BHP

Jimblebar Optimisation Project: Jimblebar Iron Ore Mine Revised Proposal

Environmental Review Document – referral supplementary report

August 2019

Authorisation

Version	Description	Name	Position	Date
0	Final	Chris Serginson	Manager Environment Analysis & Improvement	28/08/2019

Abbreviations

Term	Meaning
AEP	Annual Exceedance Probability
AH Act	*Aboriginal Heritage Act 1972* (WA)
AHD	Australian Height Datum
ANZECC	Australian and New Zealand Environment and Conservation Council
AMD	acid and metalliferous drainage
AUD	Australian Dollars
BC Act	*Biodiversity Conservation Act 2016* (WA)
BHP	BHP Billiton Iron Ore Pty Ltd
CALM Act	*Conservation and Land Management Act 1984* (WA)
BAM Act	*Biosecurity and Agriculture Management Act 2007*
CDP	Community Development Plan
CEO	Chief Executive Officer
cm	centimetre
CO_2-e/kt	carbon dioxide emissions (measure of Greenhouse Gas emissions)
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CY	calendar year
DBCA	Department of Biodiversity, Conservation and Attractions
DJTSI	Department of Jobs, Tourism, Science and Innovation
DMIRS	Department of Mines, Industry Regulation and Safety
DoEE	Department of Environment and Energy (Commonwealth)
DSEWPaC	Department of Sustainability, Environment. Water, Population and Communities (now DoEE)
DWER	Department of Water and Environmental Regulation
EC	electrical conductivity
EMP	Environmental Management Plan
EP Act	*Environmental Protection Act 1986* (WA)
EPA	Western Australian Environmental Protection Authority
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999* (Commonwealth)
EPWRMP	Eastern Pilbara Water Resource Management Plan

Term	Meaning
FY	financial year
GL/a	giga litres per annum
GST	Goods and Services Tax
GWL	Groundwater Licence
ha	hectare
IBRA	Interim Biogeographic Regionalisation for Australia
IBSA	Index of Biodiversity Surveys for Assessments
kL	kilo litre
km	kilometre
km^2	square kilometre
Ltd	Limited
m	metre
m^3/s	cubic metres per second
MAR	managed aquifer recharge
mbgl	metres below ground level
MCP	Mine Closure Plan
mg/L	milligrams per litre
ML/a	mega litres per annum
ML/d	mega litres per day
mm/d	millimetres per day
MNES	Matters of National Environmental Significance
mRL	metres Reduced Level
MS	Ministerial Statement
Mt CO_2-e	million tonnes of carbon dioxide equivalent (measure of Greenhouse Gas emissions)
Mtpa	million tonnes per annum
NVCP	Native Vegetation Clearing Permit
OSA	overburden storage area
%	percent
PE	polyethylene

Term	Meaning
PEC	Priority Ecological Community
PEOF	Pilbara Environmental Offsets Fund
RiWI Act	*Rights in Water and Irrigation Act 1914* (WA)
S38	Section 38 of the *Environmental Protection Act 1986* (WA)
S45C	Section 45C of the *Environmental Protection Act 1986* (WA)
SRE	short-range endemic
TEC	Threatened Ecological Community
TDS	total dissolved solids
WA	Western Australia
WAIO	Western Australian Iron Ore
WAH	Western Australian Herbarium

Glossary

Term	Meaning
BHP	BHP Billiton Iron Ore Pty Ltd, as manager and agent for and on behalf of BHP Billiton Minerals Pty Ltd, BHP Iron Ore (Jimblebar) Pty Ltd, United Iron Pty Ltd, the participants of the Mount Goldsworthy Joint Venture, Mount Newman Joint Venture and Yandi Joint Venture.
Commonwealth Strategic Approval	The approval of the taking of an action or class of actions within the Strategic Assessment Area, granted by the (Federal) Minister for the Environment on 19 June 2017 in accordance with the Program given under section 146B of the EPBC Act.
Development Envelope	The maximum area within which the Project Indicative Footprint will be located.
Existing Project	The works and activities for mining operations at Jimblebar comprising proposals approved under the existing Ministerial Statements: 683, 809 and 857 (as amended by 1029).
Indicative Footprint	The location where the physical Project elements are planned to occur.
Jimblebar Optimisation Project (the Project)	The works and activities for which approval is sought (i.e. the change to the Existing Project).
Revised Proposal	Change to the proposals approved under the existing Ministerial Statements to include the Jimblebar Optimisation Project i.e. the Jimblebar Optimisation Project and the Existing Project.
State Strategic Proposal	BHP's planned development for mining and support infrastructure for the Pilbara within the Strategic Assessment Area (as approved under Part IV of the EP Act, Ministerial Statement 1105).

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1 Introduction and background

1.1 Purpose and scope of this document

The purpose of this document is to present the environmental review undertaken by BHP for the Jimblebar Optimisation Project (Figure 1). This document is provided as a supplementary report to the referral of a Revised Proposal to change the proposals approved under the existing Ministerial Statements for the Jimblebar Iron Ore Mine, to include the Jimblebar Optimisation Project. As provided for in the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (EPA, 2018a), where a proponent aims to provide sufficient information with the referral to enable the EPA to set 'Referral Information' as the level of assessment, the proponent may prepare a supplementary report/s for the referral consistent with the requirements of an Environmental Review Document.

The scope of this document is an environmental review of the potential significant environmental impacts from the Project, which is mainly for additional waste storage and new surplus water management options. This document and supporting information comprises the following:

- Environmental Review Document for the Project - Main document
- Review of Ministerial Statements for the Existing Project (the works and activities for mining operations at Jimblebar comprising proposals approved under the existing Ministerial Statements) (Appendix 1)
- Proposed implementation conditions for the Revised Proposal (Appendix 2)
- Supporting study and survey reports (Appendices 3 to 14)
- Environmental Management Plans (Appendices 15 to 17)
- Offsets template (Appendix 18)
- IBSA data package (Appendix 19).

BHP has considered guidance in the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Procedures Manual* (Procedures Manual) (EPA, 2018a), including the following EPA Instructions, to prepare this document:

- *Instructions on how to prepare an Environmental Review Document* (EPA, 2018b)
- *Instructions on how to define the key characteristics of a proposal* (EPA, 2017)
- *Instructions on how to prepare Environmental Protection Act 1986 Part IV Environmental Management Plans* (EPA, 2018c)
- EPA factor guidelines and technical guidance (see details under relevant factor)
- *Guidelines for Preparing Mine Closure Plans* (DMP and EPA, 2015).

1.2 Proponent

The Proponent for the Revised Proposal is:

BHP Billiton Iron Ore Pty Ltd
ABN: 46 008 700 981
125 St Georges Terrace
Perth WA 6000 Australia

BHP Billiton Iron Ore is authorised as the manager and agent of BHP Iron Ore (Jimblebar) Pty Ltd and Newman Joint Venture to submit and execute the Revised Proposal, as approved. The key contact for this Revised Proposal is:

Chris Serginson
Manager Environment Analysis and Improvement (West)
Phone: (08) 6321 6967
Email: chris.serginson@bhp.com

1.3 Environmental impact assessment process

1.3.1 Part IV of the *Environmental Protection Act 1986*

BHP has determined that the Revised Proposal to change to the proposals approved under the existing Ministerial Statements for the Jimblebar Iron Ore Mine, to include the Jimblebar Optimisation Project (the Project) requires referral to the Environmental Protection Authority (EPA) under Part IV, s38 of the *Environmental Protection Act 1986* (EP Act).

Expansions to existing operations at Jimblebar are identified in the State Strategic Proposal. The EPA recommended that future proposals identified in the Strategic Proposal may be implemented, in July 2018 (EPA, 2018d). At the time of finalising this document (early July 2019), the Ministerial Statement for the Strategic Proposal had not been issued. Therefore, the Derived Proposal pathway was not an option at the time it was necessary to commit to an approvals pathway for the Project. The Ministerial Statement for the Strategic Proposal (MS1105) was subsequently issued on 11 July 2019.

Should the EPA decide to assess the Revised Proposal, BHP considers that a level of assessment of 'Assess on Referral Information' is appropriate. BHP has undertaken a comprehensive environmental review, documented in this report and supporting appendices.

1.3.2 State Agreement

The Jimblebar mining operations are conducted under the *Iron Ore (McCamey's Monster) Authorisation Agreement Act 1972* (WA) and *Iron Ore (Mount Newman) Agreement Act 1964* (WA).

1.3.3 Commonwealth EPBC Strategic Approval

BHP has a strategic approval (the Commonwealth Strategic Approval) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The *BHP Billiton Iron Ore Pilbara Strategic Assessment Program* (BHP Billiton Iron Ore, 2017a) was endorsed by the Minister for the Environment and Energy on 11 May 2017 and an Approval Decision (with conditions) for taking actions in accordance with the Program was issued on 19 June 2017. The approval covers future activities (actions) within the Strategic Assessment Area, which is the same as the State Strategic Proposal boundary. The relevant Program Matters (Matters of national environmental significance – MNES) are the following threatened fauna species: Pilbara leaf-nosed bat (*Rhinonicteris aurantius*), Northern quoll (*Dasyurus hallucatus*), Greater bilby (*Macrotis lagotis*), Ghost bat (*Macroderma gigas*) and Olive python (Pilbara subspecies) (*Liasis olivaceus barroni*).

All actions covered by the strategic approval must be taken in accordance with the endorsed Program. BHP administers a non-statutory validation decision process under Part C of the endorsed Program to decide whether an action will have an impact on Program Matters. Where BHP decides that a proposed action is notifiable, BHP will develop and issue a Validation Notice, or amend and re-issue an existing Validation Notice. Where BHP decides that actions do not exceed the trigger for a Program Matter (and therefore are not notifiable actions), BHP will document these decisions and manage the action in accordance with the requirements of applicable State environmental approvals, legislation and internal business processes.

The Project is located within the Strategic Assessment Area, and is therefore covered by the Commonwealth strategic approval. BHP is currently preparing a Validation Notice for the Project.

1.4 Other approvals and regulation

BHP Billiton Iron Ore Pty Ltd (BHPBIO) manages tenure holdings and legal structures on behalf of BHP Iron Ore (Jimblebar) Pty Ltd (BHPIOJ), as the party to the *Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972* (McCamey's State Agreement); and the Mount Newman Joint Venture as the party to the *Iron Ore (Mount Newman) Agreement Act 1964* (Newman State Agreement). New tenure and conversion of existing tenure to be held pursuant to the McCamey's State Agreement is required for the purposes of this Project.

The Jimblebar mining operations are situated on the tenure listed in Table 1 and Figure 2 shows tenure boundaries.

Table 1: Jimblebar tenure

Lease	Description	Legislation
M266SA	Mining Lease 266SA	*Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972* (WA) and *Mining Act 1978* (WA)
ML244SA	Mineral Lease 244SA	*Iron Ore (Mount Newman) Agreement Act 1964* (WA) and *Mining Act 1978* (WA)
L52/108	Miscellaneous Licence 52/108	*Iron Ore (Mount Newman) Agreement Act 1964* (WA) and *Mining Act 1978* (WA)
L52/109	Miscellaneous Licence 52/109	*Iron Ore (Mount Newman) Agreement Act 1964* (WA) and *Mining Act 1978* (WA)
G52/8	General Purpose Lease 52/8	*Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972* (WA) and *Mining Act 1978* (WA)
E52/3413	Exploration Licence 52/3413-I	*Mining Act 1978* (WA)
E52/3456	Exploration Licence 52/3456-I	*Mining Act 1978* (WA)
N049932	Sylvania Pastoral Lease	*Land Administration Act 1997* (WA)
New tenure to be applied for	Miscellaneous Licence	*Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972* (WA) *and Mining Act 1978* (WA)
Conversion of Mining Act tenure E52/3413 and G52/8 into M266SA	Mining Lease 266SA	*Iron Ore (McCamey's Monster) Agreement Authorisation Act 1972* (WA) *and Mining Act 1978* (WA)

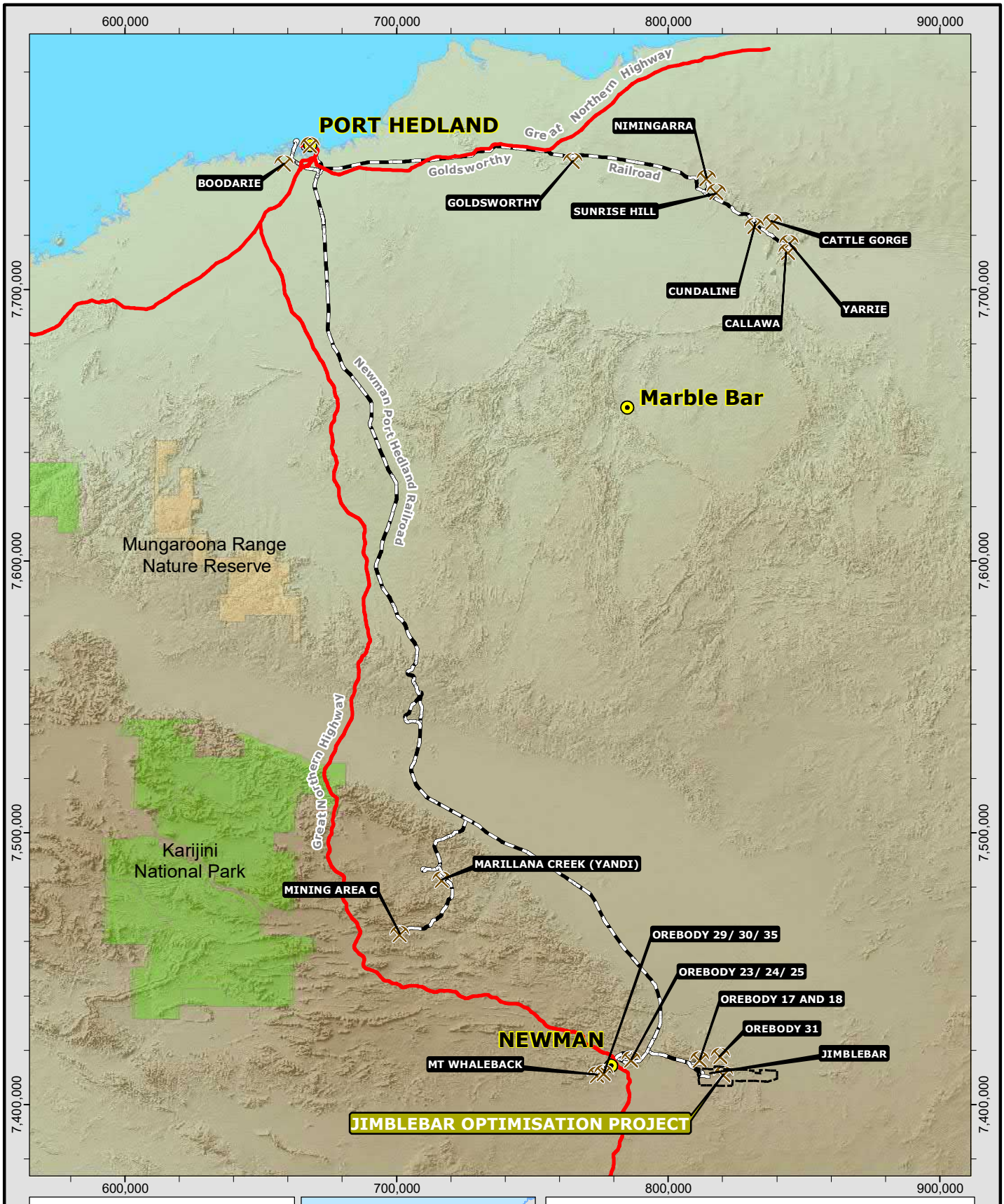
Table 2 outlines other state approvals that are required for mining operations at Jimblebar for the Revised Proposal (Existing Project and the Jimblebar Optimisation Project).

