procera* cover
A_Mulga	Area of *Acacia aneura* complex cover
A_Total Weeds	Total area of weeds identified
A_Total Veg	Total area of vegetation cover
A_Total Native Veg	Total area of native vegetation cover (A_Total Veg – A_Total Weeds)
Total Area	Area surveyed
Area NoData	Area of rehabilitation polygon without remote sensing imagery or other data.
Optional Metric	**Definition**
A_Bare	Area of contiguous ground with no vegetation, based on a radius of 10 m.
A_Debris	Area of debris
Total Bvol	Total biovolume.

2.1.1. Data Calibration and Validation

Ground Control (GC) is necessary to ensure the absolute accuracy of all deliverables. BHP WAIO are required to install adequate GC at all sites prior to aerial data acquisition.

Ground information is essential to develop, calibrate and validate imagery and to associate any changes with condition changes or other causes. Following classification of the data based on existing ML algorithms, a thorough, visual quality assessment will be carried out on the outputs. Where deemed necessary, classification errors will be manually corrected and used to retrain and improve the ML algorithms, after which they will be used to classify elements of the data a second time, if required. Machine learning deliverables are to be calibrated and validated by the consultant to meet BHP WAIO's specified standards (in development) and the associated methodology is to be included in the report.

Outputs are to be delivered in the form of a GIS Feature Class in a gbd with an associated attribute table containing the data for each rehabilitation polygon..All remote sensing outputs must follow the data structure supplied to enable successful import into the Rehabilitation Database.

2.2. Plot-based Sampling (Ground)

Plot-based ground sampling is aligned with the guidelines set out by the EPA for Level 2 Flora and Vegetation Surveys (EPA 2016). The purpose of ground-based Rehabilitation Monitoring is to collect additional data that cannot be captured by remote sensing. Plot-based Rehabilitation Monitoring is based on the assessment of species richness within 50 x 50 m quadrats. This will enable direct comparison of areas under rehabilitation with baseline datasets. Consistent with EPA guidelines (EPA 2016), plot-based Rehabilitation Monitoring should be undertaken six to eight weeks after the wet season (during April to June).

2.2.1. Quadrat (Plot) Location

Placement of the required number of quadrats within the grid is decided by random stratified sampling and will become permanent for the duration of the monitoring. The extent of WAIO Operations has been divided into 100 ha cells (1000 m x 1000 m grid aligned with the Projected Coordinate System GDA 1994 MGA Zone 50). Within the grid, the number of 50 m x 50 m quadrats established in each rehabilitated area will be determined by the area of intersection with a grid cell (Table 4.) The total quadrat area (1 quadrat = 0.25 ha) must be equal or greater than 1 % of the sum total of all WAIO rehabilitated area.

Table 4. Number of plots required depending on size of rehabilitated area within in grid cell.

Size of rehabilitated area	Number of Quadrats required
< 10 ha	**0 plots**
10 – 25 ha	**1 plot**
25 – 50 ha	**2 plots**
50 – 75 ha	**3 plots**
> 75 ha	**4 plots**

2.2.2. Quadrat (Plot) Installation

The following should be considered when establishing quadrats:

- Preferential sampling is to be used when positioning quadrats; sample sites should be placed to avoid boundaries and to minimise edge effects.
- Sampling sites should be placed at representative locations throughout the survey area to cover a mixture of landforms, geology, elevation, slope, aspect, surface or groundwater expressions, and soil types. Indicative locations will be identified to ensure representative coverage of 1 % of rehabilitated land and may be adjusted in the field as required.
- Where it is safe to do so, quadrats should be positioned in the middle section of a slope (this is to ensure the results provide an accurate representation of the rehabilitated area by not focussing on the lower part of the slope that may receive more water and nutrients).
- Topographical position of the quadrat shall be noted, with naming conventions limited to:
    - Flat: flat topography, low landscape position;

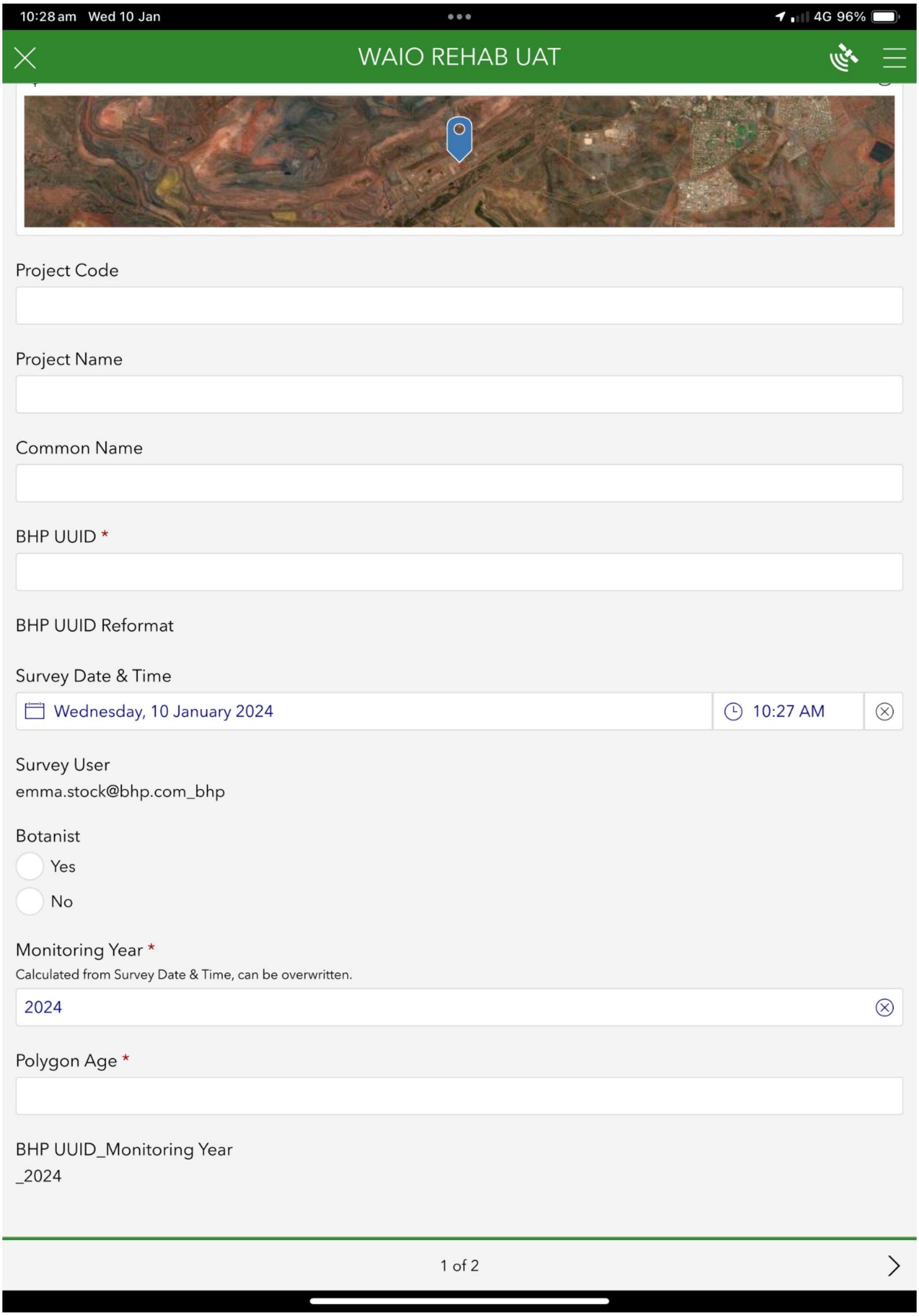
  - Slope: sloping topography;
  - Crest: flat topography, high landscape position receiving no rainfall run-on
  - Floodplain and;
  - Drainage Line.
- The primary quadrat should measure 50 m x 50 m. If the rehabilitated area does not allow for this (e.g. narrow, linear rehabilitation corridor), the quadrat dimensions may be adjusted to 25 m x 100 m.
- Any permanent quadrats replacing existing quadrats should utilize the existing steel pickets where possible. A note of the change must be made in the field datasheet and written report.
- The four points of the quadrat are permanently marked with a steel picket and their position recorded using GPS (GDA94 UTM). The north-west corner is designated as Quadrat post 1 and posts 2, 3 and 4 and Corners 2, 3 and 4 respectively in a clockwise direction.
- Quadrat orientation is to be on the northing and easting axis, where topography permits and is representative.

2.2.3. Quadrat Data

The following attributes are to be assessed and recorded within the primary (50 x 50 m) quadrat:

- Species richness
- Evidence of flowering and seed production and variable aged plants

All Quadrat data should be recorded in the ESRI Survey 123 data capture format supplied (Figures 1a and b).



10:28 am Wed 10 Jan 4G 96%

WAIO REHAB UAT

Project Code

Project Name

Common Name

BHP UUID *

BHP UUID Reformat

Survey Date & Time

Wednesday, 10 January 2024 | 10:27 AM

Survey User

emma.stock@bhp.com_bhp

Botanist

Yes

No

Monitoring Year *

Calculated from Survey Date & Time, can be overwritten.

2024

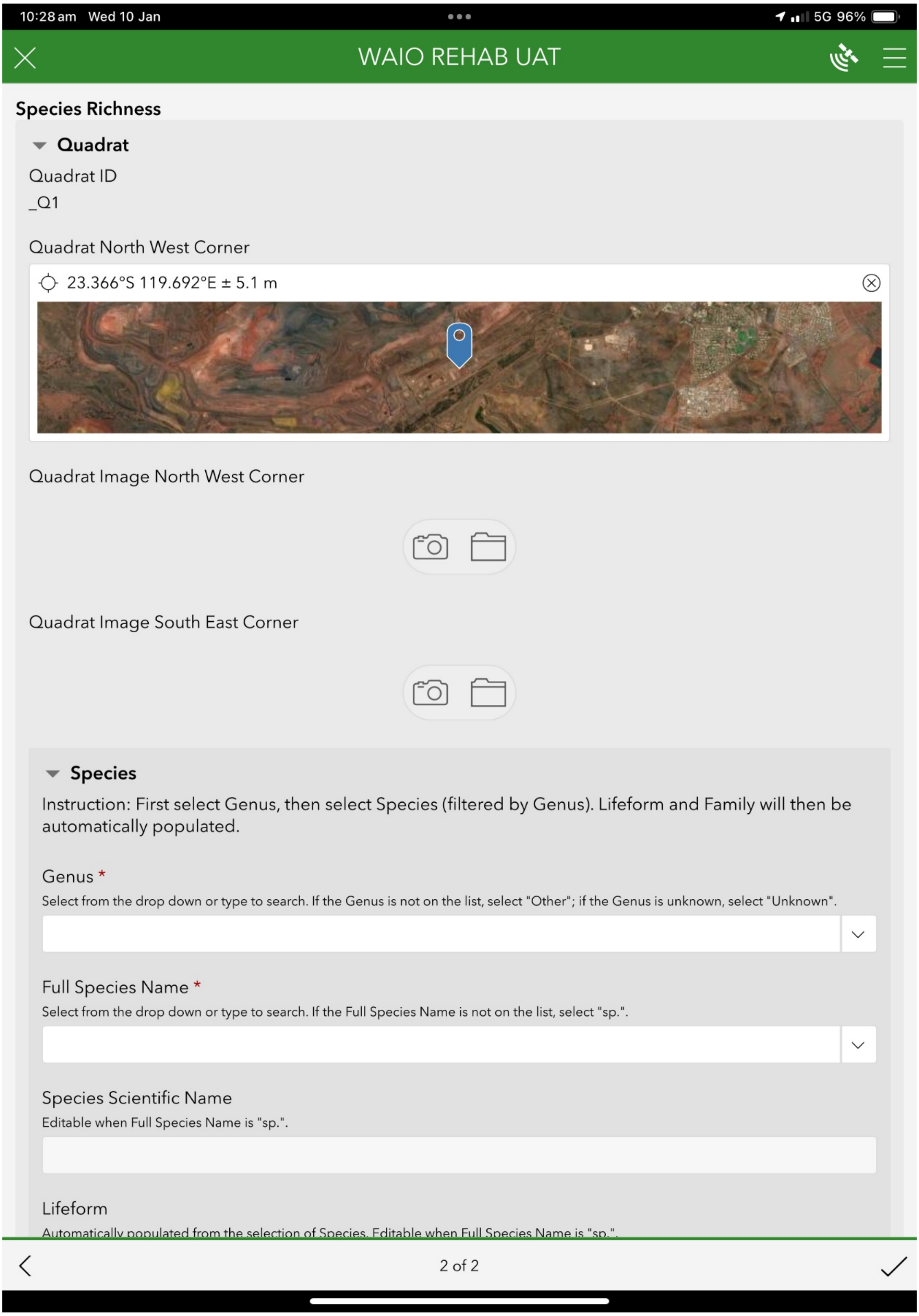
Polygon Age *

BHP UUID_Monitoring Year

_2024

1 of 2

Figure 1a. Survey 123 data capture form for quadrat monitoring – page 1.



10:28 am Wed 10 Jan

5G 96%

WAIO REHAB UAT

Species Richness

Quadrat

Quadrat ID

_Q1

Quadrat North West Corner

23.366°S 119.692°E ± 5.1 m

Quadrat Image North West Corner

Quadrat Image South East Corner

Species

Instruction: First select Genus, then select Species (filtered by Genus). Lifeform and Family will then be automatically populated.

Genus *

Select from the drop down or type to search. If the Genus is not on the list, select "Other"; if the Genus is unknown, select "Unknown".

Full Species Name *

Select from the drop down or type to search. If the Full Species Name is not on the list, select "sp.".

Species Scientific Name

Editable when Full Species Name is "sp.".

Lifeform

Automatically populated from the selection of Species. Editable when Full Species Name is "sp.".

2 of 2

Figure 1b. Survey 123 data capture form for quadrat monitoring – page 2.

2.2.4. Photo-point Locations for Quadrats

- Photographs shall be taken diagonally across the quadrat, from quadrat post 1 to quadrat post 3, and quadrat post 4 to quadrat post 2.
- Ensure the horizon is visible in the photograph.
- Photos to preferably include metadata with geotagged location and aspect, such as that provided by an app like Solocator.

2.2.5. Monitoring Schedule and Responses

The following monitoring schedule will be applied to the on-ground and remote sensing:

- 2 year rotation for hubs via remote sensing:
  - MAC, Newman Operations and Jimblebar in one year;
  - GNA and Yandi in the alternate year (Table 5).
- 2 year rotation for permanent plots (Table 6).

