

BHP

Marillana Creek Water Resource Management Plan



February 2026
Version 2.1

Document amendment record

Version	Section/page	Version description	Key changes	Date
Revision 3.0	All	Marillana Creek (Yandi) Surface Water and Groundwater Management Plan	Submitted and endorsed	11/2014
1.1	All	Marillana Creek Water Resource Management Plan Version 1.1. Changes to the approved Marillana Creek (Yandi) Surface Water and Groundwater Management Plan (2014). Included detail of groundwater monitoring and reporting process. Identified potential changes to surface water regime.	Update to incorporate response to Peer Review	31/1/2018
1.2	All	Marillana Creek Water Resource Management Plan Version 1.2. Updated in response to comments from DWER on Version 1.1. Restructured/updated to align with EPA's revised October 2021 Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans.	Updated in response to comments from DWER on Version 1.1 and restructured/updated to align with EPA's revised <i>Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans</i> (2021).	29/7/2022
1.3	All	Marillana Creek Water Resource Management Plan Version 1.3. Updated to incorporate Significant Amendment for Yandi and the revised Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans, March 2024.	Update to align with Significant Amendment.	15/3/2024
1.4	All	Marillana Creek Water Resource Management Plan Version 1.4. Yandi Significant Amendment	Updated to support referral of the Marillana Creek (Yandi) Life of Mine Significant Amendment Proposal. Updated to align with the EPA's revised <i>How to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans</i> (EPA 2024)	21/6/2024
1.5	All	Marillana Creek Water Resource Management Plan Version 1.5 – Yandi Significant Amendment	Updated to include BNTAC comments to support the referral of the Marillana Creek (Yandi) Life of Mine Significant Amendment Proposal	20/2/2025
2.0	All	Marillana Creek Water Resource Management Plan Version 2.0 – for referral to EPA with Yandi Significant Amendment	Change incorporating technical advice and further studies.	17/4/2025
2.1	All	Marillana Creek Water Resource Management Plan Version 2.1 – updates following DWER comments dated 22/9/2025.	Changes to incorporate DWER comments as part of a Part IV Significant Amendment assessment. Inclusion of subterranean and aquatic	04/02/2026

Version	Section/page	Version description	Key changes	Date
			fauna habitat monitoring and management. General updates.	

Abbreviations and Definitions

Term	Meaning
BHP	BHP Iron Ore Pty Ltd
CAR	Compliance Assessment Report
CEO	Chief Executive Officer
CID	Channel Iron Deposit
Clearing	As defined in section 51A of the <i>Environmental Protection Act 1986</i>
DBCA	Department of Biodiversity, Conservation and Attractions
DWER	Department of Water and Environmental Regulation
EMP	Environmental Management Plan
EPA	Environmental Protection Authority
EP Act	<i>Environmental Protection Act 1986</i>
GIS	Geographic Information System
km	Kilometre
ML/d	Megalitres per day
MCWRMP	Marillana Creek Water Resource Management Plan
mbgl	metres below ground level
mg/L	milligram per litre
MCP	Mine Closure Plan
MS	Ministerial Statement
OSA	Overburden Storage Area
PEC	Priority Ecological Community
Remedial Measures	Proposed actions to address trigger/threshold exceedances
RVMP	Riparian Vegetation Health Monitoring Program
RiWI Act	<i>Rights in Water and Irrigation Act 1914</i>
SSTV	Site Specific Trigger Values
SWGMP	Surface water and groundwater management plan (referred to in MS 679)
TDS	Total dissolved solids

Term	Meaning
TEC	Threatened Ecological Community
WA	Western Australia
WAIO	Western Australia Iron Ore

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Executive Summary

Marillana Creek Water Resource Management Plan	
Proposal name	Marillana Creek (Yandi) Life of Mine Proposal
Proponent name	BHP Iron Ore Pty Ltd
Ministerial Statement	XXXX
Purpose of the EMP	To meet the requirements of implementation Condition X of Ministerial Statement XXXX
Key environmental factors and objectives	<p>Inland Waters:</p> <ul style="list-style-type: none"> Monitor the impact of the proposal on key water parameters. <p>Flora and Vegetation:</p> <ul style="list-style-type: none"> Maintain the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected. <p>Subterranean Fauna:</p> <ul style="list-style-type: none"> To protect subterranean fauna so that biological diversity and ecological integrity are maintained. <p>Terrestrial Fauna:</p> <ul style="list-style-type: none"> To protect terrestrial fauna habitat quality from groundwater drawdown and discharge water quality impacts. <p>Additional conditions to be advised</p>
Key components of the plan	<p>See Table 7 and Table 8</p> <p>Outcome-based components, including trigger and threshold criteria, for:</p> <ul style="list-style-type: none"> Groundwater quantity – Groundwater levels in the Channel Iron Deposit (CID) aquifer of Marillana Creek in upstream areas from mining operations Riparian vegetation tree health – Canopy decline (defined as Crown Condition Score) and water stress (defined by Leaf Water Potential) of the riparian species <i>Melaleuca argentea</i> in upstream areas from mining operations Subterranean Fauna Habitat – Groundwater quantity- Maintain groundwater levels in the Channel Iron Deposit (CID) aquifer of Marillana Creek in upstream areas from mining operations. <p>Objective based components relating to:</p> <ul style="list-style-type: none"> Developing a dataset of groundwater levels and drawdown in upstream areas from mining operations Determining throughflow based on current groundwater levels Developing a correlative approach to monitoring groundwater levels and discharge water quality to protect multiple environmental factors including riparian tree health, terrestrial fauna habitat and stygofauna values.
Proposed construction date	N/A – project commenced in 1991 and is in the operational phase

Marillana Creek Water Resource Management Plan	
Proposal name	Marillana Creek (Yandi) Life of Mine Proposal
EMP required pre-construction?	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>

1 Context, scope and rationale

BHP Iron Ore Pty Ltd (BHP) has prepared this Marillana Creek Water Resource Management Plan (MCWRMP) for the Marillana Creek (Yandi) Life-of-Mine to meet the requirements of Ministerial Statements 679 and 1039 (as superseded by Ministerial Statement XXXX) granted under Part IV of the *Environmental Protection Act 1986* (EP Act).

The *Surface Water and Groundwater Management Plan* (SWGWMP) (BHP Billiton Iron Ore, 2014a) was submitted to the Environmental Protection Authority (EPA) on the 28 November 2014, as part of a section 45C application for Ministerial Statement 679 (MS679), and subsequently approved on 1 April 2015 (Ref: A427483:OEPA2001/000759). This plan updates and replaces the previous SWGWMP (BHP, 2014).

This plan has been substantially reviewed and updated to meet the requirements of the *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (hereafter, the Instructions) (EPA 2024), as far as practical.

Potential impacts to Marillana Creek were first identified and assessed as part of the original Part IV EP Act referral in 1988. The 1987 Public Environmental Review (BHP, 1987) for the original Yandicoogina (Marillana) Project identified that long-term impacts to riparian vegetation were expected from mine dewatering, however the impacts were not expected to affect the long-term viability of the riparian vegetation species. BHP are required to monitor the impacts of drawdown and discharge on surface and groundwater quality, and riparian vegetation communities within the Development Envelope (as defined in Figure 2) and minimise impacts through implementation of monitoring and management measures. This plan sets out the monitoring and management methods proposed by BHP to minimise impacts to vegetation, terrestrial fauna habitat, subterranean fauna, water quality and water quantity in Marillana Creek.

1.1 Proposal

The Yandi mine is located approximately 90 km north-west of Newman, in the Pilbara region of Western Australia (Figure 1).

Mining operations at Yandi were first approved in 1988, and mining commenced in 1991. Since that time, the Approved Proposal has undergone several modifications, which authorised increased rates of production and mining of additional pits.

The most recent modification occurred in 2025, when BHP submitted a Significant Amendment under Part IV of the EP Act for the development of the E8 orebody. This proposal includes the E8 West pit to be mined above the water table, and E8 East pit to be mined below the water table. The Indicative Footprint associated with this Significant Amendment is shown in Figure 2.

The Yandi mine is situated within the Upper Fortescue Regional Water Catchment Area. BHP describes the extent of its Yandi tenure of this regional catchment as the 'Marillana Creek Water Management Area' and has developed this MCWRMP to apply to the Development Envelope (Figure 2).

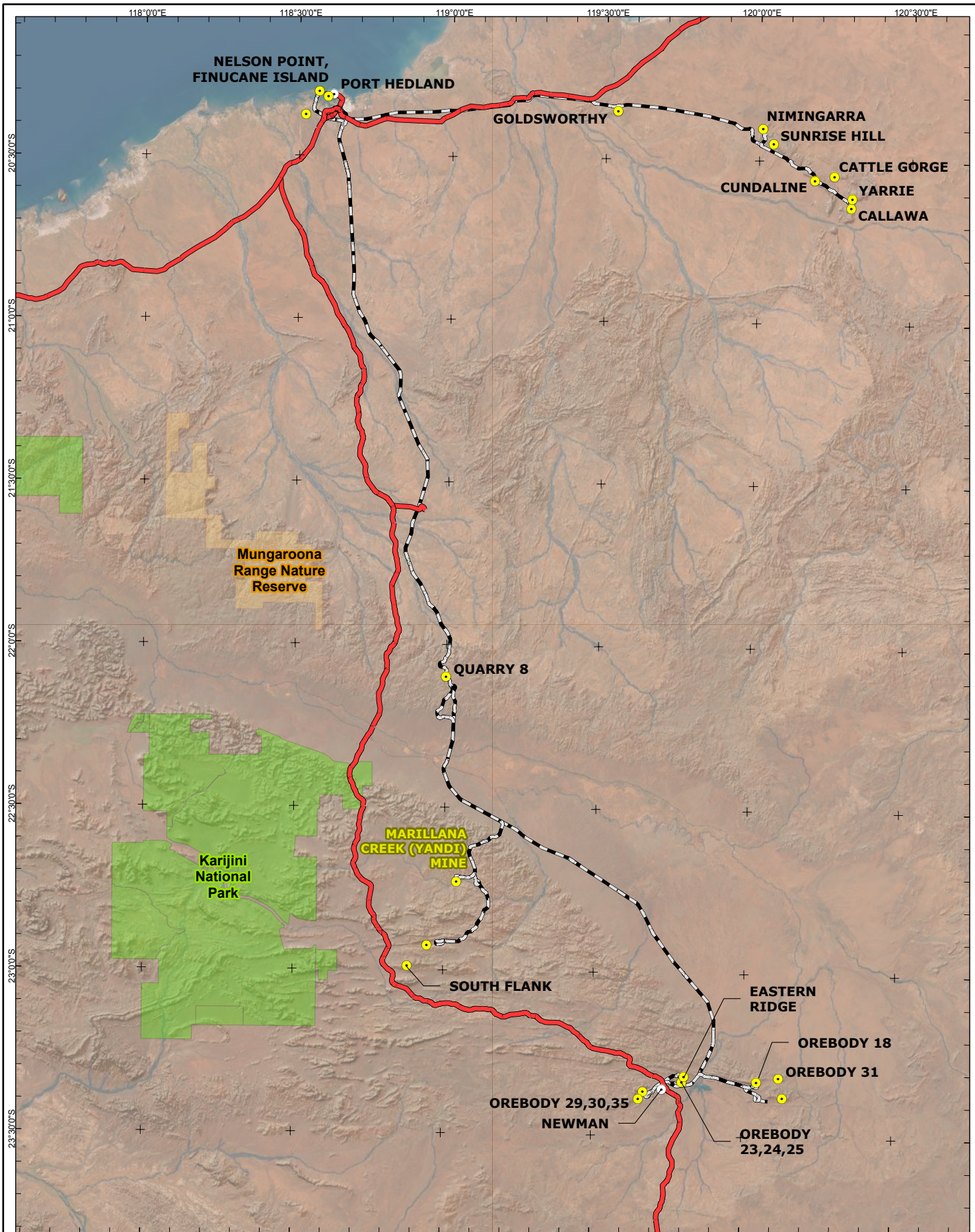
The orebody is a near surface Channel Iron Deposit (CID) which, for mine planning purposes, has been sub-divided into a series of mine resource areas known as the Western 0 to Western 6 pits, Central 1 to Central 5 pits and, Eastern 1 to Eastern 8 pits (Figure 2). Ore is mined using conventional open pit mining methods, including mine dewatering and below water table mining, before being transported by rail to Port Hedland for export.

The Yandi mine includes:

- open cut mining of overburden and ore from the CID
- dewatering of the orebody during mining operations
- placement of overburden in mined-out voids and out of pit storage areas
- processing, loading and rail transportation of ore
- supply and distribution of power and raw water to meet operational demands
- provision of service infrastructure (e.g. access roads, workshops, administration areas, accommodation village, airstrip).

The Yandi mine required the diversion of the Marillana Creek to access several deposits. Diversion activities operate under a separate *Marillana Creek Diversion Management Plan* (BHP 2016a).

Mine dewatering is undertaken to facilitate mining below the water table. Water is extracted and used to meet local mine water demand (beneficial use), with the surplus being discharged to Marillana Creek via one discharge point and one supplementary discharge point (Figure 3). Dewatering has been carried out in almost all pits at Yandi to enable the extraction of ore, with some areas currently being actively dewatered (Western 0, Western 1, Western 2, Western 5, Western 6, Eastern 1, Eastern 3, Eastern 5, and Eastern 7) and others where abstraction continues to prevent pit lake formation and support backfilling activities.



- Town
- BHP WAIO operation
- Rail
- National highway
- National park
- Nature reserve



BHP

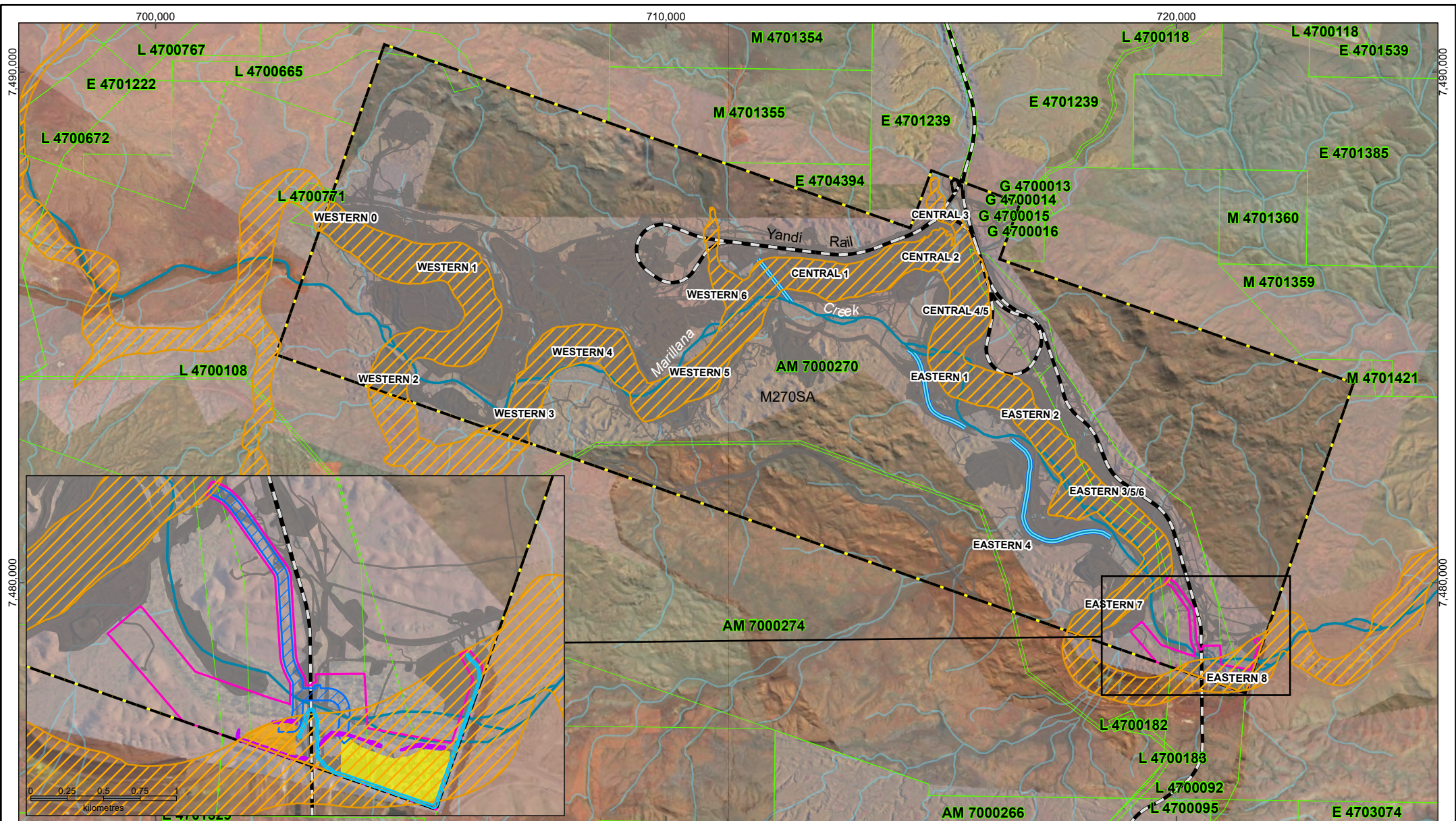
PUBLIC

**MARILLANA CREEK (YANDI)
MCWRMP
REGIONAL LOCATION**

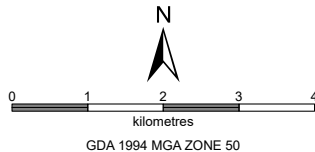
WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A4: 1:1,700,000 PREPARED: GEOMATICS FIGURE: 1
DATE: 6/04/2025 REQUESTOR: ENV APPROVALS NO:

A1205-091-RevA



- BHP rail
- Constructed Creek Diversion
- Flood bunds
- Haul Road
- LV road
- Adjacent Mining Tenements
- BHP Tenement
- Indicative Footprint
- Development Envelope
- CID channel
- Eastern Pit
- Western Pit
- Existing Disturbance



BHP PUBLIC

**MARILLANA CREEK (YANDI) MCWRMP
YANDI MINE OVERVIEW**

WAIO PLANNING, TECHNICAL & ENVIRONMENT
 SCALE @ A4: 1:100,000 PREPARED: GEOMATICS FIGURE: 2
 DATE: 24/04/2025 REQUESTOR: ENV APPROVALS

A1205-092-RevB

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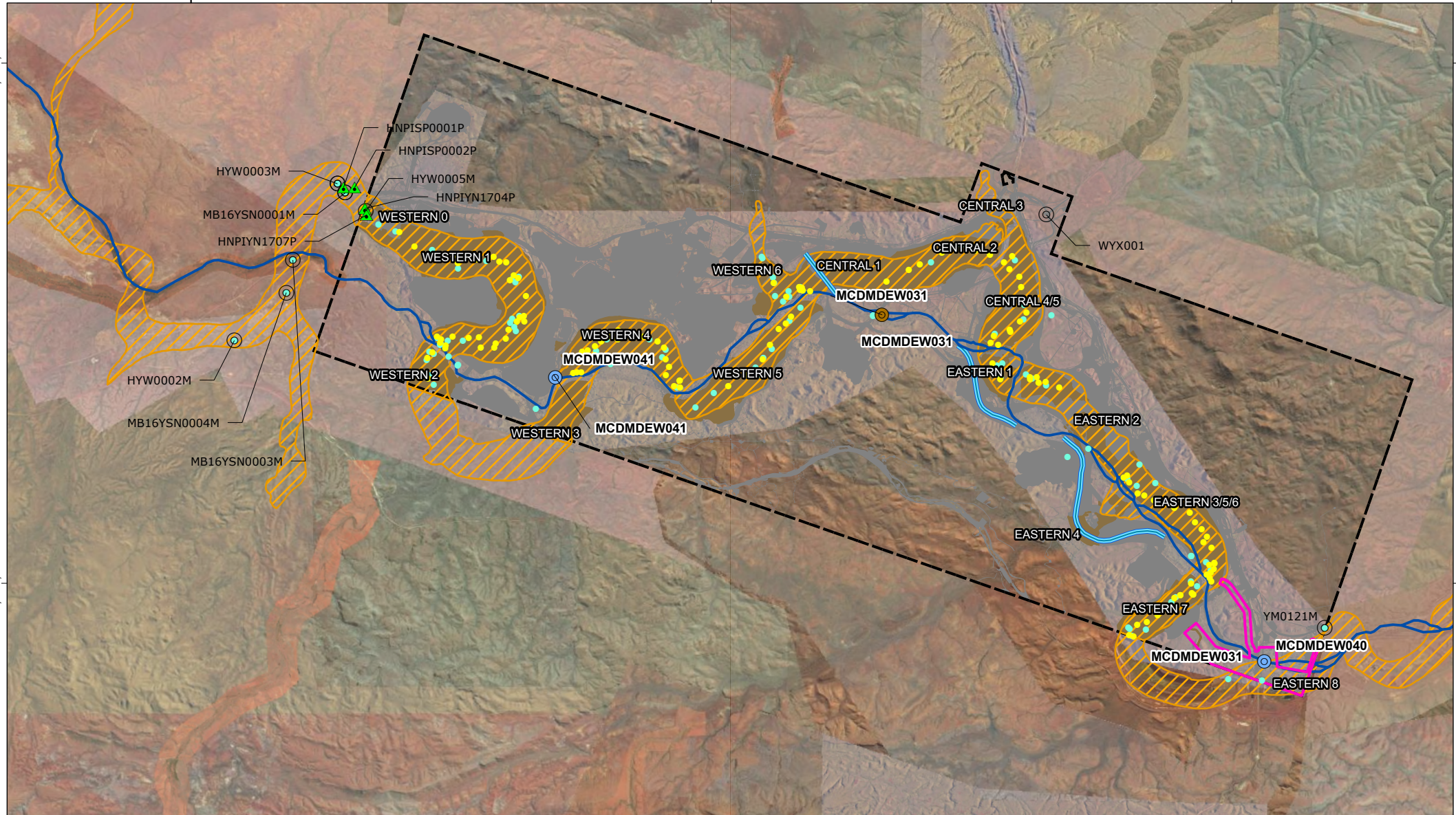
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7,490,000

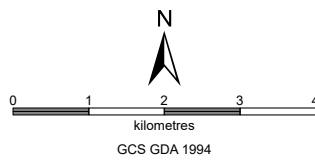
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- ▲ Surface Water Monitoring Points
- Up gradient and down gradient bores
- Discharge point
- Decommissioned Discharge point
- Monitoring Borehole
- Production Borehole
- Marillana Creek
- Constructed creek diversion
- Development Envelope
- CID channel
- Indicative Footprint
- Existing Disturbance
- Pits



BHP PUBLIC

**MARILLANA CREEK (YANDI) MCWRMP
MARILLANA CREEK DISCHARGE POINTS
AND MONITORING BORES**

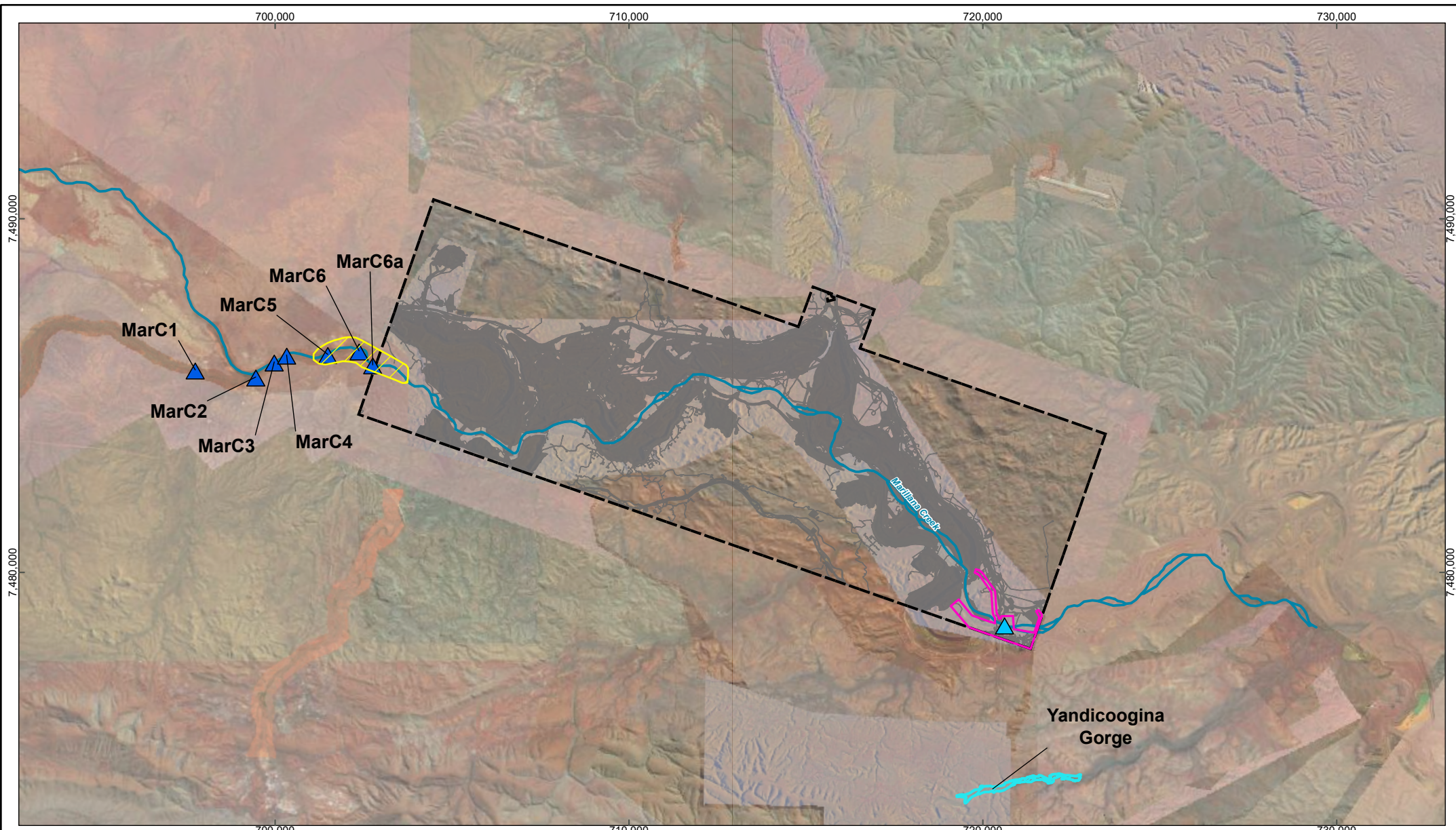
WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A4: 1:100,000 PREPARED: SPATIAL DATA FIGURE: 3

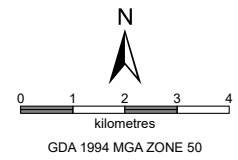
DATE: 24/04/2025 REQUESTOR: ENV APPROVALS

A1205-093-RevB

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- ▲ Surface Water Discharge Point
- ▲ Marillana Creek Pools (Biologic 2022)
- Marillana Creek
- Indicative Footprint
- Development Envelope
- Indicative location of Flat Rocks
- Existing Disturbance



BHP **PUBLIC**

MARILLANA CREEK (YANDI) MCWRMP
FLAT ROCKS AND SURFACE WATER
DISCHARGE LOCATION

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A4: 1:145,000	PREPARED: GEOMATICS	FIGURE: 4
DATE: 28/04/2025	REQUESTOR: ENV APPROVALS	

A1205-104-RevA

1.2 Key environmental factors, values and potential impacts

The key environmental factors relevant to the MCWRMP are Inland Waters, Flora and Vegetation, Terrestrial Fauna and Subterranean Fauna. Table 1: summarises the environmental values, mine activities and actual or potential impacts on the key environmental factors addressed by this MCWRMP.