Table 2: Other approvals

Proposal activities	Land tenure/access	Type of approval	Legislation regulating the activity
Clearing	Mining Lease, Mineral Lease, Miscellaneous Licence	Native Vegetation Clearing Permit	EP Act – Part V
Processing, surplus water management, waste management, bulk storage of chemicals	Mining Lease, Mineral Lease, Miscellaneous Licence	Works Approval and Licence	EP Act – Part V
Groundwater abstraction, including for dewatering	Mining Lease, Mineral Lease, Miscellaneous Licence	5C Licence	RiWI Act
Disturbance of Aboriginal heritage sites	Mining Lease, Mineral Lease, Miscellaneous Licence	Section 18 consent	*Aboriginal Heritage Act 1972*
Development and operations	Mining Lease, Mineral Lease, Miscellaneous Licence	State Agreement	*Iron Ore (McCamey's Monster) Authorisation Agreement Act 1972* *Iron Ore (Mount Newman) Agreement Act 1964*
Ground disturbance, development within new tenure	Miscellaneous Licence	Mining Proposal	*Mining Act 1978*

Based on other approvals required for mining operations at Jimblebar (Table 2) BHP considers that the Decision-Making Authorities for the Revised Proposal are the following:

- CEO, Department of Water and Environmental Regulation
- Minister for Water
- Minister for Aboriginal Affairs
- Minister for State Development
- Executive Director: Resource and Environmental Compliance, Department of Mines, Industry Regulation and Safety.



LEGEND

- BHP Billiton Operation
- Pilbara Town

N

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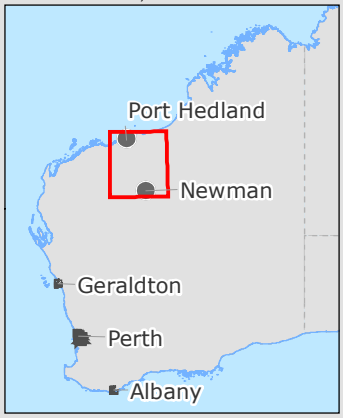
Kilometres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994



BHP

Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Regional Location

Not to scale	Prepared: J. VIS	Project No: A949/052 REV 0
Date: 20/08/2019	Checked:	Figure: 1
Revision: REV 0	Reviewed: ENVIRO. A&I	

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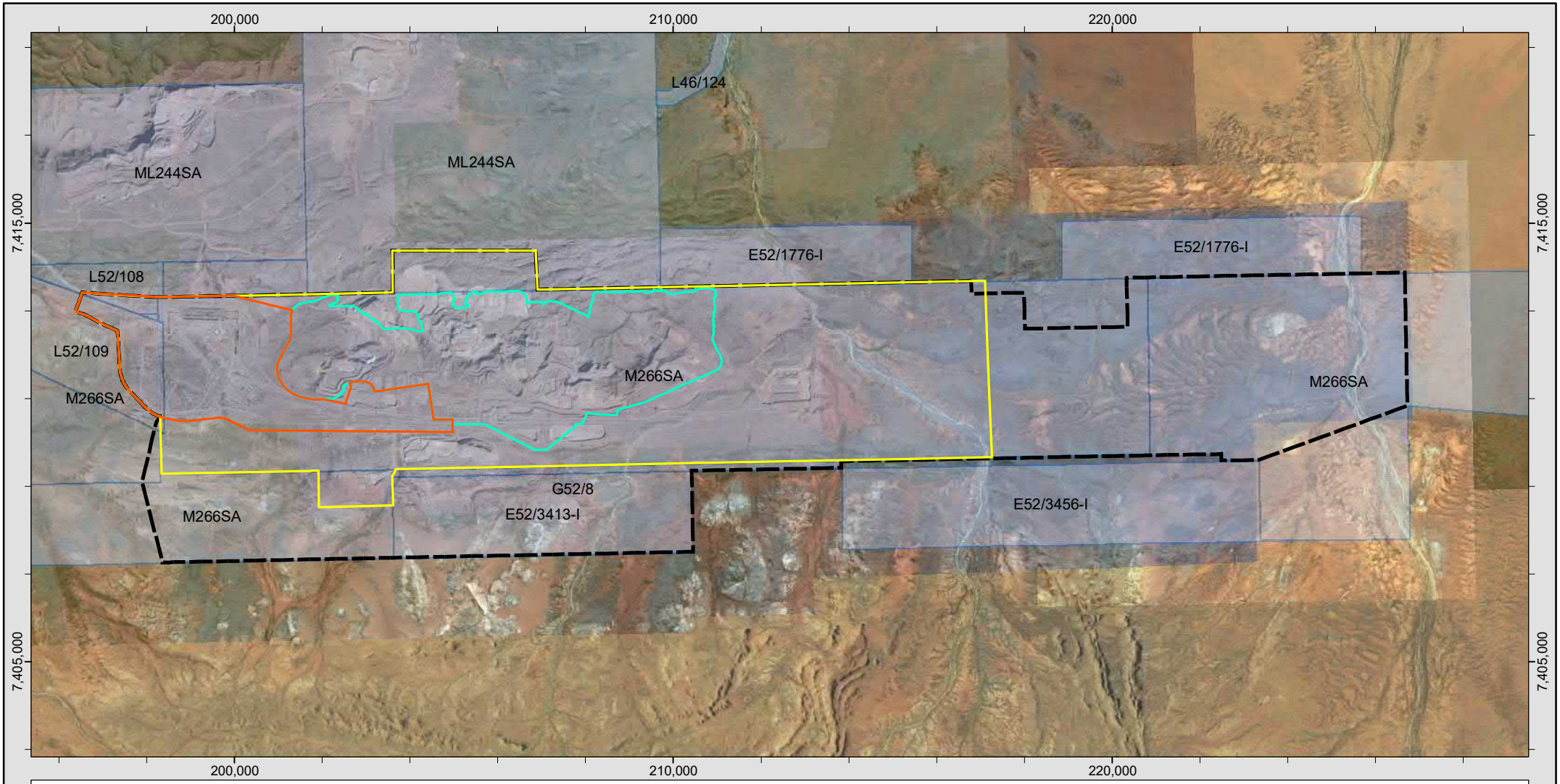

Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Tenure and Existing Ministerial Statements

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/003 REV 0
Date: 20/08/2019	Checked:	Figure: 2
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Ministerial Statement 683
- Ministerial Statement 809
- Ministerial Statement 857 (as amended by 1029)
- Proposed Development Envelope
- BHP Tenements - Granted

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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2 The proposal

2.1 Background

2.1.1 Existing Project

Mining operations commenced at the Jimblebar site nearly thirty years ago. The Jimblebar operations are approved under Part IV of the EP Act by four Ministerial Statements (683, 809 and 857 (as amended by 1029)) (Figure 2). The Existing Project is summarised below:

- mining above and below the water table at Wheelarra Hill, Hashimoto and South Jimblebar deposits;
- dewatering of the below water table deposits and the discharge of surplus water via pipeline to Ophthalmia Dam;
- Jimblebar Borefield to supply water to Jimblebar Hub;
- ore processing facilities, including ore handling, crushing and screening;
- ore transportation, including conveyors, train facilities and rail infrastructure;
- in-pit and ex-pit overburden storage areas (OSAs); and
- associated mining infrastructure including roads, service corridors, administration areas, workshop areas, storage areas, water supply and distribution, and power supply and distribution.

2.1.2 Existing approvals and summary of changes

Table 3 summarises the original Part IV approvals for the Existing Project and any subsequent changes to these approvals that have since been granted.

There are no Commonwealth EPBC Act approvals for the Existing Project. However, as discussed in Section 1.3.3, Jimblebar is within the Commonwealth Strategic Assessment, which was approved on 19 June 2017. The action associated with the increase in the MS857 Development Envelope (to allow for the first stage of one of the southern OSAs included in this Project) approved under s45C of the EP Act in November 2018 (Table 3) was subject to a validation decision under the Commonwealth Strategic Approval. BHP determined that the action was not a notifiable action.

Table 3: Existing Jimblebar Part IV approvals and summary of changes

Date	EP Act Section	Summary of original proposal/change
MS683: Wheelarra Hill Iron Ore Mine Extension, Life-of-Mine Proposal, Mining Lease 266SA, 40 km East of Newman, Shire of East Pilbara		
16 August 2005	s38	**Original proposal**: Life-of-mine proposal to mine and crush iron ore within M266SA at a rate of 12 Mtpa (increase from 8 Mtpa).
17 November 2006	s45C	**Attachment:** Increase Area Disturbed from 1,960 ha to 2,022 ha.
MS809: Wheelarra Hill Mine Modification Shire of East Pilbara		
07 October 2009	s38	**Original proposal**: Increase in the mining rate from approximately 12 Mtpa to 45 Mtpa. Increase in clearing (580 ha), water supply (to 11,800 kL per day). Construction and use of a new rail spur and rail loop, train loadout, ore handling plant and an overland conveyor system. Upgrading and installation of power lines.
MS857: Jimblebar Iron Ore Project, 40 Kilometres east of Newman, Shire of East Pilbara		
18 February 2011	s38	**Original proposal**: Extend existing Wheelarra open pits, develop the South Jimblebar and Hashimoto deposits, increase processing capacity to 75 Mtpa, and discharge surplus water to Ophthalmia Dam.
22 October 2015	s45C	**Attachment 1:** • Increase land disturbance from 2,042 ha to 2,300 ha and increase the development envelope from 7,880 ha to 8,183 ha. • Remove power supply as not a key proposal characteristic.
01 June 2016	s46 (MS1029)	**Change to conditions:** Add Condition 14. Offsets (applies to clearing authorised from 22 October 2015 onwards).
09 November 2018	s45C	**Attachment 2:** Increase to the Development Envelope from 8,183 ha to 8,324 ha (to allow for the development of the first stage of a southern OSA).

2.2 Justification

The Jimblebar Optimisation Project is needed to provide additional areas for mining infrastructure (including ex-pit overburden storage) and new surplus water management options at Jimblebar.

In early 2018, BHP identified a need for additional disturbance for OSAs south of the Jimblebar South pits due to:

- A lack of available area to allow expansion of OSAs, specifically adjacent to South Jimblebar, with the northern area constrained by existing infrastructure and the southern area constrained by the Existing Project Boundary.
- A higher waste to ore ratio at South Jimblebar.

- Backfill options being limited by pit stage sequencing requirements (a partial backfill schedule was developed to reduce the size of the OSAs required).
- Long-term impracticality of hauling waste material to backfill the depleted pit WH4 at the Wheelarra Hill deposit area.

Additional disturbance around the newly developed Hashimoto deposit area will be required for competent waste material and topsoil storage for future OSA rehabilitation. It may also be used for OSAs outside of the originally proposed areas.

BHP has proposed new surplus water management options (managed aquifer recharge and creek discharge) at Caramulla to provide greater flexibility in surplus water management. Surplus water will first be used onsite for local dust suppression and processing, but the water demand is significantly less than the planned dewatering volume. BHP considered *Strategic Policy 2.09: Use of Mine Dewatering Surplus* (Department of Water, 2013a), however, did not identify any other suitable complementary economic or innovative options. The Caramulla systems will provide alternative options for managing the surplus dewater from the Jimblebar mine, which is currently discharged to Ophthalmia Dam, as approved under Ministerial Statement 857.

BHP identified the Caramulla area as a preferred option for the MAR scheme because it is located sufficiently far away to avoid recirculation of current and planned dewatering. Caramulla Creek was identified as the most suitable option for creek discharge because it is in the same area as the MAR (so avoids duplication of pipeline infrastructure) and also has a wide sandy bed.

2.3 Proposal description

The Revised Proposal is the Jimblebar Optimisation Project and the Existing Project.

2.3.1 Jimblebar Optimisation Project

The Project includes the following key elements (Figure 3):

- New overburden storage areas (OSAs) and expansions to existing OSAs.
- New haul roads including across Jimblebar Creek.
- New surplus water management options:
    - Discharge of surplus mine dewater from Jimblebar mining operations into a new managed aquifer recharge (MAR) borefield east of Jimblebar (in Caramulla).
    - Discharge of surplus mine dewater from Jimblebar mining operations into Caramulla Creek.
- New pipeline from Jimblebar mine to transfer surplus dewater from Jimblebar mining operations to new Caramulla MAR and Caramulla Creek.
- Small diversion of a creek tributary to maintain surface water flow to Copper Creek around the proposed new southern OSAs.