Appendix 1 shows the steps undertaken when a rehabilitation site is progressing towards completion criteria or maintenance is required.

Table 5. Monitoring schedule for remote sensing across WAIO rehabilitation hubs.

	HUBS						
	YEAR	GOLDSWORTHY	YARRIE	YANDI	MAC/SF	NEWMAN	JIMBLEBAR
ROTATION 1	2024				✓	✓	✓
ROTATION 2	2025	✓	✓	✓			
ROTATION 1	2026				✓	✓	✓
ROTATION 2	2027	✓	✓	✓			
ROTATION 1	2028				✓	✓	✓
ROTATION 2	2029	✓	✓	✓			

Table 6. Number of permanent plots to be monitored across WAIO rehabilitation hubs, noting that numbers may increase in the future as additional sites are completed.

	HUBS						
	YEAR	GOLDSWORTHY	YARRIE	YANDI	MAC/SF	NEWMAN	JIMBLEBAR
ROTATION 1	2024				13	36	15
ROTATION 2	2025	24	60	14			
ROTATION 1	2026				13	36	15
ROTATION 2	2027	24	60	14			

2.2.6. Landform Stability and Erosion

The purpose of the landform stability and erosion assessment is to record the extent and severity of erosion features on rehabilitated areas. This information can assist in identifying whether any remedial action is required to prevent erosion features from developing further.

The erosion / stability assessment shall identify:

- Absence / presence of rilling or sheet erosion.
- Is the erosion active or inactive (will the erosion likely get worse, or self-heal).
- Failed frontal / interbunds.
- Evidence of slumping.

BHP is in the process of considering methods of quantitative erosion modelling using remote sensed lidar data.

Rehabilitation Monitoring inspection will be undertaken where remote sensing analysis shows a decline in some completion criteria ecological metrics.

3. Data Submission

The information collected from the on-ground assessment and the remote sensing analysis is to be stored in D2 (Rehabilitation Monitoring folder) and the ESRI Rehabilitation database. The quantitative plot-based ground sampling monitoring data is to be recorded using the Survey 123 form (WAIO_Rehab) and the remote sensing data is to be loaded into the RS_2024_UUID_ Template and the ESRI rehabilitation database. The on-ground and remote sensing rehabilitation data is presented in the Annual Environment Report and the Derived Proposal WAIO Rehabilitation Reports in line with our reporting requirements. All data should adhere to the following requirements:

- **Written report** (electronic format) which contains the following minimum requirements:
  - Brief summary of the rainfall received since the last reporting period;
  - Location details of the permanent ground plots that were assessed and/or installed and a well-presented map displaying their location;
  - Reference to this document in the methods section, and a detailed description of any changes made to the methods, including justification;
- **GIS data** of monitoring locations is to be recorded and integrated into the GIS layers used by BHPWAIO, in accordance with the Rehabilitation Data Capture Technical Process Instruction (0001006)
- **Raw field data, photos, and summary data** (electronic format) to be submitted in accordance with the Rehabilitation Data Capture Technical Process Instruction (0001006).

4. Rehabilitation Database

Analysis of rehabilitation monitoring data against Rehabilitation Criteria will be completed in the BHP Rehabilitation Database (in development).

5. Responsibilities

Role	Description of Task
Superintendent Rehabilitation & Contaminated Sites	• Responsible for management and monitoring of contract. •
Specialist / Principal Rehabilitation	• Prepare annual monitoring schedule and issue scope of works to contractor. • Prepare and issue aerial imagery scope of work to contractor. • Plan and coordinate monitoring schedule and liaise with site Environmental Specialist. • Review and feedback on reports. • Data collation and analysis. • Upload on-ground and remote sensing data into rehabilitation database. • Prepare rehabilitation monitoring site summaries for AER. • Support site Environmental Specialist with contractor supervision where possible. • Revise and update rehabilitation monitoring procedure as required. • Update rehabilitation species list on an annual basis.
Specialist Environment	• Provide support with contractor supervision where possible

6. Definitions & Abbreviations

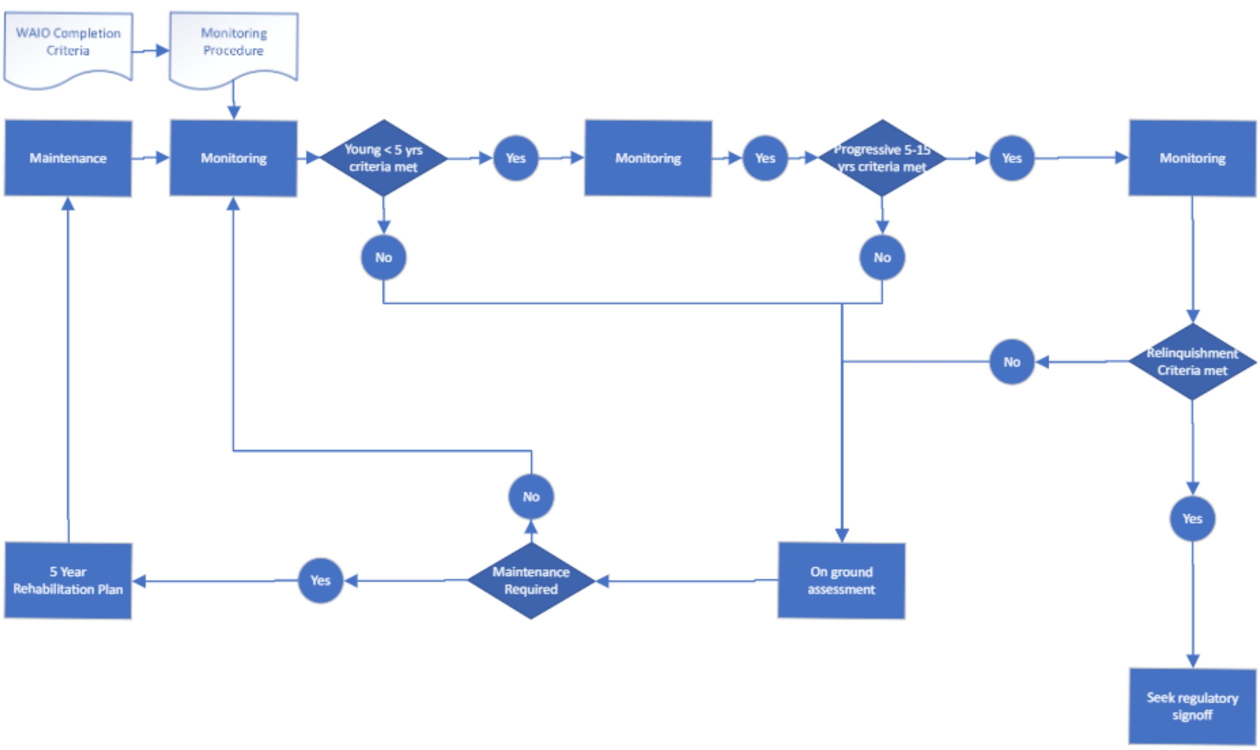
Term	Description
AER	Annual Environmental Review
AOI	Area of Interest
BHPWAIO	BHP Western Australian Iron Ore
DGPS	Differential Global Positioning System
DSM	Digital Surface Model
GC	Ground Control
GPS	Global Positioning System
GSD	Ground Sample Distance
ML	Machine Learning
OSA	Overburden Storage Area

7. Reference Table

Document Number	Reference Title
	BAM Act 2007. Biosecurity and Agricultural Management Act 2007. State of Western Australia.
	CSIRO 2007. Australian Soil and Land Survey Field Handbook (Third Edition). The National Committee on Soil and Terrain. CSIRO Publishing.
	EPA 2016. Technical Guide – Flora and Vegetation Surveys for Environmental Impact Assessment. Technical Report of the Environmental Protection Authority and the Department of Parks and Wildlife.
0001006	BHPWAIO Rehabilitation Data Capture Technical Process Instruction
	RS_Template_2024_UUID
	BHP WAIO Rehabilitation Criteria Workbook (2023)
	BHP Rehabilitation Improvement Projects: Monitoring Approach
	WAIO Rehab on ground Survey123 form

8. Appendices

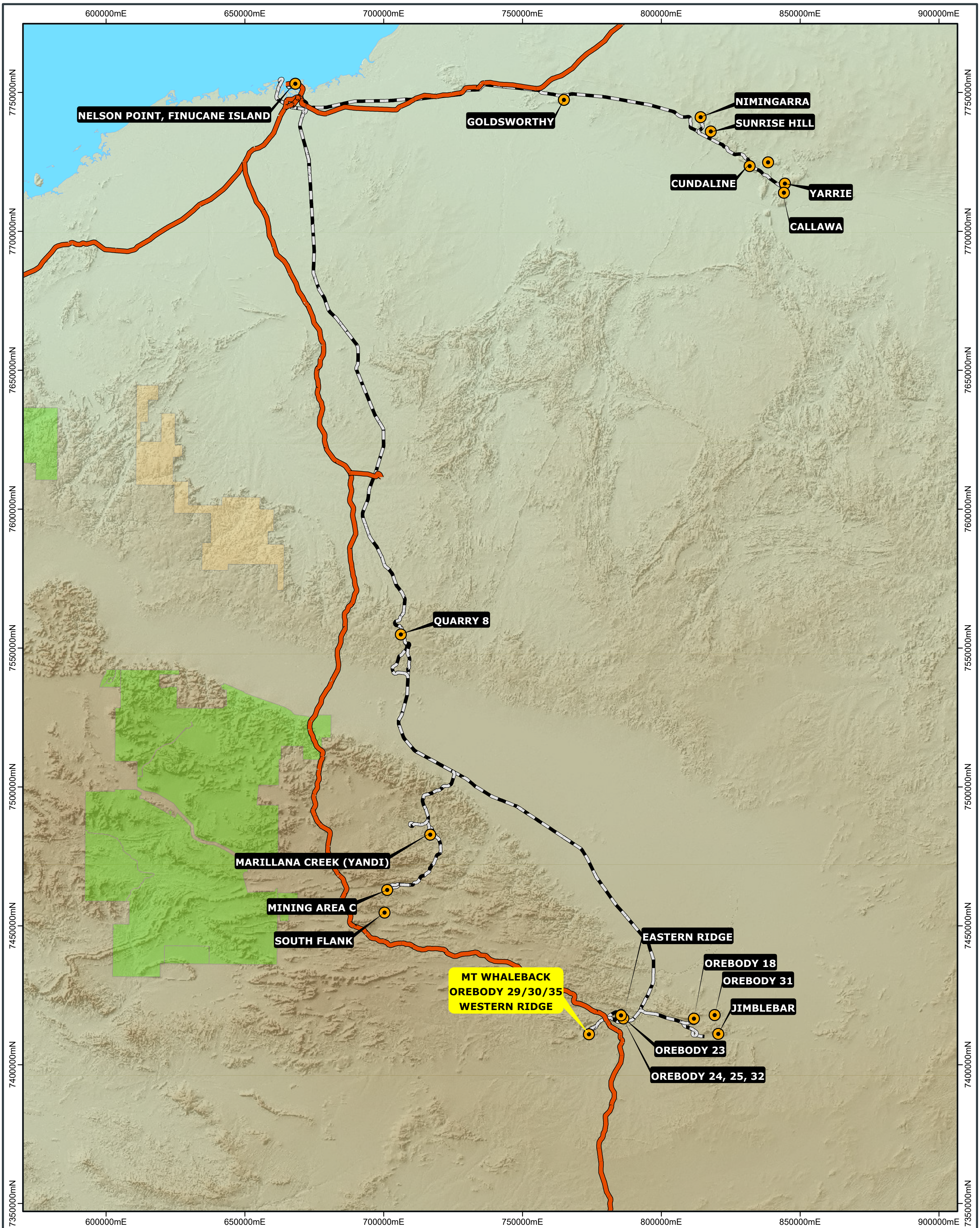
Appendix 1: Rehabilitation Monitoring On Track or Maintenance Required Flow Chart



Appendix M. Technical study reports

This appendix is supplied separately – the information is commercially sensitive and not for public release