Table 1: Key environmental factors, values, activities and impacts

Key environmental factor	Environmental values	Proposal activities	Actual/Potential Impacts
Inland Waters	Marillana Creek groundwater system	Groundwater drawdown dewatering from mine pits	Direct impacts <ul style="list-style-type: none"> • Drawdown of groundwater table • Altered CID through flow • Altered groundwater chemistry
	Marillana Creek surface water	Discharge of surplus water from mine dewatering into Marillana Creek	Direct impacts <ul style="list-style-type: none"> • Changes to surface water regime of Marillana Creek – timing and duration of flow • Altered water chemistry
	Marillana Creek pools (including Flat Rocks) and aquatic fauna habitat	Groundwater drawdown from dewatering mine pits	Indirect impacts <ul style="list-style-type: none"> • Decline in water levels in pools
Flora and Vegetation	Marillana Creek riparian vegetation	Groundwater dewatering from mine pits	Indirect impacts <ul style="list-style-type: none"> • Reduction in extent and health and changes in composition of riparian vegetation along Marillana Creek due to drawdown (particularly where it crosses the CID adjacent to mine pits being actively dewatered).
		Discharge of surplus mine dewater along Marillana Creek	Indirect impacts <ul style="list-style-type: none"> • Reduction in health and changes in composition of riparian vegetation along Marillana Creek due to more frequent inundation at discharge points (e.g. saturation of rooting zones, weed invasion). • Degradation of riparian vegetation health through groundwater contamination/ altered groundwater chemistry
Subterranean Fauna	Stygofauna habitat	Groundwater dewatering from mine pits	Direct impacts <ul style="list-style-type: none"> • Changes to stygofauna habitat and species assemblages from groundwater drawdown

Key environmental factor	Environmental values	Proposal activities	Actual/Potential Impacts
		Discharge of surplus mine dewater along Marillana Creek	Indirect impacts <ul style="list-style-type: none"> Degradation of stygofauna habitat through groundwater contamination/ altered groundwater chemistry
		Groundwater dewatering from mine pits	Indirect impacts <ul style="list-style-type: none"> Degradation of terrestrial fauna habitat through groundwater drawdown Degradation of terrestrial fauna habitat through groundwater contamination/ altered groundwater chemistry
Terrestrial Fauna	Terrestrial Fauna habitat	Discharge of surplus mine dewater along Marillana Creek	Indirect impacts <ul style="list-style-type: none"> Degradation of fauna habitat along Marillana Creek due to more frequent inundation at discharge points (e.g. saturation of vegetation rooting zones, weed invasion).

1.3 Condition requirements

Ministerial Statement (XXXX) requires the following objectives to be met, as attributable to BHP's Yandi mine:

1. Minimise potential impacts on surface water flow rates, water levels and water quality in Marillana Creek.
2. Minimise potential impacts to the health, extent and diversity of riparian vegetation within the Development Envelope because of changes to groundwater regimes and water quality.
3. Minimise potential impacts to subterranean fauna habitat because of changes to groundwater regimes.
4. Minimise potential impacts to aquatic fauna habitat because of changes to surface or ground water regimes.
5. Implement the Marillana Creek Water Resource Management Plan (MCWRMP), with the purpose of ensuring objectives 1 to 4 above are achieved, monitored and substantiated.

1.4 Other Regulatory Requirements

This EMP does not intend to duplicate monitoring and/or controls in other statutory decision-making processes for water-related activities at the Yandi mine. This includes regulation administered by DWER including approvals issued under Part V of the EP Act and the *Rights in Water and Irrigation Act 1914* (RiWI Act). Monitoring and controls from these approvals are provided in the appendices of this plan to illustrate the actions required under separate regulatory instruments. This plan does not seek to duplicate the regulatory requirements of these separate approvals.

Yandi Biodiversity Environmental Management Plan (BHP 2024a)

The Yandi Biodiversity Environmental Management Plan (BEMP) specifically relates to the Flora and Vegetation and Terrestrial Fauna factor guidelines, and the EPA's Statement of Environmental Principles, Factors and Objectives (EPA 2023a) which lists the following as their objective for flora and vegetation:

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

And for Terrestrial Fauna:

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

The BEMP provides the management targets, management actions, monitoring and reporting requirements including the following

- Minimise or avoid impacts on identified flora species, vegetation associations and habitat areas for fauna species of conservation significance.
 - Annual record of the number of remaining Priority Flora records within the development area that have been disturbed.
 - Annual land disturbance reconciliation (hectares and spatial footprint).
 - Undertake weed mapping annually to monitor the presence/absence and intensity of weeds
 - Undertaken weed control and eradication measure in high priority and/or risk areas at least annually prior to the end of June.
- Minimise or avoid impacts on fauna and habitat areas for species of conservation significance.
 - Annual review of conservation significant fauna habitat within the Development Envelope that have been disturbed.
 - Annual land disturbance reconciliation (hectares and spatial footprint).

The results of the BEMP are included in the BHP Annual Environmental Report.

Marillana Creek Diversion Management Plan (BHP 2016)

The “*Life of Mine Proposal*” for the Yandi (Marillana Creek) Mining Operations was submitted to the Environmental Protection Authority in 2005. Key characteristics of the Proposal included diversion of sections of Marillana Creek in order to maximise resource use in the W5 mine area and the E1 to E6 mine area. The Marillana Creek Diversion Management Plan (MCDMP) is to provide environmental measures so that diverted sections of Marillana Creek function as a fluvial system in a similar manner to the existing creek system.

The MCDMP includes the following management actions:

- surface water monitoring of flow, turbidity and total suspended solids;
- index of diversion condition monitoring;
- fixed point photographs and aerial photography analysis;
- assessment of condition of any rectification or rehabilitation measures; and
- evaluation of ecological indicators.

The monitoring results of the MCDMP are included in the BHP Annual Environmental Report and the BHP Annual Aquifer Review.

Licence to Take Water

Groundwater quality and abstraction is managed via the *Rights in Water and Irrigation Act, 1914* (RiWI Act) 5C Licence to Take Water GWL89501 which allows for the annual abstraction of 20,650,520 kL of groundwater.

The groundwater abstraction is carried out in accordance with the Groundwater Licence (GWL) Operating Strategy for Yandi (Marillana Creek) Operations Version 3.1 (BHP Billiton 2024) (GWOS) as stipulated in Condition 3 which:

- specifies monitoring at the source (production and dewatering bores) - abstraction rate, abstraction volume, groundwater levels and water quality, noting that the measurement of surplus water quality is not a requirement; and
- specifies monitoring along the pathway (regional bores) and receptor (tree health monitoring bores) – groundwater levels.

Groundwater quality monitoring is included in the GWOS and includes two hydrochemistry suites, a comprehensive suite undertaken at bore installation and a standard suite done for routine monitoring. Both suites meet the requirements of DWER *Operational policy 5.12 Hydrogeological reporting associated with a groundwater well licence* (DoW, 2009) and outline the minimum reportable parameters as per the current GWOS. The latest version of the GWOS should always be referred to.

Site-specific water quality internal trigger values developed for Yandi are provided in the GWOS. The GWOS forms part of the licence conditions for GWL89501 issued by DWER under section 5C of the *RiWI Act*. These trigger values are concentrations/values that, if exceeded, shall 'trigger' a management process. The trigger values are not designed to be used as 'compliance' or threshold values at which an environmental impact is inferred if exceeded; rather, they are designed to be used in conjunction with professional judgment and site-based experience to provide an initial assessment of the state of the water body (ANZG, 2018). An exceedance of the trigger values are intended to provide an 'early warning' mechanism to flag a variance from the expected response. The appropriate response may be further site-specific investigation, or management action dependent upon the circumstances. Management actions are further defined in Table 7 and 8. BHP submits Annual Aquifer Reviews (AARs) and Triennial Aquifer Reviews (TARs) to the DWER which describe the aquifer, borefield and abstraction at the Yandi mine as required by conditions of the GWL89501. Changes to aquifer levels and aquifer water quality are monitored and reported annually to DWER as per the 5C licence requirements. A summary of the monitoring requirements of GWL89501 are summarised in Appendix 1a and 1c and the location of monitoring bores are shown on Figure 3.

Operating Licence

Surplus water discharge to Marillana Creek (including water quality) is regulated under the EP Act Part V Environmental Licence L6168/1991/11. The Licence allows for discharge of excess mine dewatering water (of up to 15,000,000 tonnes per annual period) to Marillana Creek at MCDMDEW040 discharge point and at supplementary discharge point MCDMDEW041 as a contingency for discharge to Marillana Creek during wet weather events (Figure 3). Currently, MCDMDEW040 is used as the primary discharge point. MCDMDEW031 is a retired discharge point. Compliance with water quality licence conditions is reported in the Annual Environment Report.

Licence conditions under existing MS 679 relevant to this MCWRMP include:

- Condition 12: Specifies the location of the point source emissions (discharge of excess mine water) to Marillana Creek;
- Condition 22: Specifies monitoring at the point source of emissions (Marillana Creek) – volumetric flows, physical and chemical properties; and
- Conditions 18, 19 20 and 21: Specifies water quality monitoring methodology along the pathway (Marillana Creek).

- Condition 25: Specifies monitoring of ambient surface water quality at upper and lower Marillana Creek within the Proposal boundary.

The monitoring requirements of L6168/1991/11 are summarised in Appendix 1b.

1.4.1 Staging of mining operations

The Yandi mine has been in operation since 1991. Dewatering at Yandi mine commenced in May 1991 and is expected to continue post mining until backfilling activities (in below water table (BWT) pits) are complete.

Groundwater dewatering at Yandi has been ongoing for the last 35 years. The peak in dewatering rate occurred just over 10 years ago in 2015. The maximum observed groundwater drawdown (within the Development Envelope) has reached approximately 50 m to 60 m in the CID aquifer. Therefore, the majority of drawdown as a result of past and future dewatering has already occurred.

1.4.2 Riparian Vegetation Health Monitoring

The management approach of this MCWRMP utilises data collection gained through BHP's Marillana Creek (Yandi) Riparian Vegetation Monitoring Program (RVMP).

The monitoring of riparian vegetation was undertaken to meet the requirement of MS679 Condition 8-1 with respect to monitoring the effects of drawdown from dewatering on phreatophytic vegetation communities within the project area.

The three main phreatophytic species monitored at Marillana Creek are:

- *Eucalyptus camaldulensis*: a tall tree (up to 20 to 30 m), primarily located along watercourses and a species generally considered a facultative phreatophyte, i.e. species that use groundwater opportunistically or to satisfy a proportion of water requirements but that are not necessarily restricted to habitats with shallow groundwater.
- *Eucalyptus victrix*: a moderately tall tree (12 to 15 m), considered a facultative phreatophyte or a vadophyte.
- *Melaleuca argentea*: a moderate to tall tree (up to 18 to 25 m), often restricted to the banks of watercourses and swamps and is considered an obligate phreatophyte, i.e. a species restricted to habitats with groundwater or the associated capillary fringe within the root zone. *Melaleuca argentea* has a predominantly shallow root system, the majority of which comprises surface lateral roots (Maunsell 2006; Loomes 2010).

Revision of the RVMP

A summary of the Marillana Creek (Yandi) Riparian Vegetation Monitoring Program (RVMP) in place prior to 2021 with monitoring sites and monitoring zones used is provided in Appendix 2a. BHP has revised the RVMP, primarily in relation to boundaries of monitoring zones and Tree Health Monitoring Sites, to consider the following:

- updated knowledge of potential impact areas
- the type of potential impact identified in various parts of the creek (dewatering and/or discharge)
- updated selection of monitoring stands of *Melaleuca argentea* based on whole-of-creek survey results (Astron Environmental Services (Astron) 2022) (Figure 5)
- alignment with the current mine disturbance footprint
- the destruction of Tree Health Monitoring Sites by bushfires.

The revised monitoring zones and Tree Health Monitoring Sites as of 2025 are shown in Figure 6 and summarised in Table 2 and Table 3. There are currently eight active Tree Health Monitoring Sites (Sites MC1, MC4, MC4a, MC4b,

MC5b, MC7, MC8 and MC9), and four *M. argentea* monitoring stands distributed across three management zones and a reference site which are described in the most recent annual report (Astron 2024). A summary of monitoring variables used in the RVMP is provided in Table 3. In addition, vegetation cover and health across the Marillana Creek riparian management zones are monitored with remote sensing metrics.

During 2024, between 50% and 100% of monitoring trees were impacted by fire at sites MC1, MC5B, MC7, MC8 and MC9.

Table 2: Proposed management zones and location of active monitoring sites

Management zone	Description	Tree Health Monitoring Site
Drawdown Impact	Potential impact zone within and beyond the BHP lease.	MC4, MC4A, MC4B, MC5B, MC8, Stand H, Stand I, Stand J, and Stand L
Discharge Impact	Potential impact zone within the BHP lease downstream of active discharge points.	MC1
Diversion Impact	Potential impact zone within the BHP lease covering creek diversions including downstream sections of the original creek.	NA
Long Term Monitoring Sites	Long term monitoring outside the BHP lease and upstream of mining operations	MC7, MC9

Table 3: Monitoring variables used in Riparian Vegetation Monitoring

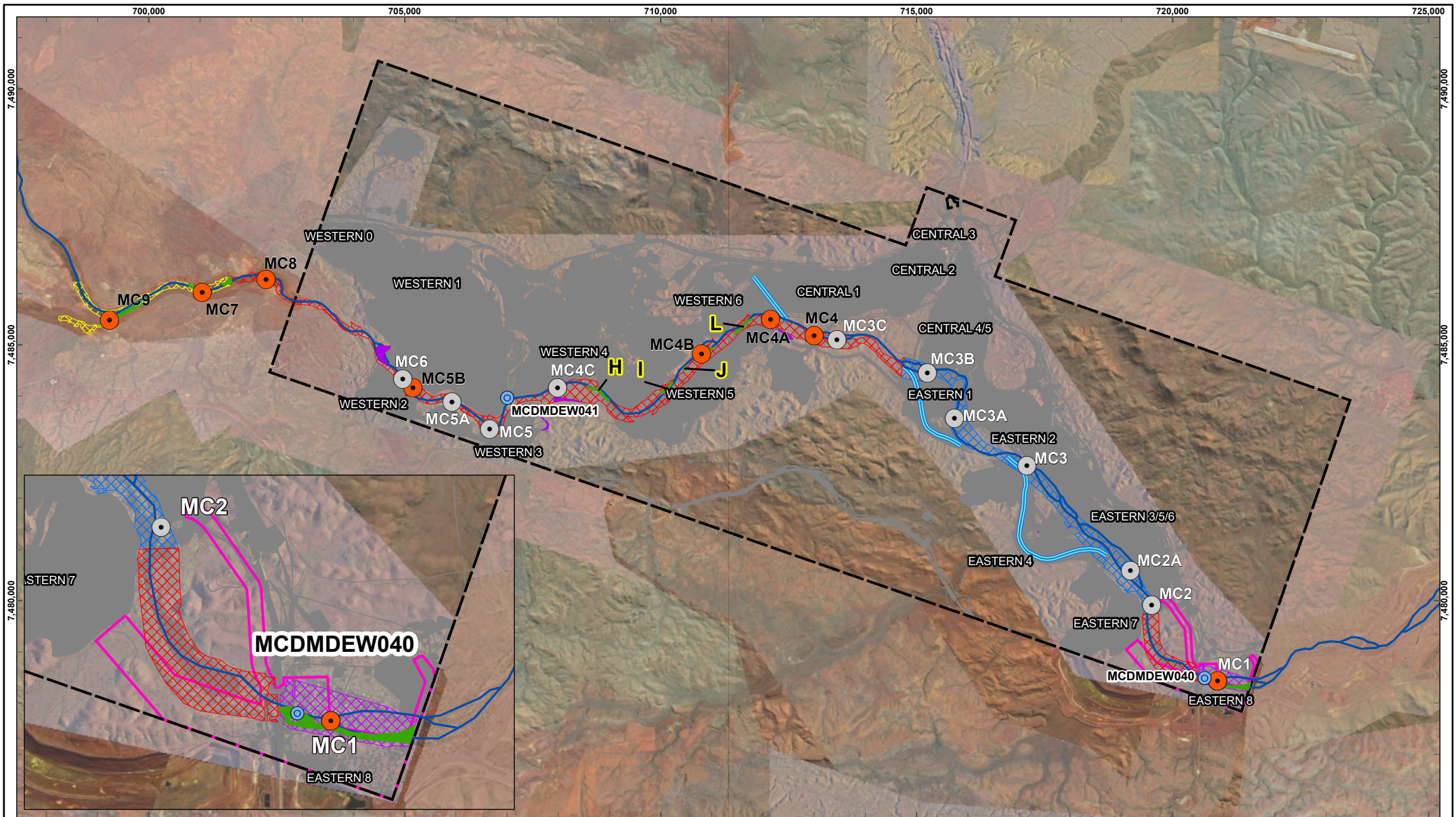
Parameter	Monitoring method	Description	Frequency
Predawn leaf water potential (Ψ PD) ¹	Pressure chamber (Scholander <i>et al.</i> 1965)	<i>Melaleuca argentea</i> shoots are collected before dawn and tested in a pressure chamber (n = 3 to 8 trees/site depending on abundance). Lower (more negative) values indicate greater water stress.	Biannual ²
Crown condition score (CCS) ³	Visual ratings (Souter <i>et al.</i> 2009)	Percentage estimate of crown extent and crown density of live trees (n = up to 22 trees/site, with roughly even numbers of <i>Melaleuca argentea</i> , <i>Eucalyptus victrix</i> and <i>E. camaldulensis</i>).	Biannual
Understorey condition (cover)	Visual estimates	Percentage cover of all vegetation, separated into native cover and weed cover measured in permanent 10 m by 10 m quadrats (n = 3 quadrats/site).	Biannual
Site condition (general)	Photographs and visual observations	Observational notes and visual rating (0 – 3) of abundance of tree mortality, regeneration, pests/diseases, grazing, fire, flood.	Biannual
Vegetation and tree condition (remote sensing) ⁴	Remote sensing and long-term historical satellite imagery)	A vegetation health index (e.g. Modified Soil Adjusted Vegetation Index (MSAVI)) is used to quantify vegetation cover and condition.	Biannual
Recent canopy loss (ground-truthing)	Visual estimation	Areas of change detected in remote sensing analysis prior to on-ground monitoring are inspected if data available.	Biannual
Unconfined groundwater system	Sensors and loggers in Yandi mine monitoring bores	Supporting data collated for interpretation of vegetation health data.	Continuous
Climate and weather	Data from on-site (Yandi mine) and regional (Barimunya) weather stations	Supporting data collated for interpretation of vegetation health data. Includes rainfall, temperature, and relative humidity data collated.	Continuous
Streamflow	Data from gauging station (Flat Rocks)	Supporting data collated for interpretation of vegetation health data. Includes natural streamflow.	Monthly

¹ Leaf water potential provides an important leading or 'real time' measure of plant water status. It is assumed that pre-dawn leaf water potential (Ψ PD) approximates the matric and osmotic potential in the water source used by the tree. It assumes that the hydraulic gradient across the tree equilibrates over night when there is negligible transpiration demand.

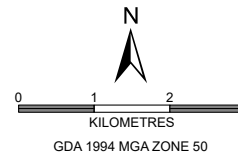
² Biannual refers to end of the dry season and the end of the wet season.

³ Crown condition refers to the physical status of the leaves and branches. Visual assessments of canopy condition based on qualitative scoring systems can provide cost effective, informative data on tree condition. A ground based visual health assessment method for evaluating the health of riparian eucalypts (Souter *et al.* 2009) has been adapted for use in the Pilbara region by BHP. Crown Condition Score (CCS) is a lagging indicator, as visual changes to the canopy may take weeks or months to manifest following a stress event.

⁴ Collection and analysis of remote sensing data for Marillana Creek water management area is used to maintain a site-scale overview of changes in vegetation condition. Monitoring of water indicators, as required under other secondary approvals (see Tables 3 and 4), including groundwater level, surface water flow, and water quality have provided the hydrological context for any observed changes.



- Development Envelope
- Indicative Footprint
- Existing Disturbance
- Marillana Creek
- Constructed creek diversion
- Discharge point
- Yandi tree health monitoring sites**
- Active
- Retired
- Melaleuca monitoring stands
- Vegetation Association dominated by *Melaleuca argentea* (MA MaEcrEv MgAcpAtr Cyy)
- Proposed Monitoring Zones**
- Potential impact - creek diversion
- Potential impact - discharge
- Potential impact - drawdown
- Reference Zone



BHP PUBLIC

MARILLANA CREEK (YANDI) MCWRMP
MELALEUCA ARGENTEA VEGETATION
MONITORING STANDS AT
MARILLANA CREEK

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A4: 1:100,000 PREPARED: GEOMATICS FIGURE: 5

DATE: 29/04/2025 REQUESTOR: ENV APPROVALS

A1205-094-RevC

700,000 705,000 710,000 715,000 720,000

7,490,000

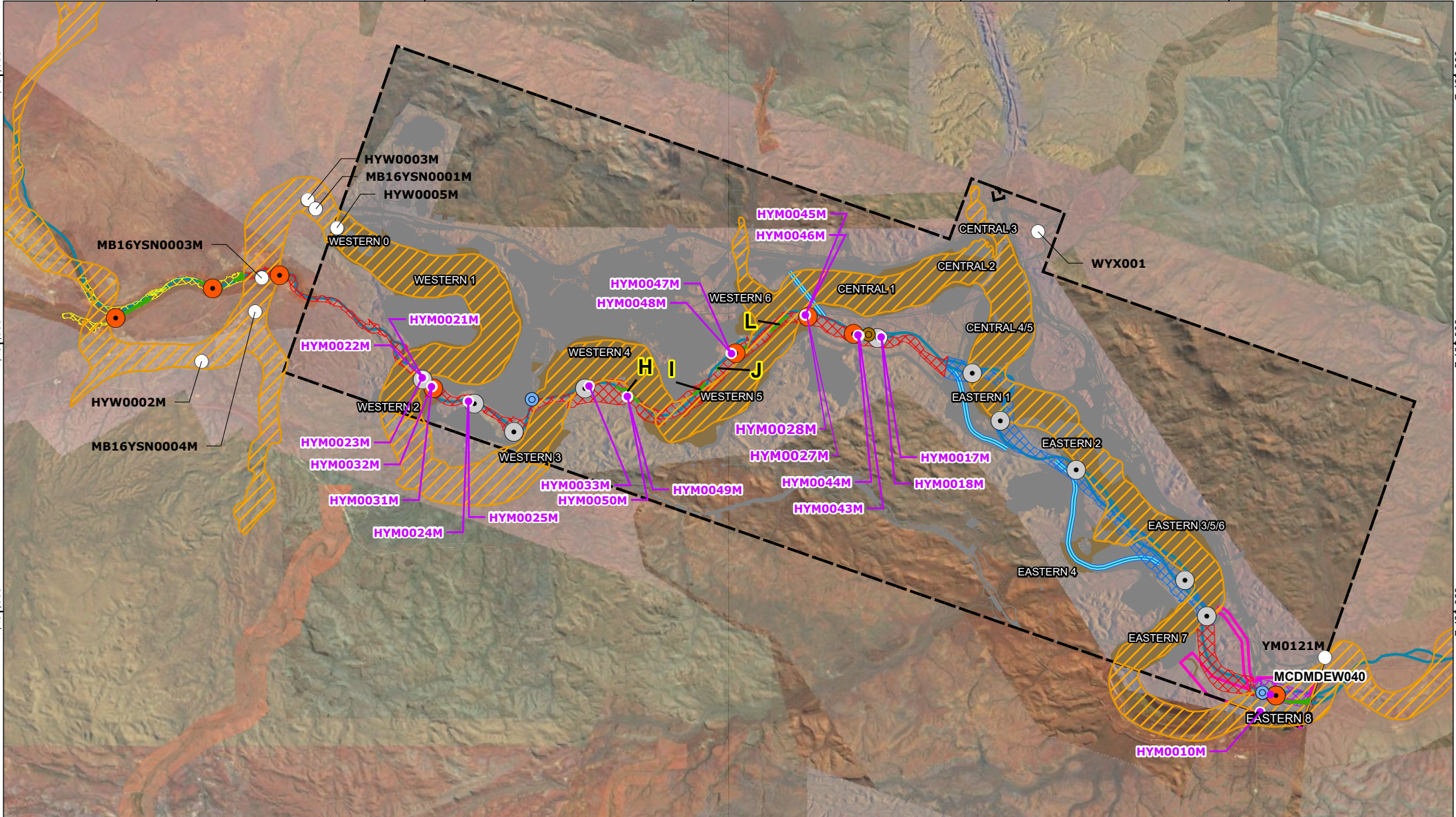
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7,485,000

7,485,000

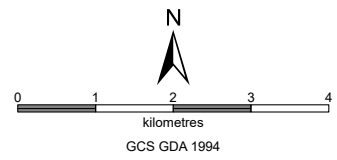
7,480,000

7,480,000



- Discharge point
- Decommissioned Discharge point
- Up gradient and down gradient bores
- Golder Monitoring Bores
- Yandi tree health monitoring sites**
- Active
- Retired
- National highway
- Constructed creek diversion
- Marillana Creek