Surplus water management – proposed options and design

Surplus mine dewater will be transferred from Jimblebar to the Caramulla Valley at a planned maximum capacity of 75 ML/d. The proposed transfer system is likely to include the following components:

- a polyethylene (PE) trunkmain pipeline from the Jimblebar mine to Caramulla, with a buried creek crossing at Jimblebar Creek and minor drainage lines; and

- a pump station, consisting of duty pumps and standby pumps and power supply.

Some borrow material will also be sourced from various locations within the proposed Caramulla area to provide suitable material needed to support the construction of the infrastructure for the pipeline and the creek discharge and MAR schemes. Final borrow locations are yet to be confirmed, however, the proposed disturbance has been factored into the overall amount requested as part of this Project.

Caramulla Creek discharge

The proposed creek discharge system is likely to include the following components:

- a discharge structure within the creek; and
- a portable solar monitoring station to provide power to discharge instruments.

Caramulla Managed Aquifer Recharge

The proposed MAR borefield is likely to include the following components:

- duty injection bores and standby bores;
- a balancing tank;
- spur pipelines from the trunkmain supplying water to each injection bore; and
- solar monitoring stations at each bore to provide power to bore headwork instruments.

2.3.2 Existing Project

BHP **does not seek any changes** to the following:

- Mine pits and mining rates approved under MS857, MS809 and MS683.
- Groundwater abstraction (including dewatering) rate of 22 GL/a approved under *Rights in Water and Irrigation Act 1914* (RiWI Act) 5C Licence GWL158795(9).
- Surplus water discharge rate of 45 ML/d (16.425 GL/a) to Ophthalmia Dam approved under MS857.

2.3.3 Key proposal characteristics

The key characteristics of the Project are summarised in Table 5 (‘Proposed change’ column).The key characteristics of the Revised Proposal are summarised in Table 4 and Table 5 (‘Revised Proposal’ column). The proposed Development Envelope for the Revised Proposal is shown in Figure 3.

BHP has provided a detailed review of the conditions and key proposal characteristics of the Ministerial Statements for the Existing Project in Appendix 1. If the decision is that the Revised Proposal may be implemented, BHP requests that one Ministerial Statement be issued for the Revised Proposal, which supersedes MS683, MS809 and MS857 (as amended by MS1029). BHP has provided a draft set of proposed implementation conditions for the Revised Proposal in Appendix 2.

Table 4: Summary of the Revised Proposal

Proposal title	Jimblebar Iron Ore Mine
Proponent name	BHP Billiton Iron Ore Pty Ltd
Short description	The Revised Proposal is for mining operations at Jimblebar, located approximately 40 km east of the town of Newman. Mining of iron ore deposits will be undertaken above and below the water table. Mining operations will include open pits, overburden storage areas and the construction and operation of associated mine, processing and rail infrastructure. Groundwater will be abstracted for water supply and to dewater the orebodies. Surplus water management will include transfer to Ophthalmia Dam, controlled creek discharge and managed aquifer recharge.

Table 5: Location and proposed extent of physical and operational elements

Element	Location	Existing approvals	Proposed change (The Project)	Proposed extent (Revised Proposal)
Mine and associated infrastructure	Appendix 2 Figure 1	**Part IV Ministerial statements (MS857, MS809, MS683)** Clearing of up to a total of 4,902 ha: • Land disturbance area: Not more than 2,300 ha within the 8,324 ha Development Envelope and not more than 14 ha outside the Development Envelope for the pipeline (MS857). • Total Area of Disturbance: An additional 580 ha (maximum) (MS809). • Area disturbed: 2,022 ha (MS683).	Additional clearing of up to 2,000 ha of native vegetation. Remove the 14 ha for clearing for pipeline outside the Development Envelope (from MS857).	Clearing of no more than 6,902 ha of native vegetation within the Development Envelope of 14,206 ha.
Groundwater abstraction	-	**RiWI 5C Licence GWL158795(9)** 22 GL/a (including for dewatering).	No change.	- (Authorised under existing RiWI 5C Licence).
Surplus water management	-	**MS857** Construction of a 45 mega litres per day pipeline within existing disturbance corridors to convey excess dewatering discharge to the Ophthalmia Dam (MS857).	Surplus water management including any or all of the following options: • Controlled discharge along Caramulla Creek to extend no further than 34 km from the northern boundary of the Development Envelope under natural, no-flow conditions. • Managed aquifer recharge in the Caramulla area to limit groundwater level rise to 25 m below ground level.	Surplus water management including any or all of the following options: • Discharge of up to 16.425 GL/a to Ophthalmia Dam. • Controlled discharge along Caramulla Creek to extend no further than 34 km from the northern boundary of the Development Envelope under natural, no-flow conditions. • Managed aquifer recharge in the Caramulla area to limit groundwater level rise to 25 m below ground level.

Element	Location	Existing approvals	Proposed change (The Project)	Proposed extent (Revised Proposal)
		Part V Licence L5415/1988/9 (Amendment Notice 3) Category 6 Discharge capacity (Jimblebar component): • 3.65 GL/a reinjected (Jimblebar MAR scheme). • 2.19 GL/a discharged to Jimblebar Creek and Copper Creek. • 16.425 GL/a discharged to Ophthalmia Dam.	No change.	- (Authorised under existing Part V Licence).

2.3.4 Assessment areas

The Indicative Footprint of the location where the physical proposal elements of the Project are planned to occur, is shown in Figure 3. The Indicative Footprint represents the boundary of proposed disturbance that is additional to disturbance assessed and approved for the Existing Project. The disturbance assessed and approved for the Existing Project is shown by the indicative area cleared (as at 31 July 2019) and the remaining indicative previously assessed area in Figure 3. The remaining indicative previously assessed area is still required and is mostly the Hashimoto and Jimblebar South deposits that have started to be developed, and associated OSAs.

Consistent with the *Instructions on how to define the key characteristics of a proposal* (EPA, 2017), the Indicative Footprint is the boundary of the footprint; therefore the area within the Indicative Footprint (2,712 ha) is larger than the proposed clearing (2,000 ha), particularly as the exact MAR location and requirement have not been finalised. Consistent with the *Instructions on how to define the key characteristics of a proposal* (EPA, 2017), the Development Envelope is the maximum area within which the Indicative Footprint will be located. The proposed Development Envelope area is calculated to be 14,205.4 ha. BHP has rounded this area up to 14,206 ha for the proposed extent (Table 5). Table 6 shows the breakdown of the existing and additional area in the proposed Development Envelope.

Table 6: Assessment areas

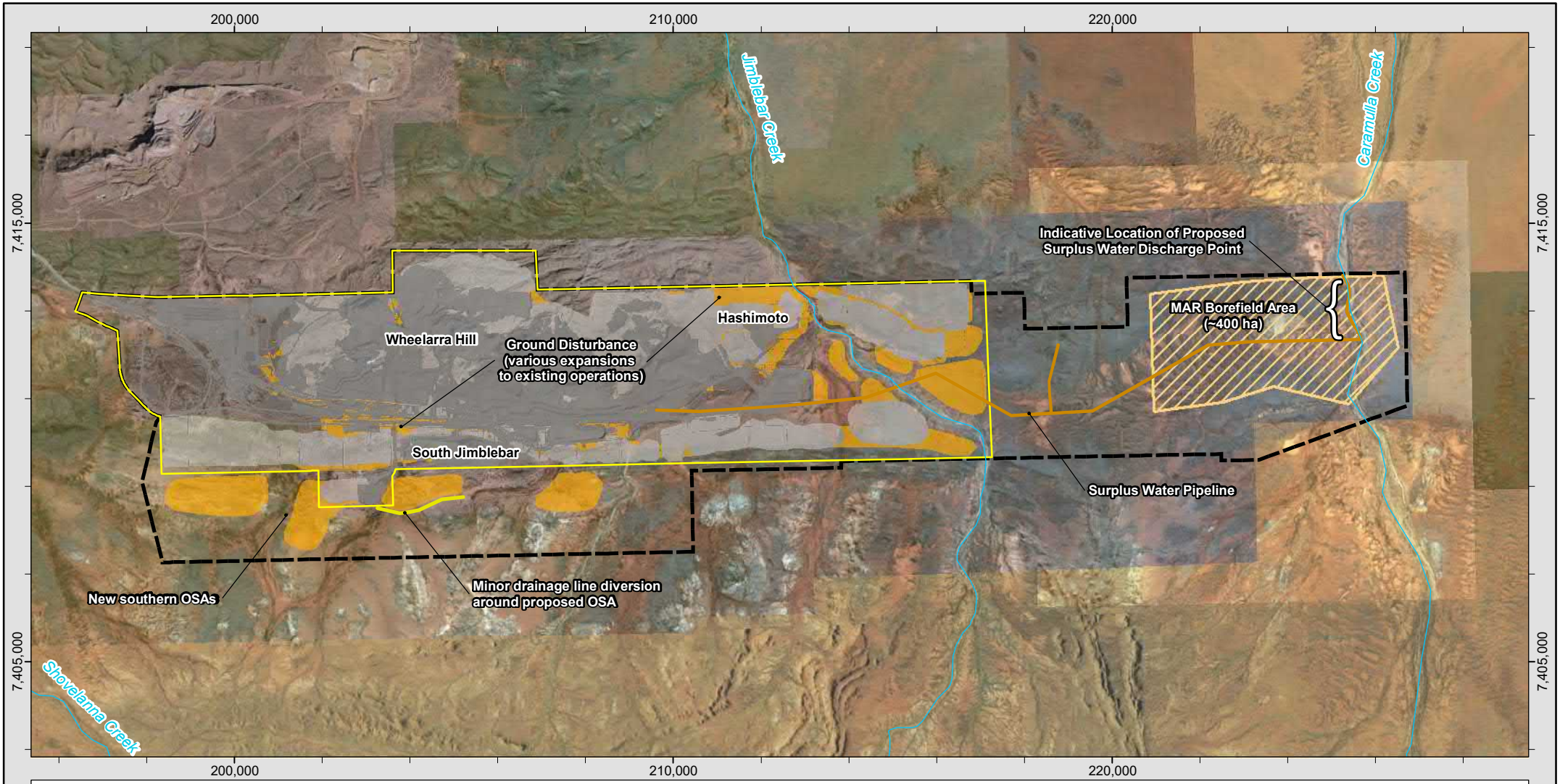
Project area	Area within Indicative Footprint (ha)	Area within proposed Development Envelope (ha)
Area within Existing Project Boundary	737	8,315.6
Additional area: • south of Existing Project Boundary (for southern OSAs) • east of Existing Project Boundary (Caramulla surplus water management)	1,975	5,889.8
Total	**2,712**	**14,205.4**

BHP has assessed potential impacts within the Indicative Footprint area and within the broader proposed Development Envelope to provide flexibility for the location of Project elements, to allow for changes to the project design, and/or to avoid or minimise impacts.

2.4 Local and regional context

The Project is located in the Eastern Pilbara region, 40 km east of the town of Newman (Figure 4). The Project is located within the ephemeral Jimblebar Creek and Caramulla Creek catchment areas in the Upper Fortescue River Basin. The dominant land use is pastoral and iron ore mining operations, including BHP's existing mining operations at Jimblebar and Newman. The Project is located within and adjacent to (south and east) the Existing Project. BHP's Orebody 18 and Orebody 31 operations are north of Jimblebar in the Jimblebar Creek catchment. The nearest third-party iron ore mining operations is Rio Tinto's Hope Downs 4 operations located 55 km to the northwest of the Project.

The Project is located within the Nyiyaparli native title determination area. The nearest National Park or conservation reserve is Karijini National Park, 147 km northwest of the Project (Figure 1). The Ethel Gorge alluvial and calcrete aquifer 20 km to the west of the Project supports the Ethel Gorge aquifer Stygobiont community Threatened Ecological Community (Ethel Gorge TEC). Ophthalmia Dam located 5 km upstream of Ethel Gorge is operated as a managed aquifer recharge facility to manage groundwater levels in the Ethel Gorge aquifer. The dam currently receives surplus water from BHP's Jimblebar, Orebody 31 and Newman operations. Jinerabar Pool, an intermittent river pool on Jimblebar Creek, is located 45 km north of the northern boundary of the proposed Development Envelope. Innawally Pool, a semi-permanent pool on Jimblebar Creek, is located within the proposed Development Envelope, near the northern boundary.