Appendix N. Maps

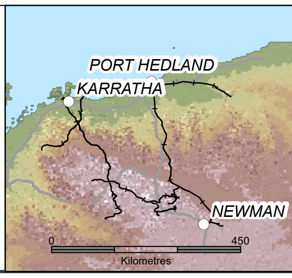


- BHP Operation
- National Highway
- Rail

N

0 5 10 15 20
KILOMETRES

GDA 1994 MGA ZONE 50



BHP

PUBLIC

OB 29/30/35
REGIONAL LOCATION

WAIO- PLANNING, STANDARDS & ENVIRONMENT

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DATE:	14/10/2024	PREPARED:	C.DEVLIN	NO:	A817-103 RevA
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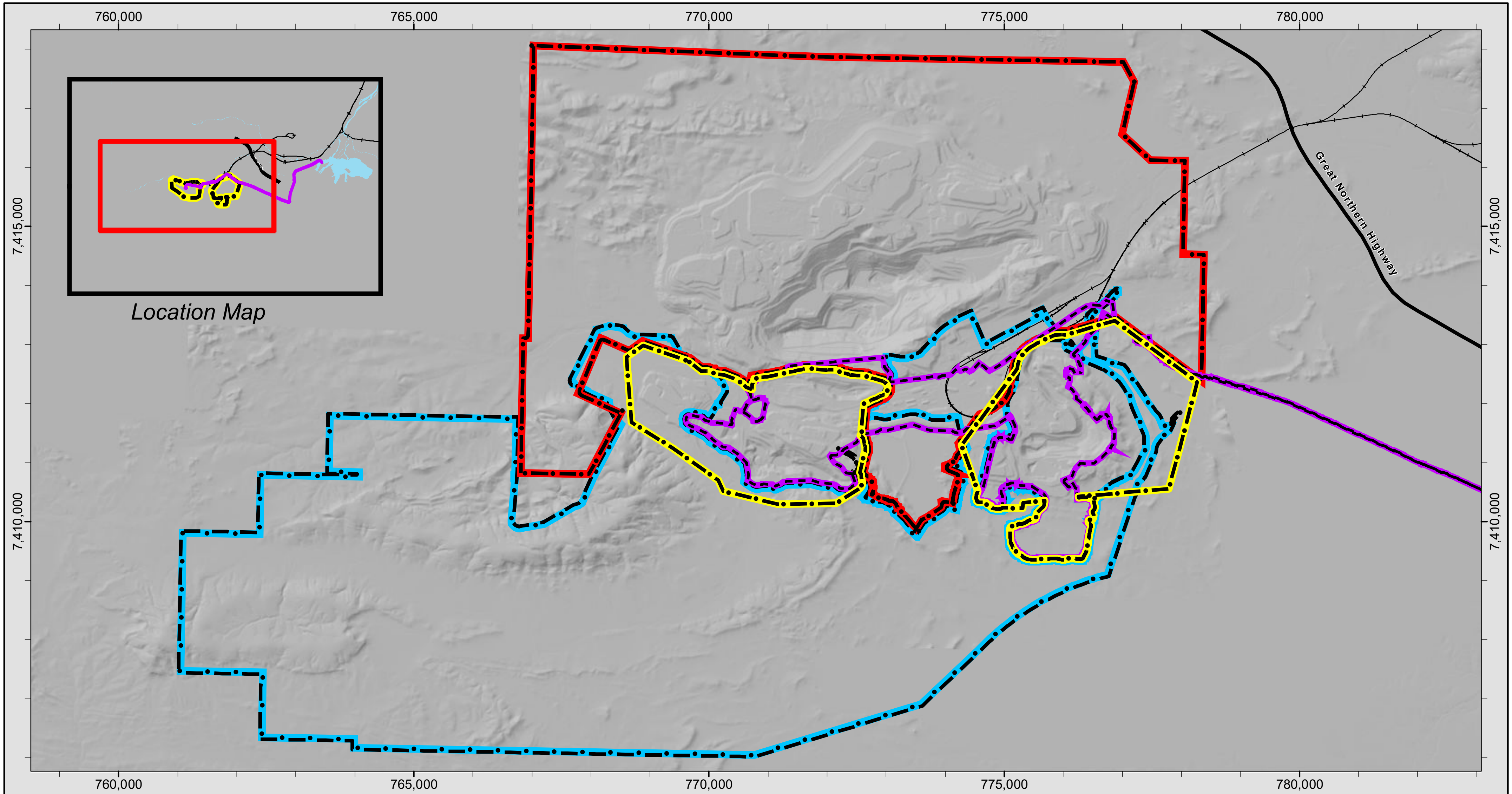
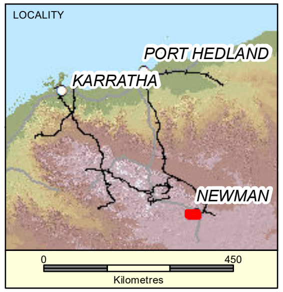


OB 29/30/35 Closure Plan Area
OB 29/30/35 Significant Ammendment Development Envelope
Whaleback Closure Plan Area
Western Ridge Development Envelope
WAIO Railway
Great Northern Highway



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Regional Closure Boundaries

N
0 500 1,000 1,500 2,000
Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:90,000	Prepared: C. Devlin	Project No: A817/104
Date: 16/10/2024	Checked: D. Noonan	Figure:

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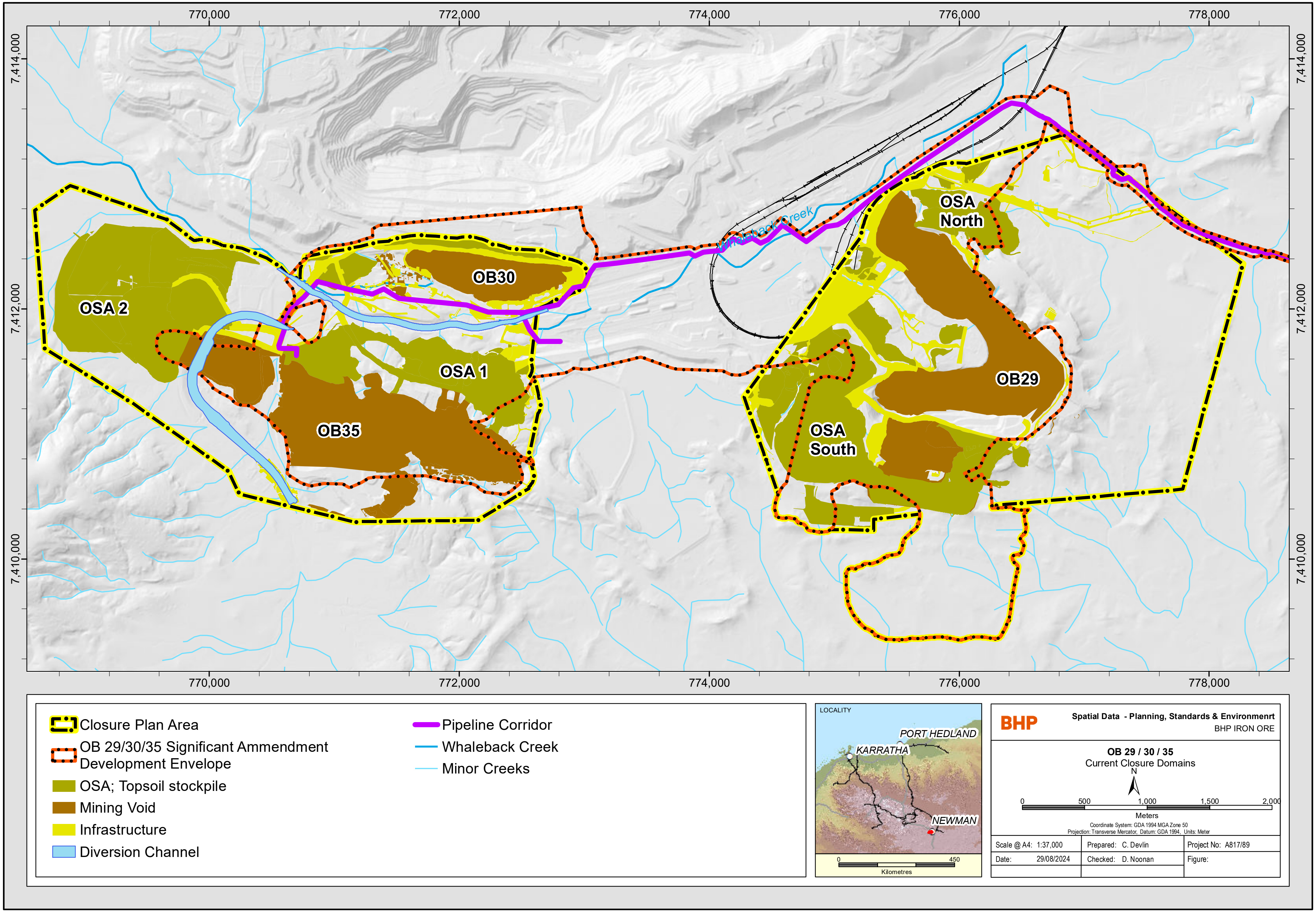

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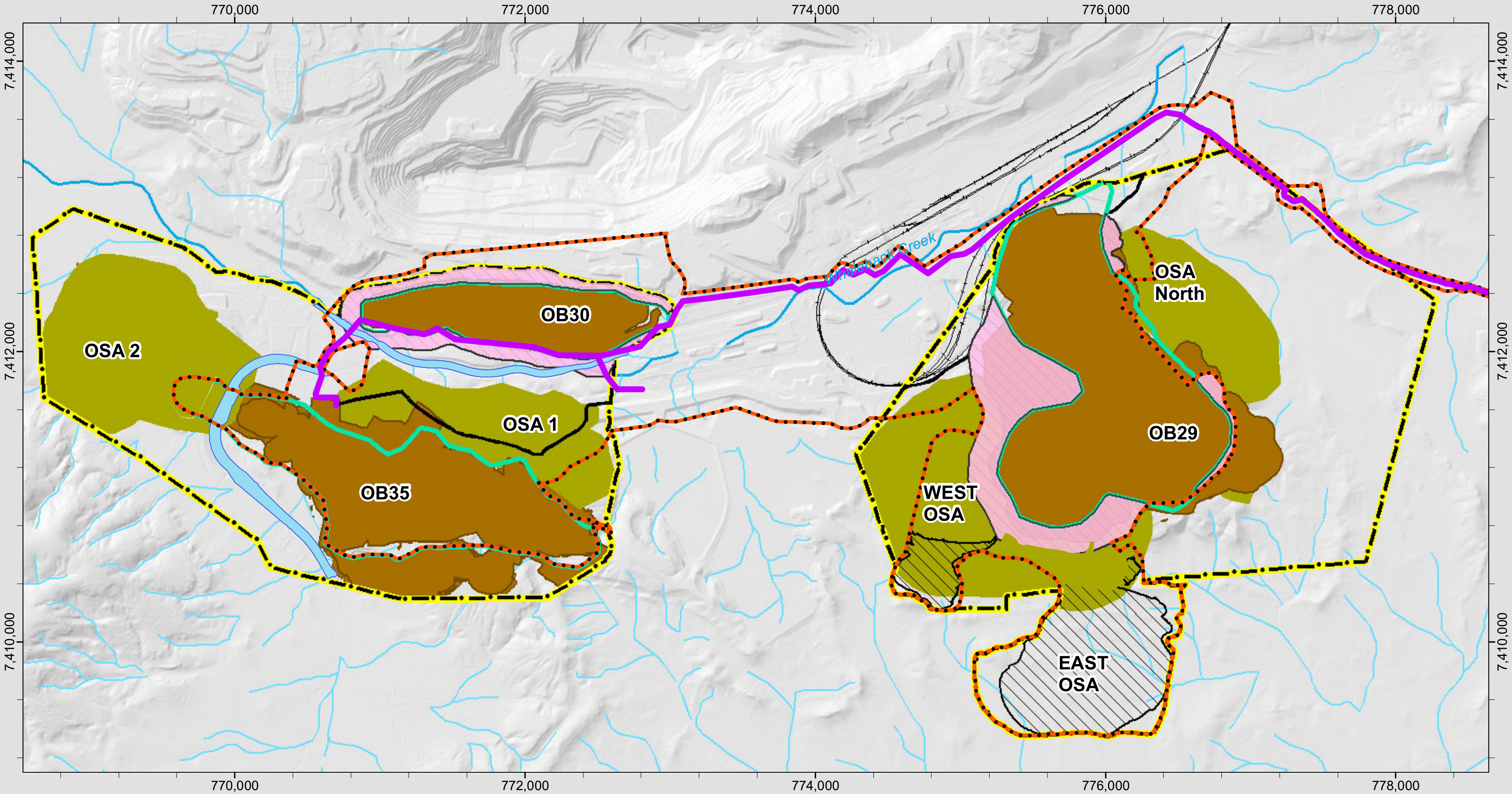
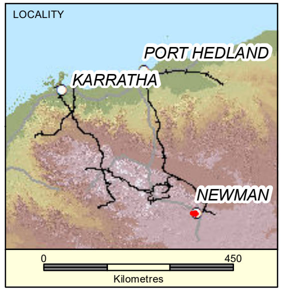


Closure Plan Area
OB 29/30/35 Significant Ammendment Development Envelope
OSA; Topsoil stockpile
Mining Void
Pipeline Corridor
Diversion Channel
Whaleback Creek
Minor Creeks

Significant Ammendment DE and Footprint

OSA Expansion
Ministerial Footprint 963
Pit Expansion



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Future Closure Domains

N

0 500 1,000 1,500 2,000
Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:37,000	Prepared: C.Devlin	Project No: A817/90
Date: 2/09/2024	Checked: D. Noonan	Figure:

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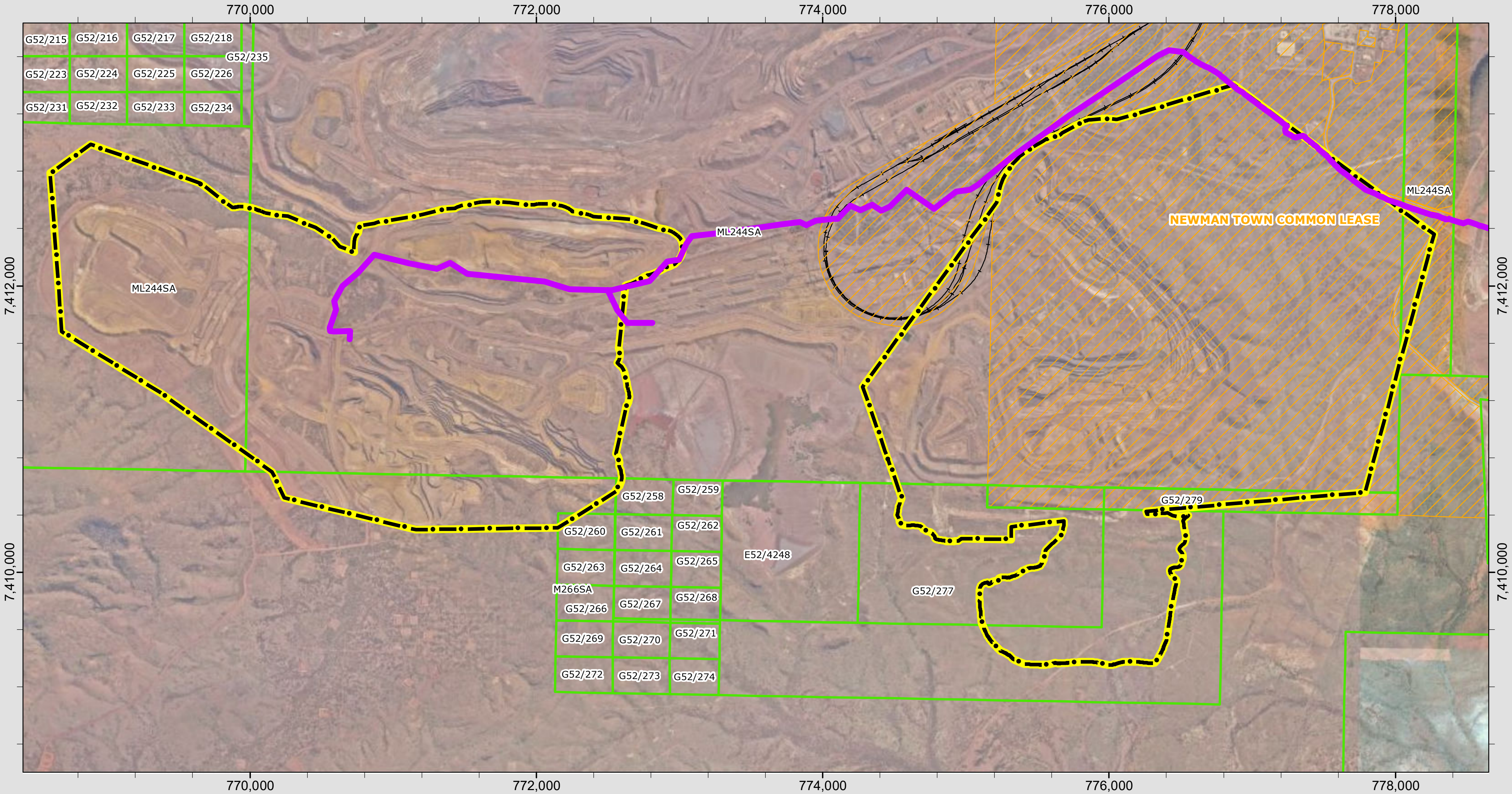
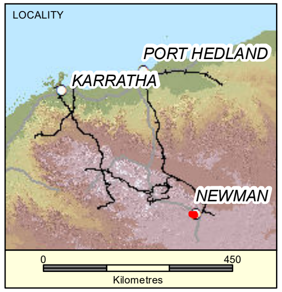