- Development Envelope
- Indicative Footprint
- Existing Disturbance
- CID channel
- Pits
- Melaleuca monitoring stands
- Proposed Monitoring Zones**
- Potential impact - creek diversion
- Potential impact - discharge
- Potential impact - drawdown
- Reference Zone



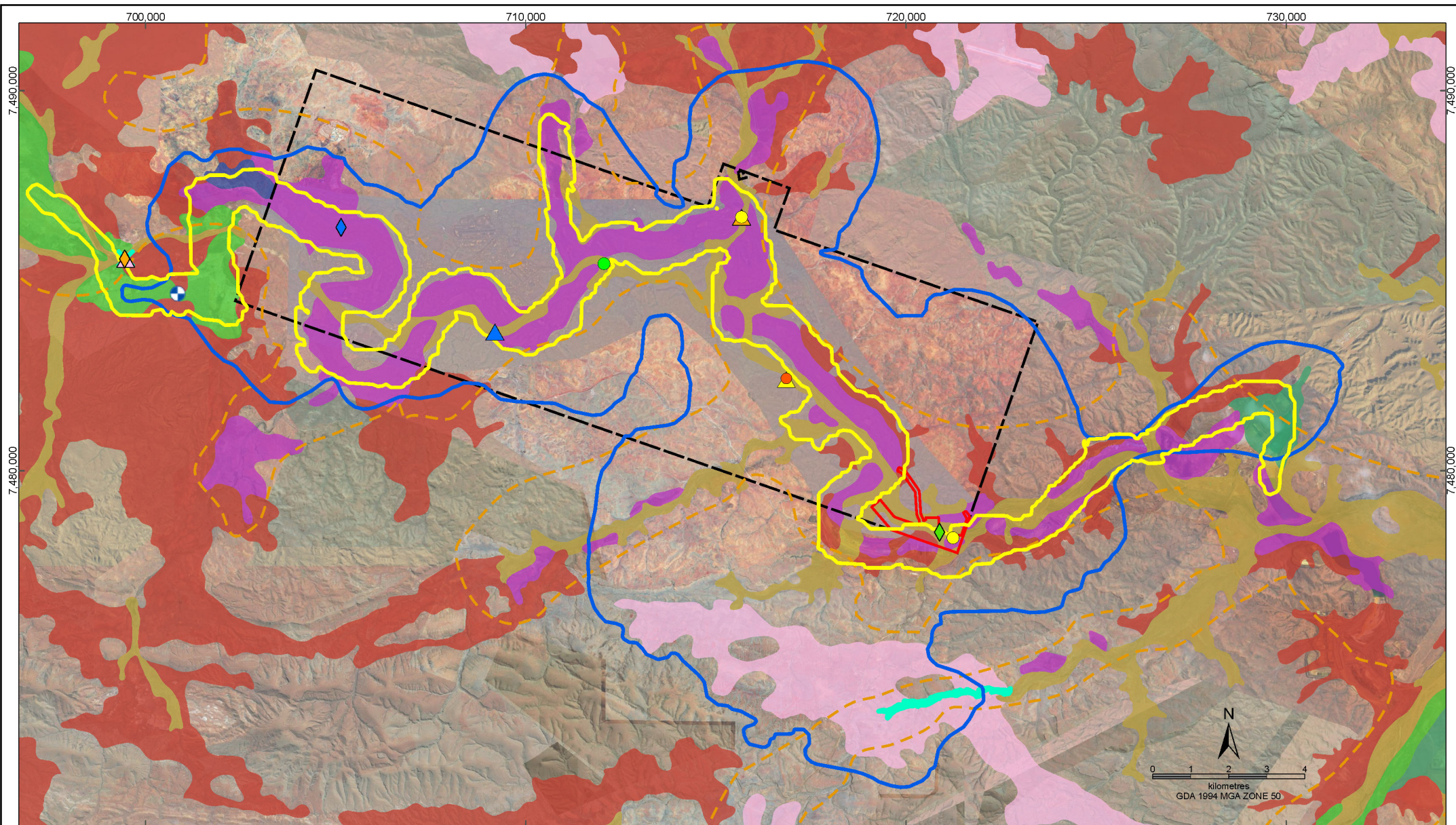
BHP PUBLIC

MARILLANA CREEK (YANDI) MCWRMP
REVISED RIPARIAN VEGETATION
MONITORING PROGRAM

WAIO PLANNING, TECHNICAL & ENVIRONMENT

SCALE @ A4: 1:97,300 PREPARED: GEOMATICS FIGURE: 6
 DATE: 28/04/2025 REQUESTOR: ENV APPROVALS

A1205-095-RevC



- Development Envelope
- Indicative Footprint
- Palaeovalleys (Bell et. al. 2012)
- Yandicoogina Gorge
- Groundwater Monitoring Bore
- Groundwater Drawdown Contours (m)**
- CID
- Basement
- Potentially Restricted Stygofauna:**
- Marillana Creek Pools**
- nr *Phyllognathopus* 'sp. Biologic-HARP058'
- Bathynellidae* sp.

- Parastenocaris* sp. 'Biologic-HARP037'
- Development Envelope**
- Pilbaranella* sp.
- Paramelitidae* sp. 'Biologic-AMPH070'
- Darwinulidae* sp.
- Dussarticyclops* 2222 - 'BCY095'
- Candonopsis* - 'BOS1831'
- Pilbaranella* - 'BSY372'
- Elaphoidella* sp. S2
- Haplotaxidae* sp. S1

- Prospective habitat (surface geology) for stygofauna**
- Czc - Colluvium - partly consolidated valley-fill deposits
- Czk - Calcrete - sheet carbonate usually formed in major drainage lines
- Czp - ROBE PISOLITE - pisolitic limonite deposits developed along old river channels
- Qa - Alluvium - unconsolidated silt, sand and gravel
- Qc - Colluvium - unconsolidated quartz and rock fragments in soil

- Qw - Alluvium and colluvium - red-brown sandy and clayey soil
- Czir - Hematite-goethite deposits on banded iron-formation and adjacent scree deposits

BHP

PUBLIC

MARILLANA CREEK (YANDI) WATER
RESOURCE MANAGEMENT PLAN
STYGOFAUNA VALUES WITHIN THE COMBINED
PROPOSAL DRAWDOWN AREA

WAI0 PLANNING, TECHNICAL & ENVIRONMENT

SCALE @A4: 1:135,000	PREPARED: GEOMATICS	FIGURE: 7
DATE: 28/01/2026	REQUESTOR: ENV APPROVALS	

A1205-107_C

1.4.3 Alternative Dewatering Discharge Locations and Strategies

BHP has conducted an evaluation of alternative locations and methods for managing the discharge of surplus water pumped from the Yandi mine borefields. The evaluation included an assessment of alternatives such as pumping the excess water to a mined-out section of the orebody and discharging it directly into the CID aquifer, or use of the water by third parties in the catchment (e.g. neighbouring mines, Marillana Creek Pastoral Station [owned by BHP] or Juna Downs Pastoral Station). Appendix 3 provides the results of the evaluation of alternatives.

Based on the outcome of the evaluation, BHP will continue to discharge at the approved locations on Marillana Creek in accordance with L6168/1991/11 (Figure 3). MCDMDEW040 was chosen as the primary discharge point in preference to upstream of mining operations areas as this minimises the likelihood of discharged water recirculating into the dewatering borefield. BHP will continue to consult with DWER and other stakeholders where relevant, regarding alternative methods for managing the discharge of surplus water, as required.

1.5 Rationale and approach

Table 4 and Table 5 provide a concise description (in tabular format) of the rationale for the EMP components in Section 2 for Inland Waters, Riparian Vegetation and Subterranean Fauna, including:

- outcomes and objectives
- survey and study findings
- assumptions and uncertainties
- rationale for choice of indicators and/or management actions.

Survey and study reports used to source information for Table 4 and Table 5 are provided in Appendix 4.

BHP considers Terrestrial Fauna habitat and Aquatic Fauna habitat can be adequately managed by the management targets and actions for Inland Waters and Flora and Vegetation detailed in this plan.

Table 4: Rationale for EMP components for Inland Waters

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
Environmental value: Marillana Creek		
<p>Groundwater system</p> <ul style="list-style-type: none"> ○ The aquifer system of the Yandi mine area can be broadly classified into the following hydrogeological units: <ol style="list-style-type: none"> 1. The shallow alluvial aquifer associated with the various creeks forms points of recharge/discharge where the creeks cross the CID aquifer. 2. The CID palaeochannel orebody is a strip aquifer extending over 85 km in length and is the main aquifer in the area, of which 39 km is within the Yandi mine area (BHP Billiton Iron Ore 2010). ○ The Weeli Wolli formation (referred to as the Basement) surrounds the CID and presents highly variable characteristics. Immediately beneath and adjacent to the CID it is likely that the Weeli Wolli Formation presents an elevated hydraulic conductivity due to weathering. However, beyond this zone the hydraulic conductivity may range from very low to moderate and storage is low (BHP 2024b). ○ Groundwater in the Yandi mine region flows preferentially along the CID, which forms a long, narrow aquifer following the course of a Tertiary paleochannel (Figure 8). The CID forms a high storage aquifer with high permeability and transmissivity. Recharge to the CID aquifer occurs via downward infiltration of creek flow during flow events as well as throughflow from upstream CID. The ecohydrological representation of the CID aquifer is shown in Figure 8. ○ Regional groundwater flow directions follow the surface hydrology of Marillana Creek, moving downgradient and to the east toward the Weeli Wolli palaeochannel (and Rio Tinto Yandicoogina Operations), which ultimately discharges into the Fortescue Marsh. <p>Groundwater quantity/levels</p> <ul style="list-style-type: none"> ○ Pre-mining groundwater elevations are estimated as 601 mAHD on the western side of the Development Envelope falling to 520 mAHD on the eastern side (BHP, 2024b). Prior to dewatering and mining, groundwater levels in the CID and Marillana Creek alluvium were the same. At this time groundwater levels downgradient along Marillana Creek were sustained for long periods between rainfall events as water was able to discharge from the CID and into the creek bed. ○ Groundwater abstraction for dewatering activities commenced in the Development Envelope in the Western part of the CID in 1991 reaching its maximum abstraction during 2012-2015. Observed groundwater drawdown throughout the Development Envelope has ranged between approximately 50 m-60 m in the CID (BHP, 2024). ○ Recent groundwater levels for the regional upgradient (west of Yandi mining area) monitoring boreholes reported in the AERs for Yandi mine are provided in Figure 3 of Appendix 5. The CID groundwater level has varied at bore HYM0002M by approximately 5 m prior to being impacted by dewatering (naturally ranging between 613 and 618 mAHD between 1994 and 2003). Since 2012 the water level at this bore lowered by 5 m (from 614 to 609 mAHD). To recover water levels dewatering reduction and subsequent ceasing of dewatering occurred in W0 which resulted in groundwater level recovery to 610 mAHD at HYM0002M in early 2025. ○ Groundwater levels in the Marillana Creek alluvium aquifer system fluctuate with seasonal rainfall and streamflow. During creek flow events the alluvium can become fully saturated with increases in water levels ranging from 3 m-12 m (subsurface) (BHP 2024b). Once wet season rains subside groundwater levels in the alluvium also subside and monitoring has shown that most bores will dry out completely or retain a few meters of water (BHP 2024b). The only exception to this is groundwater bore HYM0011M in the alluvium which maintains an almost fully saturated profile year-round regardless of rainfall due to its proximity to the surplus water discharge outlet. <p>Groundwater throughflow</p>	<p>Assumptions</p> <ul style="list-style-type: none"> • There are three interrelated components of the Marillana Creek system: <ol style="list-style-type: none"> 1. groundwater aquifer system 2. surface water and 3. existing and potential environmental values (e.g. riparian vegetation, pools) • Existing monitoring bores specified in this MCWRMP are functional and representative of their purpose, e.g. regional, operational etc. • Monitoring of regional bores on third party (Rio Tinto) tenure (HYW0002M, MB1SN0004M, MB16YSN003M and MB16YSN0001M) assumes no limitation to data collection due to access or provision by a third party. • Groundwater levels in upstream bores HYW002M and HYW003M are not impacted by drawdown attributable to Rio Tinto mining activities. • Aquifer water quality is monitored and reported annually to DWER as per 5C licence requirements and is not considered a risk factor requiring management under this plan. • Post closure water quality, when pit lakes may form, will be managed under the closure plan. • Reduction in surface water quantity or altered flows from diversions is not considered a risk factor under this plan as it is managed under the <i>Marillana Creek Diversion Management Plan</i> (BHP 2016a). • Creek crossings have been designed to maintain the flow volumes in Marillana Creek. As a result, these changes have not resulted in a material reduction in flow in the main channel. • The primary source of discharge of surplus dewatering at Yandi mine is MCDMDEW040 managed under Environmental licence L6168/1991/11 (Figure 3). • It is assumed that the Marillana Creek Pools have contributions from shallow groundwater and streamflow. There is limited groundwater level data to support this assumption. <p>Uncertainties</p>	<p>Type of components</p> <p>BHP considers that a combination of outcome-based and objective-based components address the environmental management of inland waters.</p> <p>Choice of outcome-based components</p> <ul style="list-style-type: none"> • Outcome-based components have been chosen on the basis of the following: <ul style="list-style-type: none"> ○ Monitoring the impact of the Proposal on water parameters involves measurable parameters which can be monitored; hence outcomes are appropriate to capture these requirements. ○ EPA (2020) includes performance indicators and accompanying environmental criteria under their definition of outcome-based EMPs. Groundwater quantity and quality performance criteria are included in the MCWRMP, outcomes, are considered appropriate to capture this requirement, with trigger and threshold criteria representing the performance criteria. • Management measures are provided to minimise impacts on surface water and groundwater, these are partially addressed through the outcome-based components designed to manage drawdown-impacts to groundwater. Surface water is considered adequately managed under the EP Act Part V Environmental Licence L6168/1991/11 and no additional measures are necessary in this EMP to minimise impacts. • Water quality management is considered addressed through water quality monitoring required under the EP Act Part V Environmental Licence L6168/1991/11 and RiWi Act. • Monitoring data for groundwater levels exist for regional bores and operational bores over more than 15 years which may be drawn upon to develop indicators. BHP has chosen regional bores upstream of Marillana Creek, outside BHP's mining footprint and tenure, as a receptor area. The rationale behind the upstream focus is based on: <ul style="list-style-type: none"> ○ Significant drawdown has already occurred adjacent to pits in operational bores on tenure. ○ Relatively less drawdown has been experienced at regional bores outside of Yandi tenure upstream (see Figure 2 and 3 in Appendix 5). Therefore, groundwater levels in upstream areas are considered a suitable indicator to manage possible future drawdown impacts. ○ Monitoring at regional upstream monitoring bores will allow the identification of changes in water levels and enable BHP to implement mitigation measures if the changes are due to Yandi operations. • The upstream bore HYW0002M (a BHP bore on Rio Tinto tenure) has been specifically chosen to develop triggers and thresholds for groundwater drawdown for the following reasons: <ul style="list-style-type: none"> ○ Data set is available for groundwater levels from January 1994 to present for this bore (see Figure 3 in Appendix 5). ○ Groundwater levels at HYW0002M has declined beyond the recorded low in 1994 (approximately 3.5 m) compared to significant drawdown being recorded in the monitoring bores downstream near W1 (HYW003M and HYW005M) suggesting less drawdown impacts in this area of the CID. • The calculated trigger and threshold values for HYW002M have been set at 609.6 and 608.6 m AHD, respectively, based on analysis of historical groundwater level

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
<p>Environmental value: Marillana Creek</p> <ul style="list-style-type: none"> ○ Estimates of groundwater throughflow in the CID aquifer throughout the Marillana and Weeli Wolli Creeks vary, with groundwater throughflow generally greater in areas that are in close proximity to Marillana Creek and/or where the aquifer has relatively high hydraulic conductivity (BHP Billiton Iron Ore 2004). ○ Groundwater flow along the CID aquifer was (before dewatering influence) sympathetic with the surface hydrology with fall in the pre-mining groundwater levels within the CID aquifer of approximately 70 m across the length of M270SA and an estimated flowthrough of 2.5 to 3 ML/day (Aquaterra 2004; TAR 2010). ○ The shallow alluvial aquifer associated with Marillana Creek is estimated to have a throughflow of 5 kL/day (TAR 2010). This contributes to groundwater throughflow by recharging the underlying CID aquifer. This occurs via the creek bed alluvium, in places where (and close to where) the current creek and creek-bed alluvium aquifer crosses the deeper CID aquifer (Aquaterra 2004; TAR 2010). ○ Drawdown established throughout the CID aquifer to enable dewatering has depleted the groundwater storage and reduced throughflow across the Yandi lease. Discharge of excess dewatering volumes at the downstream lease boundary achieves continuity of groundwater flow downgradient of BHP and onto the RTIO lease. <p>Groundwater quality</p> <ul style="list-style-type: none"> ○ A review of the analytical results of routine sampling of the water chemistry in operational and production bores and at discharge points compared against BHP internal trigger levels for the FY2024 AER period shows stable water quality that is reflective of the local geochemical environment (see Appendix 6). There are no distinct trends regarding pH or EC values apart from seasonal influences on the groundwater quality. Some groundwater quality parameters, e.g. Nitrate, Boron, are raised but this is a consistent finding and not considered an adverse risk <p>Surface water flow</p> <ul style="list-style-type: none"> ○ Streamflow in Marillana Creek is ephemeral, due to the irregular nature of rainfall and high evaporation rates. Flow events in Marillana Creek tend to be from flash rain events with very little post-rainfall flow persistence. There is significant inter-annual variability in stream flow, with extended periods of no flow or low flow interspersed with large discharge events (Appendix 7a) ○ The available flow data from the Flat Rocks Pools gauging station extends from 1967 to 2023 and indicates that total annual discharge from the stream varies from a maximum of 144,500 ML/annum in 1975 to a minimum of 5.8 ML/annum in 2023. ○ The mean annual flow at Flat Rocks, over the period of recording, is equivalent to a catchment runoff of about 10 mm or some 3% of rainfall. Recorded annual runoff has varied from 0.03 mm in 1991 to 105.5 mm in 1975. ○ The daily surplus water discharge into Marillana Creek at the main discharge point averages at 10 ML/day but can rise to four to five times this amount in the wet season. ○ The Marillana Creek system has evolved such that the low flow channel can convey the one in two-year average recurrence interval (ARI) event before the floodplain is activated. For Marillana Creek, the one in two-year flow volume is 152 m³/s. A discharge of 10ML/d or 0.116m³/s at the main discharge point would represent approximately 1,300th of the creek capacity. <p>Surface water quality</p> <ul style="list-style-type: none"> ○ Surface water in Marillana Creek can be classified as fresh to brackish (with electrical conductivity ranging between 136 and 1,805 µS/cm) with a neutral to slightly alkaline pH (recorded pH between 6.10 and 8.70) (BHP Billiton, 2014). ○ Surface water monitoring is currently undertaken at monitoring points MCSW002 and MCSW005 in accordance with the Yandi mine environmental licence L6168/1991/11. Monitoring after flow events has been ongoing at these locations since 2002. ○ Surface water monitoring sites had no flow in FY2024, samples collected in FY2022 indicate that Marillana Creek is slightly alkaline and fresh. 	<ul style="list-style-type: none"> • Current hydraulic gradient and CID throughflow – it is necessary to re-calculate this at various locations along Marillana Creek to reflect current aquifer conditions. • There is limited seasonal water level information within the Marillana Creek Pools and no groundwater bores associated with each pool. • Climate variability has the potential to impact on groundwater levels, and streamflow in Marillana Creek. This variability is to be considered in future monitoring of trigger and threshold values. 	<p>monitoring. Detailed rationale for these calculated levels are provided in Appendix 5. In summary, the trigger value for HYW002M was calculated based on the groundwater level required to maintain groundwater close to the surface elevation at Tree Health Monitoring Site 9 further upstream (approximately 617.6 m AHD). The threshold value was then calculated using the same method, however allowing for a 1 m lower groundwater level at Tree Health Monitoring Site 9.</p> <ul style="list-style-type: none"> • BHP considers that monthly monitoring of groundwater levels in the upstream bore HYW0002M is frequent enough to determine groundwater decline and respond accordingly. Monthly monitoring is also consistent with the frequency of monitoring for groundwater undertaken as part of RiWI licence GWL89501. BHP will review the monitoring frequency if the groundwater levels reach the trigger point. <p>Choice of objective-based components</p> <ul style="list-style-type: none"> • Objective-based components have been chosen on the basis of the following: <ul style="list-style-type: none"> maintaining the quantity and quality of water so that existing and potential environmental values, including ecosystem maintenance, are protected, will require management actions and targets to achieve. • The key to the groundwater monitoring programme being effective, is the maintenance of current/up to date groundwater data. Management actions and targets have been included to ensure that data is uploaded in a timely fashion into a centralised database to maintain up to date groundwater data. BHP will commit to routine analysis of the groundwater data. Appropriate action will be taken in the event any exceedance of trigger and threshold values.

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
Environmental value: Marillana Creek		
<ul style="list-style-type: none"> ○ Surface water quality monitoring at discharge points during the FY2024 reporting period recorded values which were below BHP internal trigger values (see Appendix 7c). ○ Despite occasional elevations of Carbonate and Potassium, which are not considered to pose an environmental risk, water chemistry at these monitoring sites is reflective of the local geochemical environment and does not show any deleterious trends. The data indicates that the hydrochemistry levels are relatively stable when compared to previous reporting periods. <p>Upper Marillana Creek Pools</p> <ul style="list-style-type: none"> ○ One semi-permanent pool (MarC1) and associated lower significance GDE within the tributary of Marillana Creek ○ There are five semi-permanent pools (MarC2-MarC6) within Marillana Creek including Flat Rocks which is of significant cultural value to the Banjima People. ○ The pools have been monitored \ biannually during the wet and dry season since 2020 (Biologic 2024). Pool depths vary from dry to up to 2 m. ○ Vegetation surrounding the pools is characterised as riparian/groundwater dependent. ○ A drying trend has been observed since monitoring commenced with many pools noted as dry in the 2023 wet season. ○ Macroinvertebrate and wetland flora richness within the pools is high and is statistically comparable to sites with known high diversity such as Weeli Wolli Springs PEC. 		

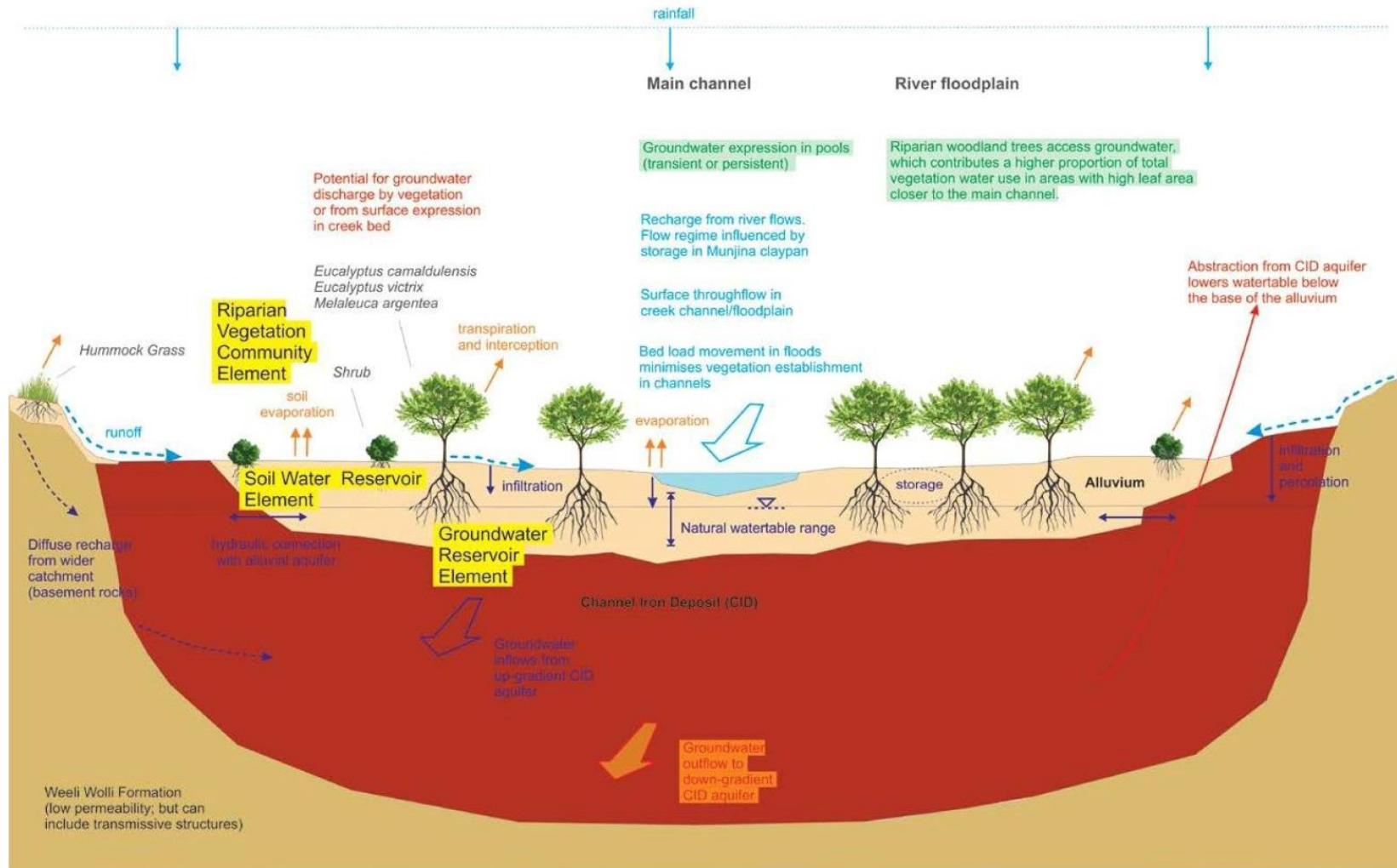


Figure : Marillana Creek eco-hydrogeological conceptualisation (within CID)