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JIMBLEBAR OPTIMISATION PROJECT
Proposed Development Envelope and Indicative Footprint

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/002 REV 0
Date: 23/08/2019	Checked:	Figure: 3
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Watercourse
- Existing Project Boundary
- Proposed Development Envelope
- Indicative Previously Assessed Area
- Indicative Cleared Area as at FY2019

Indicative Footprint

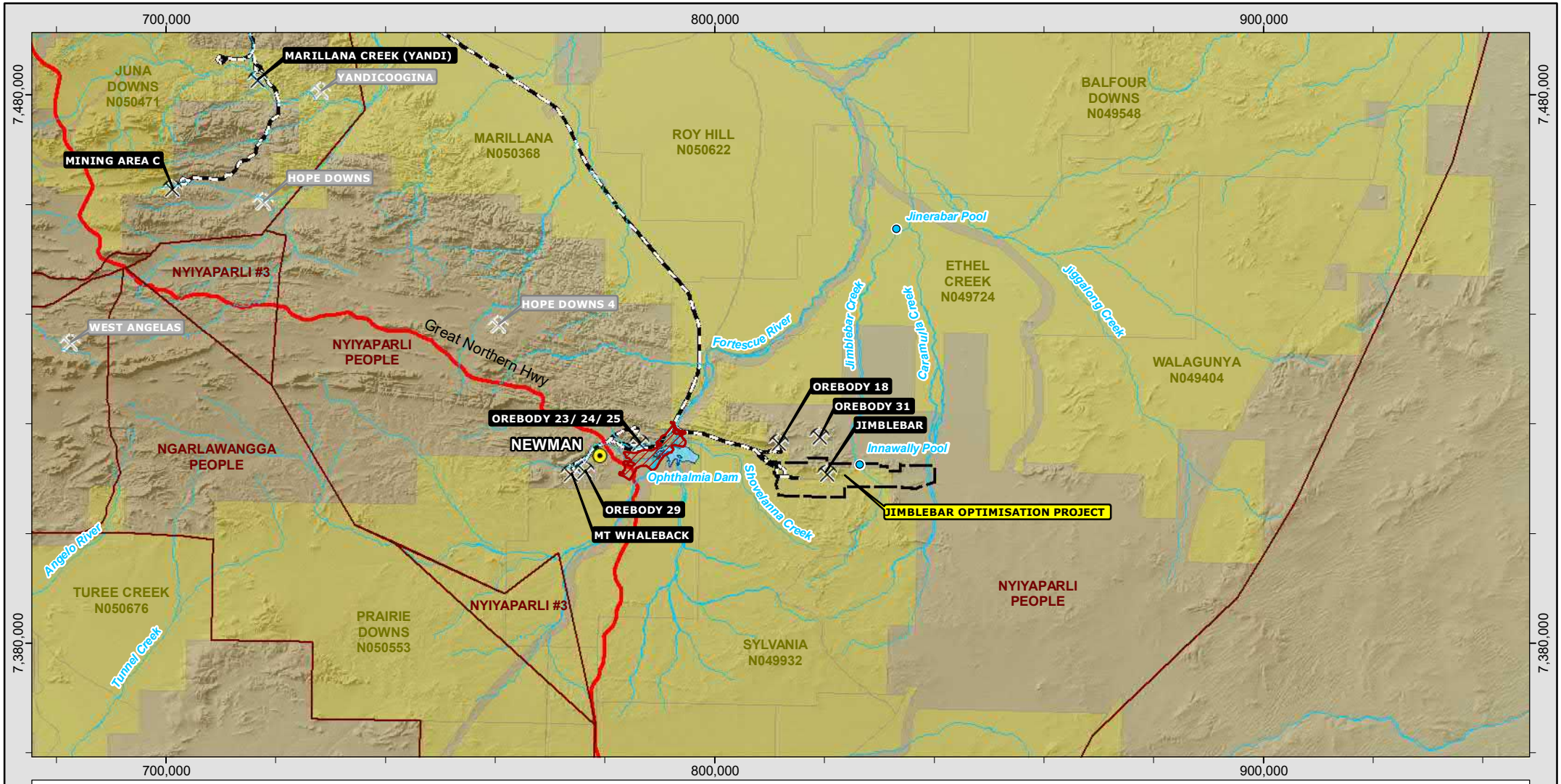
- Drainage Line Diversion
- Surplus Water Pipeline
- MAR Borefield Area
- Ground disturbance (OSA, various expansions and associated activities)

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_002_E_ProposedDevelopmentEnvelope_Rev0.mxd



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JIMBLEBAR OPTIMISATION PROJECT
Local Context

Scale @ A4: 1:1,000,000	Prepared: J.VIS	Project No: A949/54 REV 0
Date: 26/08/2019	Checked:	Figure: 4
Revision: REV 0	Reviewed: ENVIRO. A&I	

- BHP Operations
- BHP Rail
- Proposed Development Envelope
- Other Mining Operations
- Highways
- Watercourse
- Ethel Gorge TEC
- Pastoral Leases
- Native Title Determinations

N

0 10 20 30
Kilometres

Coordinate System: GDA 1994 MGA Zone 50
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_054_E_RegionalContext_Rev0.mxd

3 Stakeholder engagement

3.1 Key stakeholders

During the development of the Project, BHP undertook targeted stakeholder engagement based on interest and proximity to the Project location. The key stakeholders for the Project are summarised in Table 7.

Table 7: Key stakeholders

Stakeholder group	Stakeholder
State Government	Department of Water and Environmental Regulation (DWER) Department of Biodiversity, Conservation and Attractions (DBCA) Department of Mines, Industry Regulation and Safety (DMIRS) Department of Jobs, Tourism, Science and Innovation (DJTSI)
Traditional Owners, Native Title Claimants and Representative Bodies	Nyiyaparli Native Title Holders

3.2 Stakeholder engagement process

BHP meets regularly with the key stakeholders identified above to facilitate regular, open and honest dialogue to understand expectations, concerns and interests of stakeholders and to incorporate them into business planning. Consultation undertaken until early June 2019 for the Project was undertaken with the intent to refer a Derived Proposal. Consultation since then has been based on the plan to refer a Revised Proposal, as at the time of preparation of this document, the Ministerial Statement for the State Strategic Proposal had not been issued by the time it was necessary to commit to an approvals pathway for the Project.

3.3 Stakeholder consultation

Table 8 summarises stakeholder consultation undertaken specifically for this Project. BHP has not included aspects of consultation that related solely to the State Strategic Proposal/ Derived Proposal in the table.

Table 8: Stakeholder engagement

Stakeholder	Date	Topics/issues discussed	BHP response and outcome
DWER – EPA Services	13 August 2019	Presented the Project scope and the assessment outcomes for the preliminary key environmental factors (Inland Waters, Flora and Vegetation and Terrestrial Fauna). BHP confirmed it intended to provide sufficient information at the time of referral for a s38 'Assessment on Referral Information' assessment pathway for a Revised Proposal. BHP also reiterated the request should the Revised Proposal be approved, to supersede the four existing Ministerial statements to manage the Jimblebar mine under one new Ministerial Statement, with implementation conditions that closely align to the recently approved Strategic Proposal (Ministerial Statement 1105).	BHP has prepared this Environmental Review Document as a supplementary report with the referral, which provides sufficient information for the EPA's assessment. BHP has also reviewed the existing Ministerial Statements and the applicability of the existing key proposal characteristics and implementation conditions (Appendix 2) to a single, contemporary Ministerial Statement for the Revised Proposal. BHP welcomes the opportunity for a site visit with the EPA and/or DWER officers during the assessment.
	30 July 2019	Discussed the anticipated submission date of the referral documentation. BHP also sought confirmation whether a pre-referral presentation and a draft copy of the referral documentation and would be required by EPA Services prior to submission.	EPA Services requested a pre-referral presentation and indicated a draft copy of the referral documentation would not be required. BHP committed to arranging a pre-referral meeting prior to 19 August 2019.
	25 June 2019	Discussed BHP's plan to change referral from a Derived Proposal to a Revised Proposal as Ministerial Statement for the Strategic Proposal had not yet been issued. EPA Services indicated that Assess on Referral Information was a possible assessment pathway if sufficient, robust information was provided.	BHP confirmed intent to submit a Revised Proposal referral in late August 2019, with an Environmental Review Document (and supporting surveys, studies and management plans), to meet information requirements for Assess on Referral Information.
	13 February 2019	Discussed requirements for 'targeted surveys' as per the Strategic Proposal Recommended Environmental Conditions *Guidelines for submitting a Derived Proposal* – 1(b) and direction on level of survey required for various activities with EPA Services and Terrestrial Ecosystems Branch representatives. Advice was to present information detailing level of survey coverage across the proposed Development Envelope.	Since the decision to prepare a Revised Proposal, BHP has undertaken additional biodiversity surveys to meet the requirements of EPA survey guidance for standard s38 proposals. BHP has addressed survey coverage in Sections 6.3 and 7.3.
	5 December 2018	BHP advised that the first Derived Proposal is likely to be an expansion of the Jimblebar Mine.	BHP communicated that the referral date for the Derived Proposal is anticipated to be June/July 2019.

Stakeholder	Date	Topics/issues discussed	BHP response and outcome
	16 November 2018	BHP outlined the scope of the Project. Main points discussed were: • how a proposed Derived Proposal would condition an area also subject to existing Ministerial Statements • level of survey required for various different activities (i.e. light infrastructure versus OSAs) and how to define 'targeted survey'.	EPA Services Branch requested BHP present a clear scope and level of survey coverage across the proposed Development Envelope. BHP has discussed the scope of the Project in Section 2 and biodiversity surveys in Sections 6.3 and 7.3.
DWER – Regulatory Services (Water)	5 June 2019	BHP discussed the surplus water strategy for the Project and presented the MAR modelling results. No specific feedback was received.	BHP finalised the MAR modelling report - *Caramulla MAR Injection Modelling* (BHP, 2019a), which is included in Appendix 3.
DBCA	29 April 2019	Discussed BHP's request for a meeting to discuss the Derived Proposal. DBCA confirmed by email that DBCA recommends that all consultation planned for Derived Proposals involves EPA Services (until the process is clear and agreed to). DBCA suggested providing further information, if applicable, on the potential impacts of the Project on matters protected under the *Biodiversity Conservation Act 2016* and/or *Conservation and Land Management Act 1984*.	Following the finalisation of the impact assessment of the biodiversity factors, BHP has concluded that there is unlikely to be a significant impact on BC Act or CALM Act matters (see Sections 6 and 7). BHP has developed a draft Flora and Vegetation Management Plan (Appendix 15) that addresses potential impacts to the Priority 1 flora species *Eremophila capricornica*. BHP will consult with DBCA on the development of relevant management plans, if required.
	12 February 2019	BHP outlined the scope of this Project and intent to refer it as the first Derived Proposal; also whether DBCA would review a draft application and provide comments ahead of a formal referral. DBCA advised they would consider reviewing a draft application if resources were available at the time. DCBA also indicated their preference for BHP to only provide/highlight those aspects of the Project relevant to matters protected under the *Biodiversity Conservation Act 2016* and/or *Conservation and Land Management Act 1984*. BHP sought also feedback from DBCA on current approach to management plans and definition of targeted surveys.	Since the decision to prepare a Revised Proposal, BHP has completed additional biodiversity surveys to meet the requirements of EPA survey guidance for standard s38 proposals. BHP has addressed survey coverage in Sections 6.3 and 7.3.

Stakeholder	Date	Topics/issues discussed	BHP response and outcome
		DBCA advised that they will assess the application based on the approach endorsed by the EPA for management plans and targeted surveys.	
DWER, DBCA, DMIRS	6 March 2019	BHP (together with Syrinx Environmental consultants) presented and discussed the draft BHP WAIO rehabilitation completion criteria related to revegetation, developed as part of the work for the report on rehabilitation success required for the Strategic Proposal Recommended Environmental Conditions *Guidelines for submitting a Derived Proposal* – 1(c). Meeting attendees were generally supportive of the approach proposed and the detail. During the meeting, DBCA noted that Buffel Grass (**Cenchrus ciliaris*) will need to be addressed, should it be listed as a Declared Pest.	BHP updated the Jimblebar Mine Closure Plan (Version 2) (Appendix 16), with the new completion criteria. This is consistent with the EPA's advice (EPA Report 1619, 2018d) on the Strategic Proposal, that information in the report on rehabilitation success should be used to inform the development of mine closure plans.
DJTSI	29 January 2019	BHP briefed DJTSI on the new water management project at Jimblebar (Caramulla) and advised they would submit one State Agreement Proposal for the Jimblebar South OSAs and Caramulla surplus water project.	BHP advised they would draft the Local Participation Plan (LPP) and Community Development Plan (CDP) "6 month notice of intention" to submit a State Agreement Proposal in April 2019 for DJTSI review. BHP plans to submit the State Agreement Proposal in February 2020 (pending tenure conversion) with approval anticipated in April 2020.
	20 August 2018	BHP briefed DJTSI on the Jimblebar South OSAs and advised that development on Exploration tenure (E52/3413) is not fit for purpose.	Conversion to State Agreement tenure via State Agreement Proposal is required. Application to include E52/3413 and G52/8 into M266SA and held pursuant to the McCameys Monster State Agreement was lodged 27 September 2018. Minister confers with Minister for Mines 29 November 2018.
Nyiyaparli Native Title Holders	5 August 2019	BHP provided the Environmental Review Document, the draft Flora and Vegetation Management Plan (Appendix 15), the Jimblebar Mine Closure Plan (Appendix 16) and the draft Water Management Plan	BHP acknowledges the long-term interest in these issues over the life of any mine and beyond for the Nyiyaparli. The referral documentation has been updated where required and any ongoing concerns will be discussed through the regular Implementation

Stakeholder	Date	Topics/issues discussed	BHP response and outcome
		(Appendix 17) for review in advance of referral of the Project to the EPA. In response, the Karlka Nyiyaparli Aboriginal Corporation provided general comments via email on 19 August 2019 on the key themes of water, vegetation and weeds, fauna and mine closure.	Committee forum. A letter was provided to the Nyiyaparli on 26 August 2019 summarising BHP's response to the comments. BHP has proposed a site visit to further discuss any specific concerns the Nyiyaparli may have with the implementation and the long-term on-ground management of this Project.
	16 April 2019 (Biannual Meeting)	During the meeting, BHP's presentation and discussion included BHP's water management approach and the Project. There was general discussion about the Project but no specific issues were raised.	BHP confirmed that they would provide copies of draft referral documentation prior to submission to allow Nyiyaparli to provide feedback.
	18 October 2018 (Biannual Meeting)	During the meeting, BHP's presentation and discussion included the following: • BHP's general approach to surplus water management in the Pilbara; and • upcoming environmental approvals (including Jimblebar).	BHP has addressed its approach to surplus water for this Project in Section 2.2 and Section 5 – Inland Waters. BHP also offered a site visit in 2019. It was agreed at this meeting that BHP would provide further detailed information on the Project scope at the next meeting (April 2019).
	6 April 2018 (Biannual Meeting)	BHP presented the Project including the location, extent and nature of the project. No specific issues were raised. The recent ethno-biological site visit (March 2018) was also presented.	BHP offered further opportunity to discuss the Project on-site to identify if there were any specific environmental issues of interest/concern to the Nyiyaparli. It was proposed that this could occur in conjunction with upcoming Heritage surveys.
	March 2018	BHP's Heritage and Environmental Teams, with four Nyiyaparli representatives and Onshore Environmental consultants, undertook a survey to better understand the bush tucker within the Jimblebar area. A lot of time was spent at Innawally Pool.	