Closure Plan Area
Pipeline Corridor
BHP Tenements
BHP Freehold Leasehold Easements
WAIO Railway



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29/ 30 / 35
Tenure

N

0 500 1,000 1,500 2,000
Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:37,500	Prepared: C. Devlin	Project No: A817/91
Date: 30/08/2024	Checked: D. Noonan	Figure:

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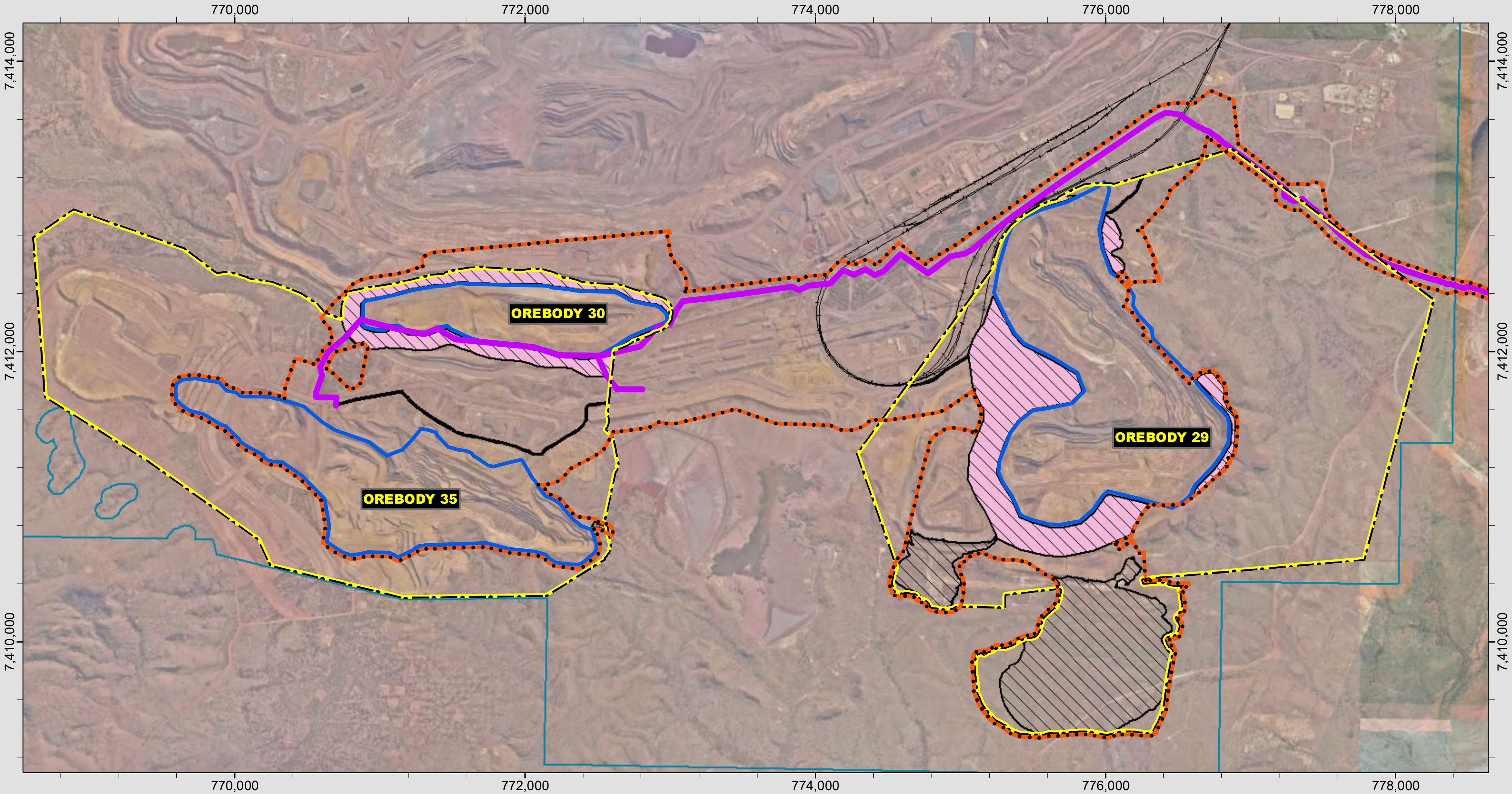
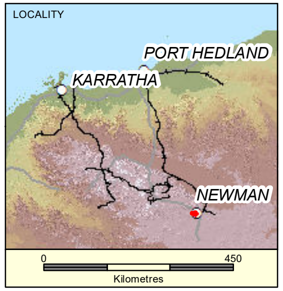


Closure Plan Area
OB 29/30/35 Significant Ammendment Development Envelope
Pipeline Corridor
Ministerial Statement 963 Area (Mining below water table only)
Native Vegetation Clearing Permit Area
WAIO Railway

Significant Ammendment DE and Footprint
OSA Expansion Area
Pit Expansion



Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Approvals

N
0 500 1,000 1,500 2,000
Meters
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:37,000	Prepared: C. Devlin	Project No: A817/92
Date: 6/09/2024	Checked: D. Noonan	Figure:

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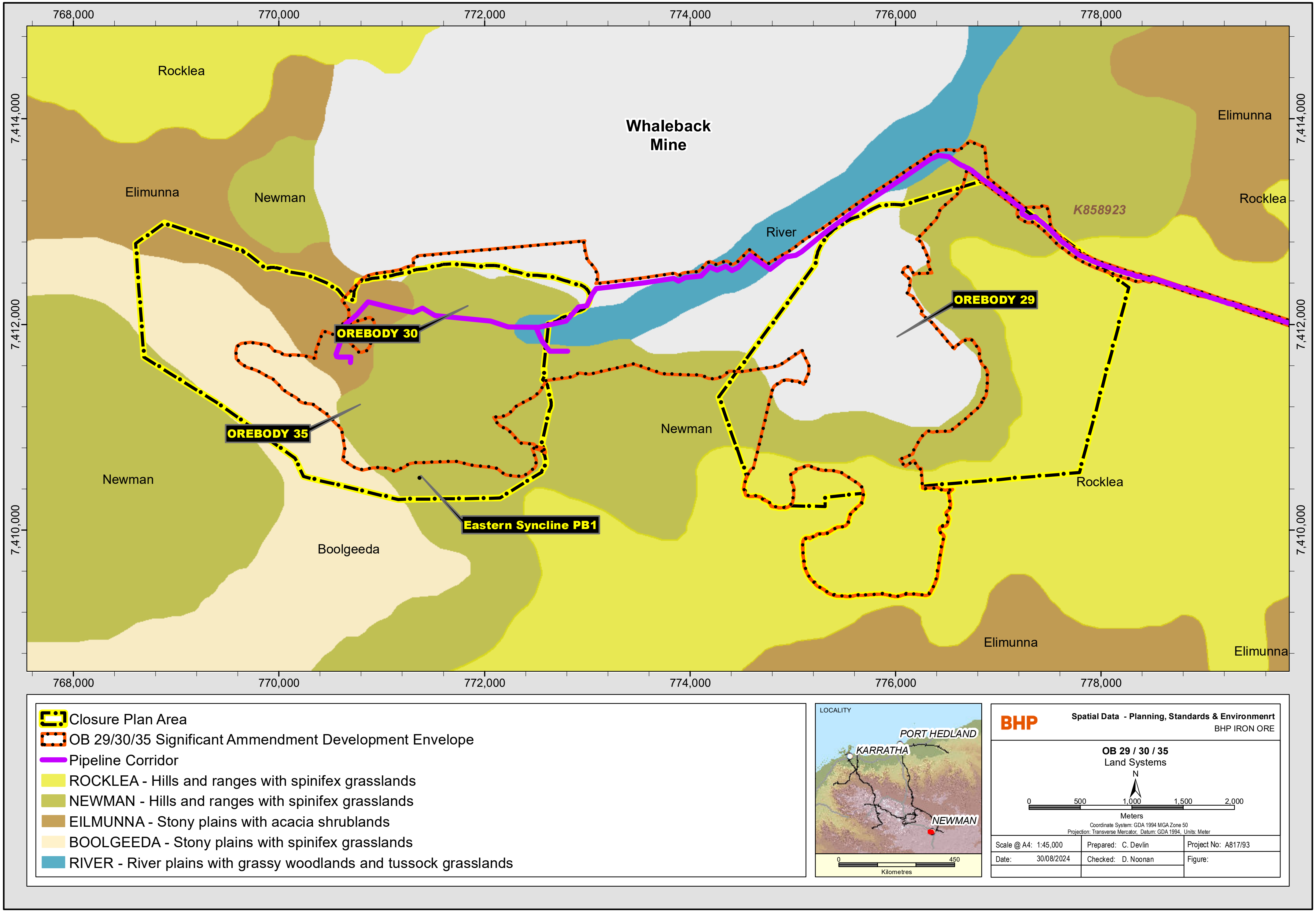

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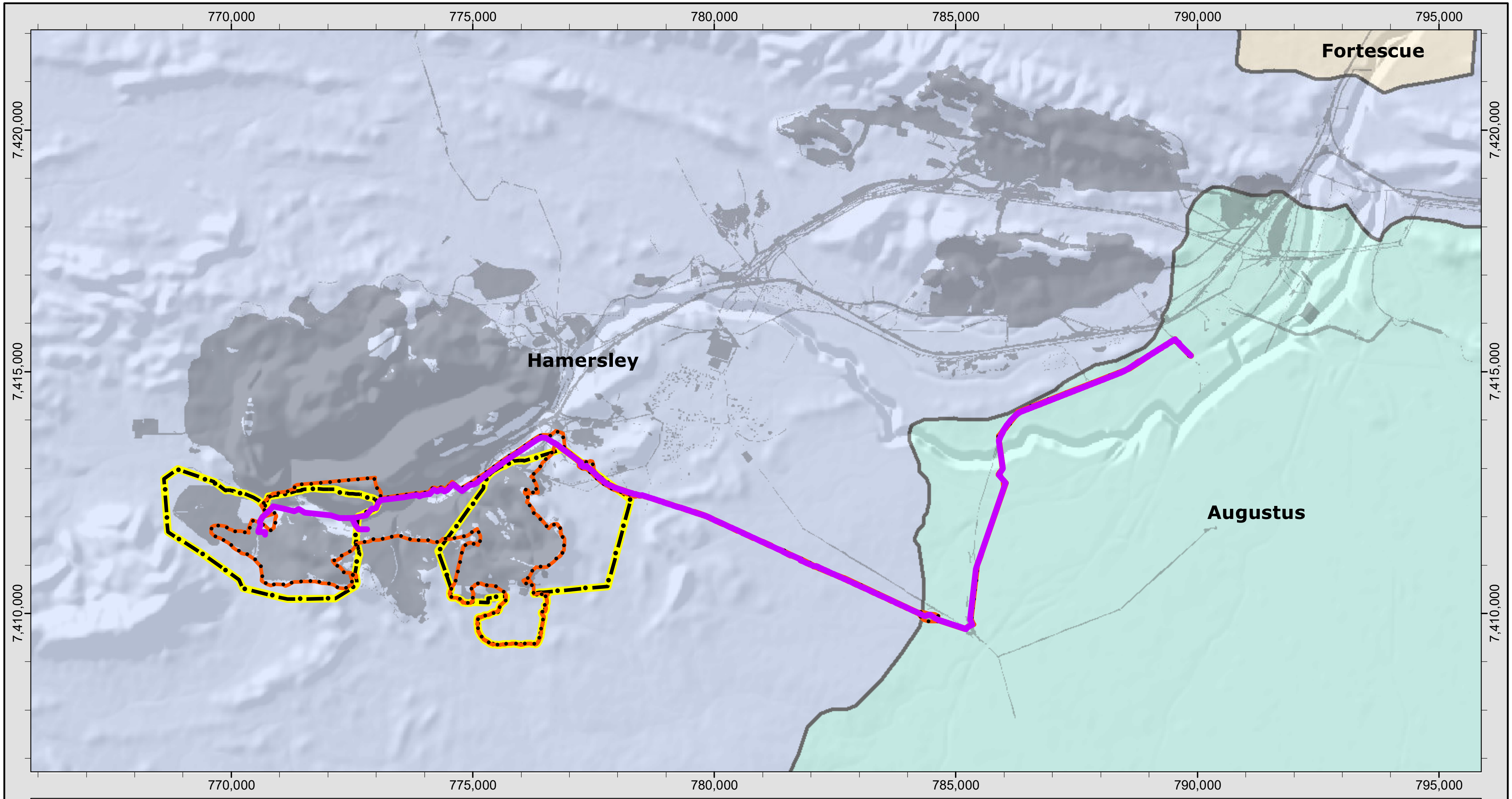

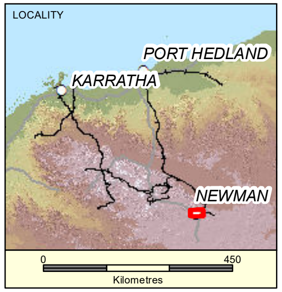

Closure Plan Area
OB 29/30/35 Significant Ammendment Development Envelope
Pipeline Corridor
Existing WAIO Operational Footprint