Table 5: Rationale for EMP components for Riparian Vegetation Health

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
Environmental value: Marillana Creek Riparian Vegetation Health		
<p>Flora and Vegetation</p> <ul style="list-style-type: none"> Detailed riparian vegetation mapping of Marillana Creek by Onshore Environmental (2015) recorded 22 vegetation associations for the creek system and adjacent plains. Based on the main landform types of the creek, vegetation within the creek can be summarised as: <ul style="list-style-type: none"> Stream bed of Major Channels - Open forest to open woodland of tall riverine eucalyptus (<i>Eucalyptus victrix</i>, <i>E. camaldulensis</i> subsp. <i>refugens</i>) and cajeput (<i>Melaleuca argentea</i>) over variable understorey of small trees or tall shrubs (<i>Acacia citrinoviridis</i>, <i>Acacia coriacea</i> subsp. <i>pendens</i>, <i>Melaleuca glomerata</i> and <i>Melaleuca bracteata</i>) over open low shrubs or heath (<i>Corchorus crozophorifolius</i>, <i>Tephrosia rosea</i> var. <i>Fortescue</i> creeks (M.I.H. Brooker 2186)) and perennial tussock grasses (<i>Eriachne</i> species). Open woodland of riverine eucalyptus (<i>Eucalyptus victrix</i>, <i>E. camaldulensis</i> subsp. <i>refugens</i>) over low woodland (<i>Acacia coriacea</i> subsp. <i>pendens</i>, <i>Atalaya hemiglaucula</i>, <i>Acacia citrinoviridis</i>, <i>Acacia pruinocarpa</i>, <i>Corymbia hamersleyana</i>) with low shrubs (<i>Corchorus crozophorifolius</i>, <i>Acacia pyrifolia</i>) over hummock grasses (<i>Triodia</i> species) and tussock grasses (<i>Eriachne tenuiculmis</i> and <i>Enneapogon lindleyanus</i>). Three riparian species have been recorded at Marillana Creek: <i>Eucalyptus victrix</i>, <i>E. camaldulensis</i> subsp. <i>refugens</i> and <i>Melaleuca argentea</i>. Riparian trees at Yandi mine may use a combination of groundwater and vadose-zone water; <i>Melaleuca argentea</i> in particular, is considered to have an obligate dependence on groundwater (Loomes 2010). <i>Eucalyptus victrix</i> and <i>E. camaldulensis</i> are considered facultative phreatophytes, i.e. species that use groundwater opportunistically or to satisfy a proportion of water requirements but that are not necessarily restricted to habitats with shallow groundwater (Loomes 2010). The principal riparian tree species most susceptible to health decline in the Marillana Creek system is <i>Melaleuca argentea</i>. The major riparian Eucalypt species may be more resilient to lowered water tables, depending on baseline depth to groundwater and variability, the rate of groundwater drawdown, and the surface water regime (i.e. frequency and amount of vadose zone water replenishment). Marillana Creek has been impacted by a number of fires over the duration of the riparian vegetation monitoring program, the most recent in January 2024, when between 50% and 100% of monitoring trees were burnt at sites MC1, MC5B, MC7, MC8 and MC9. <p><u>Measuring water stress</u></p> <ul style="list-style-type: none"> Predawn leaf water potential (PDLWP) data for <i>Melaleuca argentea</i> collected at RVMP sites since 2012 shows trees are relatively more water stressed post-dry season than post-wet season (Appendix 2b). In most years, trees follow the expected seasonal trend of lower PDLWP (indicating relatively greater water stress) post-dry season and higher PDLWP (indicating relatively less water stress) post-wet season, with values across sites ranging between -0.7 and -1.2 MPa in January 2021 (post-dry season), and between -0.3 and -0.7 in June 2021 (post-wet season) (Astron 2021a). Souter <i>et al.</i> (2009 and 2010) established a visual tree health assessment tool which uses a conceptual model of the symptoms of tree health decline from water stress, and indicators of recovery as conditions improve. Several aspects or symptoms of tree health (e.g. crown growth, epicormic growth, leaf die off etc.) are used to develop a “crown condition rating” score from 0-9. CCS data collected for all three riparian species at RVMP sites since 2012 is presented in Appendix 2b. <p><u>Groundwater drawdown and <i>Melaleuca argentea</i></u></p> <ul style="list-style-type: none"> Lowering of the groundwater table by dewatering in the CID aquifer may impact tree root water availability. This reduction in water availability can cause stress and eventually death of riparian vegetation that is dependent on groundwater. Specifically, in areas where there is direct hydraulic connection between the alluvial aquifer and the CID (i.e. where Marillana Creek intersects the CID), groundwater levels in the alluvial aquifer have already declined and tree deaths of <i>Melaleuca argentea</i> have been recorded in these areas. <p><u>Discharge of surplus water and <i>Melaleuca argentea</i></u></p>	<p>Assumptions</p> <ul style="list-style-type: none"> The potential impact to riparian vegetation at Marillana Creek requiring management is decline in tree health due to groundwater drawdown from dewatering. Groundwater levels in upstream bores are not impacted by drawdown attributable to Rio Tinto mining activities. Riparian vegetation in the current discharge zone near Site 1 (which has experienced augmented growth attributable to discharge) will most likely decline when the discharge of surplus water ceases. This impact scenario, i.e. that there would be tree death at the discharge points when these cease discharging, was included in BHP’s Life of Mine Environmental Protection Statement for Yandi mine (BHP 2005). <p>Uncertainties</p> <ul style="list-style-type: none"> There is limited understanding of the long-term response of riparian vegetation to the cumulative effects of dewatering drawdown and other stressors such as fire and climatic variability. 	<p>Type of components</p> <p>BHP considers that a combination of outcome-based and objective-based components address the environmental management requirements of flora and vegetation (riparian vegetation).</p> <p>Choice of outcome-based components</p> <ul style="list-style-type: none"> Outcome-based components have been chosen on the basis of the following: <ul style="list-style-type: none"> Monitoring of the impact of the effects of drawdown dewatering on phreatophytic vegetation communities within the project area involves measurable parameters, hence outcomes are appropriate to capture this requirement. BHP has selected the health of <i>Melaleuca argentea</i> as an indicator species to represent the response of ‘riparian vegetation’ and ‘phreatophytic vegetation communities’ to drawdown and dewatering impacts. <i>Melaleuca argentea</i> is a known obligate phreatophyte (solely reliant on groundwater) and can be assumed to be at higher risk of groundwater drawdown than <i>Eucalyptus camaldulensis</i> and <i>E. victrix</i>, which tend to be classed as facultative phreatophytes. As a species reliant on groundwater, it is considered an indicator of the health of phreatophytic flora in monitoring areas and will respond to mine water management practices, including dewatering and surplus discharge. Riparian vegetation in upstream areas of Marillana Creek have been chosen as a target management area in need of outcome-based components in this plan as: <ul style="list-style-type: none"> Intact good condition riparian vegetation which may be vulnerable to drawdown impacts is located in this area. Tree health impacts downstream on tenure have already occurred. Groundwater levels at the majority of the on-tenure tree health monitoring sites are now more heavily reliant on rainfall and stream flow to provide seasonal replenishment of groundwater to the creek alluvium since the CID aquifer can no longer contribute water to the area. Recent field observations indicate that groundwater levels at the upstream intersection of the CID (near Tree Health Monitoring Site 9) are much closer to the creek bed and therefore still support tree health through water availability (see Figures 2 and 3 in Appendix 5). This suggests that whilst dewatering of the W1 pits has caused groundwater level drawdown to extend to Tree Health Monitoring Site 8 (located on the CID), it has not reached Tree Health Monitoring Site 9. This makes Tree Health Monitoring Site 9 a priority area to manage and thus trigger and threshold criteria have been developed to protect this site. On-ground RVMP tree health monitoring is undertaken at the end of the dry season and the end of the wet season. This choice of timing will allow tree health to be captured at two extremes of natural climatic conditions where surface water and groundwater conditions may vary. While BHP activities have the potential to impact the water environment and riparian vegetation health, climate/rainfall variability may also influence tree health. Lack of rainfall and subsequent reduced runoff and streamflow may result in a detrimental effect to riparian vegetation health. Climatic data, streamflow data, occurrence of fire and vegetation health data will be reviewed to determine whether any exceedance of triggers and threshold criteria are a likely result of BHP activity, other factors such as poor rainfall or a combination of both.

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
<p>Environmental value: Marillana Creek Riparian Vegetation Health</p> <ul style="list-style-type: none"> EPA (2005) acknowledged that enhanced riparian vegetation growth and seedling establishment was evident in the vicinity of the discharge point. Astron (2021b) reported that long-term irrigation with large volumes of water at the discharge area near site 1 had proven to maintain the health of large, mature trees and result in substantial recruitment of seedlings, saplings and young trees. Plants may be subsequently vulnerable to drought stress and health decline once the artificial water source is removed, such as likely to be the case as when the discharge at MCDMDEW040 ceases. Groundwater dependent trees such as <i>Melaleuca argentea</i> are considered most vulnerable to this impact (Astron 2021b). Localised areas along the drainage channel that become inundated for extended periods will experience changes to the composition and/or density of riverine vegetation due to the increased and prolonged availability of water to vegetation. Areas with elevated soil moisture are more susceptible to colonisation by introduced weed species. Recent monitoring reported in the FY2024 AER has shown discharge water quality conditions and surface water quality conditions have been maintained with no deleterious trends in parameters or nutrients which are known to influence the health and growth of riparian species (e.g. pH, TSS, nitrates, phosphates, calcium, sulphur, magnesium, iron, boron, zinc, copper, nickel and potassium) (Appendices 6b and 7c). Although occasional elevations in Boron and Nitrate have been recorded in groundwater naturally (see Appendix 6a) (even prior to groundwater drawdown), this is not considered a negative for riparian plant growth as it is a lack of this micronutrient which can cause plant death. 		<ul style="list-style-type: none"> The methods used have been subject to regular review over the years, with little change in the past four years. Table 4 provides a summary of monitoring methods and metrics used as part of the RVMP. The trigger and threshold criteria for <i>Melaleuca argentea</i> tree health were selected using RVMP metrics known to show changes in vegetation condition: <ul style="list-style-type: none"> Crown Condition Score (CCS) – A percentage estimate of crown extent and crown density of live trees (Souter <i>et al.</i> 2009) Pre-dawn leaf water potential (ψPD) – a measure of water stress with lower readings representing a higher water stress (Scholander <i>et al.</i> 1965). Statistical analyses have been used in the past to compare long-term temporal trends of predawn leaf water potential and crown condition score between monitoring sites and management zones (i.e. impact vs reference zone). While this analysis has provided some insight into trends operating at larger spatial (landscape) and temporal (decadal) scales, the high degrees of spatial variation within and between sites, and temporal variation between seasons and years, has made it difficult to detect meaningful differences on an individual site or sampling date basis. Instead, comparing the values of predawn leaf water potential and crown condition score against nominated control limits, displayed using control charts is considered to be of more use in eliciting management responses. The control limits used to generate trigger and threshold criteria for predawn leaf water potential and crown condition score have been based on a review of long-term monitoring data for riparian species in Marillana Creek, inclusive of <i>Melaleuca argentea</i>, as part of the RVMP (see Appendix 2b; Astron 2021a). Pre-dawn leaf water potential trigger level has been set at > -1.6 Mpa and threshold level at > -1.9 for <i>Melaleuca argentea</i> based on a calculation of the 25th percentile and 5th percentile, respectively, of a historic data set of tree ψPD for Yandi mine compiled by Astron (2021a) (see Appendix 2b). These levels remain unchanged from the previous RVMP. Tree deaths have been associated with recorded mean values of -2.3 MPa. Crown condition score trigger level has been revised in the current RVMP to less than or equal to 4 (cf. 5 in previous RVMP) and the threshold level remains at less than or equal to 3 (no change with previous RVMP) over two consecutive surveys (one undertaken at the end of the dry season and one at the end of the wet season, in no particular order). These values have been recommended by Astron (2021a) based on review of historical data sets of CCS at Yandi for riparian species, including <i>Melaleuca argentea</i>, at impact and reference sites (see Appendix 2b). Data collected from reference site 9 reflect the minimum CCS values that can occur in a near pristine environment with a population of large, healthy trees: mean values recorded in June 2020 were 5.6 for <i>Melaleuca argentea</i>, 5.7 for <i>Eucalyptus camaldulensis</i> and 5.3 for <i>E. victrix</i> (Appendix 2b). A reduction of the CCS trigger level from ≤ 5 to 4 was therefore considered justified. Two consecutive surveys are considered an adequate timeframe to capture seasonal influences on riparian vegetation health and thus help discern climatic causes of decline from dewatering effects. <p>Choice of objective-based components</p> <ul style="list-style-type: none"> Objective-based components have been chosen on the basis of the following: <ul style="list-style-type: none"> Management measures to minimise potential impacts on riparian vegetation associated with dewatering and at the discharge point.

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
<p>Environmental value: Marillana Creek Riparian Vegetation Health</p>		
		<ul style="list-style-type: none"> ○ Management measures to minimise potential impacts on riparian vegetation associated with dewatering and at the discharge point, which are already addressed in outcome components whereby triggers and thresholds have been applied for riparian tree health in upstream areas. ● Management actions have focussed on enhancing understanding of riparian tree health with groundwater conditions by: <ul style="list-style-type: none"> ○ continuing the monitoring program at all active Tree Health Monitoring Sites as per the revised RVMP (including all three riparian species). ○ ensuring all Tree Health Monitoring Sites on tenure (e.g. Site 1, 4, 4a, 4b and 5b) have associated functional groundwater bores to monitor groundwater levels to allow improved correlation of local groundwater levels with riparian vegetation health data. ○ utilising groundwater data in upstream areas to allow improved correlation of local groundwater levels with riparian vegetation health data at Tree Health Monitoring Sites 7 and 8. ○ reviewing surplus discharge water quality changes with riparian vegetation health i.e. if changes are observed in water quality parameters beyond current trigger levels, then riparian vegetation health in the subsequent monitoring period will be reviewed for any declines.

Table 6: Rationale for EMP Components for Subterranean Fauna

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
Environmental values: Stygofauna		
<p>Stygofauna habitat</p> <p><u>Development Envelope</u></p> <p><u>Hydrogeology</u></p> <p>The hydrogeology of the Development Envelope can be broadly classified into three hydrogeological units:</p> <ul style="list-style-type: none"> The shallow alluvial aquifer associated with Marillana Creek. A hydraulic connection exists between the Marillana alluvium and the CID aquifer where the two units interface and cross; elsewhere, hydraulic connectivity is limited. The Marillana Formation which is a strip aquifer extending over 85 km in length and is the main aquifer within the Development Envelope. The aquifer incorporates the CID paleochannel orebody, is heterogeneous, and contains zones of higher permeability associated with secondary porosity features such as cavities and zones of lower permeability within the Lower CID and Basal Clay/Conglomerate. Marginal sediments have low permeability but can still transmit groundwater where cavities exist. The Weeli Wolli Formation which is a fractured-rock aquifer along the basement of the Marillana/Yandicoogina system and which is considered lower yielding for subterranean fauna compared to the CID and alluvial aquifer. <p>Depth to groundwater across the Development Envelope generally ranges between 10 and 63 mbgl; however, the alluvium within Marillana Creek will sustain groundwater levels either just below or at surface during seasonal wet periods in several places. Large sections of the CID within the Yandi Development Envelope are currently drawn down to 50 mbgl or more. However, areas where depth to groundwater is relatively shallow (i.e. less than 40 m; noting that depth to groundwater is recognised as a potential constraint to stygofauna abundance and diversity; Halse 2018 in Bennelongia 2024a). salinity is fresh, and transmissivity is high, would likely provide highly suitable for stygofauna, with the CID and the superficial alluvial systems of Marillana Creek known to support a diverse stygofauna community (Bennelongia 2022; 2015).</p> <p>Groundwater hosted within the CID forms the primary stygofauna habitat, while the fractured/weathered parts of the Weeli Wolli Formation may also provide deeper habitat in some areas within the palaeochannel (Biologic 2024). Following historic mining and dewatering, the alluvial detritals are unlikely to occur BWT and so are likely to only provide some temporary stygofauna habitat following sporadic flood events.</p> <p>In addition to the above, the Yandicoogina Palaeovalley overlaps several areas of the Development Envelope and connects to the north-east with the much larger Robe Palaeovalley, which is a globally significant subterranean fauna hotspot (Bennelongia 2024a; Bell <i>et al.</i> 2012; Clark <i>et al.</i> 2021). Stygofauna are often associated with palaeovalleys, which usually provide highly prospective stygofauna habitats in the centre of the valley (Bennelongia 2024a).</p> <p>Based on the surface geology, hydrogeology and occurrence of the Yandicoogina Palaeovalley, the subterranean habitats throughout the Development Envelope are likely to provide suitable habitat for troglofauna and stygofauna and are likely to extend beyond the boundaries of the Development Envelope (Bell <i>et al.</i> 2012; Bennelongia 2024a), see Figure 7.</p> <p><u>Groundwater Quality</u></p> <ul style="list-style-type: none"> Groundwater quality within the Development Envelope ranges from fresh to brackish (414 S/cm – 1,767 S/cm) which is suitable for stygofauna (noting that stygofauna mostly occur in fresh to hyposaline water, some species can tolerate higher salinities; Bennelongia 2024). A review of the analytical results of routine sampling of the water chemistry in operational and production bores and at discharge points compared against BHP internal trigger levels for the FY2024 AER period shows stable water quality that is reflective of the local geochemical environment (see Appendix 6). There are no distinct trends regarding pH or EC values apart from seasonal influences on the groundwater quality. Some groundwater quality parameters. e.g. Nitrate, Boron, are raised but this is a consistent finding and not considered an adverse risk. <p>Off-tenure stygofauna habitat (i.e. outside the Development Envelope)</p>	<p>Assumptions</p> <p>The potential impacts to subterranean fauna at Yandi requiring management are:</p> <ul style="list-style-type: none"> changes to stygofauna habitat and species assemblages from groundwater drawdown due to dewatering degradation of stygofauna habitat through groundwater contamination/changed groundwater chemistry <p>The Combined Proposal will result in a maximum drawdown of 55 m (to 468 mAHD) from pre-development groundwater levels within the Indicative Footprint, and a maximum of 60 m from pre-development groundwater levels throughout the rest of the Development Envelope. This represents an additional 20 m drawdown within the Indicative Footprint but limited additional drawdown within the rest of the Development Envelope given that a 50-60 m decline in groundwater levels has already occurred as a result of the Approved Proposal.</p> <p>Based on this, it is assumed that there will be no <u>additional</u> impacts to five of the six potentially restricted stygofauna species, as they are known from operational areas already subject to drawdown, whereas one stygofauna species, <i>Dussartyclops</i> 2222 `BCY095`, will be subject to an additional 10-20 m drawdown as a result of the Combined Proposal, see Figure 7</p> <p>To protect stygofauna values, groundwater drawdown should not be greater than predicted.</p> <p>Groundwater drawdown associated with dewatering is assumed to reduce stygofauna populations and/or alters assemblage composition, but that this reduction is often temporary, with assemblages seemingly returning, to some extent, once groundwater levels recover (Bennelongia 2013)</p> <p>Given that stygofauna of the Pilbara evolved in an environment where groundwater levels have shown considerable changes over both short and long timeframes, stygofauna would be expected to be tolerant of reductions in groundwater habitat and water chemistry changes associated with drought-induced drawdown (Bennelongia 2013).</p> <p>Groundwater levels in the alluvium aquifer system within Marillana Creek fluctuate with seasonal rainfall and streamflow and will dry out completely or retain a few meters of water (BHP 2024b) whereas natural</p>	<p>Type of components</p> <p>BHP considers that a combination of outcome-based and objective-based components address the environmental management of stygofauna values.</p> <p>Choice of outcome-based components</p> <ul style="list-style-type: none"> Outcome-based components have been chosen on the basis of the following: <ul style="list-style-type: none"> Monitoring the impact of the Proposal on water parameters involves measurable parameters which can be monitored; hence outcomes are appropriate to capture these requirements. EPA (2020) includes performance indicators and accompanying environmental criteria under their definition of outcome-based EMPs. Groundwater quantity and quality performance criteria are included in the MCWRMP, outcomes, are considered appropriate to capture this requirement, with trigger and threshold criteria representing the performance criteria. Management measures are provided to minimise impacts on surface water and groundwater, and as such, stygofauna habitat. These management measures are partially addressed through the outcome-based components designed to manage drawdown-impacts to groundwater. Surface water is considered adequately managed under the EP Act Part V Environmental Licence L6168/1991/11 and no additional measures are necessary in this EMP to minimise impacts from surface water on subterranean fauna. Water quality management for stygofauna is considered addressed through water quality monitoring required under the EP Act Part V Environmental Licence L6168/1991/11 and RiWi Act licence GWL89501 requirements Monitoring data for groundwater levels exist for regional bores and operational bores over more than 15 years which may be drawn upon to develop indicators. BHP has chosen regional bores upstream of Marillana Creek, outside BHP's mining footprint and tenure, as a receptor area. The rationale behind the upstream focus is based on: <ul style="list-style-type: none"> Significant drawdown has already occurred adjacent to pits in operational bores on tenure. Relatively less drawdown has been experienced at regional bores outside of Yandi tenure upstream (see Figure 2 and 3 in Appendix 5). Therefore, groundwater levels in upstream areas are considered a suitable indicator to manage possible future drawdown impacts. Monitoring at regional upstream monitoring bores will allow the identification of changes in water levels and enable BHP to implement mitigation measures if the changes are due to Yandi operations. The upstream bore HYW0002M (a BHP bore on Rio Tinto tenure) has been specifically chosen to develop triggers and thresholds for groundwater drawdown for the following reasons: <ul style="list-style-type: none"> Data set is available for groundwater levels from January 1994 to present for this bore (see Figure 3 in Appendix 5). Groundwater level at HYW0002M has declined beyond the recorded low in 1994 (approximately 3.5 m).

Survey and study findings	Key assumptions and uncertainties	Rationale for choice of components
<p>Environmental values: Stygofauna</p> <p>Suitable stygofauna habitat extends beyond the Development Envelope, throughout Flat Rocks and areas to the west beyond the Development Envelope boundary, within the CID, alluvium, colluvium and areas of calcrete (where BWT). The extent and likely connectivity of these habitats is also indicated by historical monitoring surveys which have recorded at least 14 shared stygofauna species at Yandi and from the Upper Marillana area, approximately 3-10 km to the north-west (Bennelongia 2013; 2025).</p> <p>Areas to the east and south, around the E8 Proposal area, are currently impacted by Rio Tinto's Yandicoogina mining operations. The current extent of suitable stygofauna habitats in these areas is unknown, however suitable habitats do occur north of the E8 Proposal area, which likely extend to the north, beyond the Development Envelope and drawdown impact area, see Figure 7</p> <p>Stygofauna assemblages</p> <p>The stygofauna assemblage within the Yandi Hub is considered to be relatively rich with at least 56 stygofauna taxa having been recorded within the Yandi Development Envelope and groundwater drawdown area (Bennelongia 2024, 2025). This includes six species that are currently not known from elsewhere: <i>Dussartcyclops</i> 2222 'BCY095', <i>Pilbaranella</i> 'BSY372', <i>Candonopsis</i> 'BOS1831', <i>Elaphoidella</i> sp. S02, Haptotaxidae sp. S01 and Darwinulidae sp. (Bennelongia 2024).</p> <p>At Ministers North (within the Approved Proposal drawdown), a total of six stygofauna species have been collected (Bennelongia 2024b). None of the six stygofauna species are restricted species and the stygofauna assemblage at Ministers North is considered relatively depauperate, likely to be due to deep groundwater depths (i.e. over 40 m; Bennelongia 2024b).</p> <p>None of the stygofauna taxa, nor the communities recorded within the Yandi Hub are listed or recognised as conservation priorities under state or federal legislation.</p>	<p>fluctuations within the CID can range from 5-7 m. The local stygofauna assemblages are likely to have adapted to this environment and fluctuating groundwater levels.</p> <p>The use of triggers and thresholds for monitoring groundwater quality and groundwater levels are an appropriate surrogate for protecting stygofauna habitat and assemblages.</p> <p>Uncertainties</p> <ul style="list-style-type: none"> • Taxonomic uncertainties exist for almost all the identified potentially restricted stygofauna • It is unknown if any of the six potentially restricted stygofauna occur outside the drawdown 	<ul style="list-style-type: none"> • The calculated trigger and threshold values for HYW002M have been set at 609.6 and 608.6 m AHD, respectively, based on analysis of historical groundwater level monitoring. Detailed rationale for these calculated levels are provided in Appendix 5. In summary, the trigger value for HYW002M was calculated based on the groundwater level required to maintain groundwater close to the surface elevation at Tree Health Monitoring Site 9 further upstream (approximately 617.6 m AHD). The threshold value was then calculated using the same method, however allowing for a 1 m lower groundwater level at Tree Health Monitoring Site 9. • BHP considers the use of triggers and thresholds for groundwater quality and groundwater levels are an appropriate surrogate for monitoring potential impacts to stygofauna, rather than destructive sampling techniques to monitor species assemblages using haul nets, pumping, trapping or plankton nets • BHP considers that monthly monitoring of groundwater levels in the upstream bore HYW0002M is frequent enough to determine groundwater decline and respond accordingly. Monthly monitoring is also consistent with the frequency of monitoring for groundwater undertaken as part of RiWI licence GWL89501. BHP will review the monitoring frequency if the groundwater levels reach the trigger point. • BHP has approval to mine the entire Channel Iron Deposit (CID) within the Yandi Development Envelope, subject to conditions of MS679 as amended by MS1039. • Large sections of the CID within the Yandi Development Envelope are drawn down to 50 mbgl. • The Yandicoogina Palaeovalley (Appendix 8, Figure 1), which likely provides suitable stygofauna habitat, extends upstream of the Yandi Development Envelope, outside the influence of BHP and third-party operators. • BHP will utilise the upstream bore HYW0002M (a BHP bore on Rio Tinto tenure) to ensure groundwater levels are maintained upstream along the CID to protect stygofauna habitat. • BHP will utilise the SSTVs within the GWOS (Appendix 1c) to ensure water quality is maintained within the Development Envelope, minimising impacts downstream of the operational area.

2 EMP Components

BHP has provided detail of the EMP components in Table 7 and Table 8, as per the preferred approach outlined in the Instructions. BHP has not used the 'Schedule' approach (which the Instructions state may be used), as this EMP covers only one operation.

The purpose of Table 7: is to meet the requirements of Condition XX for surface water, groundwater and subterranean fauna habitat of Ministerial Statement XXXX.