4 Environmental principles and factors

4.1 Principles

Table 9: EP Act principles

Principle	Consideration
1. The precautionary principle *Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation.* *In application of this precautionary principle, decisions should be guided by:* *(a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and* (b) *an assessment of the risk-weighted consequences of various options.*	BHP has undertaken baseline biodiversity surveys and hydrological studies (Appendices 3 to 14) to provide scientific information for BHP to assess the risks and potential impacts on the environment from the Project (Sections 5 to 8). In designing the Project, BHP has considered different options (Section 2.2) and has applied the mitigation hierarchy (Sections 5.6, 6.6, 7.6 and 8) to avoid and minimise impacts on the environment. BHP considers that there will not be a threat of serious or irreversible damage if the mitigation measures are applied. BHP's application of a precautionary approach where there is scientific uncertainty includes: reducing the proposed Development Envelope to avoid populations of the Priority 1 flora species *Eremophila capricornica*; and limiting groundwater level rise to avoid impacts to facultative phreatophytic vegetation.
2. The principle of intergenerational equity *The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.*	BHP has demonstrated how it has applied the mitigation hierarchy (Sections 5.6, 6.6, 7.6 and 8) to avoid, minimise and rehabilitate environmental impacts, to maintain the health, diversity and productivity of the environment. BHP has consulted with the Nyiyaparli Native Title Holders and undertaken extensive ethnographic and archaeological surveys, to understand the aspects of the environment that are important to the Nyiyaparli as the Traditional Owners. BHP has also updated the Jimblebar Mine Closure Plan (Appendix 16) which has an overarching closure objective to develop a safe, stable, non-polluting and sustainable landscape that is consistent with social and environmental values agreed by key stakeholders. This includes considering closure issues of interest to the Nyiyaparli and returning the site to a post-mining landuse that is consistent with the pre-mining environment and is viable for future generations.
3. The principle of the conservation of biological diversity and ecological integrity *Conservation of biological diversity and ecological integrity should be a fundamental consideration.*	BHP has considered biodiversity and hydrological information from recent surveys and studies completed for this Project and from extensive knowledge gained from numerous surveys and studies completed for Jimblebar since the early 1990s, when BHP acquired the Jimblebar operations. This principle is a key consideration for the Project as it also part of the EPA's objectives for the land biodiversity factors of Flora and Vegetation, Terrestrial Fauna and Subterranean Fauna. BHP has considered this principle through the assessment of these factors (Sections 6 to 8). Through the Project design and application of the mitigation hierarchy, BHP considers that biological diversity and ecological integrity will be conserved.
4. Principles relating to improved valuation, pricing and incentive mechanisms	BHP accepts that it is responsible for the costs relating to the management of waste and pollution, including avoidance, containment, decommissioning, rehabilitation and closure.

Principle	Consideration
(1) Environmental factors should be included in the valuation of assets and services. *(2) The polluter pays principles – those who generate pollution and waste should bear the cost of containment, avoidance and abatement.* *(3) The users of goods and services should pay prices based on the full life-cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any waste.* *(4) Environmental goals, having been established, should be pursued in the most cost effective way, by establishing incentive structures, including market mechanisms, which enable those best placed to maximise benefits and/or minimise costs to develop their own solutions and responses to environmental problems.*	The storage, treatment, movement and disposal of waste is a key consideration for the Project, as the minimisation of waste provides an environmental and financial benefit. BHP's Life of Mine waste strategy is informed by the Jimblebar Mine Closure Plan.
5. The principle of waste minimisation *All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.*	Standard waste management measures are a key element for the implementation of this Project. It is standard practice for BHP to apply the waste management hierarchy to all sites and this will be the case in relation to this Project (i.e. avoidance, reuse, recycling, recovery of energy, treatment, containment and disposal). BHP's closure philosophy for Jimblebar is to minimise ex-pit waste through the backfill of waste into mined-out pit voids, as outlined in the Jimblebar Mine Closure Plan. However, additional waste storage is required as part of the Project. A partial backfill schedule was developed to reduce the size of the OSAs required (Section 2.2).

4.2 Environmental factors

BHP considered the various matters that the EPA may have regard to in considering the significance of potential impacts, as outlined in the EPA's Procedures Manual (2018a) and *Statement of Environmental Principles, Factors and Objectives* (2018e). At the start of the environmental impact assessment, BHP identified that the preliminary key environmental factors (i.e. those factors that may be significantly impacted by the Project) were:

1. **Inland waters**: Direct impacts to surface water regimes from discharge of surplus water to Caramulla Creek. Direct impacts to groundwater regimes from injection of surplus water to regional aquifer.
2. **Flora and vegetation**: Direct impacts associated with clearing of native vegetation. Indirect impacts associated with changes to surface water regimes.
3. **Terrestrial fauna**: Potential indirect impacts on conservation significant species from removal of habitat.

BHP's assessment of the preliminary key environmental factors is detailed in Sections 5 to 7. BHP has discussed Inland Waters first to avoid repetition, as the assessment of Flora and Vegetation includes discussion of potential indirect impacts associated with changes to surface water regimes.

BHP's evaluation of 'other environmental factors' is summarised in Section 8. This includes justification as to why BHP considers that they are not preliminary key environmental factors.

5 Inland Waters

5.1 EPA objective

The EPA's objective for Inland Waters is:

> *To maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected.*

5.2 Policy and guidance

BHP assessed this environmental factor consistent with the following relevant EPA policies and guidance:

- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2018e); and
- *Environmental Factor Guideline – Inland Waters* (EPA, 2018f).

BHP considers that other guidance applicable to this factor is:

- *Western Australian Water in Mining Guideline* (Department of Water, 2013b).

5.3 Receiving environment

5.3.1 Studies and surveys

Table 10 summarises the specific studies undertaken by BHP to support the assessment of Inland Waters for the Project. Other supporting information is referenced in these documents, where relevant.

Table 10: Inland Waters – studies

Title	Date	Summary	Appendix
Caramulla MAR injection modelling (BHP, 2019a)	June 2019	To predict increase in groundwater levels from injection of surplus dewater into Caramulla MAR scheme.	Appendix 3
Jimblebar surplus water management: Caramulla Creek discharge modelling (BHP, 2019b)	August 2019	To predict extent of surface water flow from discharge of surplus dewater into Caramulla Creek	Appendix 4

BHP considers that the studies meet the relevant EPA guidance to support the assessment of Inland Waters for the Project.

5.3.2 Project setting and environmental values

Surface Water

At the regional scale, the Project is located within the Upper Fortescue River Basin (Figure 7). At the local scale, the Project is located within both the Jimblebar Creek and Caramulla Creek surface-water catchment areas. For surface water management, these catchment areas fall within BHP's Eastern Pilbara region. Two major ephemeral tributaries of the Fortescue flow north through the proposed Development Envelope – Jimblebar Creek and Caramulla Creek. The surface water quality within these creeks is fresh (less than 500 mg/L total dissolved salts (TDS)) as creeks flow following large rainfall events with pH 6-8 (neutral) (RPS, 2014).

Caramulla Creek is approximately 77 km long from its source in the Caramulla Creek catchment, to the confluence with the Fortescue River. Within the proposed Development Envelope, the Caramulla Creek catchment discharges via the Caramulla Creek main channel and via a smaller unnamed tributary to the east. The main creek channel typically has a 100 to 200 m bed width with banks 1 to 2 m high. Approximately 4 km downstream of the proposed Development Envelope, where the unnamed tributary merges into the main Caramulla Creek flowpath, Caramulla Creek becomes very braided. However, a defined main channel is maintained downstream to where Caramulla Creek merges into the Fortescue River (RPS, 2015).

In this confluence zone the topography is extremely flat (less than 0.1%) and the main flow channels become braided and less defined. Discharges from these main river/creek systems tend to disperse into a wide floodplain and travel via smaller flow channels and as overland flow. Mapping indicates that this floodplain is potentially 10 to 20 km wide (RPS, 2015).

Indicative peak discharges for Caramulla Creek catchment (estimated from Fortescue River at Newman gauging station) range from 155 m^3/s for a 50% Annual Exceedance Probability (AEP) to 970 m^3/s for a 1% AEP (RPS, 2015).

Groundwater

At the regional scale, the groundwater system comprises Tertiary detrital and underlying Wittenoom Formation (dominated by Paraburdoo Member dolomite), which are bound within low-permeability geological types. At the local scale, the Project is located within the Dolomite Aquifer.

The proposed Caramulla MAR site is characterised by a roughly East-West trending palaeovalley (filled with Tertiary detritals) underlain by the Paraburdoo Dolomite Member of the Wittenoom Formation. Drilling undertaken within the proposed MAR area suggests that the Tertiary detrital sequence extends from 0 m to approximately 85 metres below ground level (mbgl). The Tertiary detrital contains a clay unit from 20 to 70 mbgl, which appears to be behaving as a confining unit on the aquifers beneath it. A vuggy breccia unit is intersected beneath the clay. This forms the detrital base unit, has a variable thickness and was found to extend to over 100 mbgl in places. It is hydraulically connected to the underlying Dolomite (BHP, 2019c).

Data (from March to May 2019) in the Caramulla area indicate that groundwater pH ranges between 7.5 and 8.4, and water quality is generally fresh (TDS 500 to 900 mg/L). The water quality is comparable with the groundwater at Jimblebar (data from February to June 2019), which has a pH between 6.7 and 9.4, and is fresh (TDS 300 to 1000 mg/L).

The regional groundwater table was typically at least 50 metres below the ground level (mbgl) in the western end of the proposed Development Envelope (around Jimblebar) (Aquaterra, 2009) prior to mining below the groundwater table being approved under MS857 (groundwater dewatering approved for the Existing Project is described in Section 2.2). The groundwater level at Caramulla in the eastern end of the proposed Development Envelope, where the proposed Caramulla MAR will be developed in the Caramulla Valley, is also approximately 50 mbgl (measured as a standing water level) (BHP, 2019a).

Key environmental values

The key environmental values relating to Inland Waters are water-dependent ecosystems that have ecological, cultural and recreational value.

The Ethel Gorge TEC supports a significant stygofauna community, located approximately 20 km to the west of the proposed Development Envelope (Figure 4). BHP currently has approval under MS857 to discharge surplus mine dewater from Jimblebar via a pipeline to Ophthalmia Dam, which infiltrates into Ethel Gorge. Ophthalmia Dam also has recreation value.

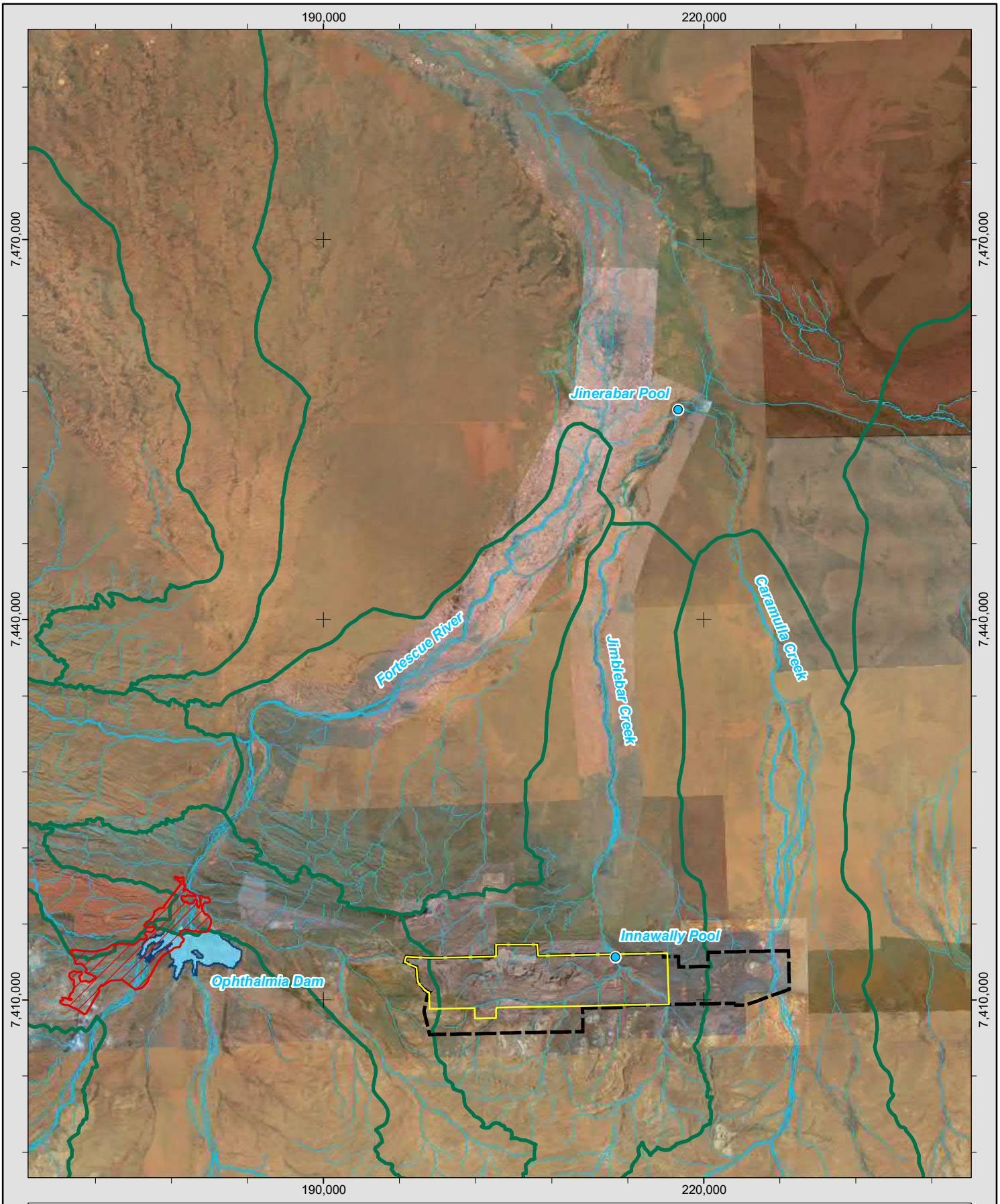
Innawally Pool is located within the proposed Development Envelope in the Jimblebar Creek main channel (Figure 5 and Figure 7) and receives runoff from the upstream creek system and from some minor local drainage lines. Anecdotal information indicates that the pool is semi-permanent and holds water for many months following a runoff

event. Regional groundwater levels under the Hashimoto ridgeline are at a depth of approximately 50 m below the base of Innawally Pool. This suggests that Innawally Pool is a perched water feature and is not connected with the regional watertable (RPS, 2015). The pool's extent changes seasonally and is currently approximately 500 m long by 30 m wide (Figure 5). Measurements taken in the wet season (March 2015) and dry season (July 2016) indicate that the pool is fresh (salinity less than 200 mg/L), with a pH of approximately 7.8. Nutrient levels exceed ANZECC guidelines (Ecologia, 2017). The pool supports aquatic fauna including turtles and frogs.