Interim Biogeographic Regionalisation for Australia (IBRA) - Sub Regions

Augustus
Fortescue
Hamersley

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
IBRA Regions

0 1 2 3 4
Kilometres
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:110,000	Prepared: C. Devlin	Project No: A817/94
Date: 30/08/2024	Checked: D. Noonan	Figure:

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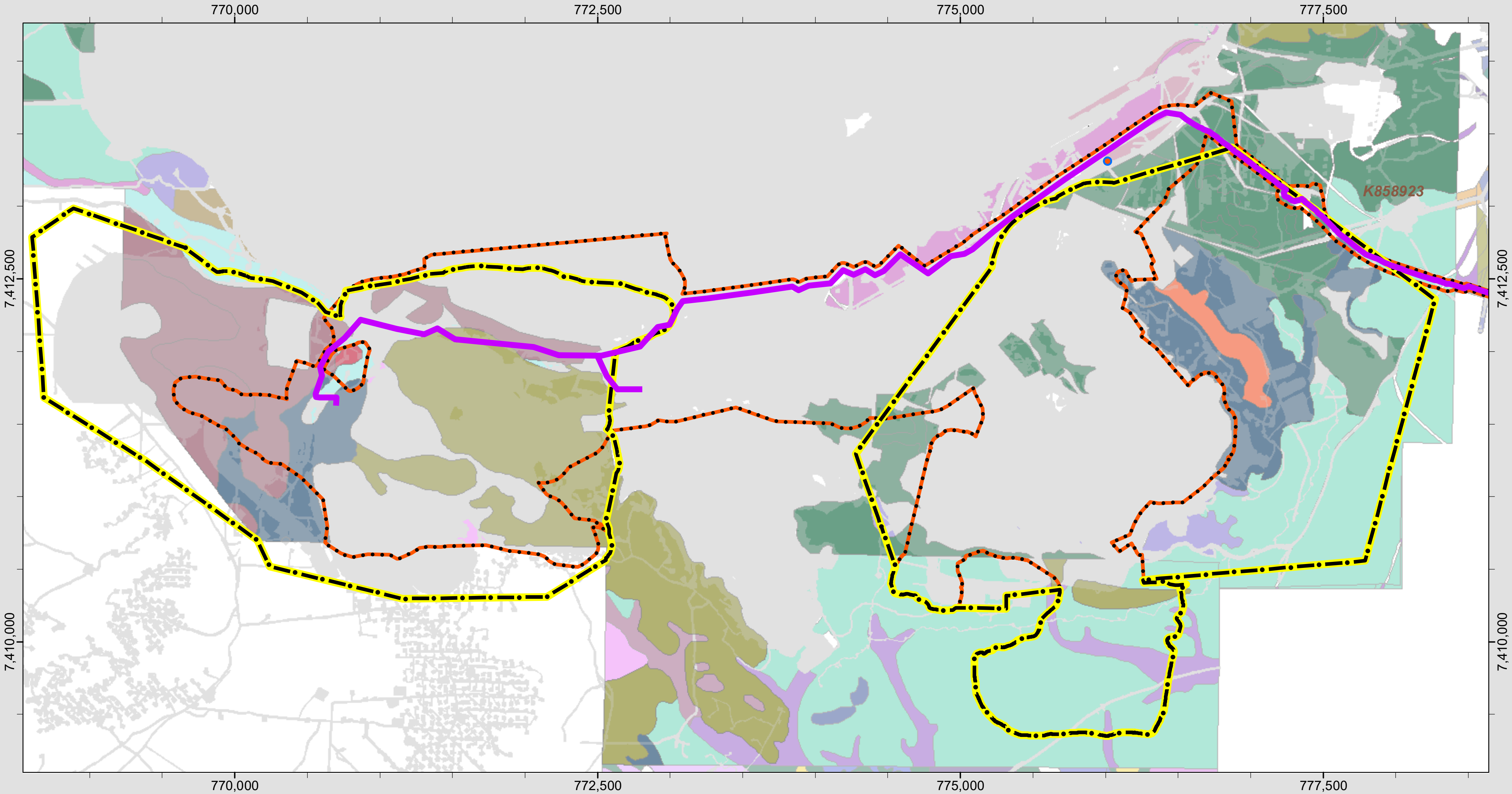


Closure Plan Area

OB 29/30/35 Significant Ammendment Development Envelope

Pipeline Corridor

WAIO Railway

Disturbed at time of Survey

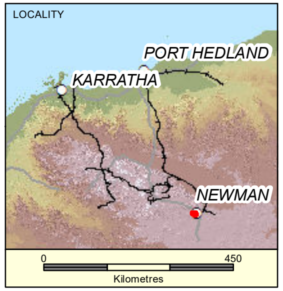
Significant Flora Observations (DPaW Database)

Priority 1

Vegetation Code, Broad Floristic Formation

- FP AcaoAaEx Erff Tp, Acacia Low Woodland
- FP ApAaApr AsyErffPto CcAriArc, Acacia Low Woodland
- HC TwTbrTp EllCh AmaGrwhAb, Triodia Hummock Grassland
- HS AcaoAaApr ScaErllAb TbrTw, Acacia Low Open Forest
- HS TbrTw AiAprHc ErfrErpd, Triodia Hummock Grassland
- HS TsTpTb AaAprAw AteEreErll, Triodia Open Hummock Grassland
- HS Tw EllChHc AancAbAa, Triodia Hummock Grassland
- MA CcTtEua ChCa AbAtpAss, *Cenchrus Tussock Grassland
- ME TpTlo ExAciCh PlApypGoro, Triodia Hummock Grassland
- SP AprAa AiAb Ts, Acacia Low Woodland
- SP Tl AancApa ApAprCh, Triodia Open Hummock Grassland
- SP TpTb Eg PlAbAanc, Triodia Hummock Grassland
- SP Ts Ai, Triodia Hummock Grassland

LOCALITY



BHP

Spatial Data - Planning, Standards & Environmenrt

BHP IRON ORE

OB 29 / 30 / 35

Vegetation Association & Significant Flora

N

0 500 1,000 1,500 2,000

Meters

Coordinate System: GDA 1994 MGA Zone 50

Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:37,000	Prepared: C. Devlin	Project No: A817/95
Date: 15/10/2024	Checked: D. Noonan	Figure:

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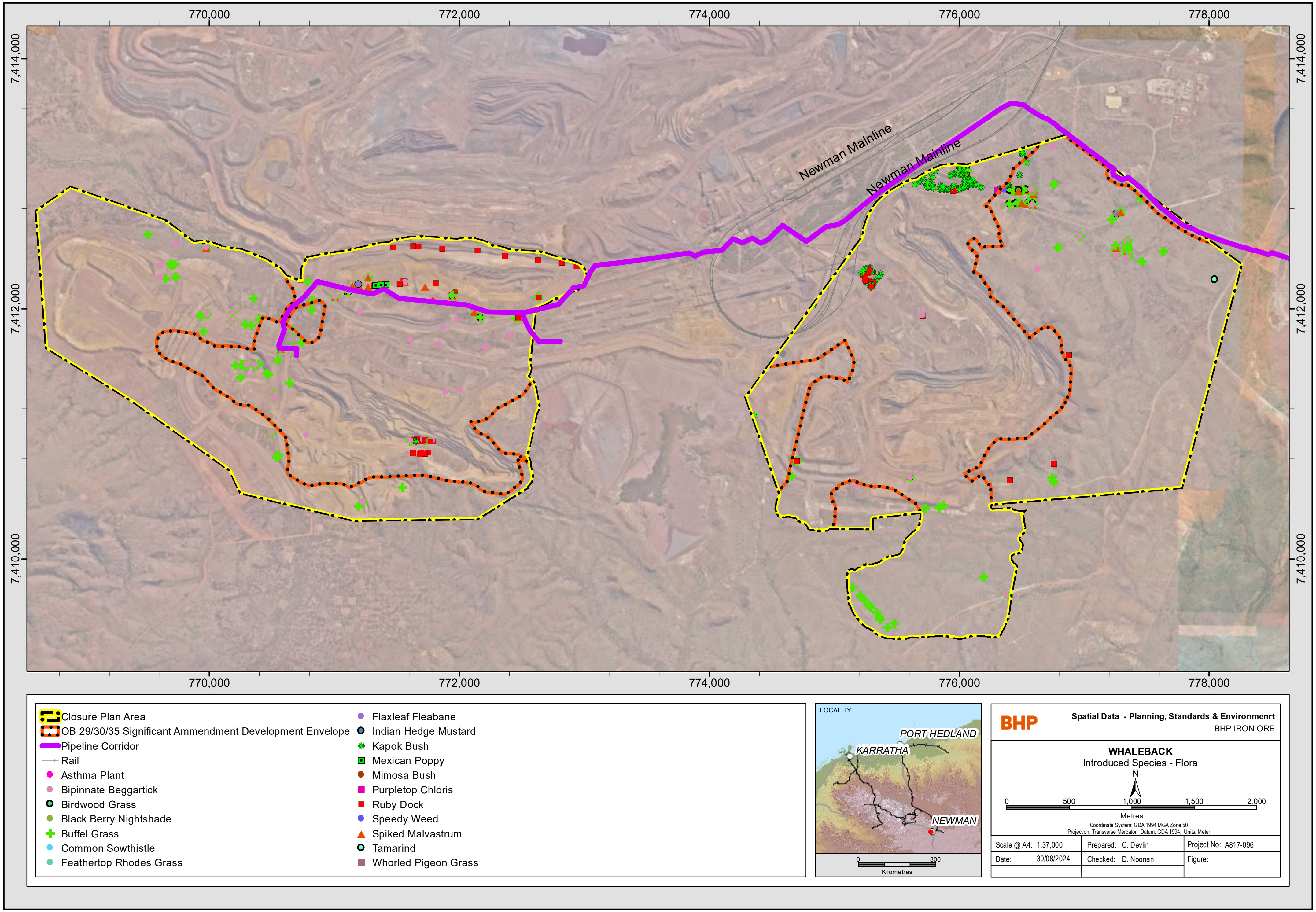

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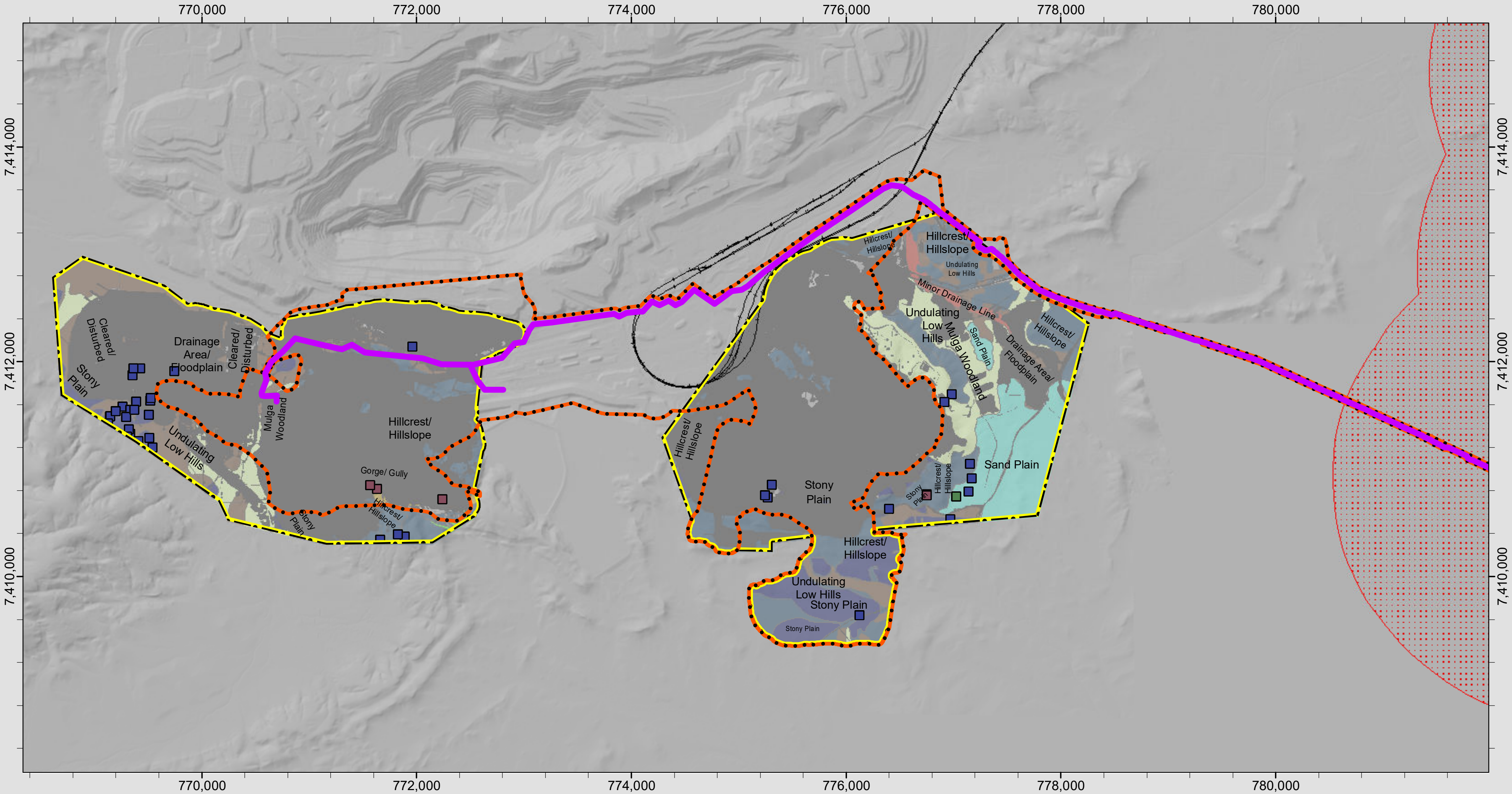
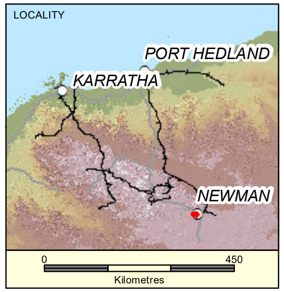


- Closure Plan Area
- OB 29/30/35 Significant Ammendment Development Envelope
- Pipeline Corridor
- Ethel Gorge Threatened Ecological Community - 2,000m Buffer
- Coracina novaehollandiae subsp. subpallida
- Falco cenchroides
- Grallina cyanoleuca
- Haliastur sphenurus
- Macroderma gigas
- Pseudomys chapmani
- Disturbed at time of Survey
- Breakaway/ Cliff
- Drainage Area
- Gorge/ Gully
- Hill Crest/ Slope
- Minor Drainage Line
- Mulga Woodland
- Sandy Plain
- Stony Plain