Table 7: Outcome-based components

EPA factor and objective	<p>Inland Waters - To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.</p> <p>Flora and Vegetation - To protect flora and vegetation so that biological diversity and ecological integrity are maintained.</p> <p>Terrestrial Fauna - To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.</p> <p>Subterranean Fauna - To protect subterranean fauna so that biological diversity and ecological integrity are maintained.</p>
Environmental Outcomes	<p>No further decline in groundwater levels as a result of the combined proposal to maintain the Marillana Creek pool water regimes</p> <p>No permanent loss of aquatic or terrestrial fauna habitat as a result of groundwater drawdown from the Combined Proposal at Flat Rocks and Marillana Creek Pools</p> <p>No adverse impact to terrestrial or aquatic fauna habitats as a result of changes to water quality from the Combined Proposal</p> <p>No permanent loss of riparian vegetation as a result of groundwater drawdown from the Combined Proposal at Flat Rocks and Marillana Creek Pools</p> <p>Marillana Creek Riparian vegetation within the Development Envelope maintained commensurate with the final hydrological regime at closure</p> <p>No further loss or modification of stygofauna habitat at Flat rocks and Marillana Creek Pools as a result of dewatering from the Combined Proposal</p>
Key environmental value/s	<p>Marillana Creek groundwater system</p> <p>Marillana Creek riparian vegetation</p> <p>Marillana Creek stygofauna habitat</p> <p>Marillana Creek terrestrial fauna habitat</p>
Key impacts and risks	<p>Groundwater drawdown within and outside of the Yandi Development Envelope (upstream of mining areas in Marillana Creek)</p> <p>Decline in riparian vegetation health / terrestrial fauna habitat from groundwater drawdown and/or changes to water quality</p> <p>Loss or reduction of stygofauna habitat outside of Yandi Development Envelope (upstream of mining areas in Marillana Creek) associated with groundwater drawdown</p> <p>Degradation of stygofauna habitat associated with changes to water quality</p>

Outcome-based components			
Environment criteria	Contingency response actions:	Monitoring	Reporting
<p>GROUNDWATER QUANTITY*</p> <ul style="list-style-type: none"> Trigger Criteria - Groundwater levels at HYW0002M decline to 609.6 m AHD Threshold Criteria - Groundwater levels at HYW0002M decline to 608.6 m AHD 	<p>Trigger level actions will include:</p> <ul style="list-style-type: none"> Investigate source of groundwater level change to evaluate whether change is due to BHP activity; and If exceedance of trigger criterion is considered due to dewatering by BHP, evaluate and design aquifer supplementation program. <p>Threshold level actions will include:</p> <ul style="list-style-type: none"> Investigate source of groundwater level change to evaluate whether change is due to BHP activity; If exceedance of threshold criterion is considered due to dewatering by BHP: <ul style="list-style-type: none"> implement aquifer supplementation program; and/or modify dewatering rate. Monitor and review to ensure contingency actions are successful and review procedures, if appropriate. Review vegetation health trends. 	<ul style="list-style-type: none"> Monthly monitoring of groundwater levels (AHD) during operations (i.e. active dewatering) at the bore HYW0002M (see Figure 6). 	<p>Refer to Table 9</p>

Outcome-based components			
Environment criteria	Contingency response actions:	Monitoring	Reporting
<p>GROUNDWATER QUALITY*</p> <ul style="list-style-type: none"> • Trigger Criteria - detailed in GWOS for individual analytes at Active pits (W1, W2, W3, W4, W5, C1, C2, C3, C4, C5, E1, E2, E3/5/6, E4, E7) • Threshold Criteria – none defined. Managed in accordance with the GWOS 	<p>Trigger level actions will include:</p> <ul style="list-style-type: none"> • Investigate source of groundwater quality change to evaluate whether change is due to BHP activity; and • If exceedance of groundwater quality trigger criterion is considered due to BHP, evaluate requirement for implementation of remedial measures to mitigate water quality impacts. • Monitor and review remedial measures to ensure they are successful and review procedures, if appropriate. • Review tree health at downstream monitoring points. 	<ul style="list-style-type: none"> • Biannually – standard hydrochemistry suite • Monthly – Field EC and pH 	<p>Refer to Table 9 and the AER, Annual Aquifer Review and Triennial Aquifer Review required under GWL</p>
<p>RIPARIAN VEGETATION#</p> <p>Trigger criteria – for <i>Melaleuca argentea</i> an average crown condition score of ≤ 4 at site 9 over two consecutive sample periods or an average pre-dawn leaf water potential score of > -1.5 MPa at site 9 over two consecutive sample periods.</p> <p>Threshold criteria – for <i>Melaleuca argentea</i> an average crown condition score of ≤ 3 at site 9 over two consecutive sample periods or an average pre-dawn leaf water potential (LWP) score of > -1.95 MPa at site 9 over two consecutive sample periods.</p>	<p>Trigger level actions will include:</p> <ul style="list-style-type: none"> • Investigate the crown condition decline and/or decrease in LWP and ancillary data to evaluate whether change is due to BHP drawdown activities (e.g. is a decline in groundwater levels at HYW0002M coinciding with these changes) or other factors (e.g. drought, fire, pathogens etc.) • Increase the frequency of riparian vegetation health monitoring if appropriate; and/or • If exceedance of trigger criterion is considered to be due to dewatering by BHP, evaluate suitability of an aquifer supplementation program. • Investigate if change is due to groundwater quality and evaluate whether change is due to BHP operations. <p>Threshold level actions will include:</p> <ul style="list-style-type: none"> • Investigate the crown condition decline and or/decrease in LWP and ancillary data to evaluate whether change is due to BHP drawdown activities (e.g. is a decline in groundwater levels at HYW0002M coinciding with these changes) or other factors (e.g. drought, fire, pathogens etc.) • If exceedance of threshold criterion is considered due to dewatering by BHP: <ul style="list-style-type: none"> ○ implement aquifer supplementation program (based on feasibility of long-term persistence considering post closure groundwater levels); and/or ○ modify dewatering rate (where feasible). 	<ul style="list-style-type: none"> • Biannual (wet and dry season) crown condition scoring and pre-dawn leaf water potential measurements of <i>Melaleuca argentea</i> at Site 9 (Figure 5). <p>Ancillary data</p> <ul style="list-style-type: none"> • remote sensing data analysed to measure vegetation cover and health indices • site condition assessment • weather, streamflow and groundwater data 	<p>Refer to Table 9</p>

Outcome-based components			
Environment criteria	Contingency response actions:	Monitoring	Reporting
	<ul style="list-style-type: none"> ○ Develop a riparian vegetation rehabilitation strategy, aligned with predicted groundwater recovery trajectories and closure modelling • If exceedance of SSTV for groundwater quality is from BHP operations, AND exceedance of threshold criterion for riparian vegetation: <ul style="list-style-type: none"> ○ Modify dewatering rate (where feasible); and/or ○ evaluate if alternative disposal methods are necessary (containment, evaporation ponds, irrigation, treatment, reinjection). • Monitor and review to ensure contingency actions are successful and review procedures, if appropriate. 		

* environmental criteria for groundwater quality and quantity will assist in managing potential impacts to riparian vegetation, terrestrial fauna habitat, aquatic fauna habitat and stygofauna habitat

environmental criteria for riparian vegetation will assist in managing potential impacts to terrestrial and aquatic fauna habitat

The purpose of Table 8 is to meet the requirements of Condition XX for surface water, groundwater and subterranean fauna habitat of Ministerial Statement XXXX.

Table 8: Objective-based components

EPA factor and objective	<p>Inland Waters - To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.</p> <p>Flora and Vegetation - To protect flora and vegetation so that biological diversity and ecological integrity are maintained.</p> <p>Terrestrial Fauna - To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.</p> <p>Subterranean Fauna - To protect subterranean fauna so that biological diversity and ecological integrity are maintained.</p>
Environmental Objectives	<p>Monitor of the rate of through-flow and quality of groundwater at the downstream boundary of mining lease 270SA, at appropriate locations along the channel iron deposit aquifer and in the pit lakes⁵ within the Development Envelope.</p> <p>Minimise potential impacts to riparian vegetation associated with dewatering and surface water discharge.</p> <p>Enhance the understanding of the Marillana Creek Pools.</p> <p>Minimise impacts to subterranean fauna habitat.</p> <p>Minimise impacts to terrestrial fauna habitat along Marillana Creek</p>
Key environmental value/s	<p>Marillana Creek groundwater system</p> <p>Marillana Creek riparian vegetation</p> <p>Stygofauna habitat</p> <p>Marillana Creek terrestrial fauna habitat</p>
Key impacts and risks	<p>Groundwater drawdown and altered throughflow.</p> <p>Decline in riparian vegetation health due to groundwater drawdown and increased inundation at discharge points.</p> <p>Decline in stygofauna habitat availability due to groundwater drawdown Decline in stygofauna habitat quality from mining operations.</p> <p>Decline in Marillana Creek terrestrial fauna habitat quality from mining operations</p>

Objective-based components			
Management target	Management action	Monitoring	Reporting
<p>GROUNDWATER</p> <p>Management targets for enhancing understanding:</p> <ol style="list-style-type: none"> 1.) Current hydraulic gradient and CID throughflow is confirmed at various locations within six months of endorsement of this plan. 2.) Establish the feasibility of an engineering option to protect areas upstream from mining operations from groundwater drawdown within 12 months of endorsement of this plan. 3.) Review of groundwater modelling in accordance with Triennial Aquifer Review <p>Management targets during operations:</p> <ol style="list-style-type: none"> 4.) Groundwater measurements (levels and quality) are uploaded onto centralised system within 2 months of acquisition. 	<p>Management actions for enhancing understanding:</p> <ol style="list-style-type: none"> 1.) Hydrogeological team reviews existing groundwater levels and reviews groundwater modelling of groundwater abstraction from CID and shallow aquifers to estimate the extent and depth of groundwater drawdown, particularly propagation of drawdown into upstream areas. 2.) Hydrogeological team confirm the current hydraulic gradient and CID throughflow at various locations. 3.) Hydrogeological team to consult with RTIO to investigate the use of any new bores and incorporate into hydrogeological studies. 4.) Hydrogeological team to investigate the feasibility of an engineering option to improve groundwater level recovery. 5.) BHP to provide a review of the feasibility of an impermeable barrier to protect upstream areas from groundwater drawdown impacts. <p>Management actions during operations:</p> <ol style="list-style-type: none"> 6.) Hydrogeology team stores groundwater measurements in a centralised database within 2 months of acquisition. 	<p>Groundwater quantity/quality:</p> <p>Monthly groundwater levels (mbgl) at HYW0002M, and groundwater levels and quality in other bores consistent with the requirements outlined in the Groundwater License Operating Strategy (BHP 2024). The GWOS details operational bores located in the active pits.</p> <p>Throughflow:</p> <p>Hydraulic gradient and throughflow at the eastern (downstream) boundary of M270SA. Throughflow monitored at downstream bores in accordance with the GWOS and at appropriate locations along the CID.</p>	<p>Refer to Table 9</p>

⁵ Monitoring of groundwater quality within pit lakes is to be covered in the MCP

Objective-based components			
Management target	Management action	Monitoring	Reporting
	7.) Hydrogeology team review upstream groundwater levels changes via the annual aquifer review process within 12 months of endorsement of this plan.		
<p>RIPARIAN VEGETATION HEALTH (TERRESTRIAL FAUNA HABITAT QUALITY)</p> <p>Management targets for enhancing understanding:</p> <ol style="list-style-type: none"> 1.) All Tree Health Monitoring Sites on tenure have associated functional groundwater bores to monitor groundwater levels within a year of endorsement of this Plan. <p>Management targets during operations:</p> <ol style="list-style-type: none"> 2.) Establish groundwater levels corresponding to active Tree Health Monitoring Sites on tenure, and where possible upstream off tenure, within 12 months of endorsement of this Plan 3.) Monitor vegetation health (Crown Score) and water quality at the discharge point annually 	<p>Management actions during operations:</p> <ol style="list-style-type: none"> 1.) Site continues to implement Tree health monitoring using the RVMP at Tree Health Monitoring Sites with reports generated annually. 2.) Hydrogeology team monitors groundwater levels at tree health bores and replacement bores biannually and uploads into a centralised database within 2 months of acquisition. 3.) Review trends in riparian vegetation with groundwater levels at all Tree Health Monitoring Sites with associated groundwater bores as part of pre-dry season and post-dry season monitoring in RVMP within a year of endorsement of this Plan. 4.) Review riparian vegetation health at Tree Health Monitoring Site 1 in the event water quality data for parameters considered influential on riparian vegetation health (including but not limited to: pH, TSS, nitrates, phosphates, calcium, sulphur, magnesium, iron, boron, zinc, copper, nickel and potassium) show unexpected trends or spikes whilst discharge continues. 5.) Should monitoring of riparian vegetation determine a significant decline in vegetation health, loss of species diversity or abundance, implement mitigation measures. These may include, but are not limited to: <ul style="list-style-type: none"> • Cease or reduce groundwater abstraction from the relevant borefield (where feasible) and allow groundwater levels to recover. • Provide alternative water supply to the affected trees (i.e. irrigation, infiltration or groundwater reinjection, based on feasibility of long-term persistence considering post closure groundwater levels) subject to approval from the regulatory authority. • Develop a rehabilitation strategy for areas of riparian vegetation health decline within the Development Envelope, commensurate to groundwater level recovery predicted through closure modelling • Monitor and review to ensure management actions are successful and review procedures, if appropriate. 	<p>Tree health with dewatering/drawdown:</p> <p>Biannual (pre-dry season and post-dry season) monitoring of groundwater levels at functional Golder bores and replacement bores on tenure and MB16YSN0003M and/or MB16YSN0004M off tenure (Figure 6).</p> <p>Pre-dry season and post-dry season tree health monitoring as per revised RVMP at Tree Health Monitoring Sites and Tree health reference sites (Figure 6).</p> <p>Tree health at the discharge point:</p> <p>Quarterly surface water hydrochemistry at Marillana Creek discharge point MCDMDEW040</p> <p>Pre- and post-dry season tree health monitoring as per revised RVMP at Tree Health Monitoring Site 1.</p>	Refer to Table 9
<p>MARILLANA CREEK POOLS</p> <p>Management targets for enhancing understanding</p> <ol style="list-style-type: none"> 1.) Establish monitoring of pool depth (continuous) and pool ecology to collect suitable baseline data to determine suitable performance criteria. 	<p>Management actions during operations.</p> <ol style="list-style-type: none"> 1.) Establish suitable monitoring site at Marillana Creek Pools MarC1 to MarC6 to record baseline data of pool depth. 2.) Establish ecological baseline monitoring at Marillana Creek Pools MarC1 to MarC6 3.) The Mine Closure Plan will be updated to incorporate additional aquatic fauna protection measures if monitoring conducted in accordance with this MCWRMP indicates that closure responses additional to those contained in the Mine Closure Plan are required 	<p>Pool Depth and Ecological Baseline Monitoring</p> <p>A staff gauge assembly and telemetry is to be installed within Marillana Creek Pools MarC1-MarC6 within a 12-month period to provide a continuous record of water depth within the pool</p> <p>Ongoing ecological baseline monitoring will continue in MarC1 to MarC6 within Marillana Creek and associated reference sites biannually, once in each the wet and dry season.</p> <p>The parameters to be monitored may include:</p> <p>Water Quality (when water present):</p>	Refer to Table 9

Objective-based components			
Management target	Management action	Monitoring	Reporting
		<ul style="list-style-type: none"> Physical parameters (pH, electrical conductivity dissolved oxygen, temperature, redox, turbidity) Ionic composition (Ca, K, Mg, Na, HCO₃, Cl, SO₄, CO₃, alkalinity and hardness) Nutrients (nitrite, nitrate, nitrogen oxides, ammonia, total nitrogen, and total phosphorus) Dissolved metals (aluminium, arsenic, boron, barium, cadmium, cobalt, chromium, copper, iron, manganese, molybdenum, nickel, lead, selenium, uranium, vanadium, and zinc) <p>Macrophytes (submerged and emergent) and dominant riparian vegetation specimens collected from each site</p> <p>Zooplankton (microinvertebrate fauna) samples collected by sweeping over a 15 m distance with mesh pond net.</p> <p>Hyporheos fauna sampled using the Karaman-Chappuis method</p> <p>Macroinvertebrate sampling using a D-net across as many habitats as possible.</p> <p>Fish sampling using light weight fine mesh gill nets and direct observation.</p>	
<p>SUBTERRANEAN FAUNA</p> <p>Management targets for enhancing understanding:</p> <ol style="list-style-type: none"> 1.) Current hydraulic gradient and CID throughflow is confirmed at various locations within six months of endorsement of this plan. 2.) Establish the feasibility of an engineering option to protect areas upstream from mining operations from groundwater drawdown within 12 months of endorsement of this plan. 3.) Review of groundwater modelling in accordance with Triennial Aquifer Review <p>Management targets during operations:</p> <ol style="list-style-type: none"> 4.) Groundwater measurements (levels and quality) are uploaded onto centralised system within 2 months of acquisition. 	<p>Management actions for enhancing understanding:</p> <ol style="list-style-type: none"> 1.) Periodically review existing groundwater levels and groundwater modelling of groundwater abstraction from CID and shallow aquifers to estimate the extent and depth of groundwater drawdown, particularly propagation of drawdown into upstream areas. 2.) Confirm the current hydraulic gradient and CID throughflow at various locations. 3.) Hydrogeological team to consult with RTIO to investigate the use of any new bores and incorporate into hydrogeological studies. 4.) Hydrogeological team to investigate the feasibility of an engineering option to improve groundwater level recovery. 5.) BHP to provide a review of the feasibility of an impermeable barrier to protect upstream areas from groundwater drawdown impacts. <p>Management actions during operations:</p> <ol style="list-style-type: none"> 6.) Hydrogeology team stores groundwater measurements in a centralised database within 2 months of acquisition. 7.) Hydrogeology team review upstream groundwater levels changes via the annual aquifer review process within 12 months of endorsement of this plan. 	<p>Groundwater quantity/quality:</p> <p>Monitor monthly groundwater levels (mbgl) at HYW0002M, and groundwater levels and quality in other bores, consistent with the requirements outlined in the GWOS (BHP 2024c). The GWOS details operational bores located in the active pits.</p> <p>Throughflow:</p> <p>Hydraulic gradient and throughflow at the eastern (downstream) boundary of M270SA. Throughflow monitored at downstream bores in accordance with the GWOS and at appropriate locations along the CID.</p>	Refer to Table 9

3 Reporting

BHP must report to DWER as detailed in Table 9.

Table 9: Management plan regulatory reporting requirements

Action or Criteria	Reporting Time	Reporting Requirements
Threshold Criteria exceedance	Report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified;	<p>In the event that monitoring, tests, surveys or investigations indicates exceedance of threshold criteria specified in this Management Plan, the proponent shall:</p> <ol style="list-style-type: none"> (1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified; (2) immediately implement the threshold contingency actions (responses) specified in the Management Plan and continue implementation of those actions until the threshold criteria are being met and implementation of the threshold contingency actions are no longer required; (3) investigate to determine the cause of the threshold criteria being exceeded; (4) identify additional measures required to prevent the threshold criteria being exceeded in the future; (5) investigate to determine potential environmental harm or alteration of the environment that occurred due to threshold criteria being exceeded; and (6) provide a report to the CEO within ninety (90) days of the exceedance being reported. <p>The report shall include:</p> <ol style="list-style-type: none"> (a) details of any threshold contingency actions implemented; (b) the effectiveness of the threshold contingency actions implemented, monitored and measured against threshold criteria; (c) the findings of the investigations required above; (d) additional measures to prevent the threshold criteria being exceeded in the future; and (e) measures to prevent, control or abate the environmental harm or alteration of the environment which may have occurred.
Non-achievement of Management Targets	Report the failure to implement the management targets in writing to the CEO within seven (7) days of identification.	<p>If monitoring, tests, surveys or investigations indicate that one or more management targets specified in this Management Plan has not been implemented, the proponent shall:</p> <ol style="list-style-type: none"> (1) report the failure to implement the management targets(s) in writing to the CEO within seven (7) days of identification; (2) investigate to determine the cause of the management targets(s) not being implemented;

Action or Criteria	Reporting Time	Reporting Requirements
		<p>(3) investigate to determine the potential environmental harm or alteration of the environment that occurred due to the failure to implement the management targets(s);</p> <p>(4) provide a report to the CEO within twenty-one (21) days.</p> <p>The report shall include:</p> <p>(a) the cause of the failure to implement the management targets;</p> <p>(b) the findings of the investigations;</p> <p>(c) relevant changes to proposal activities;</p> <p>(d) measures to prevent, control or abate the environmental harm which may have occurred.</p>
Annual Compliance Reporting	Annually by 1 October each year	<p>Submit an annual Compliance Assessment Report as part of the Annual Environment Report to the DWER by 1 October each year.</p> <p>Each annual Compliance Assessment Report will be endorsed by the proponent’s Chief Executive Officer, or a person approved by proponent’s Chief Executive Officer to be delegated to sign on the Chief Executive Officer’s behalf.</p> <p>1.) Each annual Compliance Assessment Report will state:</p> <ul style="list-style-type: none"> (a) whether each Ministerial Statement condition relevant to this Management Plan has been complied with; (b) achievement of Management Plan management actions, targets and monitoring; (c) exceedances of trigger or threshold criteria; (d) the implementation of contingency response actions; and (e) requirements to implement adaptive management. <p>2.) provide evidence to substantiate statements of compliance, or details of where there has been a non-compliance;</p> <p>3.) include the corrective, remedial and preventative actions taken in response to any potential non-compliance;</p> <p>4.) be provided in a form suitable for publication on the proponent’s website and online by the Department of Water and Environmental Regulation.</p>

Action or Criteria	Reporting Time	Reporting Requirements
		5.) be prepared and published consistent with the latest version of the Compliance Assessment Plan which the CEO has confirmed by notice in writing satisfies the relevant requirements of the implementation conditions.

4 Adaptive management and review of the EMP

4.1 Adaptive management approach

BHP applies an adaptive management framework for implementing management measures identified in this EMP, which is consistent with the Instructions. Adaptive management is a structured, iterative process to decision making. The framework embeds a cycle of monitoring, reporting and implementing change where required. It allows an evaluation of the management and mitigation measures so that they are progressively improved and refined, or alternative solutions adopted, to ensure that environmental objectives and outcomes in the plan are achieved. The steps of the adaptive management approach are outlined in Figure 9.

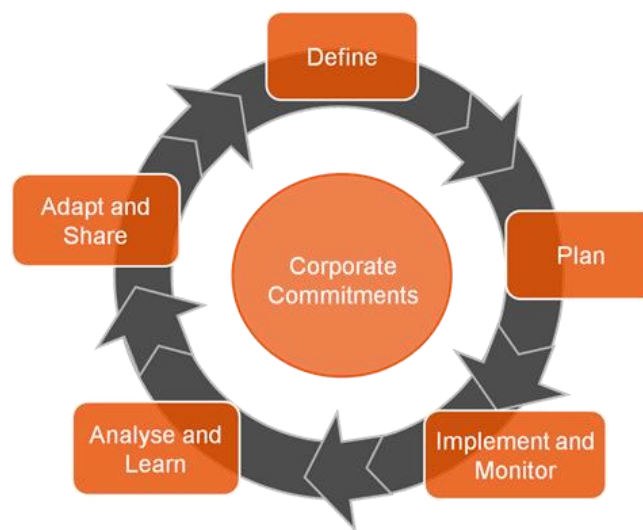


Figure : BHP's adaptive management approach

Where the EMP is a requirement of a MS condition, BHP notes that if it chooses to amend a non-administrative EMP component in Table 6 or Table 7 based on information gained through adaptive management, it must seek formal approval from the Department of Water and Environmental Regulation (DWER).

4.2 Review and update of this EMP

BHP will review this EMP (and update it if required), to ensure that it achieves the identified environmental objectives and meets MS conditions. A review may arise from the following:

- Where required by an MS condition, this EMP will be reviewed, and revised as required, at intervals not exceeding 5 years (including independent peer review).
- If initiated by BHP as part of the adaptive management process.

Changes to the endorsed version of the EMP may arise from the following:

- BHP reviews the EMP if the EPA or relevant government agencies develop new or amend existing guidance or policy.
- BHP adds components when a change to the existing operation is proposed.

5 Stakeholder consultation

BHP has considered feedback from consultation on previous draft versions of this revised EMP prepared to meet the requirements of Condition 8 of Ministerial Statement 679 when developing the current MCWRMP (Table 10).

BHP will make the latest endorsed version of the MCWRMP (that meets the requirements of the SWGWMP) available to stakeholders, including members of the public, upon request or in accordance with an implementation condition.

Table 10: BHP Stakeholder consultation

Stakeholder	Date of Consultation	Description of Consultation	Topics / Issues Raised	Stakeholder/BHP Response
DWER-EPA Services	Monthly	Approvals progressing	<ul style="list-style-type: none"> BHP has provided monthly updates to the EPA on the progress of management plans under preparation, including the MCWRMP. 	The EPA noted that BHP was in the process of revising the plan with submission imminent.
Banjima Native Title Aboriginal Corporation	30 August 2024	Provision of MCWRMP as part of draft Environmental Review Document (ERD) technical review	<ul style="list-style-type: none"> BHP and BNTAC undertook a workshop to review the technical details of environmental impact assessment presented in the draft ERD, and the management measures provided in the management plans and Mine Closure Plan. 	Review of draft ERD and associated management plans. BNTAC raised several technical queries regarding the impact assessment and management actions detailed in the ERD and management plans. BHP have responded to the questions raised and updated the ERD and supporting management plans to provide additional information and clarity.
DWER-EPA Services	29 Oct 2020	Provision of revised Version 1.2 of the MCWRMP to satisfy the intent of condition 8-1 and 8-3 of MS679.	<ul style="list-style-type: none"> BHP noted that a revised EMP is in preparation to address DWER April 2018 comments. BHP updating the EMP to consider the recently revised <i>Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans</i> (EPA, 2021). The Yandi BEMP is undergoing an internal review. 	None.
Office of the Environmental Protection Authority (OEPA)	6 and 26 December 2017	The (former) Yandi Surface Water and Ground Water Management Plan submission timeframe	<ul style="list-style-type: none"> BHP requested a formal extension for the submission of the revised (former) Yandi Surface Water and Ground Water Management Plan in accordance with condition 8-1 and 8-3. BHP proposed to align the requirement of condition 8 of the Ministerial Statement 679 with the Pilbara Water Resource Management Strategy (BHP, 2014a), the Marillana Creek Diversion Management Plan (BHP, 2016a) and the Yandi Closure Plan (BHP, 2016c) 	The OEPA noted that BHP was in the process of revising the plan and considered the proposed submission date of 31 October 2017 to be acceptable.
Environmental Protection Authority Services	31 October 2017	Provision of Version 1.0 of the MCWRMP to satisfy the intent of	<ul style="list-style-type: none"> In addition to the provision of the updated plan by the 31 October 2017, BHP indicated that the plan was developed in accordance with the EPA Guidance (EPA, 2017) and the plan was, at the time of writing, seeking an independent peer 	EPA noted BHP's intent to potentially resubmit a Version 1.1 as a result of addressing the independent peer review comments.