Figure 5: Innawally Pool

Jinerabar Pool, an intermittent pool, is located on Jimblebar Creek (on Ethel Creek Station) (Pinder *et al*., 2017) approximately 45 km downstream of the northern boundary of the proposed Development Envelope. It is located 1.5 km upstream of the confluence between Jimblebar and Caramulla creeks and the Fortescue River, on the alluvial Fortescue Land System where flow merges during large floods. Jinerabar Pool is filled by surface runoff. There is evidence of heavy grazing of riparian vegetation (Pinder *et al*., 2017) (Figure 6).

Figure 6: Jinerabar Pool



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JIMBLEBAR OPTIMISATION PROJECT
Regional and Local Hydrology

Scale @ A4: 1:400,000	Prepared: J.VIS	Project No: A949/053 Rev 0
Date: 20/08/2019	Checked:	Figure: 7
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Watercourse
- Ethel Gorge TEC
- Hydrographic Sub-catchments
- Existing Project Boundary
- Proposed Development Envelope

N

0 5 10
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

5.4 Potential impacts

BHP has considered the potential impacts outlined in the EPA's Inland Waters Guideline (2018f) and considers that those relevant to the Project are:

- Changes to surface water regimes from discharge of surplus water to creeks and construction of infrastructure (direct).
- Changes to groundwater regimes from MAR - injection of surplus water (direct).
- Changes to surface and groundwater quality (direct).

This Project does not seek any change (or additional activities) related to the discharge of surplus water to Ophthalmia Dam (including impacts to Ethel Gorge), beyond those already assessed and approved for the Existing Project, and will not be discussed further in this section.

As discussed in Section 2.3.3, a large proportion of the proposed Development Envelope is within the Existing Project Boundary (Figure 3), where impacts have already been assessed and approved. Therefore, BHP has focused the discussion on potential impacts of the Project in the Indicative Footprint and in the additional areas within the proposed Development Envelope to the south and east of the Existing Project Boundary. The discussion of cumulative impacts considers existing impacts, including from the Existing Project.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation and/or management measures are applied, if required).

5.4.1 Changes to surface water regimes

Discharge of surplus water to creeks

As discussed in Section 2.3.1, one of the surplus management options for the Project is controlled discharge to Caramulla Creek. Consistent with the options for mine surplus water outlined in the *Water in Mining Guideline* (Department of Water, 2013b), BHP intends to use controlled creek discharge as an option, to reduce pressure on Ophthalmia Dam, if required, and/or when the Caramulla MAR scheme is unavailable (i.e. during construction, or when the scheme reaches capacity). Surface water discharge has the potential to change the hydraulic regime of Caramulla Creek by resulting in surface water flows during natural no-flow conditions and increasing the duration of flow.

BHP undertook hydrological modelling of Caramulla Creek to estimate the extent of wetting from creek discharge using an analytical water balance model. The model was run for a range of discharge rates (45 ML/d, 65 ML/d, 75 ML/d and 90 ML/d) for a High-Loss scenario (seepage loss of 100 mm/d) and a Low-Loss scenario (seepage loss of 1 mm/d). Although the current approved groundwater abstraction rate (under RiWI 5C Licence GWL158795(9)) for Jimblebar is 22 GL/a (approximately 60 ML/d), BHP assessed higher discharge rates as part of future planning for higher dewatering rates and/or transfer of surplus water from other operations (BHP, 2019b).

The modelled wetting front extents for the High-Loss scenario ranged between 2.2 km and 4.3 km for discharge rates of between 45 ML/d and 90 ML/d respectively. The modelled wetting front extents for the Low-Loss scenario ranged between 21 km to 41 km from the modelled discharge point for discharge rates between 45 ML/d and 90 ML/d respectively. BHP has taken a conservative approach to the wetting front modelling and used the results from the Low-Loss scenario to predict and assess potential impacts. While historic flow events suggest higher infiltration capacity than the modelled rates used for the Low-Loss scenario, uncertainty remains as infiltration rates are difficult to determine until discharge commences. While there is uncertainty in the infiltration rates, BHP considers that the Low-Loss scenario is appropriate for BHP to assess the possible impacts from surplus water discharge.

Figure 8 shows the predicted wetting front extents for the Low-Loss scenario. BHP also estimated flow depths and widths for the various discharge rates at locations downstream of the modelled discharge point. The estimated flow

depths and flow widths are up to 0.19 m and 21 m respectively. Figure 9 shows a cross-section and creek characteristics (estimated flow depth and width) at a location 40 km from the modelled discharge point, closest to the furthest modelled wetting front extent (41 km). Figures at other representative locations are provided in *Jimblebar surplus water management: Caramulla Creek discharge modelling* (BHP, 2019b). Estimates of flow depth and width indicates that discharge (even at the modelled peak discharge of 90 ML/d) is likely to be confined within the main channel.

BHP has assumed a discharge rate of 75 ML/d, which is the planned capacity of the discharge pipeline from the Jimblebar mine to Caramulla. Together the use of the Low-Loss Scenario and discharge rate of 75 ML/d represents a possible wetting front extent of 34 km from the modelled discharge point (Figure 8), which is 11 km upstream from the Fortescue River confluence. This represents 44% of the length of Caramulla Creek (77 km from its source to the confluence with the Fortescue River). Overtopping of the creek banks is unlikely to occur as the estimated flow width is approximately 20 m, compared to a main channel width of 100 to 200 m (BHP, 2019b).

The modelled peak flow volume of water discharged into Caramulla Creek (90 ML/d) is significantly smaller than the estimated peak flow volume generated by the catchment during natural flood events. As discussed in Section 5.3.2, the 50% AEP for Caramulla Creek catchment (i.e. at the modelled discharge point) is estimated to be 155 m^3/s, compared with the maximum modelled discharge rate of 90 ML/d (which is equivalent to 1 m^3/s).

There would be no impact to identified river pools (Innawally Pool and Jinerabar Pool) from the Project. Innawally Pool is on Jimblebar Creek. The predicted wetting front extent for 75 ML/d (34 km) would not reach Jinerabar Pool under natural no-flow conditions, as it is located on Jimblebar Creek approximately 1.5 km upstream of the confluence (and further than 40 km from the modelled discharge point).

From a cumulative perspective, there is no impact to Caramulla Creek from other developments. At the broader catchment scale, Orebody 31 is authorised under MS1021 to discharge surplus water into Jimblebar Creek, up to 16 km from the Orebody 31 discharge point, which is north of the proposed Development Envelope. The Existing Project is authorised to discharge up to 2.19 GL/a into Copper Creek (a tributary of Jimblebar Creek) and Jimblebar Creek under Part V Licence L5415/1988/9, upstream of Innawally Pool. BHP currently discharges surplus water during maintenance and emergency situations in accordance with the licence. No adverse impacts to Innawally Pool or Jimblebar Creek have been observed as a result of these discharges. There would be no impact on Innawally and Jinerabar pools from the Revised Proposal and other existing operations (Orebody 31). For Jinerabar Pool, this is because it is located approximately 30 km downstream of the authorised wetting front for Orebody 31. For Innawally Pool, BHP proposes to limit discharge along Jimblebar Creek to avoid the wetting front extending to this area (see Section 5.6 and Appendix 2).

Construction of infrastructure

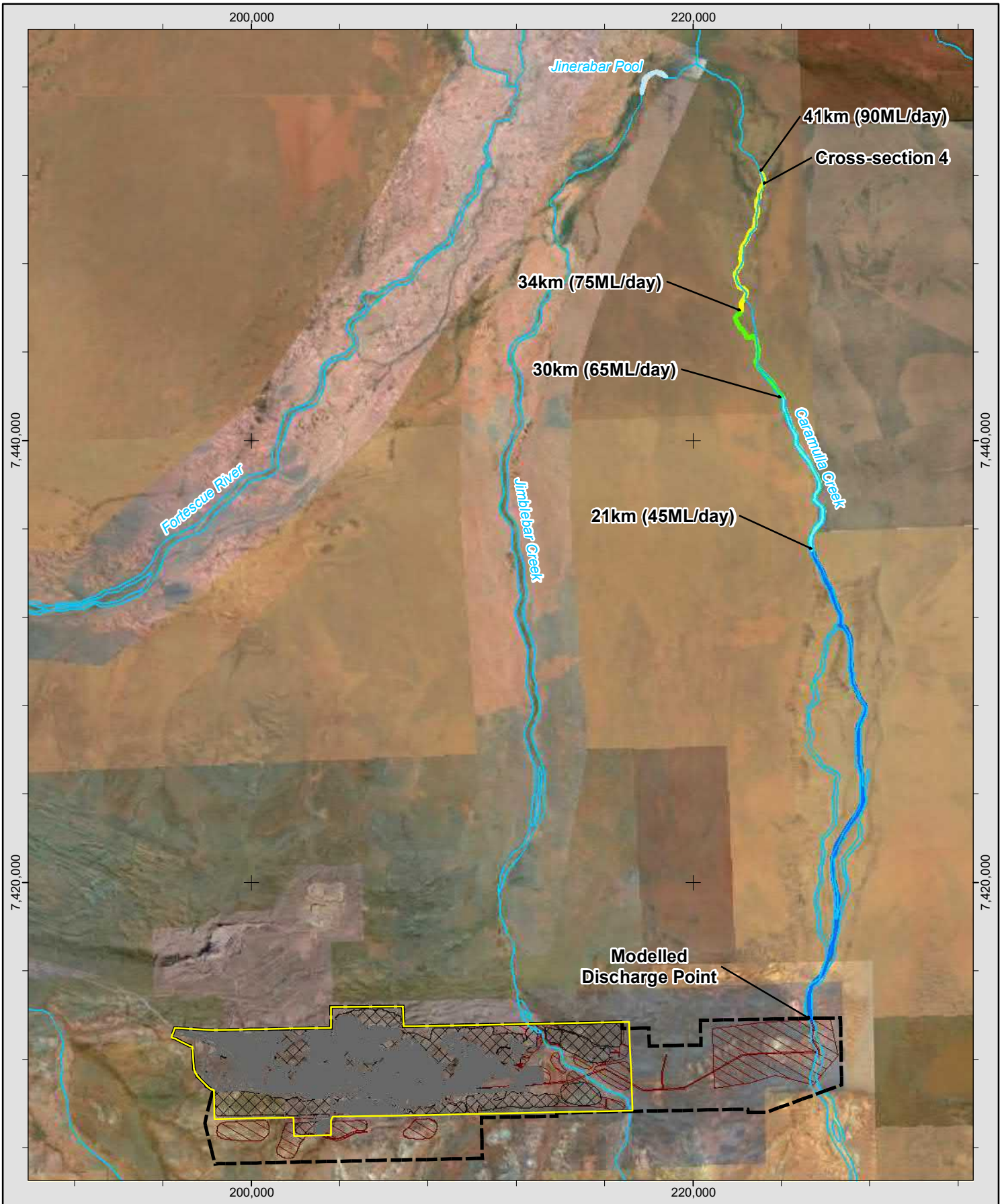
The construction of infrastructure has the potential to change surface water regimes by disrupting natural surface flows and reducing the availability of surface water downstream. The Project includes expansions to existing OSAs, other mining infrastructure at the Jimblebar mine and new OSAs to the south of the existing Jimblebar mine (Figure 3). To construct the new southern OSAs, a minor drainage line diversion is required.

To estimate the run-off loss from the proposed OSAs, BHP assumed a maximum of 50% loss of the pre-development runoff volume. BHP has assumed a 0% run-off loss from the proposed Caramulla MAR, as it is generally considered that overall runoff volumes are effectively unchanged by infrastructure and stockpile areas. For the indicative OSA expansions/developments, the maximum loss of catchment area contributing runoff to Jimblebar Creek has been estimated at 570 ha (5.7 km^2). This corresponds to approximately 0.64% of the total natural catchment of Jimblebar Creek above its junction with the Fortescue River of around 900 km^2.

When combined with the Existing Project, the estimated maximum loss of catchment area contributing runoff to Jimblebar Creek is 2,149 ha (21.49 km^2), which corresponds to approximately 2.38% of the total natural catchment of Jimblebar Creek upstream of the confluence with the Fortescue River. The loss of catchment area contributing runoff to Jimblebar Creek from the approved operations at Orebody 31 is 536 ha (5.4 km^2). The cumulative loss of

catchment (and hence potential decrease in runoff volume) at the Jimblebar Hub (including from Orebody 31 and Orebody 18) is estimated to be up to 3%.

The surplus water pipeline is proposed to extend from the centre to the eastern end of the proposed Development Envelope (Figure 3). Potential impacts to sheet-flow dependent Mulga vegetation from the surplus water pipeline and related infrastructure are discussed under Flora and Vegetation (Section 6).