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB29/30/35 Fauna Habitats & Significant Fauna Species

N

0 500 1,000 1,500 2,000
Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:50,000	Prepared: C. Devlin	Project No: A817/97
Date: 15/10/2024	Checked: D. Noonan	Figure:

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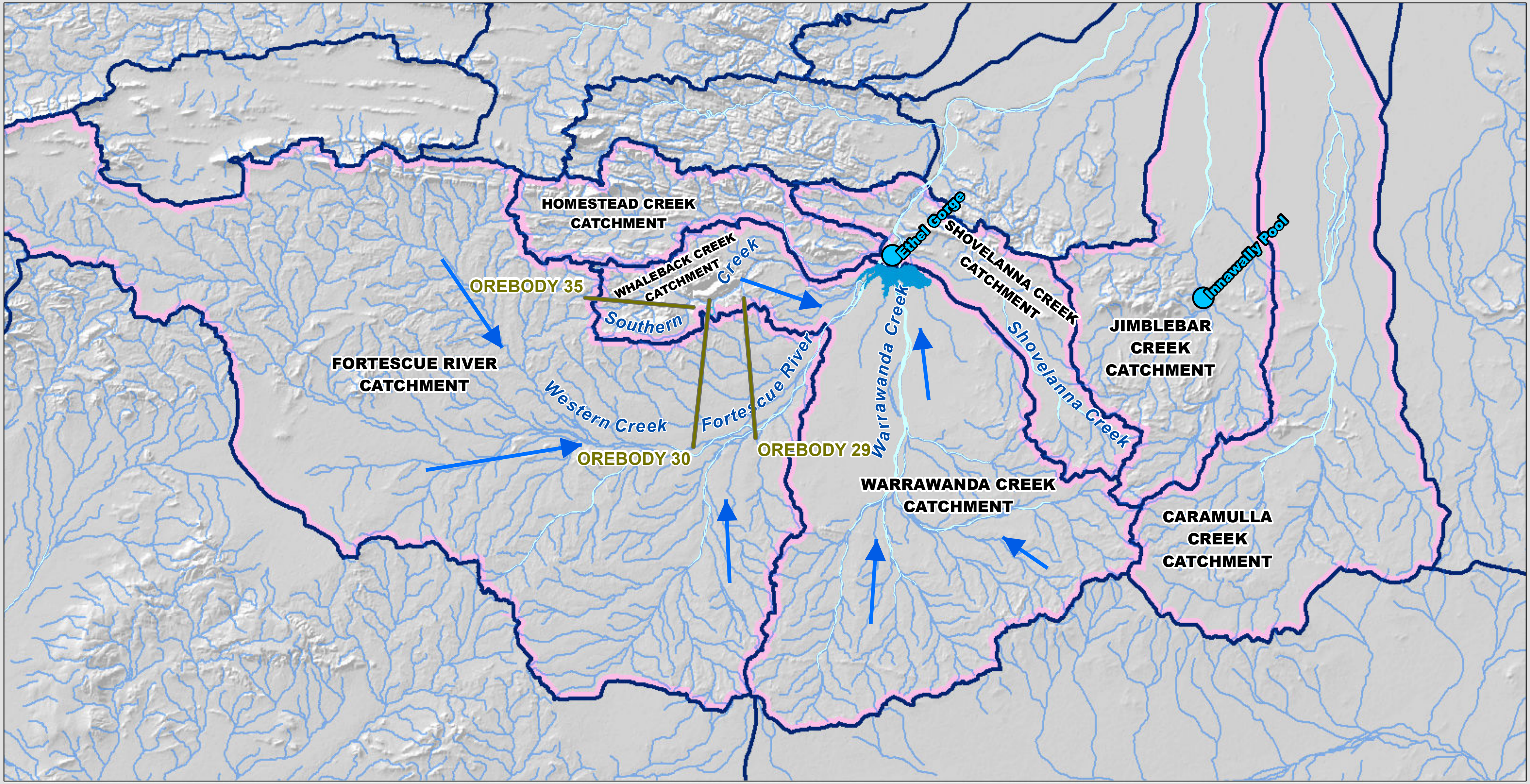
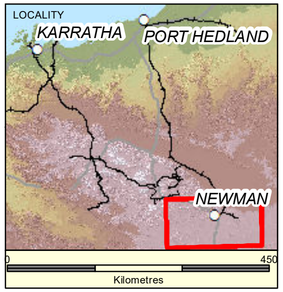


Deposits
Watercourse Areas
Town Rural Storage
Pondage Areas
Watercourse Lines
Sub Catchment
Selected Sub Catchment



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Hydrology

N

0 5 10 15 20
Kilometres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:600,000	Prepared: C. Devlin	Project No: 817/109
Date: 15/10/2024	Checked: D. Noonan	Figure:

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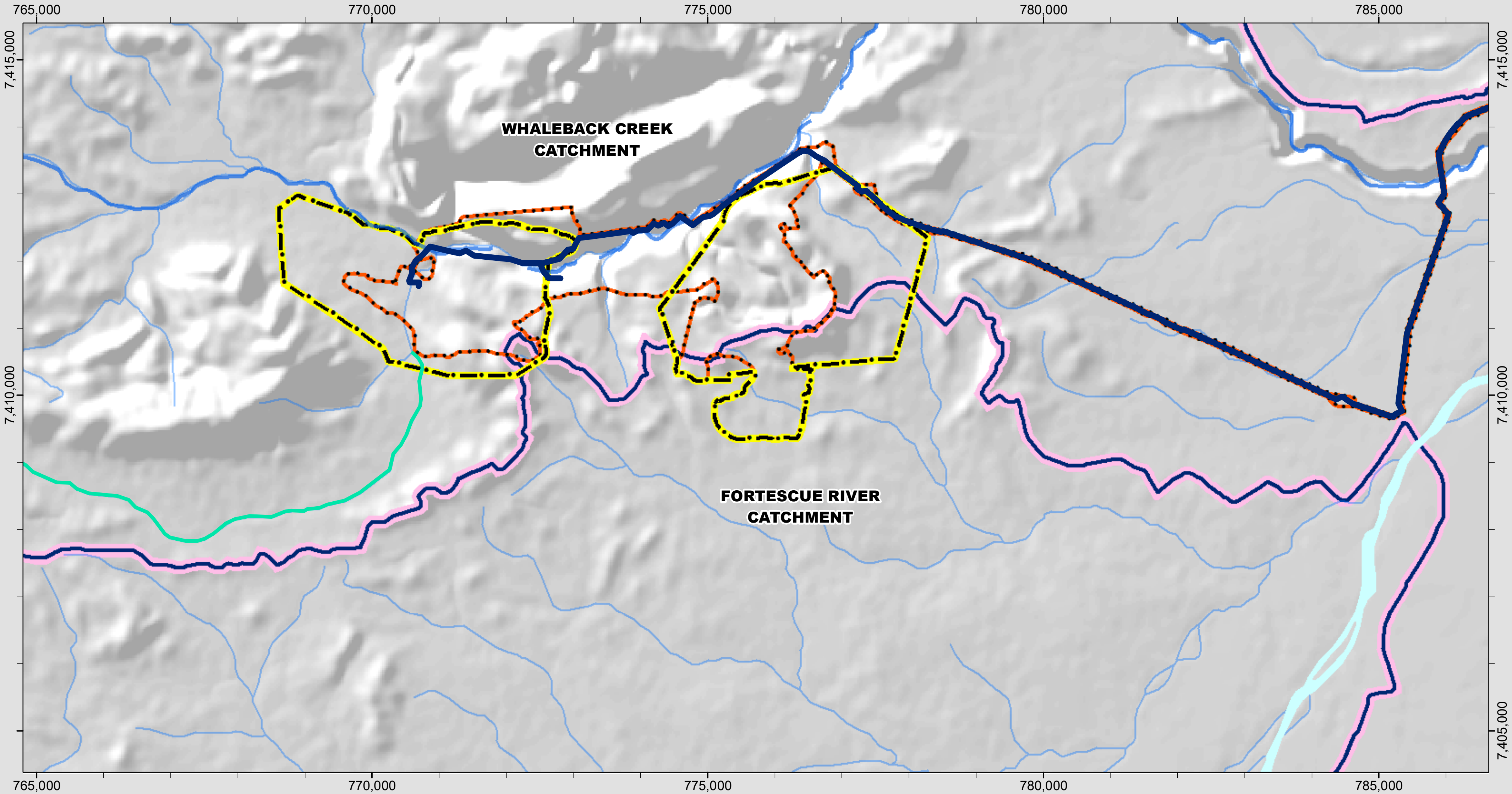
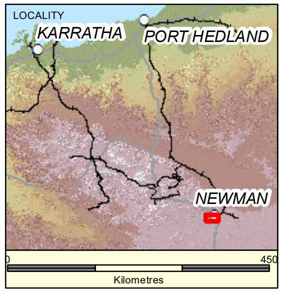


Closure Plan Area
OB 29/30/35 Significant Ammendment Development Envelope
Pipeline Corridor
Southern Creek
Whaleback Creek
Watercourse
Selected Sub Catchment Boundary



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Hydrology

N
0 1 2 3 4
Kilometres
Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:80,000	Prepared: C. Devlin	Project No: A817/98
Date: 30/08/2024	Checked: D. Noonan	Figure:

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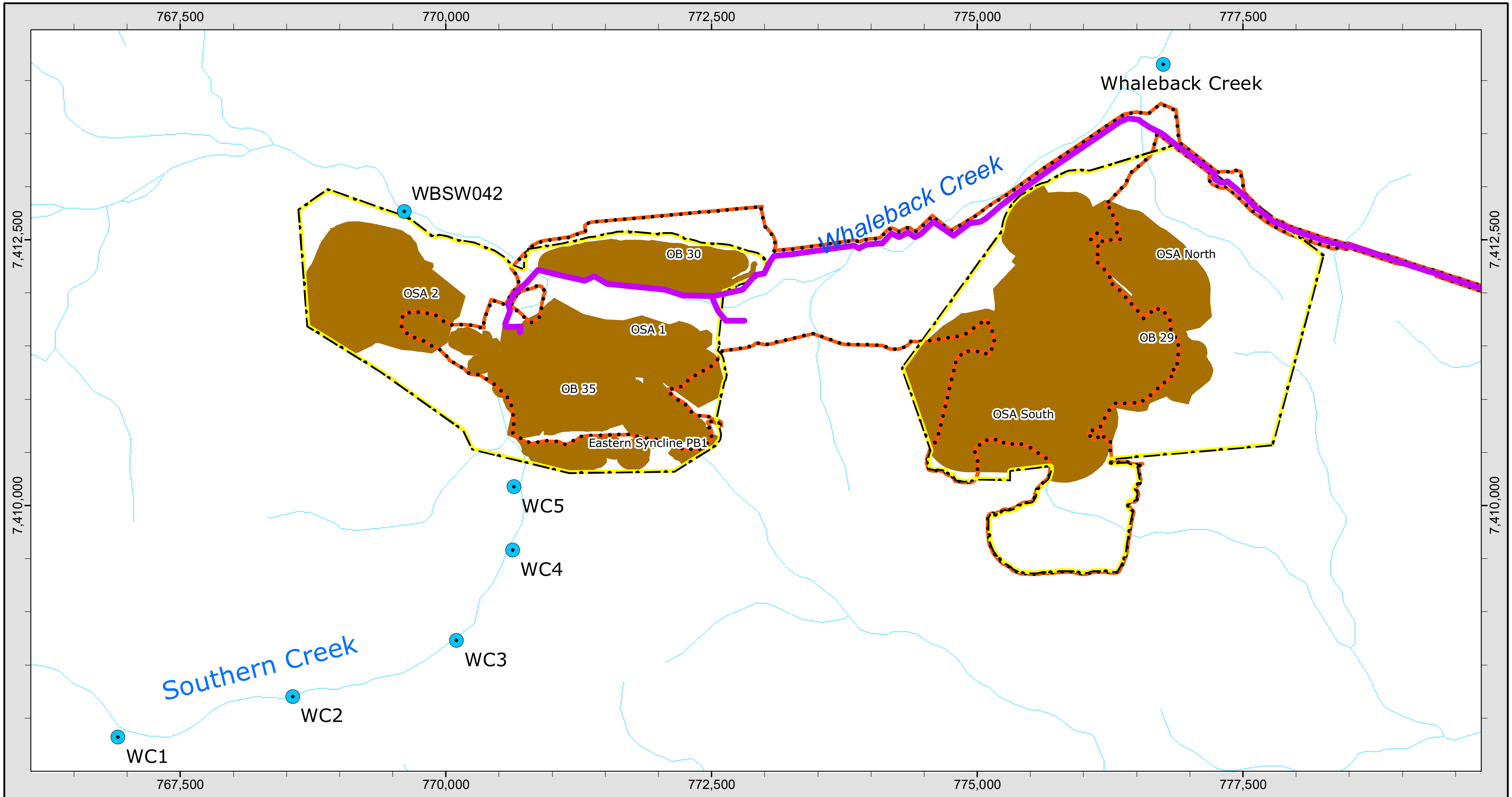
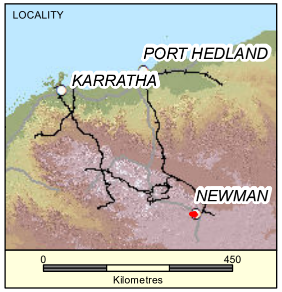


Water Monitoring Point
Pipeline Corridor
Closure Plan Area
OB 29/30/35 Significant Ammendment Development Envelope
Current Disturbance



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Surface Water Monitoring Locations

N
0 500 1,000 1,500 2,000
Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:50,000	Prepared: C. Devlin	Project No: A817/99
Date: 30/08/2024	Checked: D. Noonan	Figure:

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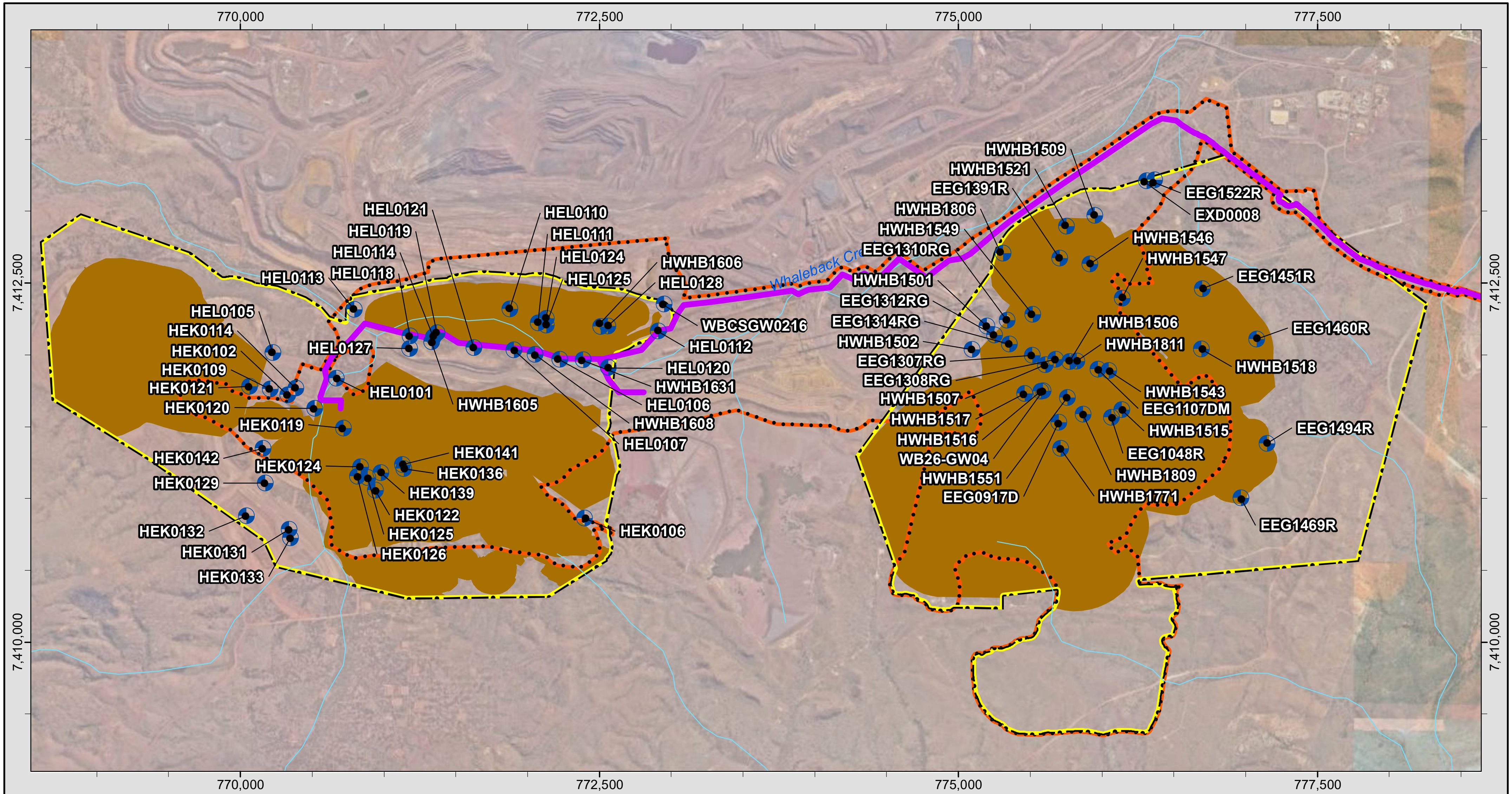

Monitoring Bore
Pipeline Corridor
Closure Plan Area
OB 29/30/35 Significant Ammendment Development Envelope
Current Disturbance

LOCALITY
PORT HEDLAND
KARRATHA
NEWMAN
0 450
Kilometres

BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Groundwater Monitoring Locations

N
0 500 1,000 1,500 2,000
Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:37,000	Prepared: C. Devlin	Project No: A817/105
Date: 30/08/2024	Checked: D. Noonan	Figure:

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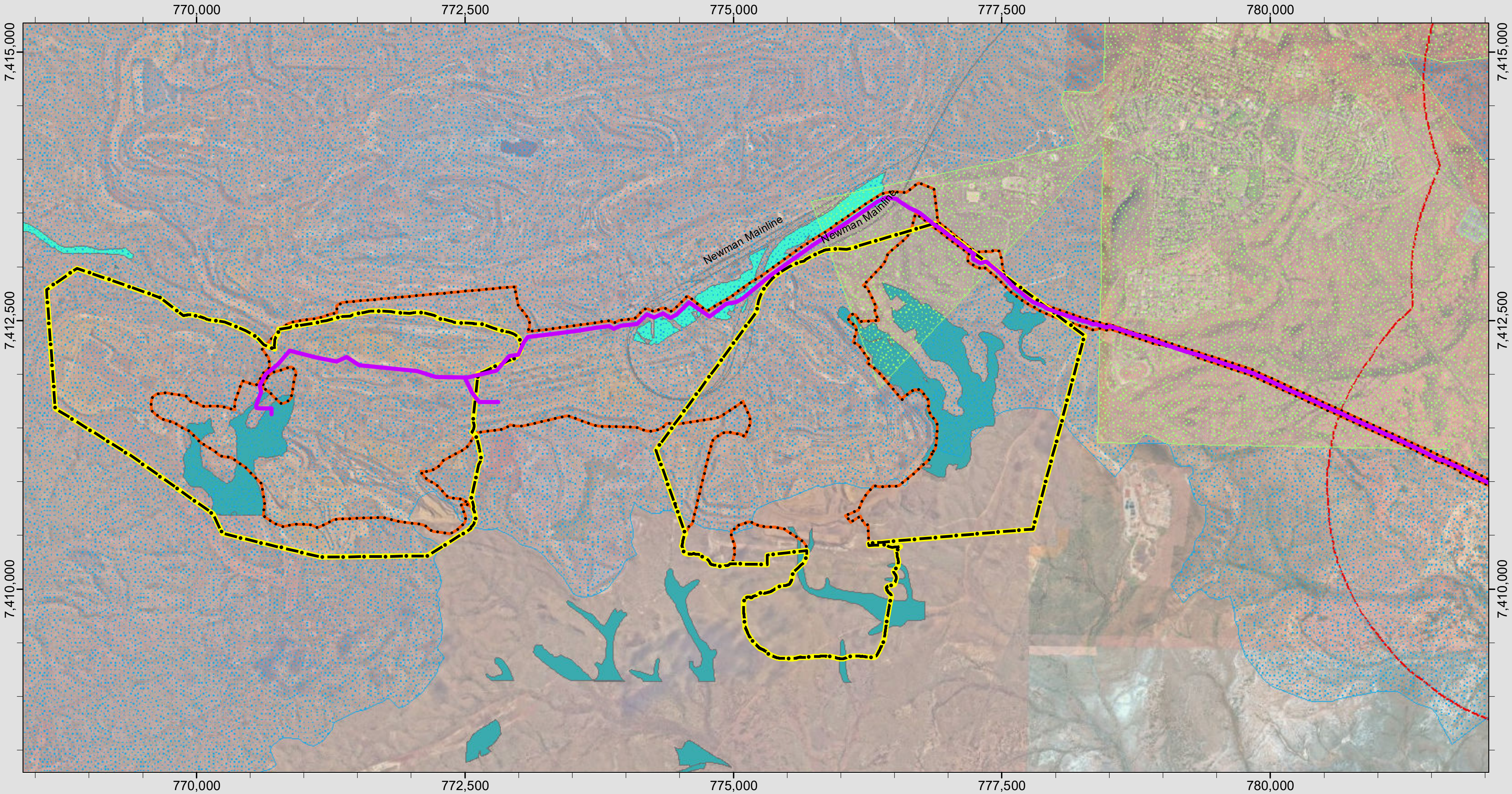


Closure Plan Area

OB 29/30/35 Significant Ammendment Development Envelope

Pipeline Corridor

Newman Drinking Water Reserve P3

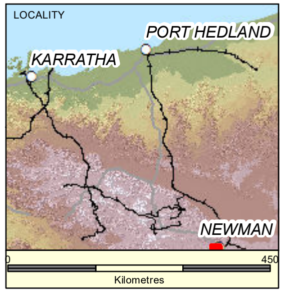
Newman Drinking Water Reserve P1

Eucalyptus Xerothermica

Eucalyptus Camaldulensis and Eucalyptus Victrix

Ethel Gorge Threatened Ecological Community - 2,000m Buffer

Rail



BHP

Spatial Data - Planning, Standards & Environmenrt

BHP IRON ORE

OB 29 / 30 / 35

Ecoyhdrological receptors

N

0 500 1,000 1,500 2,000

Meters

Coordinate System: GDA 1994 MGA Zone 50

Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:50,000	Prepared: C. Devlin	Project No: A817/101
Date: 15/10/2024	Checked: D. Noonan	Figure:

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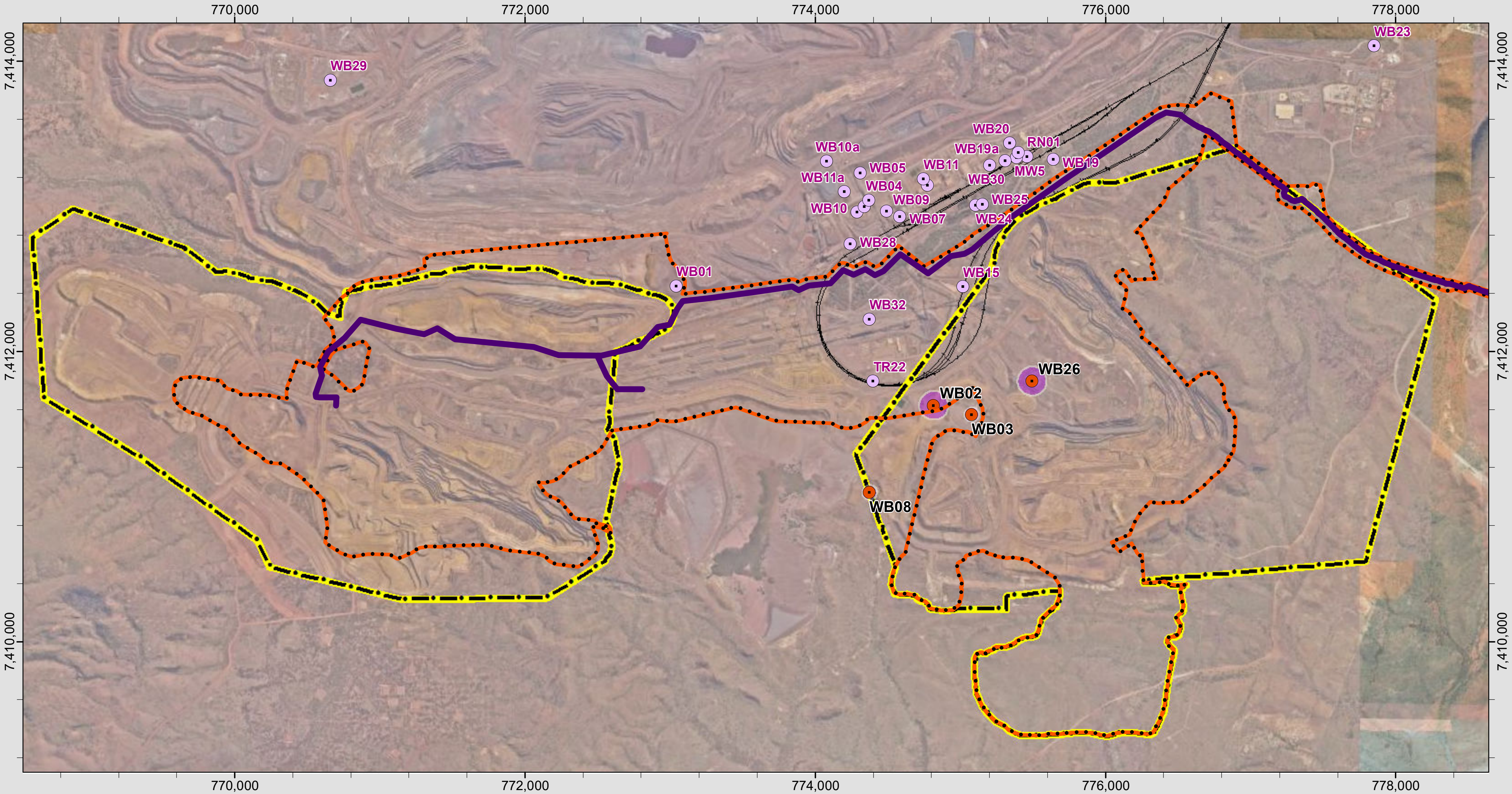


Closure Plan Area

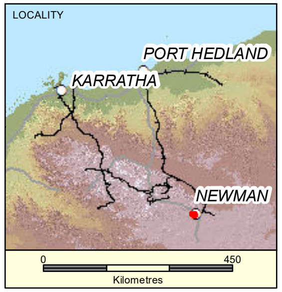
OB 29/30/35 Significant Ammendment Development Envelope

Pipeline Corridor

Contaminated Site

Contaminated Site (Not associated with this MCP)

Contaminated Potential Area of Impact



BHP

Spatial Data - Planning, Standards & Environmenrt

BHP IRON ORE

OB 29 / 30 / 35

Contaminated Sites

N

0 500 1,000 1,500 2,000

Meters

Coordinate System: GDA 1994 MGA Zone 50

Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:37,000	Prepared: C. Devlin	Project No: A817/102
Date: 30/08/2024	Checked: D. Noonan	Figure:

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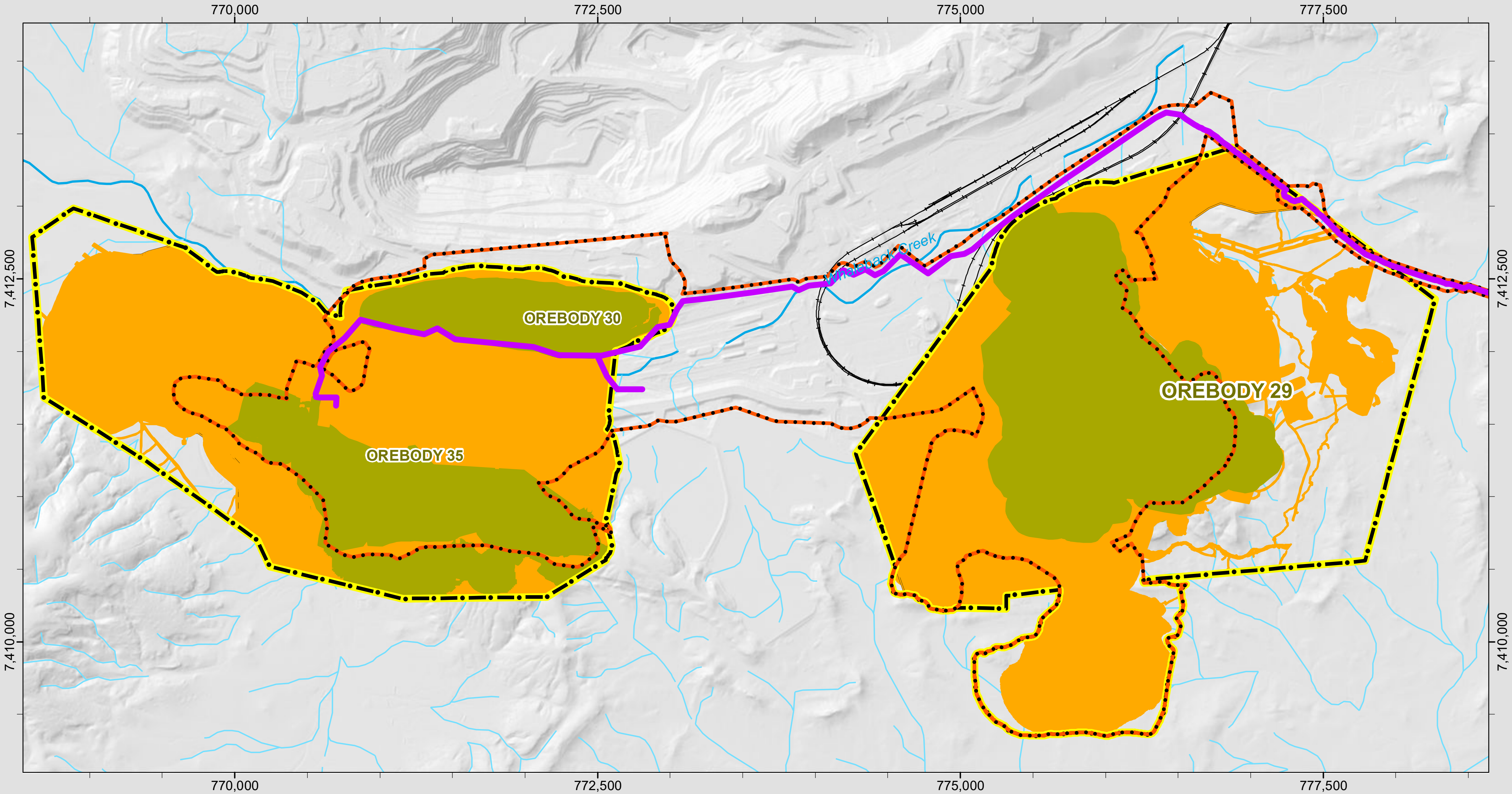
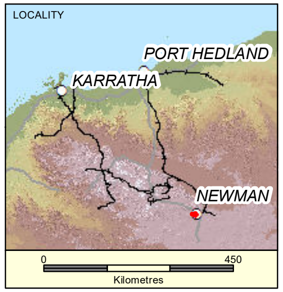


Post mining land use

- Natural environment for managed resource protection
- May not support specific land use due to ingress / egress restrictions. Further assessment required
- Closure Plan Area
- OB 29/30/35 Significant Ammendment Development Envelope
- Pipeline Corridor



BHP

Spatial Data - Planning, Standards & Environmenrt
BHP IRON ORE

OB 29 / 30 / 35
Post Mining Land Use

N

0 500 1,000 1,500 2,000
Meters

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator, Datum: GDA 1994, Units: Meter

Scale @ A4: 1:37,000	Prepared: C. Devlin	Project No: A817/108
Date: 2/09/2024	Checked: D. Noonan	Figure:

Document Path: Y:\Jobs\A501_A1000\A817\3Project\A817_108_E_Whaleback_Closure_Plan_2024_ProvisionalPostMining_RevA.mxd

Appendix O. Excerpt from 2023 AER

The excerpt below is from the BHP Annual Environment Report (AER) July 2022 – June 2023 (BHP, 2023e) for Whaleback which includes OB29/30/35.

A total of 472.6 ha of rehabilitated land was classified across 171 sites at Mt. Whaleback, which was comprised of 36 crest (52.3 ha), 71 flat (205.4 ha), and 64 slope (214.9 ha) landforms. The average native cover across rehabilitation sites greater than 0.25 ha at Mt. Whaleback was 36.8 per cent and ranged between 0.0 per cent and 93.2 per cent. Rehabilitated crests, flats, and slopes had an average native cover of 34.6 per cent, 35.4 per cent, and 39.8 per cent, respectively (Figure O 1 and Figure O 2). On average, native vegetation cover at Mt. Whaleback consisted of 2.4 per cent other grass (Tussocks), 15.9 per cent Hummock grass (Triodia spp.), 11.2 per cent shrub, 5.5 per cent Mulga (Acacia aneura complex), 1.0 per cent herb and 0.9 per cent tree cover. Mean hummock grass cover was lowest on crests and flats (13.4-13.5 per cent), relative to slope (20.1 per cent) landforms (Figure O 2). Introduced plant species (weeds) covered 16.4 per cent of Mt. Whaleback rehabilitation on average, and weed cover was highest on flat sites (21.6 per cent), relative to crest (12.0 per cent) and slope (13.2 per cent) landforms (Figure 7-6). Bare areas (defined as patches devoid of vegetation with a diameter > 20 m), covered 6.8 per cent of rehabilitated sites on average and ranged between 0.0 per cent and 99.8 per cent. Mean bare area cover varied between crest (5.1 per cent), flat (6.6 per cent), and slope (8.2 per cent) landforms.

Rehabilitation sites greater than 15 years old accounted for 8.8 ha of rehabilitated land at Mt. Whaleback, of which 43.1 per cent (3.8 ha) is currently meeting “Low Tree Steppe” completion criteria targets (Table O 1). A total of 69.6 per cent (297.0 ha) of the 426.3 ha of rehabilitated land between 5 and 15 years old (or with no accurate date information) is not currently meeting “Progressive” completion criteria targets (Table O 2). In 2023, rehabilitated land passing the Progressive completion criteria increased by 17.2 per cent from the previous monitoring year. A total of 28.2 per cent (10.6 ha) of the 37.5 ha of rehabilitated land less than 5 years old is currently meeting “Young” completion criteria targets (Table O 3). There was a decrease in the percentage of rehabilitation passing the “Young” completion criteria at slope and flat landforms in 2023 (Table 7-6), which is likely due to the addition of new rehabilitation sites, lower herb cover, and higher precision of modelling compared to previous years. In 2023, decreases in rehabilitation passing “Young” completion criteria was observed in flat (22.9 per cent) and slope (15.1 per cent) landforms, while an increase was observed in crest landforms (51.2 per cent).

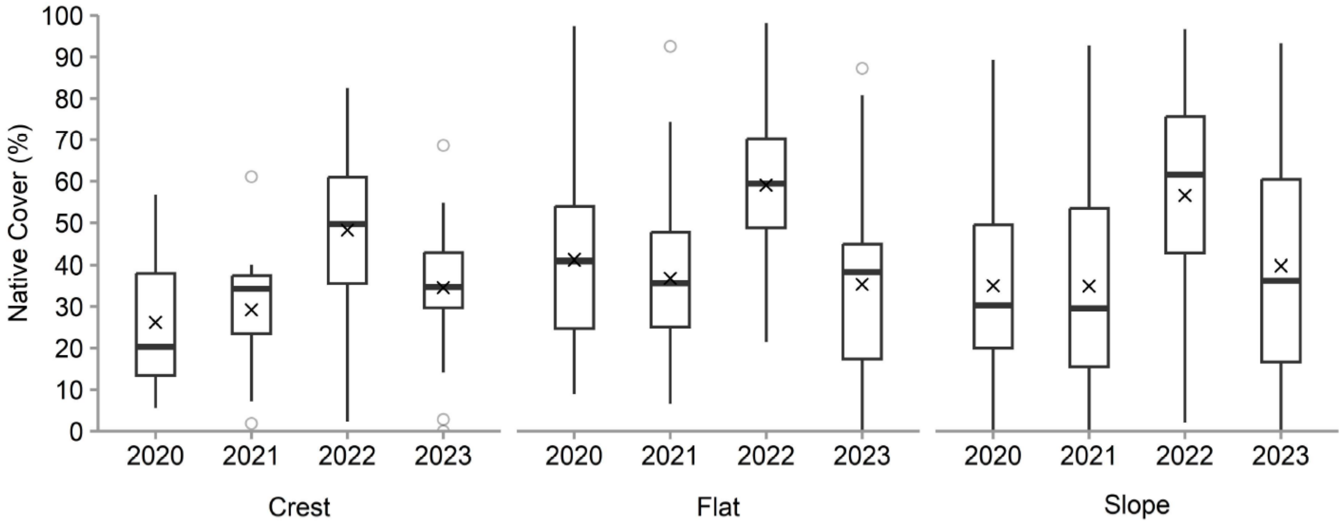


Figure O 1 Boxplots summarising the total native vegetation cover recorded at rehabilitated sites at Mt Whaleback
Boxplots display the range, quartiles, median (black), and mean (grey) of total native vegetation cover values recorded at each landform.

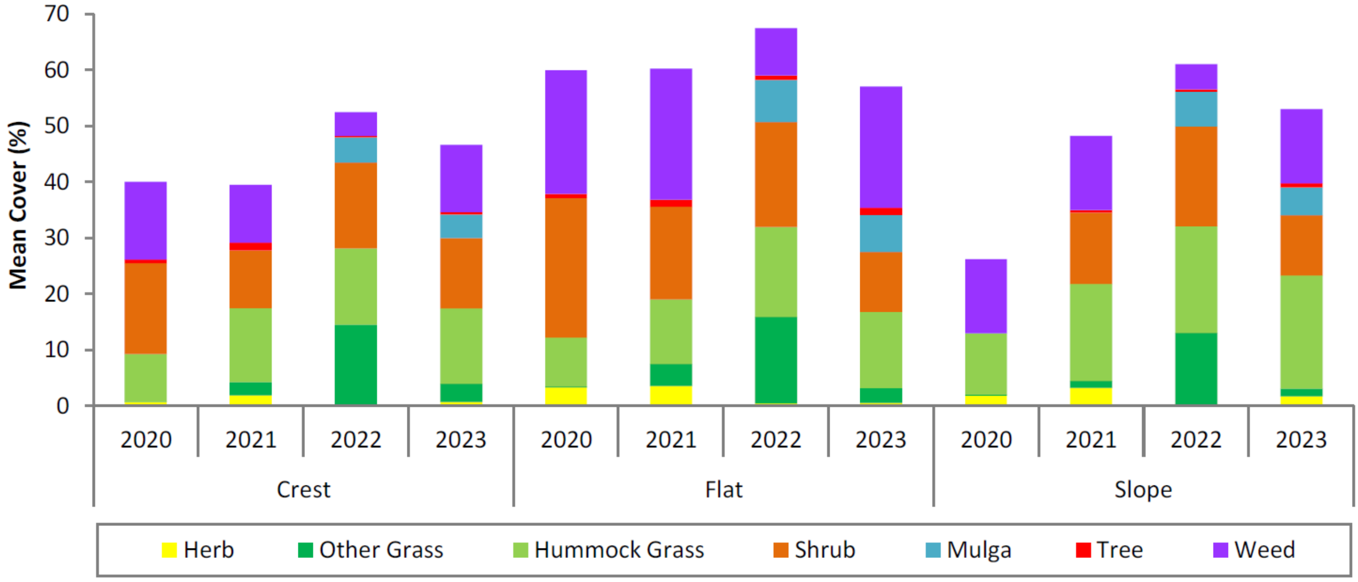


Figure O 2 Mean percent cover of lifeforms at Mt Whaleback for each landform

Table O 1 Mt Whaleback summary of Completion Criteria (< 5 Years)

Site Details			Percent of Total Rehabilitated Area			
			All Criteria	Hummock Grass/Shrub Cover Ratio	Total Weed/Hummock Grass Cover Ratio	Total Native Cover
Landform	Area (ha)	Outcome		> 2	< 1	> 12
Crest	2.6	Pass	51.2	51.2	51.2	51.2
		Change	51.2	51.2	-48.8	-48.8
Flat	21.5	Pass	42.9	58.0	58.0	69.0
		Change	-22.9	-7.8	-41.2	-31.0
Slope	13.4	Pass	0.0	18.1	25.2	8.9
		Change	-15.1	3.0	-49.0	-65.3

Table O 2 Mt Whaleback summary of Completion Criteria (5 - 15 Years)

Site Details			Percent of Total Rehabilitated Area		
			All Criteria	Hummock Grass/Native Cover Ratio	Total Weed/Hummock Grass Cover Ratio
Landform	Area (ha)	Outcome		> 0.32	< 1
Crest	49.7	Pass	28.5	30.8	32.6
		Change	-12.8	-12.7	-59.7
Flat	175.9	Pass	29.8	38.6	42.4
		Change	22.7	31.0	-17.4
Slope	200.6	Pass	31.2	43.3	32.1
		Change	18.8	29.9	-32.7

Table O 3 Mt Whaleback summary of Completion Criteria (> 15 Years)

Site Details			Percent of Total Rehabilitated Area								
			All Criteria	Bare Ground Cover	Cenchrus Cover	Total Weed Cover	Tree Cover	Shrub Cover	Hummock Grass Cover	Other Gras Cover	Herb Cover
Landform	Area (ha)	Outcome		< 50%	< 10%	< 10%	> 1%	> 2%	> 20%	> 0.04%	>0.05
Crest	-	Pass	-	-	-	-	-	-	-	-	-
		Change	-	-	-	-	-	-	-	-	-
Flat	7.9	Pass	47.8	100.0	86.7	86.7	94.9	100.0	96.9	100.0	61.1
		Change	47.8	0.0	-13.3	-13.3	13.3	0.0	61.1	0.0	-1.3
Slope	0.9	Pass	0.0	100.0	100.0	100.0	0.0.	100.0	100.0	100.0	0.0
		Change	0.0	0.0	0.0	0.0	0.0	0.0	54.2	0.0	0.0