Stakeholder	Date of Consultation	Description of Consultation	Topics / Issues Raised	Stakeholder/BHP Response
		condition 8-1 and 8-3 of MS679.	<p>review in accordance with condition 8-2 of Ministerial Statement 679.</p> <ul style="list-style-type: none"> BHP confirmed via an email dated 1 November 2017 and subsequent regular monthly EPA/BHP meeting that BHP intended to potentially improve on Version 1.0 as result of the comments received from the independent peer review. 	
Environmental Protection Authority Services	1 December 2017	Update on the Status of the Independent Peer Review of Version 1.1 of MCWRMP	<ul style="list-style-type: none"> BHP notified the EPA Services that the independent peer review was received, and it identified that the MCWRMP was essentially compliant with Ministerial Statement 679. It also identified a number of continuous improvement opportunities with regard to best practice. BHP indicated it would resubmit the MCWRMP by the end of January 2017 after it conducted a cost/benefit analysis of each improvement activity. This was considered important given Yandi mine's limited life of asset. 	EPA noted the date Version 1.1 would be submitted in the December monthly EPA/BHP meeting.

6 Changes to an EMP

Changes to the MCWRMP are documented in Table 11, as required by the Instructions.

Table 10: Changes to the EMP

Complexity of changes	Minor	Moderate <input checked="" type="checkbox"/>	Major
Number of key environmental factors	One	2-3	>3
Date revision submitted to EPA	May 2025		
Proponent’s operational requirement timeframe for approval of revision	< One month	< Six months	>Six months <input checked="" type="checkbox"/> None
Reason for timeframe	Alignment with s38 referral.		

Item no.	EMP Section no.	EMP page no.	Summary of change	Reason for change
1	All	All	Marillana Creek Water Resource Management Plan Version 1.1. Changes to the approved Marillana Creek (Yandi) Surface Water and Groundwater Management Plan (2014). Included detail of groundwater monitoring and reporting process. Identified potential changes to surface water regime.	Update to incorporate response to Peer Review.
2	All	All	Marillana Creek Water Resource Management Plan Version 1.2. Updated in response to comments from DWER on Version 1.1. Restructured/updated to align with EPA’s revised October 2021 Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans.	Updated in response to comments from DWER on Version 1.1 and restructured/updated to align with EPA’s revised <i>Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans</i> (2021).
3	All	All	Marillana Creek Water Resource Management Plan Version 1.3. Updated to incorporate Significant Amendment for Yandi and the revised Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans, March 2024.	Update to align with Significant Amendment.
4	All	All	Marillana Creek Water Resource Management Plan Version 1.4 – Yandi Significant Amendment.	Updated to support referral of the Marillana Creek (Yandi) Life of Mine Significant Amendment Proposal. Updated to align with the EPA’s revised <i>How to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans</i> (EPA 2024)

Item no.	EMP Section no.	EMP page no.	Summary of change	Reason for change
5	1.4, 1.5	All	Marillana Creek Water Resource Management Plan Version 1.5 – Yandi Significant Amendment. Updated to include BNTAC comments to support the referral of the Marillana Creek (Yandi) Life of Mine Significant Amendment Proposal	Change incorporating technical advice and further studies.
6	1.4, 1.5	All	Updates to all figures, updates to Table 3, Table 4, Table 5, Table 6, Table 7, Table 8 and Table 9. Inclusion of Marillana Creek Pools, updated rationale, update to stakeholder consultation.	Update to align with Significant Amendment and future MS conditions.
7	Executive Summary 1, 1.2, 1.3, 1.5, 2, 6, Appendices, References	All	Updates to Figure 6, Figure 7, and Figure 8, Table 6, Table 7, Table 8, Table 9 and Table 10. Inclusion of Marillana Creek Pools, Subterranean Fauna Habitat, updated rationale, appendices, update to stakeholder consultation and references to include stygofauna studies and Groundwater Operating Strategy.	Update following DWER comments in RFI received 22 September 2025.

7 References

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Appendices

Appendix 1: Existing monitoring regulatory requirements for Yandi mining operations

Appendix 1a: Excerpt of Groundwater monitoring requirements for Yandi mining operations (GWL89501)*

Monitoring requirement	Borefield or source	Bore	Monitoring Parameters	Frequency
Regional water levels	Upgradient	Representative monitoring bores up gradient of W1 deposit:	Water level	Monthly
Regional water levels	Downgradient	Representative monitoring bores down gradient of E6 deposit:	Water level	Monthly
Dewatering (source)	Active pits	All active production bores and active sumps	Cumulative volume	Monthly
		1 representative dewatering Bores ⁴ per deposit, all active sumps	Field EC and pH	Monthly
			Hydrochemistry – Standard suite	Biannually
	New bores	New Bores	Hydrochemistry – comprehensive suite ³	First sample
In-pit monitoring bores (source)	Active pits	1 representative monitoring bore per deposit	Water level	Monthly
Tree Health Monitoring bores (receptor)	In accordance with GWOS	1-4 representative monitoring bores per area	Water level	Quarterly

*Note: To avoid regulatory duplication, the bore names and monitoring parameters have been simplified, further detail can be found in the approved Groundwater Operating Strategy for GWL89501 issued under the RiWI Act.

Appendix 1b: Surface water monitoring requirements for Yandi mining operations (Part V Licence L6168/1991/11)

Borefield or source	Parameters	Frequency	Performance indicator	Approvals requirement	
Discharge point and supplementary discharge point MCSW040, MCSW041	Volumetric Flow Rate (m ³ /day)	Continuous	Discharge Water Quality (Performance criteria include the lack of unexpected trends or spikes within the data)	EP Act Licence L6168/1991/11	
	Hydrochemistry mg/L (EC, pH, TDS, TSS, TRH, BTEX, PAH, Na, K, Ca, Mg, Cl, CO ₃ , HCO ₃ , SO ₄ , NO ₃ , Total N, Total P, Al, Bo, Fe, Cu, Zn, Ag, As, Cr, Cd, Hg, Ni, Se, Mn, PFAS compounds)	Quarterly			
	Perfluorooctane sulfonic acid (PFOS)				≤0.0091 µg/L
	Perfluorooctanoic acid (PFOA)				≤19 µg/L
Marillana Creek Surface Water Monitoring Sites MCSW005 and MCSW002 (YNSWPC001 YNSWPC002).	Hydrochemistry mg/L (EC, pH, TDS, TSS, TRH, Na, K, Ca, Mg, Cl, CO ₃ , HCO ₃ , SO ₄ , NO ₃ , Al, Bo, Fe, Cu, Zn, Ag, As, Cr, Cd, Hg, Ni, Mn)	Following rain events	Water Quality (Performance criteria include the lack of unexpected trends or spikes within the data)	EP Act Licence No. L6168/1991/11	
Surface water flows	Obtain the latest water flow monitoring results for the Flat Rock gauging station from the DWERs web site (online Water Resources Data) and include in groundwater and surface water modelling as required.	Periodically	DWER Water Information (WIN) database and Hydstra database time-series data.	None	

Appendix 2: Original Riparian Vegetation Monitoring Program

Appendix 2a: Original Riparian Vegetation Monitoring Program

The original RVMP used pre-2021 established a site-specific adaptive management framework for riparian vegetation within the Marillana Creek water management area and uses various scales of monitoring:

- Landscape scale: the entire Yandi Mining lease excluding cleared and rehabilitation areas, subdivided into the riparian and non-riparian zone.
- Ecosystem scale: zones of the riparian vegetation that run along the main channel of Marillana Creek within the mining lease and further upstream according to existing environmental values (mainly the presence of stands of *Melaleuca argentea*) and the threat posed by mining activities, in particular dewatering. Zones are defined below and those monitored up until 2020 shown on Figure A1 below:
 - Zone 1: High Value – Contains patches of *Melaleuca argentea* (5 – 10 trees), semi-permanent pools (Flat Rocks), and sections of creek not expected to be diverted in future activities.
 - Zone 2: Moderate Value – Areas expected to be impacted by future creek diversion containing fewer stands of live *Melaleuca argentea* than Zone 1.
 - Zone 3: Low Value: Areas directly on the CID adjacent to the mine that have been significantly impacted by operations prior to 2012.
 - Reference: Area outside of the BHP lease and upstream of the mine, beyond the zone of predicted impact.
- Species scale: the main riparian tree species present along Marillana Creek: *Melaleuca argentea*, *E. camaldulensis*, and *E. victrix*.

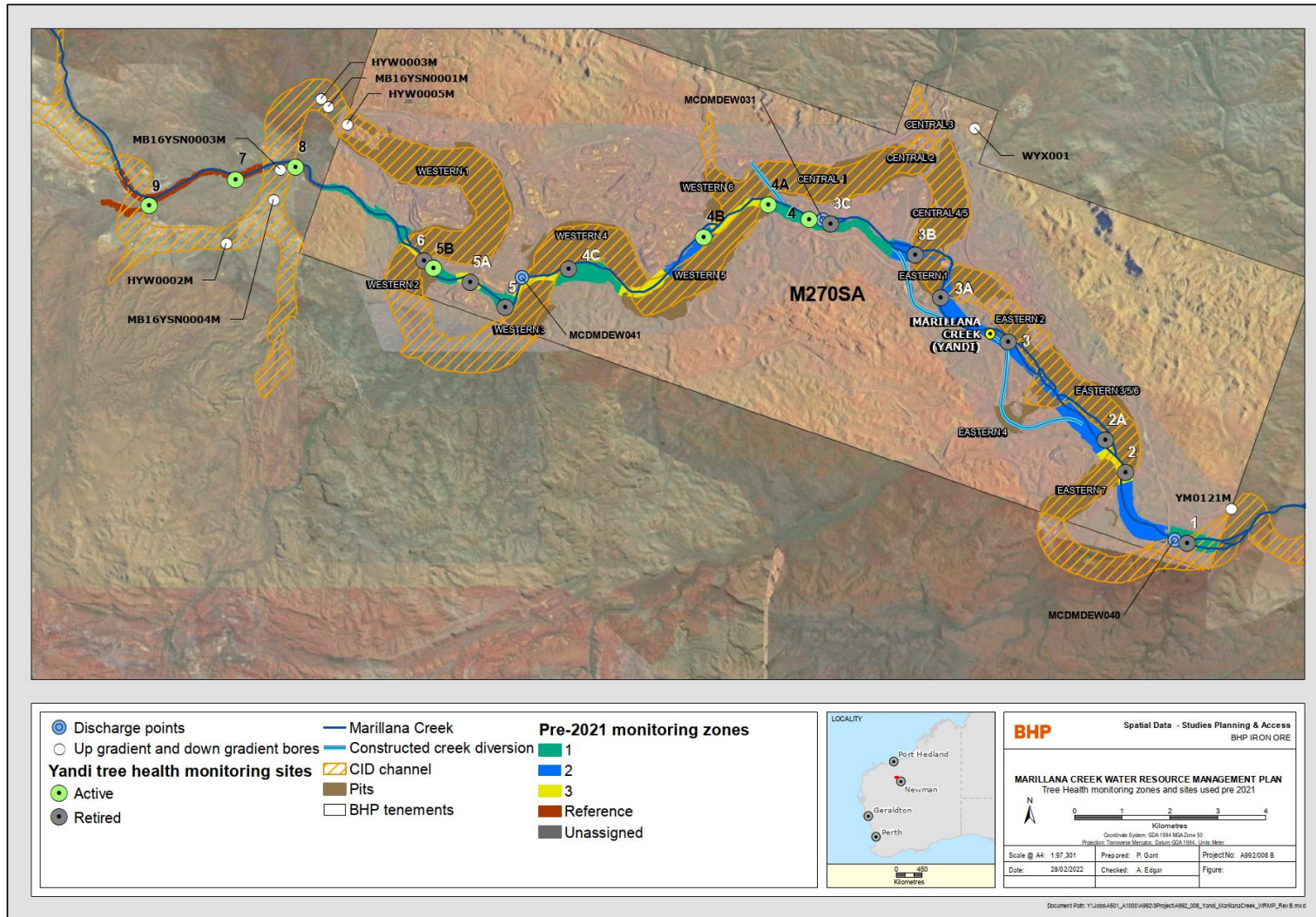


Figure A1: Yandi Tree Health Monitoring Sites

Appendix 2b: Baseline Leaf Water Potential and Crown Condition Scores

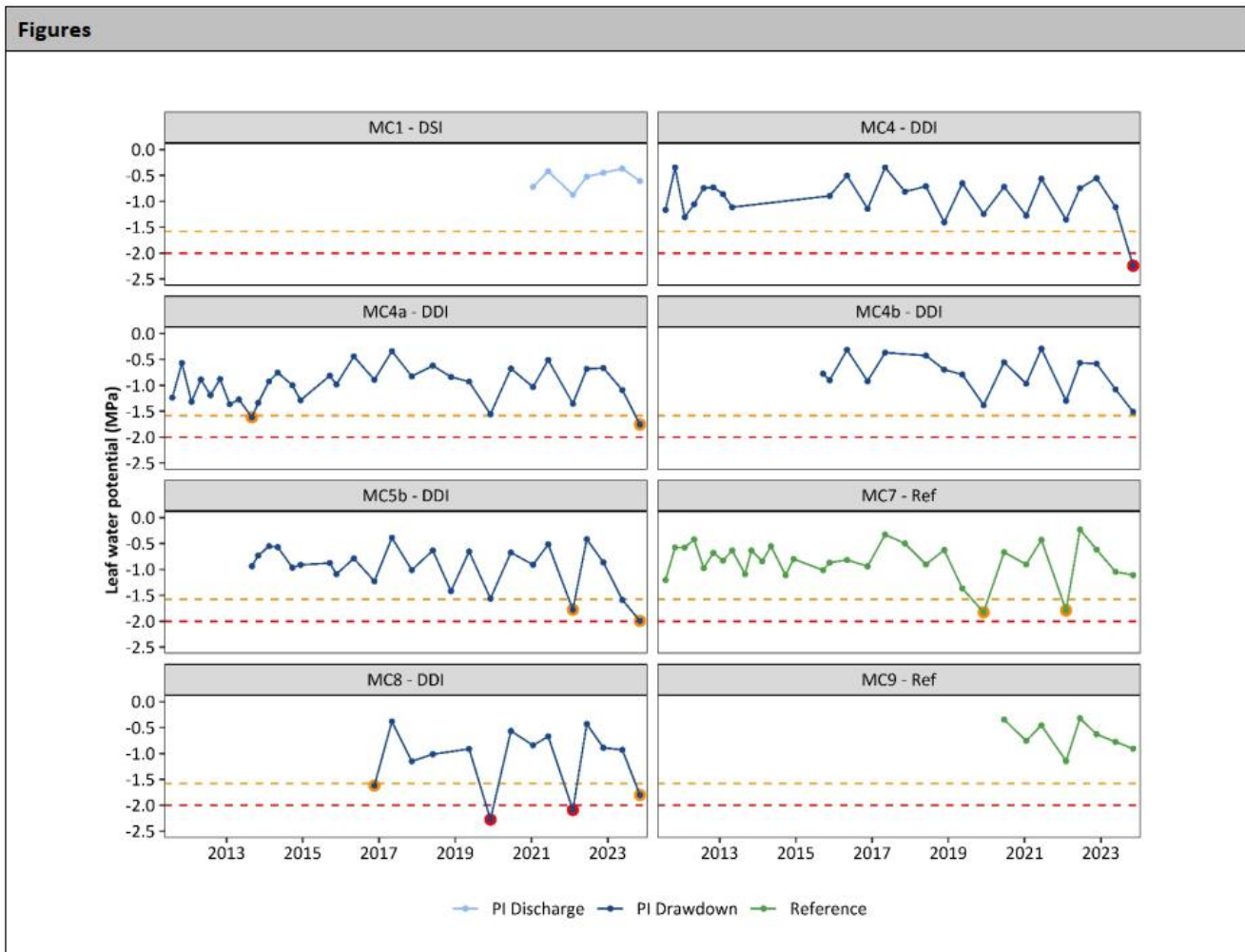


Figure 2: Control charts for predawn leaf water potential of live *Melaleuca argentea* sample trees. Sites with blue data points are potential impact sites. Sites with green data points are reference sites. Orange dashed lines indicate Control Limit 1 and red dashed lines indicate Control Limit 2. (Source: Astron 2024)

Figures

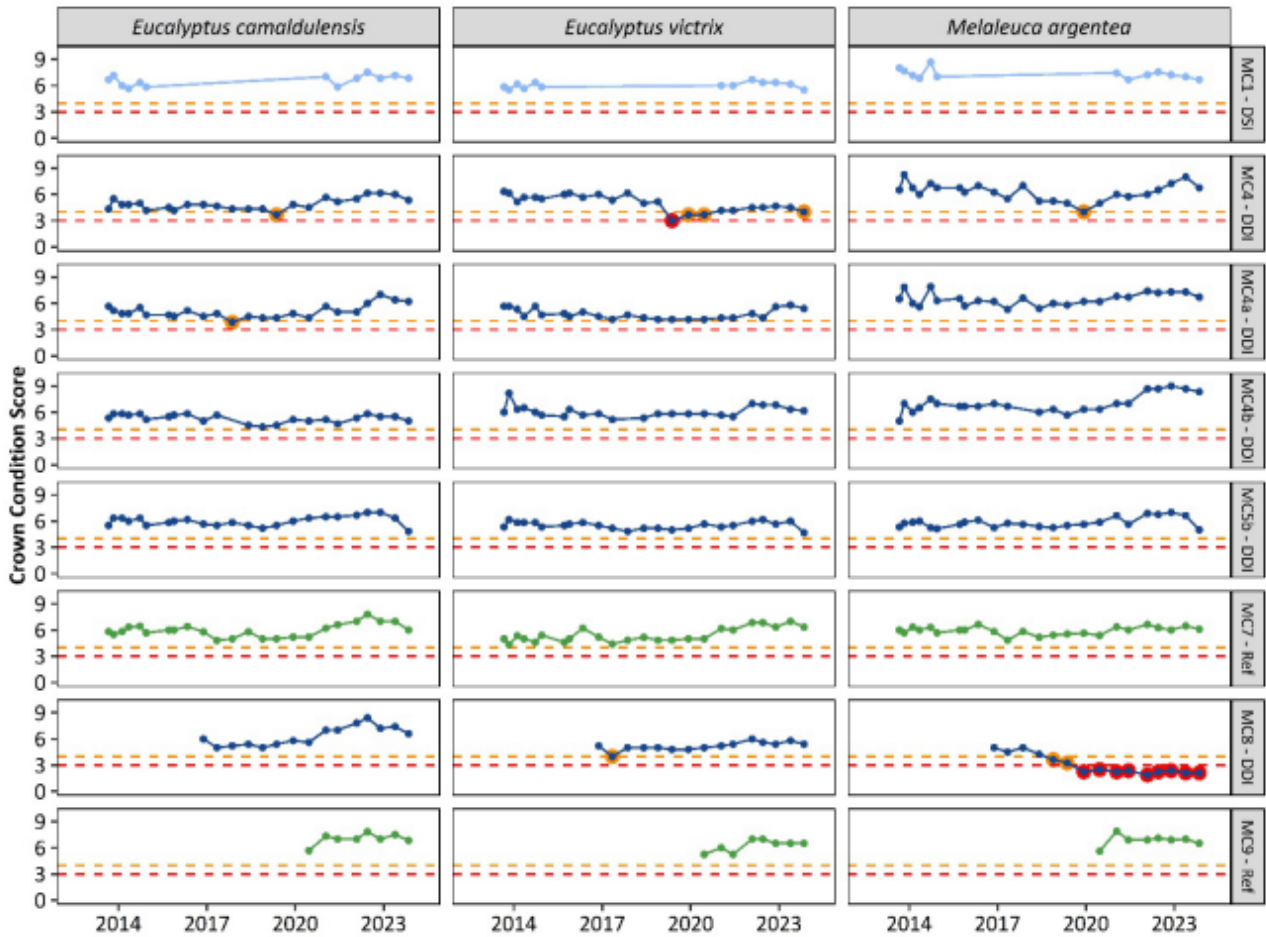


Figure 3: Control charts for crown condition score of live sample trees. Sites with blue data points are potential impact sites. Sites with green data points are reference sites. Data points are the mean of all permanent sample trees of each species. Orange dashed lines indicate Control Limit 1 (CCS ≤ 4) and red dashed lines indicate Control Limit 2 (CCS ≤ 3). (Source: Astron 2024)

Appendix 3: Evaluation of Alternative Dewatering Discharge Locations and Strategies

Alternative	Evaluation
Discharge to a mined-out pit rather than Marillana Creek.	<ul style="list-style-type: none"> Discharging mine water into mined-out parts of the CID would avoid impacts on Marillana Creek and could potentially provide a more-direct aquifer re-charge mechanism. One potential disadvantage, however, would be increased evaporation if the discharge was allowed to form a pit lake. Mined-out pit areas are considered to be unsuitable for in-pit discharge at this stage because mining will be occurring directly down gradient, and hence the water would need to be pumped back out of the CID (i.e. 'recycled') as soon as it had entered it. This could reduce the effectiveness of the mine dewatering to a point where it is no longer viable.
Move discharge point to a section of Marillana Creek that is proposed to be diverted under the Life-of-Mine plan.	<ul style="list-style-type: none"> The current discharge point is located to the east of the E7 pit, which is at the downstream end of the eastern Marillana Creek diversion. This discharge point MCDMDEW040 is located near the lease boundary, having the discharge any further upstream will increase the seepage losses back into the active pits/dewatering borefields which would cause dewatering issues.
Move discharge point to an alternative location on Marillana Creek.	<ul style="list-style-type: none"> Other possible discharge locations on Marillana Creek that are at points where the CID crosses the Creek, and are not near areas to be mined, include the point between the W1 and W2 deposits, and the point immediately upstream of the E8 deposit. The MCDMDEW040 discharge point is located near the lease boundary, having the discharge any further upstream will increase the seepage losses back into the active pits/dewatering borefields which would cause dewatering issues.
Reduce the amount of discharge to Marillana Creek by using more water for ore processing and dust suppression.	<ul style="list-style-type: none"> BHP Iron Ore's overall water use objective for all of its Pilbara operations is to maximise efficiency. BHP has put in place mechanisms to track and (if possible) limit the water use to the minimum required to meet its ore processing and dust suppression requirements. This MCWRMP has been prepared to be consistent with this objective. At this point in time, it is considered preferable to continue to operate the mine in this manner, as the excess water is discharged in a way that maximises the amount that returns to the downgradient CID aquifer (rather than it being lost off-site through evaporation or entrained in the ore).
Provide water to other users in the catchment.	<ul style="list-style-type: none"> This option is not considered to be economically viable (i.e. costs involved in piping the water to a user that could use the amount of excess water that is generated by the Mine).

Appendix 4: Survey and study reports

Inland Waters

The surveys and studies used to develop the EMP components related to inland waters are listed below:

Aquaterra Consulting Pty Ltd (2004). *Yandi Life of Mine Plan Modelling of Hydrogeological Impacts and Outcomes*. Report prepared for BHP Billiton Iron Ore Pty Ltd.

Alan Tingay and Associates (ATA) (1997). *Yandi Iron Ore Mine Marillana Creek Environmental Study 1991 – 1997 Review of Study Design*. Report prepared for BHP Billiton Iron Ore Pty Ltd.

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BHP Billiton (2015). *Groundwater Licence (GWL) Operating Strategy for Yandi (Marillana Creek) Operations*. Version 2.0

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BHP (2018). *Pilbara Water Resource Management Strategy*

BHP (2019). *Triennial Aquifer Review Yandi*

BHP (2020). *Yandi Annual Aquifer Review*

BHP (2021). *BHP Iron Ore Annual Environmental Report July 2020 - June 2021*.

BHP (2023) *Western Australian Iron Ore Central Pilbara Catchment Management Plan*. June 2023

Environmental Protection Authority (1995). *Duplication of iron ore mining operation, Yandi mine ML270SA, Hamersley Range, 90 km north-west of Newman – EPA Report and Recommendations Bulletin No. 802*.

Environment Protection Authority (2005). *Marillana Creek Life of Mine Proposal – EPA Report and Recommendations Bulletin No. 1166*.

Golder Associates (2014). *Monitoring and Interpretation of Groundwater Level Fluctuation Along Marillana Creek – Second Quarter. Yandi Marillana Creek Tree Health Study, June 2014*. Unpublished report to BHP Billiton Iron Ore Pty Ltd.

Golder Associates (2015). *Ecohydrological Conceptualisation of the Marillana Creek Region*, unpublished report to BHP Billiton Iron Ore Pty Ltd, Golder Associates, Perth

Government of Western Australia (2001). *State Water Quality Management Strategy No. 1: Framework for Implementation*.

Maunsell Australia (2006). *Pit Dewatering and Vegetation Monitoring plan: Iron Ore Mine and Downstream Processing, Cape Preston, Western Australia*. Prepared for Mineralogy Pty Ltd, Perth WA.

MWH (2016). *Marillana Creek Flow Study*. Unpublished report prepared for BHP Billiton Iron Ore.

Riparian Tree Health

The surveys and studies used to develop the EMP components related to riparian vegetation health are listed below:

AQ2 (2015). *Riparian Vegetation Monitoring Program: Marillana Creek, Jimblebar Creek and Homestead Creek*. Unpublished report to BHP Billiton Iron Ore Pty Ltd, AQ2, Perth. May 2015

Environmental Services (2021a) *Marillana Creek Riparian Vegetation Monitoring Program – Review – Memo*. April 2021

Astron (2024) *Marillana Creek Riparian Vegetation Monitoring Program (RVMP)* Report prepared for BHP

Astron Environmental Services (2021b). *Marillana Creek RVMP – Annual Summary – 2020-2021, July 2021*

BHP (2021) *BHP Iron Ore Annual Environmental Report July 2020 - June 2021*.

Biologic Environmental Survey (Biologic) (2022) *MAC Phase 4: Marillana Creek Baseline Aquatic Ecosystem Survey Dry 2020 & Wet 2021*.