BHP

Spatial Data - Studies Planning & Access
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JIMBLEBAR OPTIMISATION PROJECT
Low-Loss wetting front estimation

Scale @ A4: 1:230,000	Prepared: J.VIS	Project No: A949/037 Rev 0
Date: 20/08/2019	Checked:	Figure: 8
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Watercourse
- Existing Project Boundary
- Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint

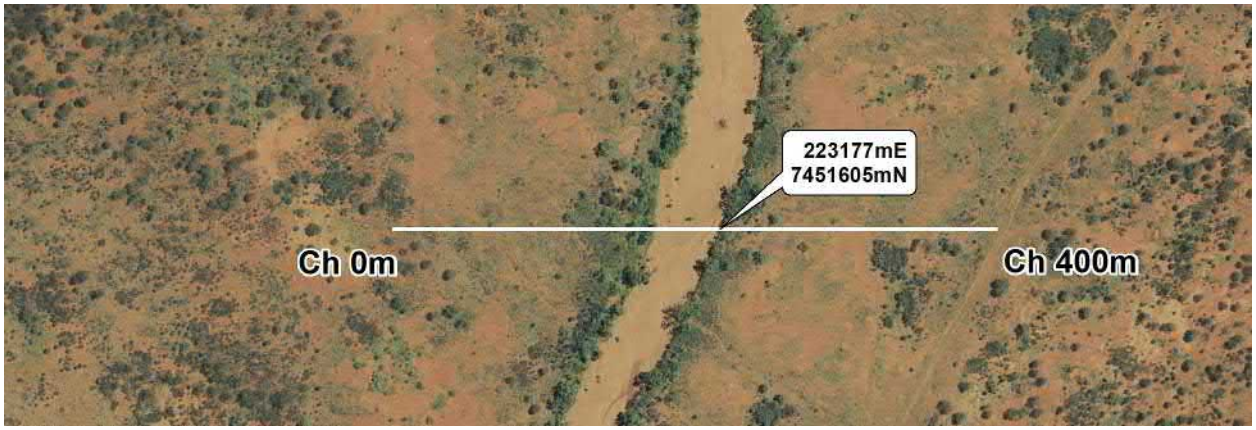
Wetting Front Extent
- 21km (45ML/day)
- 30km (65ML/day)
- 34km (75ML/day)
- 41km (90ML/day)

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_037_E_LowLossWettingFront_Rev0.mxd



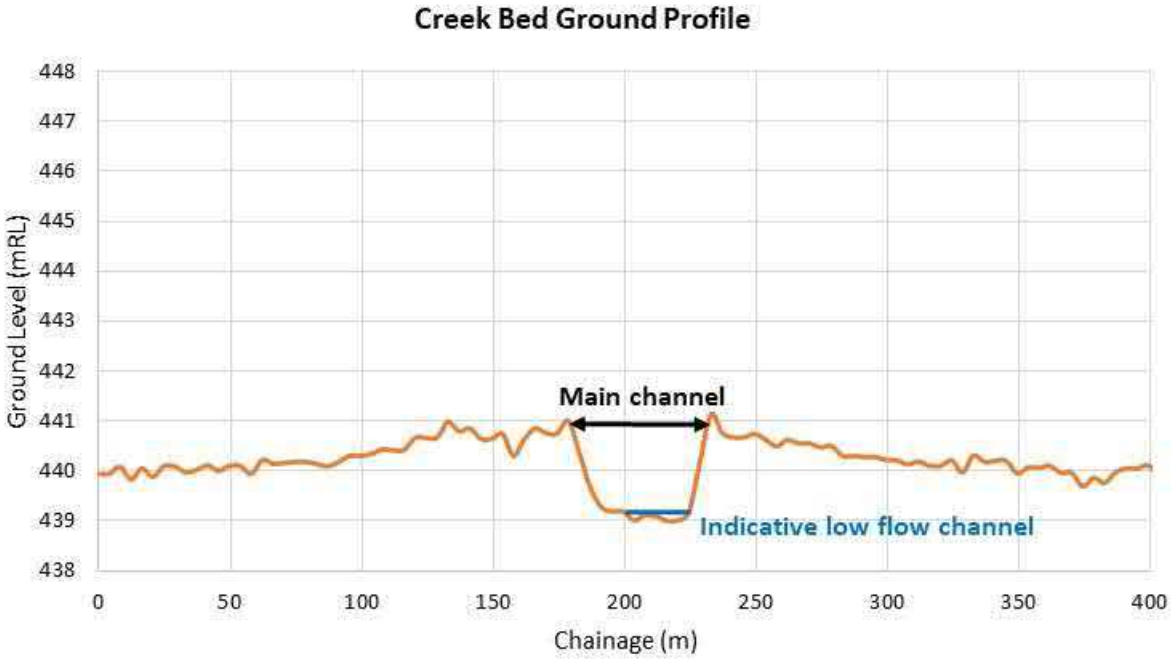


Figure 9: Caramulla Creek – Location 4 cross-section and creek characteristics

5.4.2 Changes to groundwater regimes

MAR – Injection of surplus water

As discussed in Section 2.3.1, one of the surplus management options for the Project is a MAR scheme to inject surplus water into the regional aquifer at Caramulla, east of the current Jimblebar mining areas (Figure 3). Injection of surplus water has the potential to change the groundwater regime by increasing groundwater levels (groundwater mounding).

BHP undertook injection modelling to investigate the likely capacity and groundwater mounding behaviour of the MAR scheme in the Caramulla area. The numerical model used was based on the model developed to support the increase to the RiWI 5C Licence to abstract up to 22 GL/a (BHP Billiton Iron Ore, 2017b). The model has been updated since, but has had no changes to the Caramulla area (BHP, 2019a).

As discussed in Section 5.3.2, recent drilling indicates that there is a clay unit beneath the Tertiary detrital sequence. One of the key controlling factors in terms of the MAR scheme capacity (and uncertainty) appears to be the occurrence of the clay unit in the majority of holes. Uncertainty associated with this includes the clay layer's lateral extent, hydraulic parameters and heterogeneity, and continuity. The response to injection will also be controlled by the hydraulic conductivity of the regional aquifers beneath the clay and the specific yield of the non-clay Tertiary detritals where the confining clay is not present (BHP, 2019a).

Predictive scenarios were constructed based on the following parameters (to account for hydrogeological uncertainty) and 12 scenarios were run for different combinations (BHP, 2019a):

- Three variable hydraulic parameters (hydraulic conductivity, transmissivity and specific yield); one with the high values combined, the other with the low values.
- Three simulated extents of the clay layer (small, large and patchy).
- Two MAR injection rates: 15 ML/d (5.5 GL/a) and 30 ML/d (11 GL/a).

The results of the injection modelling for the 15 ML/d and 30 ML/d scenarios are provided as hydrographs (Figure 10) of groundwater level (head) at a hypothetical observation bore in the regional aquifer beneath the clay in the centre of the proposed MAR borefield area (BHP, 2019a). Shown on the plots are the current head in the MAR borefield area (463 mAHD) and the estimated ground level (520 mAHD), indicating that the current unsaturated thickness is approximately 57 m. Also shown is a conservative threshold of 25 mbgl (495 mAHD) which represents the level below which facultative phreatophyte species (i.e. *Eucalyptus victrix* and *E. camaldulensis*) do not utilise groundwater (see Section 6.4.2).

The results shows that at an injection rate of 30 ML/d, all heads will reach the 495 mAHD level before 10 years and some will reach the ground level before 10 years. At an injection rate of 15 ML/d, some heads will remain below the 495 mAHD level at 10 years and some will reach the ground level before 10 years.

The range of likely outcomes (assuming a mounding threshold of 25 mbgl) are shaded in the graphs. The scenarios correspond to the limit of the expected range, so the most likely result is expected somewhere between them (i.e. in the shaded area). A visual inspection of the plots show that:

- At an injection rate of 15 ML/d, the likelihood of mounding from MAR staying below the 495 mAHD (25 mbgl) threshold is high for the first few years but becomes less than 50% by 10 years of continuous injection.
- At an injection rate of 30 ML/d, the likelihood of mounding from MAR staying below the 495 mAHD threshold is low.

For example, Figure 10 shows that at an injection rate of 30 ML/d for Run 1, the water level would reach the 495 mAHD threshold after approximately 2 years. An example of the predicted mounding in layer 1 (the clay) is shown for Run 1 at 2 years and 10 years in Figure 11. This shows that the head in the clay, if it behaves as assumed

in the modelling, will increase more slowly than the head in the underlying aquifers. If this is the case, the clay water level will not reach the 25 mbgl mounding threshold as rapidly as described above. BHP will further develop the numerical model and calibrate it during the early stages of scheme operation to refine predictions of aquifer response.

Groundwater mounding is likely to preferentially travel west and east away from the injection borefield along the regional dolomite and Tertiary Detrital aquifers. A low permeability clay in the area of injection may act as a confining layer above the regional aquifers. This may inhibit rapid mounding of the water table in the location of injection, depending on the lateral extent and continuity of this layer. To the west, groundwater mounding is unlikely to pass the Central Fault (a flow barrier) which is located roughly 14 km from the injection borefield (western extent of model domain) (Figure 11). To the east, there are indications that another flow barrier is present roughly 15 km to the east of the injection borefield (eastern extent of model domain) (Figure 11). These barriers are considered to be the maximum extent of potential east/west migration of mounding. Mounding is unlikely north and south of the orebody aquifers. In terms of cumulative impacts, groundwater mounding will be reduced by drawdown from dewatering of orebodies to the west. There is no other injection in this part of the aquifer, as injection into South Jimblebar has now ceased.

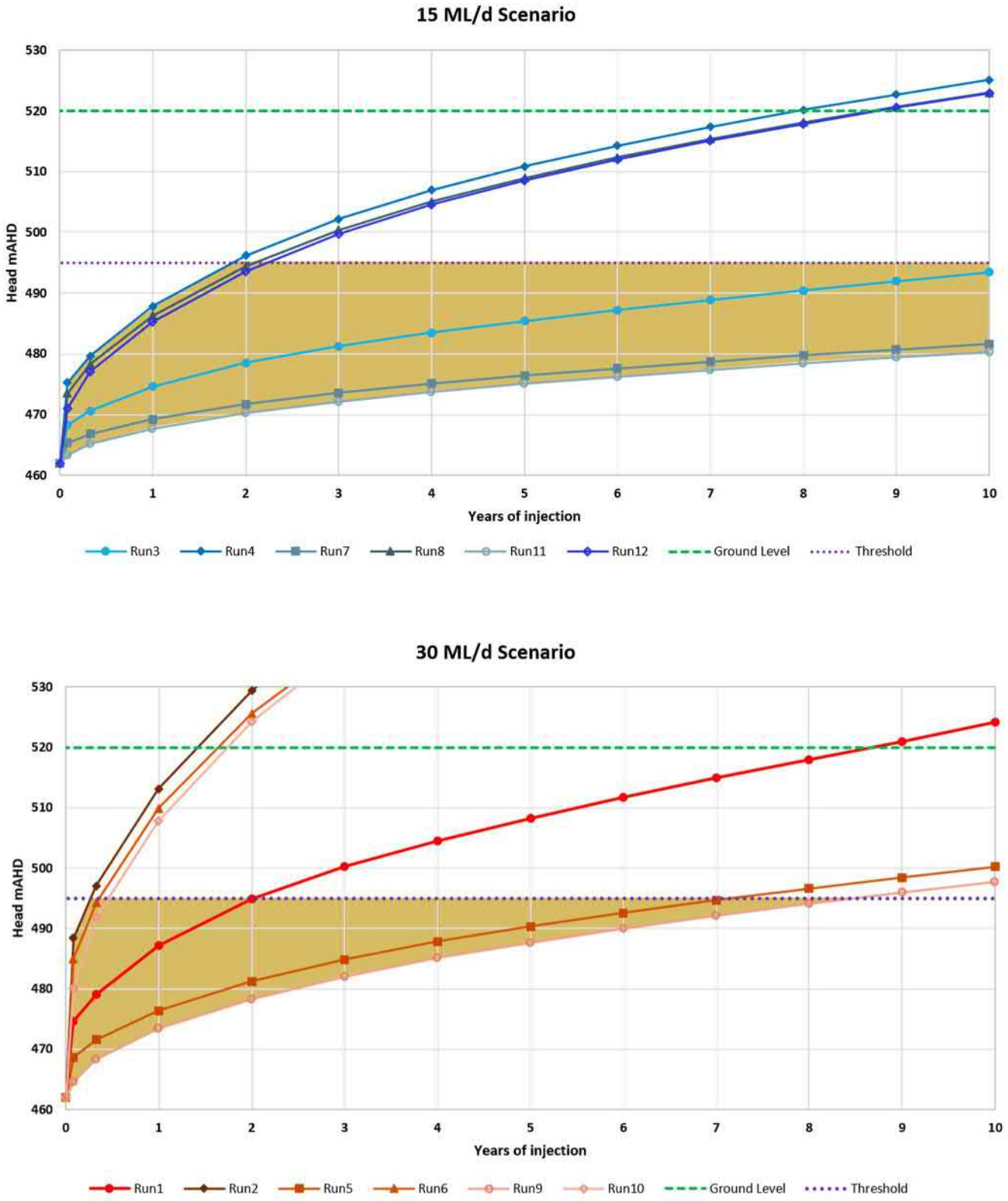
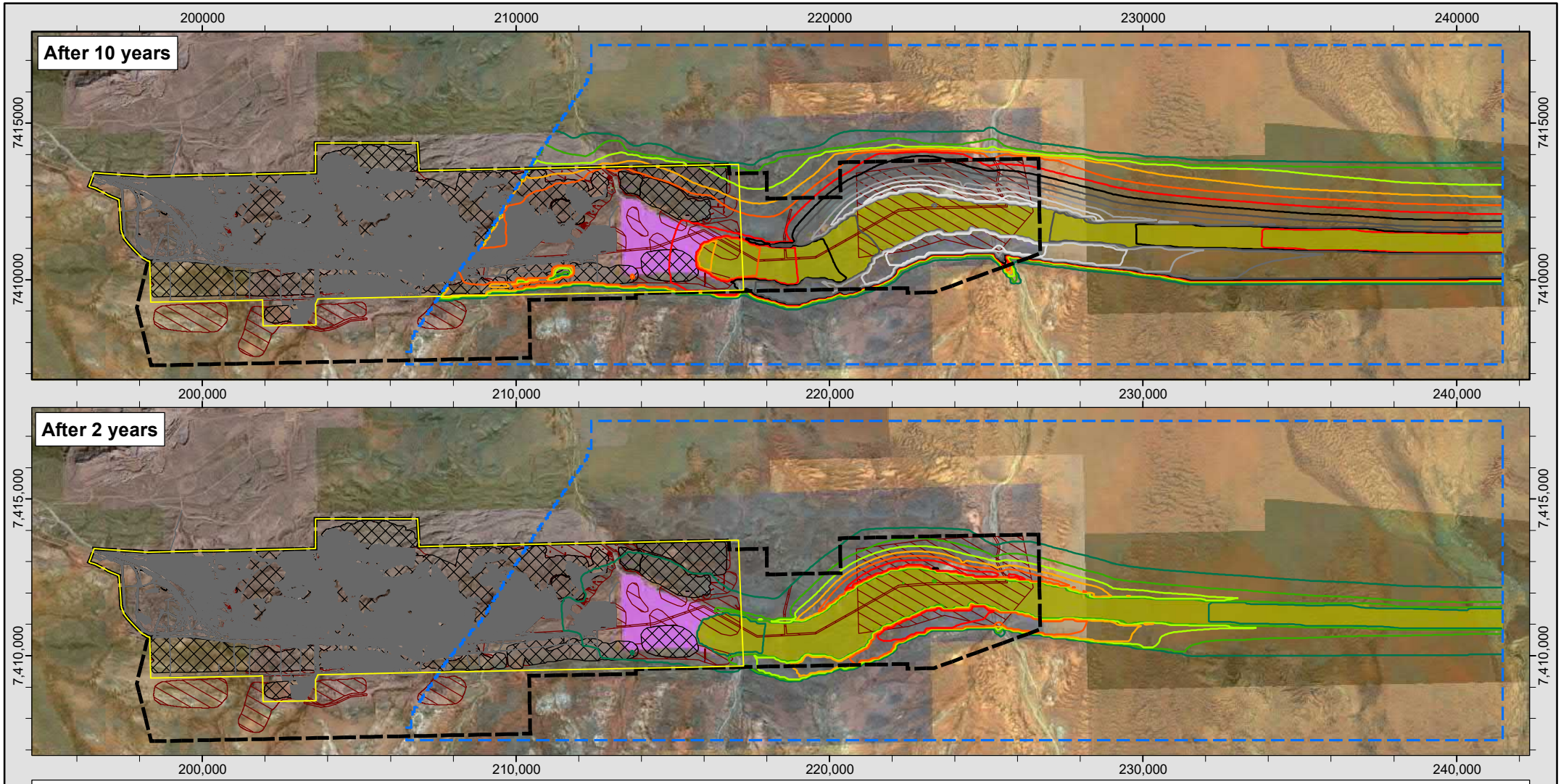