Biologic Environmental Survey (Biologic) (2023) *Yandi E8 Targeted Flora Survey. Report to BHP Western Australian Iron Ore. February 2023*.

Biologic Environmental Survey (Biologic) (2024) *Central Pilbara Hub Detailed and Targeted Flora Survey. Prepared for BHP Western Australia Iron Ore*.

Carter, J.L., Colmer, T.D. & Veneklaas, E.J. (2006). 'Variable tolerance of wetland tree species to combined salinity and waterlogging is related to regulation of ion uptake and production of organic solutes', *New Phytologist*, vol. 169, no. 1, pp. 123-34.

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Golder Associates (2014). *Monitoring and Interpretation of Groundwater Level Fluctuation Along Marillana Creek – Second Quarter. Yandi Marillana Creek Tree Health Study, June 2014*. Unpublished report to BHP Billiton Iron Ore Pty Ltd.

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Loomes, R. (2010). *Determining water level ranges of Pilbara riparian species, Environmental report no. 17*, Department of Water, Government of Western Australia, Perth.

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Scholander, P. F., E. D. Bradstreet, E. A. Hemmingsen, and H. T. Hammel. (1965). Sap pressure in vascular plants. *Science* 148:339–346.

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Souter, N.J., Watts, R.A., White, M.G., George, A.K. & McNicol, K.J. (2009). *Method Manual for the Visual Assessment of Lower River Murray Floodplain Trees. River Red Gum (Eucalyptus camaldulensis). Technical Note 2009/25*, Government of South Australia, through Department of Water, Land and Biodiversity Conservation, Adelaide.

Souter, N.J., Watts, R.A., White, M.G., George, A.K. & McNicol, K.J. (2010). Evaluation of a visual assessment method for tree condition of eucalypt floodplain forests. *Ecological Management & Restoration*. Vol 11-3, 210-214.

Appendix 5: Supporting information – Hydrogeology

Source: BHP (2024) Marillana Creek Updated Triggers and Thresholds Memo

This memo is to describe the updated triggers and thresholds for input to the Marillana Creek water resource management plan to aid the E8 Part IV approval.

Rationale

In Figure 1, Marillana Creek is represented by the solid blue line tracing the course of the creek. This line is interrupted by a yellow dashed line which also represents the course of Marillana Creek, however it is the reach of the creek which has been chosen to represent the hydrogeological conceptualisation shown in Figure 2. Tree health monitoring sites (proposed and current) are shown in green symbols, groundwater level monitoring sites are shown in blue, and dewatering (and water supply) bores are shown in red.

Dewatering of the CID aquifer at Yandi mine has been carried out for mining purposes for over two decades. Dewatering of the CID in the W1 pit commenced in 2007, with an uplift to more significant and sustained abstraction occurring in 2011. Since this time, groundwater levels in the CID, upstream of the W1 pit, have declined and the extent of this groundwater level drawdown has spread to beneath the area where Marillana Creek overlies the CID. This is the location of Tree Health Monitoring Sites 8 and 10 and where Flat Rocks Road crosses Marillana Creek. Tree health decline and deaths have been observed and documented in this area.

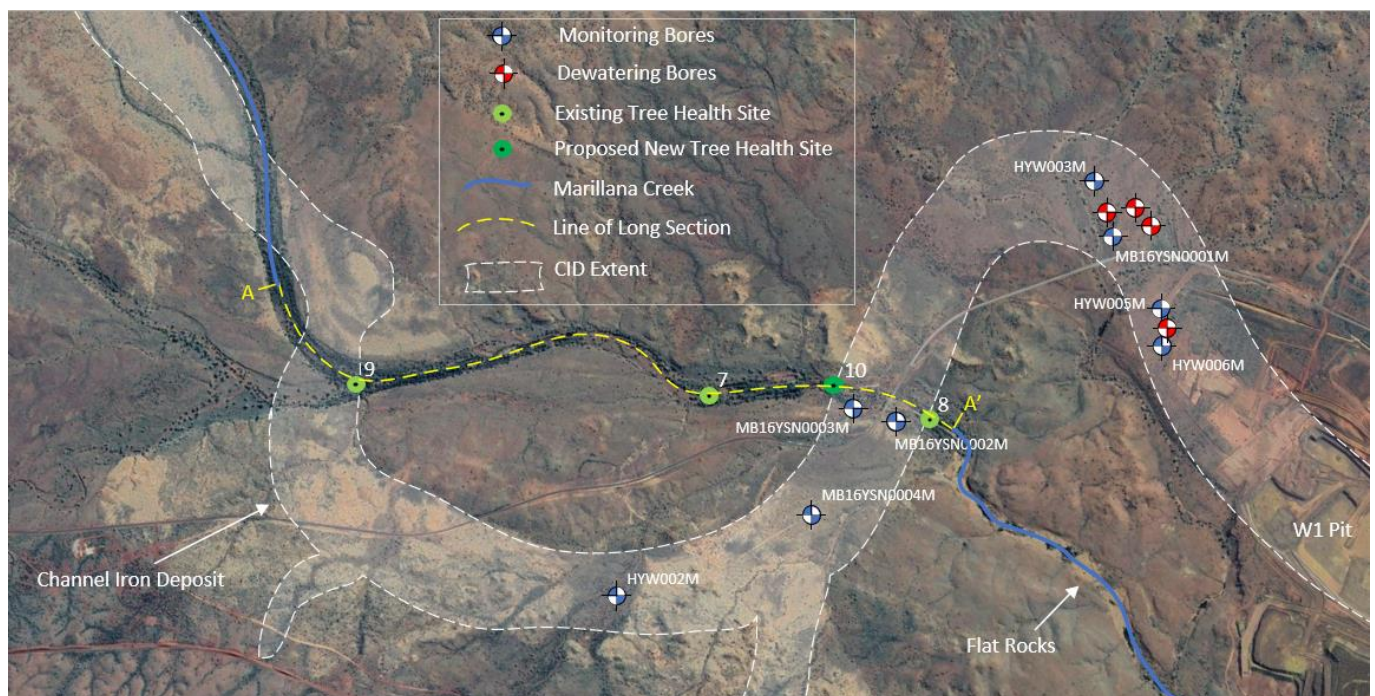


Figure 1 – Groundwater level and Tree Health Monitoring Sites – Upgradient of BHP Mining Operations

Figure 2 provides a long sectional representation of the current groundwater conditions along Marillana Creek (see yellow dashed line in Figure 1). In Figure 2, the groundwater level in the downstream intersection with the CID is much lower than the creek bed and therefore seasonal water availability in this area has been compromised. Figure 2 represents the current conditions at the Flat Rocks Road crossing with Marillana Creek where tree health impacts have been documented (Tree Health Monitoring Sites 8 and 10).

Recent monitoring data indicates that groundwater levels at the upstream intersection of the CID (near Tree Health Monitoring Site 9) are much closer to the creek bed and therefore still support tree health through water availability. This suggests

that whilst dewatering of the W1 pits has caused groundwater level drawdown to extend to Tree Health Monitoring Sites 8 and 10, it has not reached Tree Health Monitoring Site 9.

The area along Marillana Creek between these sites (including Tree Health Monitoring Site 7) is interpreted to lie between the two intersections of the CID and therefore the impact of dewatering is limited by the topography of the base of the creek alluvium (surface of the Weeli Wolli Formation). Field observations along this area indicate that there are several bedrock outcrops within the creek bed which act to interrupt the continuity of groundwater flow along the creek alluvium. These bedrock outcrops effectively result in the intermittent 'damming' of groundwater which prevents it from being drawn into the adjacent dewatered CID and therefore is allowed to persist for much longer periods following rain events. The area between Tree Health Monitoring Sites 9 and 10 (which includes Site 7) is therefore heavily dependent on rainfall and streamflow to maintain water availability for riparian vegetation and is unlikely to be further impacted by the continued decline in groundwater levels beneath the downstream crossing with the CID.

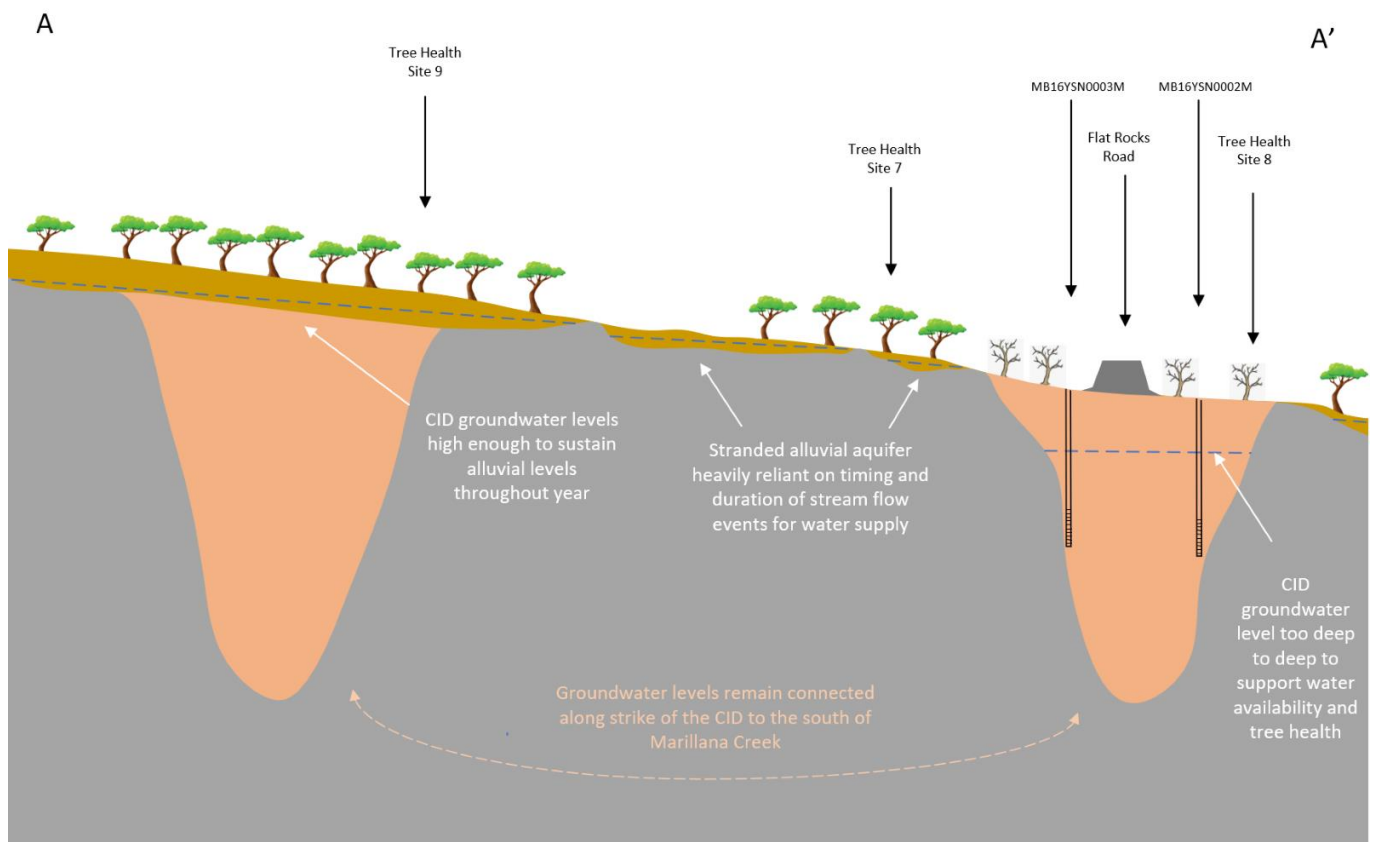


Figure 2 – Current Hydrogeological Conditions (Conceptual)

Dewatering of the W1 pit is anticipated to continue for at least the next 8 years to facilitate the completion of mining in this area. Historical water levels, Figure 3, show the onset of dewatering in Western 1 (W1) commencing in 2007 and the progressive impact of dewatering upgradient. In August 2022 a dewatering reduction was trialled and has seen water levels recover in HYW005M to 2019 levels. Improvements in water levels are propagating up the system with improvements in water levels also observed in MB16YSN001M. Figure 3 shows that groundwater level monitoring point HYW002M has declined marginally since early 2017 and is 2.5 m lower than the lowest historical reading in 1994. Due to the location of HYW002M being between the currently impacted Tree Health Monitoring Sites 8 and 10 and the unimpacted Site 9, it has been chosen for use as a trigger and threshold monitoring site for groundwater level decline that may indicate future tree health impacts at Tree Health Monitoring Site 9.

The groundwater level monitoring point HYW002M has been assigned both a trigger and threshold groundwater levels in the MCWRMP to provide an early indication that groundwater level decline could reach the upstream

intersection. Accordingly, mitigation actions have been assigned if groundwater levels fall below the threshold level in this bore. The derivation of the trigger and threshold values is explained in detail in the following sections of this appendix.

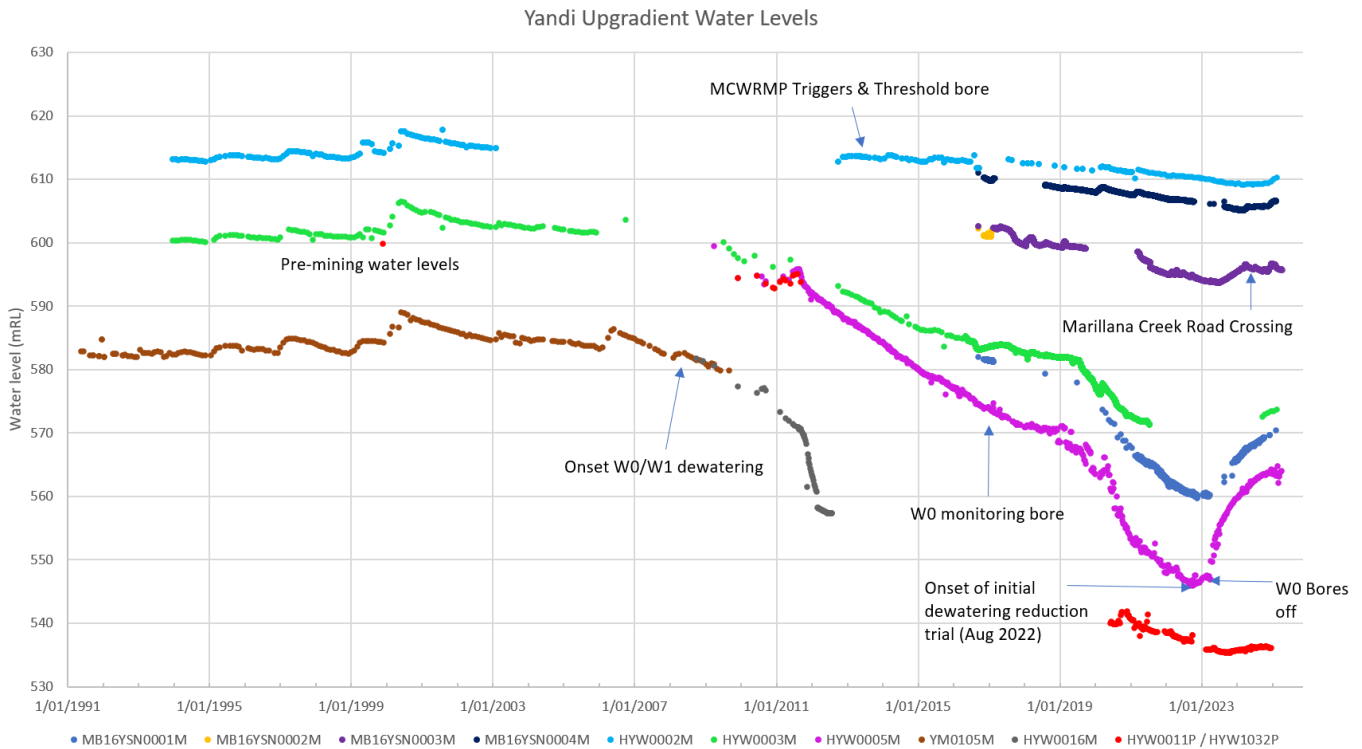


Figure 3 – Groundwater Level Monitoring Data Upgradient of W1

The trigger values assigned to HYW002M are based on analysis of historical groundwater level monitoring carried out in the upstream area of Marillana Creek. Figure 3 shows groundwater levels were recorded as early as January 1994, and a complete data set is available for two critical bores HYW002M and HYW003M until between 2003 to 2005. During this period, groundwater levels rose to 4.4 m in response to several seasons of above average rainfall. This provides an indication of the natural variability of groundwater levels in this area of the CID.

Groundwater levels are seen to decline from around 2009 when substantive dewatering commenced at the W1 pit. Despite significant drawdown being recorded in the monitoring bores near W1 (HYW003M and HYW005M), groundwater levels at have only marginally declined in HWY002M beyond the recorded low in 1994 by approximately 3.5 m.

The pre-mining groundwater gradient along the alignment of the CID was calculated for two periods, January 1994 and May 2000. The gradient was calculated using the distance along the CID between monitoring bores HYW002M, HYW003M and YM105M, and their respective groundwater levels. For these 1994 and 2000 periods, the groundwater gradients were calculated at almost 0.004 along the upgradient section of CID.

The trigger value for HYW002M was then calculated based on the level required to maintain groundwater close to the surface elevation of Tree Health Monitoring Site 9 (approximately 617.6 m AHD). This is a conservative measure as groundwater levels are likely to be able to fluctuate by up to several meters naturally between rainfall seasons and even inter-seasonally as demonstrated in Figure 3, prior to dewatering impacts. The threshold value was then calculated using the same method. The calculated trigger and threshold values for HYW002M were 609.6 and 608.6 m AHD. The use of the groundwater gradient calculations is represented in Figure 4 below.

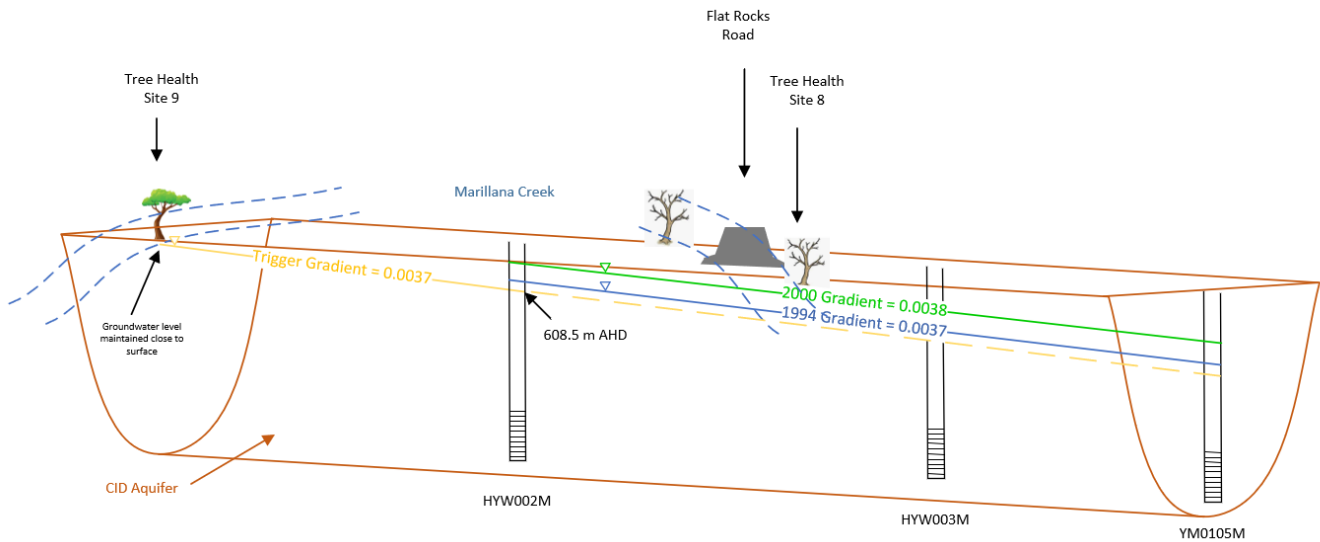


Figure 4– Graphical Representation of the Groundwater Gradient Calculations

Recommendation

It is recommended that the triggers and thresholds in the Marillana Creek water resource management plan be updated to 609.6 m and 608.6 m AHD.

Appendix 6 Groundwater quality data for Yandi mine production bores

Appendix 6a: Hydrochemistry results from production bores reported in BHP's 2024 AAR

Recording Type Name	Unit	Trigger Values	Western 2			
			HYW0237P		HYW0238P	
			Sep - 23	Mar - 24	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.079	0.068	0.078	0.066
Bicarbonate Alkalinity as HCO ₃	mg/L		480	450	490	440
Boron	mg/L	0.37	0.460	0.470	0.440	0.440
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		67.0	69.0	66.0	68.0
Chloride	mg/L		160	160	140	140
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1300	1300	1200	1200
Fluoride	mg/L		0.6	0.6	0.6	0.6
Iron Sol.	mg/L	0.3	<0.005	0.015	<0.005	0.014
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L		62.0	63.0	60.0	63.0
Manganese	mg/L	1.9	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	0.002	0.002
Nitrate as NO ₃	mg/L	4.0	7.40	7.40	9.80	0.36
pH	pH	6.5-8.0	7.9	7.6	7.9	7.7
Potassium	mg/L		13.0	12.0	13.0	13.0
Reactive Silica as SiO ₂	mg/L		69.00	73.00	69.00	73.00
Selenium	mg/L	0.011	0.003	0.002	<0.001	0.002
Silica	mg/L		64.00	65.00	64.00	66.00
Sodium	mg/L		100.0	97.0	97.0	93.0
Sulphate as SO ₄ 2-	mg/L		74	72	71	69
Suspended Solids (SS)	mg/L		<5	<5	<5	<5
Zinc	mg/L	0.072	0.007	<0.005	<0.005	<0.005
Total Alkalinity as CaCO ₃	mg/L		400	370	400	360
Total Dissolved Solids at 180°C	mg/L		740	740	710	720
Total Hardness as CaCO ₃	mg/L		420	430	410	430

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s 2024 AAR

Recording Type Name	Unit	Trigger Values	Western 3		
			HYW1015P	HYW1016P	
			Sep - 23	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.065	0.069	0.060
Bicarbonate Alkalinity as HCO ₃	mg/L		410	450	420
Boron	mg/L	0.37	0.470	0.450	0.450
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		59.0	62.0	62.0
Chloride	mg/L		150	150	150
Chromium	mg/L	0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1200	1200	1200
Fluoride	mg/L		0.5	0.6	0.6
Iron Sol.	mg/L	0.3	<0.005	<0.005	0.012
Lead	mg/L	0.005	<0.001	<0.001	<0.001
Magnesium	mg/L		55.0	57.0	58.0
Manganese	mg/L	1.9	0.002	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001
Nitrate as NO ₃	mg/L	4.0	8.00	7.50	7.60
pH	pH	6.5-8.0	8.2	7.9	7.6
Potassium	mg/L		11.0	11.0	11.0
Reactive Silica as SiO ₂	mg/L		63.00	65.00	69.00
Selenium	mg/L	0.011	0.002	<0.001	0.001
Silica	mg/L		59.00	60.00	60.00
Sodium	mg/L		100.0	100.0	96.0
Sulphate as SO ₄ 2-	mg/L		69	70	69
Suspended Solids (SS)	mg/L		<5	<5	<5
Zinc	mg/L	0.072	<0.005	0.007	<0.005
Total Alkalinity as CaCO ₃	mg/L		340	370	350
Total Dissolved Solids at 180°C	mg/L		680	700	720
Total Hardness as CaCO ₃	mg/L		380	390	390

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s 2024 AAR

Recording Type Name	Unit	Trigger Values	Western 4			
			HYW0035P	HYW0042P	HYW0051P	HYW0340P
			Mar - 24	Sep - 23	Mar - 24	Sep - 23
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.040	0.067	0.043	0.054
Bicarbonate Alkalinity as HCO ₃	mg/L		350	330	300	370
Boron	mg/L	0.37	0.580	0.420	0.340	0.410
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		58.0	65.0	46.0	50.0
Chloride	mg/L		160	260	120	120
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1100	1500	910	990
Fluoride	mg/L		0.5	0.6	0.5	0.5
Iron Sol.	mg/L	0.3	0.014	<0.005	0.012	0.009
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L		53.0	66.0	43.0	45.0
Manganese	mg/L	1.9	0.002	<0.001	<0.001	0.002
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001	<0.001
Nitrate as NO ₃	mg/L	4.0	6.60	27.00	5.20	11.00
pH	pH	6.5-8.0	7.6	7.9	7.5	7.9
Potassium	mg/L		9.1	7.6	8.4	9.0
Reactive Silica as SiO ₂	mg/L		67.00	57.00	63.00	63.00
Selenium	mg/L	0.011	0.001	<0.001	0.001	<0.001
Silica	mg/L		58.00	53.00	58.00	58.00
Sodium	mg/L		90.0	120.0	74.0	86.0
Sulphate as SO ₄ 2-	mg/L		60	100	52	60
Suspended Solids (SS)	mg/L		<5	<5	<5	<5
Zinc	mg/L	0.072	<0.005	<0.005	<0.005	<0.005
Total Alkalinity as CaCO ₃	mg/L		290	270	240	300
Total Dissolved Solids at 180°C	mg/L		650	880	550	580
Total Hardness as CaCO ₃	mg/L		360	440	290	310

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP's 2024 AAR

Recording Type Name	Unit	Trigger Values	Western 5		
			HYW0132P	HYW0134P	
			Sep - 23	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.057	0.055	0.046
Bicarbonate Alkalinity as HCO ₃	mg/L		410	400	400
Boron	mg/L	0.37	0.380	0.400	0.360
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		56.0	53.0	54.0
Chloride	mg/L		140	120	120
Chromium	mg/L	0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1100	1100	1100
Fluoride	mg/L		0.5	0.5	0.5
Iron Sol.	mg/L	0.3	<0.005	<0.005	0.012
Lead	mg/L	0.005	<0.001	<0.001	<0.001
Magnesium	mg/L		51.0	50.0	51.0
Manganese	mg/L	1.9	<0.001	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001
Nitrate as NO ₃	mg/L	4.0	5.80	11.00	11.00
pH	pH	6.5-8.0	8.0	7.9	7.6
Potassium	mg/L		9.7	8.5	8.2
Reactive Silica as SiO ₂	mg/L		61.00	2.20	62.00
Selenium	mg/L	0.011	<0.001	0.002	0.002
Silica	mg/L		57.00	56.00	56.00
Sodium	mg/L		94.0	93.0	87.0
Sulphate as SO ₄ 2-	mg/L		64	63	60
Suspended Solids (SS)	mg/L		<5	<5	<5
Zinc	mg/L	0.072	<0.005	0.005	<0.005
Total Alkalinity as CaCO ₃	mg/L		330	330	330
Total Dissolved Solids at 180°C	mg/L		640	630	650
Total Hardness as CaCO ₃	mg/L		350	340	350

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s 2024 AAR

Recording Type Name	Unit	Trigger Values	Western 6						
			HYW0355P		HYW1021P		HYW1038P	SYAN0051	
			Sep - 23	Mar - 24	Sep - 23	Mar - 24	Mar - 24	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.048	0.044	0.008	0.007	0.009	0.008	0.010
Bicarbonate Alkalinity as HCO3	mg/L		390	360	540	510	470	420	400
Boron	mg/L	0.37	0.370	0.370	0.770	0.780	1.400	0.620	0.580
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		52.0	54.0	49.0	51.0	28.0	49.0	56.0
Chloride	mg/L		140	140	170	170	240	150	150
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1100	1100	1300	1400	1700	1100	1200
Fluoride	mg/L		0.5	0.5	0.6	0.6	0.9	0.7	0.6
Iron Sol.	mg/L	0.3	<0.005	0.010	<0.005	0.011	0.010	0.020	0.021
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001	0.053	<0.001	<0.001
Magnesium	mg/L		48.0	51.0	59.0	62.0	51.0	63.0	68.0
Manganese	mg/L	1.9	<0.001	<0.001	<0.001	<0.001	<0.001	0.002	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001	<0.001	0.002	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001	0.002	<0.001	<0.001	<0.001
Nitrate as NO3	mg/L	4.0	10.00	10.00	16.00	16.00	6.80	3.40	3.50
pH	pH	6.5-8.0	8.2	8.1	7.9	7.6	8.4	8.4	8.4
Potassium	mg/L		7.6	7.5	3.8	3.7	3.5	3.9	4.4
Reactive Silica as SiO2	mg/L		58.00	62.00	60.00	66.00	63.00	48.00	51.00
Selenium	mg/L	0.011	0.002	0.002	0.002	0.002	0.002	<0.001	<0.001
Silica	mg/L		53.00	55.00	57.00	58.00	61.00	47.00	50.00
Sodium	mg/L		97.0	94.0	150.0	150.0	260.0	100.0	84.0
Sulphate as SO4 2-	mg/L		61	60	57	58	86	68	70
Suspended Solids (SS)	mg/L		<5	<5	<5	<5	19	<5	<5
Zinc	mg/L	0.072	0.005	<0.005	<0.005	<0.005	0.059	<0.005	<0.005
Total Alkalinity as CaCO3	mg/L		320	290	450	420	410	360	340
Total Dissolved Solids at 180°C	mg/L		610	620	780	790	1000	660	660
Total Hardness as CaCO3	mg/L		330	340	370	380	280	380	420

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s 2024 AAR

Recording Type Name	Unit	Trigger Values	Central 1			
			HYC0012P	HYC0015P		HYC0096P
			Sep - 23	Sep - 23	Mar - 24	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.020	0.054	0.053	0.040
Bicarbonate Alkalinity as HCO3	mg/L		450	420	370	290
Boron	mg/L	0.37	0.670	0.400	0.390	0.310
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		59.0	61.0	62.0	53.0
Chloride	mg/L		170	170	170	160
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1300	1300	1300	1000
Fluoride	mg/L		0.6	0.5	0.5	0.5
Iron Sol.	mg/L	0.3	<0.005	<0.005	0.013	0.009
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L		69.0	60.0	61.0	50.0
Manganese	mg/L	1.9	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001	<0.001
Nitrate as NO3	mg/L	4.0	13.00	13.00	12.00	9.50
pH	pH	6.5-8.0	7.9	7.7	7.6	7.8
Potassium	mg/L		6.5	7.8	7.5	7.3
Reactive Silica as SiO2	mg/L		56.00	59.00	63.00	63.00
Selenium	mg/L	0.011	0.002	0.001	0.001	0.001
Silica	mg/L		51.00	55.00	55.00	56.00
Sodium	mg/L		100.0	110.0	100.0	80.0
Sulphate as SO4 2-	mg/L		91	91	88	58
Suspended Solids (SS)	mg/L		<5	<5	<5	<5
Zinc	mg/L	0.072	<0.005	0.011	0.009	<0.005
Total Alkalinity as CaCO3	mg/L		370	340	300	230
Total Dissolved Solids at 180°C	mg/L		780	760	900	600
Total Hardness as CaCO3	mg/L		430	400	410	340

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s 2024 AAR

Recording Type Name	Unit	Trigger Values	Central 5			
			HYC0031P		HYC0068P	
			Sep - 23	Mar - 24	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.033	0.032	0.027	0.027
Bicarbonate Alkalinity as HCO ₃	mg/L		290	270	360	320
Boron	mg/L	0.37	0.310	0.290	0.350	0.310
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		41.0	42.0	43.0	44.0
Chloride	mg/L		110	120	110	110
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	870	880	930	930
Fluoride	mg/L		0.6	0.6	0.8	0.7
Iron Sol.	mg/L	0.3	0.008	0.011	<0.005	0.009
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L		42.0	44.0	47.0	49.0
Manganese	mg/L	1.9	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001	<0.001
Nitrate as NO ₃	mg/L	4.0	8.40	8.40	9.80	8.70
pH	pH	6.5-8.0	7.7	7.4	7.8	7.4
Potassium	mg/L		6.4	6.2	6.2	6.0
Reactive Silica as SiO ₂	mg/L		58.00	59.00	57.00	59.00
Selenium	mg/L	0.011	<0.001	0.001	<0.001	0.001
Silica	mg/L		54.00	54.00	53.00	54.00
Sodium	mg/L		77.0	73.0	82.0	78.0
Sulphate as SO ₄ 2-	mg/L		60	59	60	58
Suspended Solids (SS)	mg/L		<5	<5	<5	<5
Zinc	mg/L	0.072	0.016	0.009	<0.005	<0.005
Total Alkalinity as CaCO ₃	mg/L		240	220	290	260
Total Dissolved Solids at 180°C	mg/L		540	550	610	560
Total Hardness as CaCO ₃	mg/L		280	290	300	310

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s 2024 AAR

			Eastern 1 & 2							
			HYE0023P		HYE0051P		HYE0193P		HYE0194P	
Recording Type Name	Unit	Trigger Values	Sep - 23	Mar - 24	Sep - 23	Mar - 24	Sep - 23	Mar - 24	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.039	0.036	0.037	0.034	0.038	0.033	0.039	0.034
Bicarbonate Alkalinity as HCO3	mg/L		340	360	270	250	320	290	330	300
Boron	mg/L	0.37	0.380	0.380	0.310	0.270	0.290	0.260	0.300	0.270
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		51.0	54.0	42.0	44.0	44.0	46.0	44.0	45.0
Chloride	mg/L		140	150	130	130	120	130	120	120
Chromium	mg/L	0.001	0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1000	1000	880	900	950	940	920	940
Fluoride	mg/L		0.6	0.5	0.5	0.4	0.4	0.4	0.4	0.4
Iron Sol.	mg/L	0.3	0.017	0.011	<0.005	0.009	<0.005	0.009	<0.005	0.011
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L		51.0	55.0	41.0	43.0	44.0	44.0	43.0	44.0
Manganese	mg/L	1.9	0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrate as NO3	mg/L	4.0	6.40	6.50	20.00	21.00	7.00	6.50	9.10	9.10
pH	pH	6.5-8.0	8.2	7.4	7.8	7.4	7.8	7.4	7.8	7.5
Potassium	mg/L		6.3	6.3	5.9	5.8	6.5	6.3	6.5	6.3
Reactive Silica as SiO2	mg/L		52.00	52.00	51.00	51.00	50.00	50.00	51.00	51.00
Selenium	mg/L	0.011	<0.001	<0.001	<0.001	<0.001	<0.001	0.001	0.002	0.001
Silica	mg/L		49.00	50.00	48.00	50.00	47.00	48.00	49.00	49.00
Sodium	mg/L		83.0	80.0	77.0	73.0	87.0	82.0	84.0	79.0
Sulphate as SO4 2-	mg/L		55	53	52	51	67	64	58	58
Suspended Solids (SS)	mg/L		<5	<5	<5	<5	<5	<5	<5	<5
Zinc	mg/L	0.072	0.007	0.009	<0.005	<0.005	0.019	0.011	0.006	0.006
Total Alkalinity as CaCO3	mg/L		280	300	220	200	260	240	270	250
Total Dissolved Solids at 180°C	mg/L		690	620	540	540	570	560	590	580
Total Hardness as CaCO3	mg/L		340	360	270	290	290	290	290	290

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP's 2024 AAR

			Eastern 4
			HYE1523P
Recording Type Name	Unit	Trigger Values	Mar - 24
Aluminium	mg/L	0.1	<0.005
Arsenic	mg/L	0.013	<0.001
Barium	mg/L	0.088	0.008
Bicarbonate Alkalinity as HCO ₃	mg/L		530
Boron	mg/L	0.37	0.440
Cadmium	mg/L	0.001	<0.0001
Calcium	mg/L		55.0
Chloride	mg/L		90
Chromium	mg/L	0.001	<0.001
Copper	mg/L	0.01	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	1100
Fluoride	mg/L		0.6
Iron Sol.	mg/L	0.3	0.012
Lead	mg/L	0.005	<0.001
Magnesium	mg/L		65.0
Manganese	mg/L	1.9	<0.001
Mercury	mg/L	0.0006	<0.00005
Molybdenum	mg/L	0.034	<0.001
Nickel	mg/L	0.11	0.002
Nitrate as NO ₃	mg/L	4.0	12.00
pH	pH	6.5-8.0	8.2
Potassium	mg/L		1.1
Reactive Silica as SiO ₂	mg/L		67.00
Selenium	mg/L	0.011	0.002
Silica	mg/L		63.00
Sodium	mg/L		95.0
Sulphate as SO ₄ 2-	mg/L		32
Suspended Solids (SS)	mg/L		<5
Zinc	mg/L	0.072	<0.005
Total Alkalinity as CaCO ₃	mg/L		440
Total Dissolved Solids at 180°C	mg/L		650
Total Hardness as CaCO ₃	mg/L		400

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s 2024 AAR

Recording Type Name	Unit	Trigger Values	Eastern 3,5,6			
			HYE0027P		HYE0055P	
			Sep - 23	Mar - 24	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.030	0.029	0.025	0.027
Bicarbonate Alkalinity as HCO ₃	mg/L		300	280	340	300
Boron	mg/L	0.37	0.360	0.340	0.550	0.670
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		39.0	41.0	41.0	40.0
Chloride	mg/L		86	88	79	83
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	770	790	850	820
Fluoride	mg/L		0.5	0.5	0.6	0.7
Iron Sol.	mg/L	0.3	<0.005	0.009	<0.005	0.008
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L		36.0	37.0	42.0	39.0
Manganese	mg/L	1.9	0.001	<0.001	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	<0.001	<0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001	<0.001
Nitrate as NO ₃	mg/L	4.0	12.00	13.00	34.00	29.00
pH	pH	6.5-8.0	7.8	7.5	7.9	7.5
Potassium	mg/L		5.2	5.0	4.8	4.9
Reactive Silica as SiO ₂	mg/L		48.00	49.00	52.00	52.00
Selenium	mg/L	0.011	<0.001	<0.001	<0.001	<0.001
Silica	mg/L		46.00	47.00	49.00	50.00
Sodium	mg/L		70.0	67.0	76.0	73.0
Sulphate as SO ₄ 2-	mg/L		41	40	44	42
Suspended Solids (SS)	mg/L		<5	<5	<5	<5
Zinc	mg/L	0.072	<0.005	<0.005	<0.005	<0.005
Total Alkalinity as CaCO ₃	mg/L		250	230	280	240
Total Dissolved Solids at 180°C	mg/L		460	570	520	490
Total Hardness as CaCO ₃	mg/L		240	260	280	260

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6a: Hydrochemistry results from production bores reported in BHP’s FY2024 AAR

Recording Type Name	Unit	Trigger Values	Eastern 7			
			HYE0180P		HYE0181P	
			Sep - 23	Mar - 24	Sep - 23	Mar - 24
Aluminium	mg/L	0.1	<0.005	<0.005	<0.005	<0.005
Arsenic	mg/L	0.013	<0.001	<0.001	<0.001	<0.001
Barium	mg/L	0.088	0.017	0.015	0.028	0.026
Bicarbonate Alkalinity as HCO3	mg/L		380	330	340	300
Boron	mg/L	0.37	0.570	0.550	0.470	0.480
Cadmium	mg/L	0.001	<0.0001	<0.0001	<0.0001	<0.0001
Calcium	mg/L		39.0	41.0	39.0	40.0
Chloride	mg/L		84	86	85	87
Chromium	mg/L	0.001	<0.001	<0.001	<0.001	<0.001
Copper	mg/L	0.01	<0.001	<0.001	<0.001	<0.001
Electrical Conductivity at 25°C	µS/cm	90-1000	840	840	810	820
Fluoride	mg/L		0.8	0.7	0.6	0.6
Iron Sol.	mg/L	0.3	0.010	0.013	<0.005	0.010
Lead	mg/L	0.005	<0.001	<0.001	<0.001	<0.001
Magnesium	mg/L		40.0	42.0	38.0	39.0
Manganese	mg/L	1.9	0.003	0.003	<0.001	<0.001
Mercury	mg/L	0.0006	<0.00005	<0.00005	<0.00005	<0.00005
Molybdenum	mg/L	0.034	0.001	0.001	<0.001	<0.001
Nickel	mg/L	0.11	<0.001	<0.001	<0.001	<0.001
Nitrate as NO3	mg/L	4.0	3.60	4.00	7.20	8.00
pH	pH	6.5-8.0	8.2	8.1	8.0	7.5
Potassium	mg/L		5.4	5.3	5.3	5.2
Reactive Silica as SiO2	mg/L		52.00	53.00	57.00	58.00
Selenium	mg/L	0.011	<0.001	<0.001	<0.001	<0.001
Silica	mg/L		49.00	50.00	52.00	54.00
Sodium	mg/L		80.0	77.0	78.0	73.0
Sulphate as SO4 2-	mg/L		42	43	43	44
Suspended Solids (SS)	mg/L		<5	<5	<5	<5
Zinc	mg/L	0.072	<0.005	<0.005	<0.005	<0.005
Total Alkalinity as CaCO3	mg/L		310	270	280	250
Total Dissolved Solids at 180°C	mg/L		550	500	490	490
Total Hardness as CaCO3	mg/L		260	270	250	260

A blank cell indicates not analysed. Values in red indicate that it exceeded the site-specific trigger values. (Golder, 2014)

Appendix 6b: Dewatering discharge water quality monitoring results as reported in FY2024 AER

Parameter	Internal Trigger Level	Unit	MCDMDEW040 (E6)				MCDMDEW041 (W1)			
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
Temperature	15-35	°C	27.6	31.7	28.6	28.1	29.9	34	29.4	No Flow
pH	6.8 - 8.5	units	7.8	7.7	7.4	7.6	8	7.1	7.9	
EC	4,458	µS/cm	960	860	1,000	1,000	1,200	1,300	1,300	
TDS	1,500	mg/L	550	470	560	570	700	610	660	
TSS	80		<5	<5	<5	<5	<5	<5	<5	
TRH (C10-C36)	15,000	µg/L	<100	<100	110	<100	<100	<100	<100	
Na	409	mg/L	83	72	84	84	100	98	96	
K	15		6.4	4.9	5.5	7.5	12	11	11	
Ca	1,000		45	37	43	54	62	60	61	
Mg	2,000		44	38	46	52	57	58	57	
Cl	403		120	93	120	130	150	150	150	
Carbonate	5		<5	<5	<5	<5	<5	<5	<5	
Bicarbonate	476		330	320	320	350	440	440	410	
Sulphate	1,000		56	41	54	59	71	66	69	
Nitrate	400		11	17	10	11	10	7.7	12	
Al	5.5		<0.005	<0.005	<0.005	<0.05	<0.005	<0.005	<0.005	
B	0.55		0.34	0.45	0.45	0.44	0.44	0.45	0.5	
Fe	1		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Cu	0.01		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Zn	0.08		<0.005	<0.005	0.005	0.005	<0.005	<0.005	<0.005	
Ag	0.01		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Pb	0.004		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
As	0.02		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Cr	0.01		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Cd	0.001		<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	
Hg	0.0001		<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	
Ni	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Se	0.01	<0.001	0.001	0.002	0.001	0.001	0.003	0.003		
Mn	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Sn	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Total N	5		2.4	4	2.3	0.69	2.4	2.7	2.7	
Total P	0.11		<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	0.2	

Appendix 7: Baseline data on surface water flow and quality for Marillana Creek

Appendix 7a: Annual stream discharge and rainfall recorded at the Flat Rocks gauging station

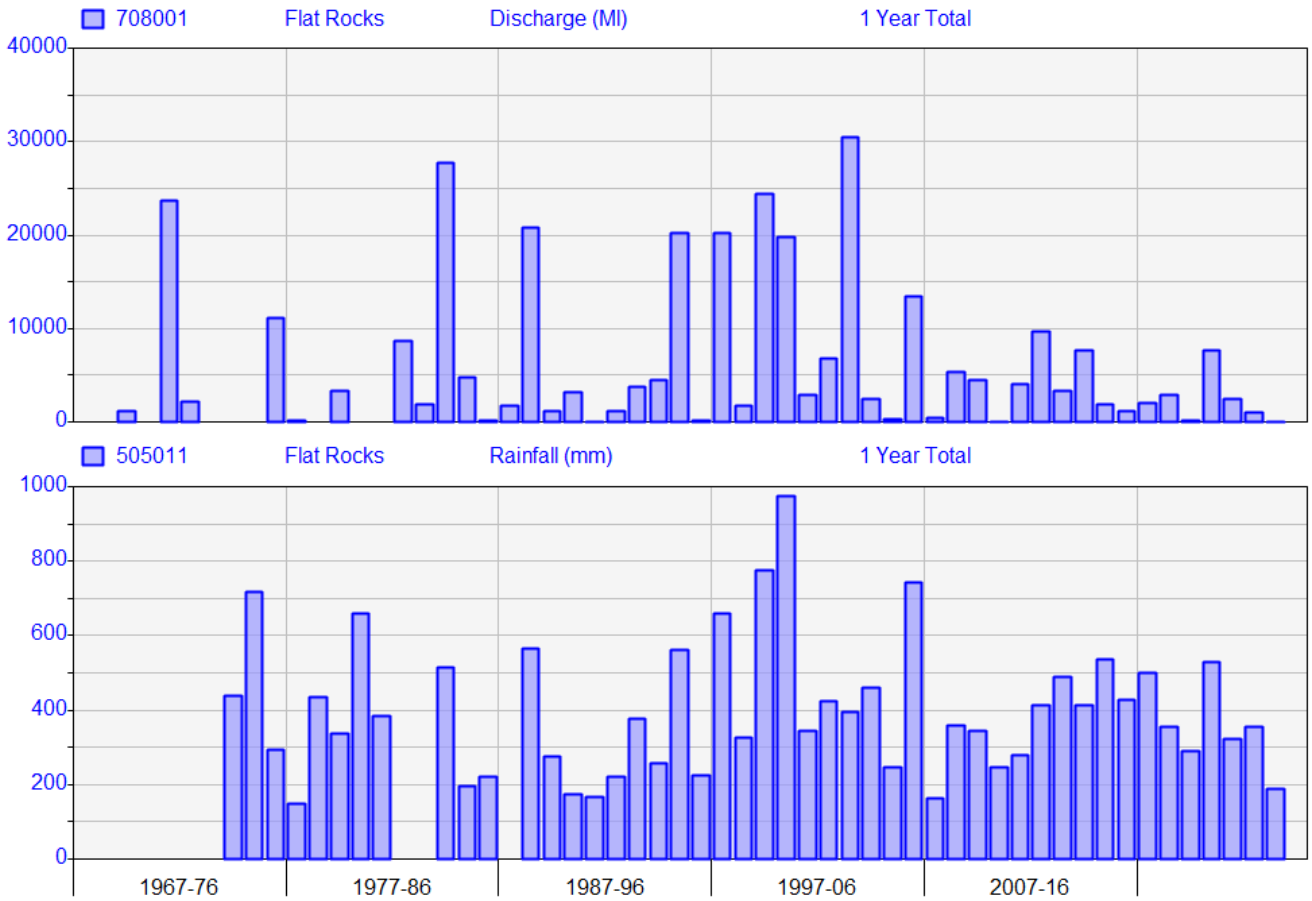
Source: <https://kumina.water.wa.gov.au/waterinformation/telem/stage.cfm>

Department of Water and Environmental Regulation

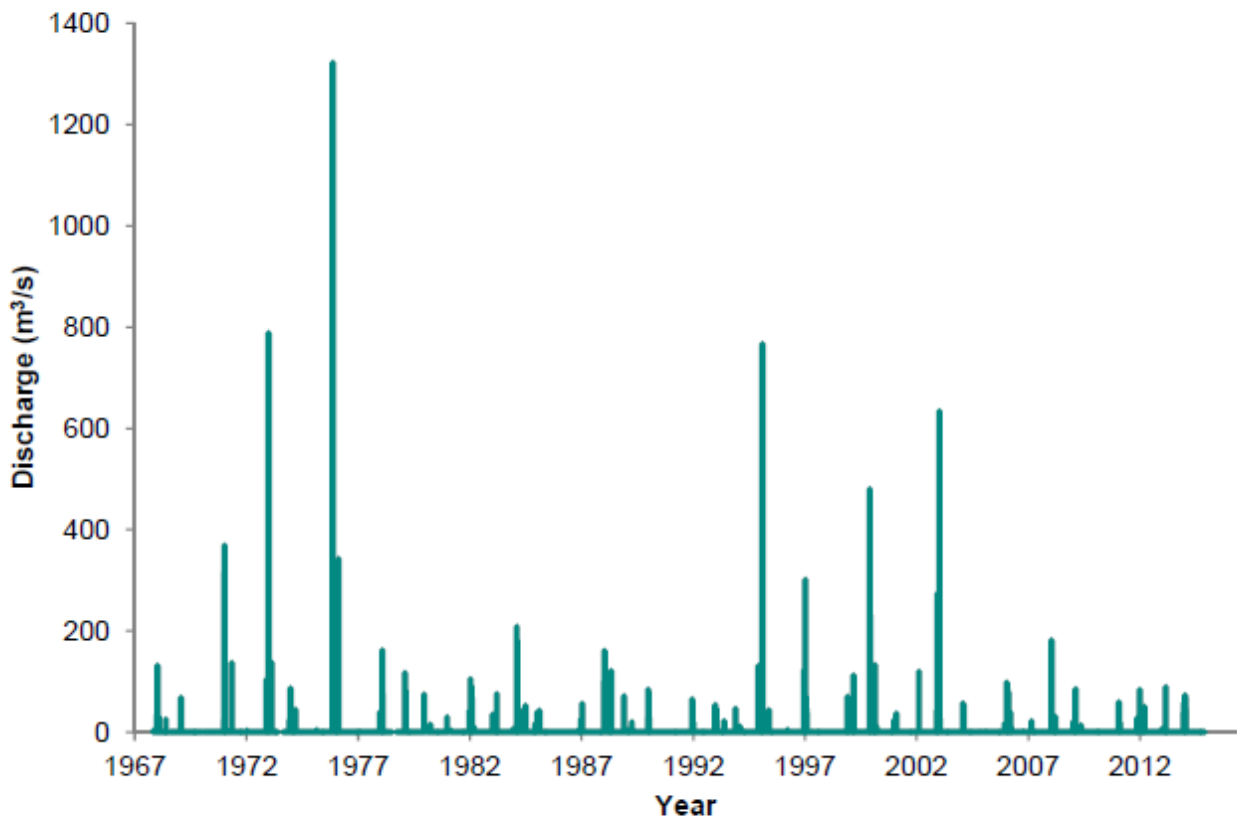
HYPLOT V134 Output 08/03/2024

Period 58 Year 01/01/1967 to 01/01/2025

1967-2024



Appendix 7b: Mean hourly stream discharge recorded at the Flat Rocks gauging station



Appendix 7c: Monitoring of surface water quality Marillana Creek FY2024

Borefield or source	Parameters	Frequency	Performance indicator	Target	Monitoring in FY2024
Discharge point and supplementary discharge point MCSW040, MCSW031	Cumulative output (kL)	Monthly	Discharge Water Quality (Performance criteria include the lack of unexpected trends or spikes within the data)	As specified in the Yandi Operating Licence L6168/1991/11	See Table 3-18 and Table 3-19 for MCDMDEW040 and MCDMDEW041.
	Temperature (°C)	Quarterly			
	Hydrochemistry mg/L (EC, pH, TDS, TSS, TPH, Na, K, Ca, Mg, Cl, CO ₃ , HCO ₃ , SO ₄ , NO ₃ , Total N, Total P, Al, Bo, Fe, Cu, Zn, Ag, As, Cr, Pb, Cd, Hg, Ni, Sn, Mn)	Quarterly (November, February, May and August)			
Marillana Creek Surface Water Monitoring Sites MCSW005 and MCSW002.	Hydrochemistry mg/L (EC, pH, TDS, TSS, TPH, Na, K, Ca, Mg, Cl, CO ₃ , HCO ₃ , SO ₄ , NO ₃ , Al, Bo, Fe, Cu, Zn, Ag, As, Cr, Pb, Cd, Hg, Ni, Sn, Mn)	Following rain events	Not defined in the SWGWMP	No specific targets have been set for surface water flows	No flow occurred during the reporting period.
Surface water flows	Obtain the latest water flow monitoring results for the Flat Rock gauging station from the DWERs web site (online Water Resources Data) and include in groundwater and surface water modelling as required.	Periodically	DWER Water Information (WIN) database and Hydstra database time-series data.	No specific targets have been set for surface water flows	

Appendix 7d: Monitoring of Volume of surface water discharged FY2024

Sample Point Name	Volume of surface water discharged (kL)			
	Q1	Q2	Q3	Q4
MCDMDEW040	492,530	240,852	276,399	253,743
MCDMDEW041	639	375	1,885	896

* Removed discharge point MCDMDEW031 from Licence L6168/1991/11 & monitoring requirements as discharge point decommissioned