Figure 10: Caramulla injection modelling - predicted groundwater level increase



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JIMBLEBAR OPTIMISATION PROJECT
Groundwater Mounding

Scale @ A4: 1:175,000	Prepared: J. VIS	Project No: A949/055 REV 0
Date: 26/08/2019	Checked:	Figure: 11
Revision: REV 0	Reviewed: ENVIRO. A&I	

Groundwater Head (mAHD)

- 465
- 470
- 475
- 480
- 485
- 490
- 495
- 500
- 505
- 510
- 515
- 520 (Ground level)

- Existing Project Boundary
- Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint
- Groundwater model domain

Model parameter zones

- Clay
- Vuggy Breccia/Tertiary Detritals

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_055_E_GroundwaterInjectionMounding_Rev0.mxd

5.4.3 Changes to surface and groundwater quality

Surface water quality

Surface discharge of surplus dewater has the potential to change the quality of water in the creek if the quality of the water in the dewatered groundwater is different to the creek water quality. As discussed in Section 5.3.2, the water in Caramulla Creek is generally fresh with a pH of 6-8. The groundwater at Jimblebar is also fresh, with a pH between 6.7 and 9.4. Therefore, the quality of surplus dewater discharged to Caramulla Creek would be of similar quality to the natural water quality of the creek.

Alterations to landforms and construction of infrastructure can lead to increased erosion and deposition of sediments in waterways. There is potential for sedimentation from the construction of new and extended OSAs and the proposed diversion of a minor drainage line to the south of the proposed Development Envelope, around new OSAs.

Groundwater quality

MAR has the potential to change the quality of groundwater if the quality of the water in the receiving aquifer is different to the aquifer that is dewatered. As discussed in Section 5.3.2, the water quality of groundwater at Jimblebar is comparable to the groundwater quality at Caramulla.

Changes to groundwater quality may occur where alterations to landforms and construction of infrastructure (including OSAs) expose acidic and/or metalliferous material. The new OSAs to the south of the existing Jimblebar mine will receive waste from South Jimblebar. An assessment of Acid and Metalliferous Drainage (AMD) risk indicated that South Jimblebar was identified as having a low risk of generating AMD (BHP Billiton Iron Ore, 2016a).

5.5 Assessment of impacts

5.5.1 Changes to surface water regimes

As discussed in Section 5.4.1, the predicted wetting front extent from the proposed discharge of surplus water into Caramulla Creek at a rate of 75 ML/d is 34 km. BHP considers that this prediction is conservative, as BHP assumed low infiltration rates (Low-Loss scenario). For any modelled scenario, the predicted wetting front would not reach any identified river pools under natural no-flow conditions. The estimated discharge flow depth (approximately 0.2 m) and width (approximately 20 m) are small compared to the main channel depth (1 m to 2 m) and width (100 m to 200 m), so flow is likely to remain within the main channel. The peak flow rate of water discharged would be much smaller than peak flows generated during natural flood events.

However, as discussed in Section 5.4.1, the wetting front extent is uncertain, due to uncertainty associated with infiltration rates. BHP also recognises that there would be a cumulative impact on the hydraulic regime at the broader scale. The existing discharge in Jimblebar Creek together with the proposed discharge in Caramulla Creek would result in surface water flows during natural no-flow conditions and increased duration of flows. Therefore, BHP considers that the unmitigated impact of surplus water discharge on Caramulla Creek may potentially be significant. To ensure that impacts are not greater than predicted, BHP has proposed management and mitigation measures (see Section 5.6).

As discussed in Section 5.4.1, only a minor drainage line diversion is required and the estimated cumulative decrease in runoff volume is less than 3%, which is within the natural variation of seasonal runoff. Therefore, the disruption to natural surface flows and reduction in the availability of surface water downstream will be minimal. The changes to surface water regimes from the construction of infrastructure are not considered to be significant.

5.5.2 Changes to groundwater regimes

As discussed in Section 5.4.2, the injection modelling results at 15 ML/d and 30 ML/d (i.e. lower than the planned surplus discharge rate of 75 ML/d) show that after 10 years of injection, groundwater levels may rise within 25 mbgl and for some runs may rise to the surface. The results show that while it is difficult to accurately predict the response to injection, groundwater level rise is likely to be within the range of modelled results.

The model results show that after 10 years of injection for Run 1, the lateral extent of groundwater mounding is likely to be limited to within approximately 2 km north and south of the proposed Development Envelope and may extend up to 15 km east of the proposed Development Envelope. There are no cumulative impacts of groundwater mounding as there is no other injection in this part of the aquifer.

The model results show that after 2 years of injection (when the 495 mAHD threshold will be reached for Run 1), the lateral extent of mounding would be much less than after 10 years. Groundwater rise greater than 10 m would be limited to a small portion south of the proposed Development Envelope and would extend approximately 6 km east of the proposed Development Envelope.

There are unlikely to be significant impacts to the regional aquifer itself and there are no water-dependent ecosystems within the predicted mounding zone. However, the potential vertical and lateral extent (to the east) of groundwater mounding has the potential to impact on environmental values that access the unsaturated zone (e.g. facultative phreatophyte species). Therefore, BHP considers that the unmitigated impact of the Project on the regional aquifer system in the Caramulla Valley may potentially be significant.

The modelling results suggest that it is unlikely that the MAR scheme will be able to accept the full planned surplus discharge rate of 75 ML/d and that the creek discharge option may be needed as a complementary option. This will depend on the how much of the surplus water is discharged to Ophthalmia Dam (45 ML/d approved under MS857). Proposed management and mitigation measures for surplus water management are discussed in Section 5.6.

5.5.3 Changes to surface and groundwater quality

AS discussed in Section 5.4.3, only minor alterations to creeks are proposed, including a diversion of a minor drainage line, which will minimise the potential for increased erosion and turbidity and there is a low risk of the OSAs generating AMD. The salinity and pH of the dewatered groundwater from Jimblebar is similar to the receiving environment for surface water discharge and MAR injection (Caramulla Creek and regional aquifer in the Caramulla area). Therefore, there is unlikely to be a significant change to water quality from the Project.

5.5.4 Summary

Table 11 summarises the potential unmitigated impacts from the Project on water values and whether BHP considers that the potential impact is significant. Where an impact (unmitigated) is potentially significant, BHP has proposed specific mitigation measures (Section 5.6).

Table 11: Summary of potential significant impacts on Inland Waters

Potential impact (unmitigated)	Value	Potentially significant
Changes to surface water regimes (direct)	Caramulla Creek	**Yes**
Changes to groundwater regimes (direct)	Regional aquifer in Caramulla area	**Yes**
Changes to water quality (direct)	Caramulla Creek	No
	Regional aquifer in Jimblebar area	No

5.6 Mitigation

5.6.1 Avoid

The Project has been designed to avoid direct impacts to Jinerabar Pool 40 km downstream of the proposed Development Envelope.

For the Revised Proposal, BHP proposes to continue to manage potential impacts to Innawally Pool through the existing Part V licence (and any amendments, if required) and specific management and mitigation measures relating to surplus water discharge in the *Jimblebar Water Management Plan* (BHP, 2019d) (Appendix 17), which includes outcome-based provisions relating to:

- Monitoring of the extent of surplus water discharge in Jimblebar Creek and a trigger and threshold for the extent of surplus water discharge upstream of Innawally Pool.
- Response actions (including modifying the discharge regime or ceasing discharge) and reporting if the trigger and threshold are reached.

BHP considers that with this mitigation there will be no direct impacts to Innawally Pool from surplus water discharge.

5.6.2 Minimise

BHP will design and construct infrastructure according to applicable Australian Standards and standard internal practices, to minimise potential impacts to hydrological regimes and surface and groundwater quality.

The preferred location for the discharge structure for the Caramulla Creek discharge is at a low elevation within the creek, to minimise water turbidity, scouring and erosion occurring from the release of surplus mine dewater into the creek. The discharge structure will nominally consist of perforated polyethylene pipes installed below ground level and covered with rock material to ground level. The structure will reduce the velocity/energy of the discharged water.

Bunding and sedimentation basins will be constructed at the toe of the OSAs to capture runoff and remove sediment prior to discharge of runoff to the environment. Sediment build up in sediment basins and diversions are typically removed after a large storm event or prior to the start of the wet season as part of site maintenance operations.

Consistent with the *Environmental Factor Guideline – Inland Waters* (EPA, 2018f) and the *Western Australian water in mining guideline* (Department of Water, 2013b), BHP's approach to manage surplus dewater is to use surplus mine dewater on-site, then MAR, before disposing of surplus water to waterways. BHP has approval to discharge surplus dewater (up to 45 ML/d or 16.425 GL/a) from Jimblebar to Ophthalmia Dam, which operates as a MAR facility to offset drawdown from the Ophthalmia Borefield. However, BHP recognises the importance of the Ethel Gorge TEC as a sensitive environmental receptor and has proposed additional surplus water management options as part of this Project, to provide flexibility in how it manages the Ophthalmia Dam/ Ethel Gorge system.

As discussed in Section 5.4.1, BHP intends to use controlled creek discharge as an option, to reduce pressure on Ophthalmia Dam, if required, and/or when the Caramulla MAR scheme is unavailable (i.e. during construction, or when the scheme reaches capacity). BHP anticipates that it will take approximately 13 months from approval, for the Caramulla MAR scheme to be operational. During this time, discharge of surplus water to Caramulla Creek may be required. As discussed in Section 5.4.2, conservative modelling based on preliminary drilling information suggests that the MAR scheme may have a capacity of between 15 ML/d and 30 ML/d (equivalent to between 5.5 GL/a and 11 GL/a). The planned capacity of the discharge pipeline from Jimblebar to Caramulla is 75 ML/d (27.4 GL/a). Therefore, creek discharge is likely to be required when the MAR scheme reaches capacity.

As discussed in Section 5.5.1, the unmitigated impact of surplus water discharge on Caramulla Creek may potentially be significant. While BHP has predicted that the wetting front will extend 34 km from the modelled discharge point, there is some uncertainty with the modelling due to uncertainty with infiltration rates along the creek. BHP has proposed specific management and mitigation measures in the *Jimblebar Water Management Plan* (BHP, 2019d)

(Appendix 17) to minimise impacts to Caramulla Creek and ensure they are not greater than predicted. These include outcome-based provisions relating to:

- Monitoring of the extent of surplus water discharge and a trigger and threshold for the extent of surplus water discharge.
- Response actions (including modifying the discharge regime or ceasing discharge) and reporting if the trigger and threshold are reached.

BHP considers that with this mitigation there will be no significant impacts to Caramulla Creek from surplus water discharge. This mitigation will also ensure that there are no impact to Jinerabar Pool from surplus water discharge.

As discussed in Section 5.5.2, groundwater injection will result in groundwater level rise in the aquifer in the Caramulla area that has the potential to impact environmental values that access the unsaturated zone. BHP has proposed specific management and mitigation measures in the *Jimblebar Water Management Plan* (BHP, 2019d) (Appendix 17) to minimise impacts to the hydrologic regime of the regional aquifer in the Caramulla area. These include outcome-based provisions relating to:

- Monitoring of groundwater rise and a trigger and threshold for groundwater level rise.
- Response actions (including modifying the injection regime or ceasing injection) and reporting if the trigger and threshold are reached.

Limiting groundwater level rise to a threshold of 25 mbgl will maintain an approximate minimum thickness of unsaturated zone of 25 m. As shown in Figure 11 (after 2 years), this will also reduce the lateral extent of groundwater mounding. BHP considers that with this mitigation there will be no significant impacts to the regional aquifer from groundwater injection.

BHP proposes that all other water-related monitoring and management relating to this Project and the Revised Proposal will continue to be addressed through the existing approved RiWI 5C groundwater licence (and Operating Strategy) and the EP Act Part V Licence, and any amendments to these approvals, if required.

BHP intends to continue to manage the surplus discharge to Ophthalmia Dam (as approved under MS857) through the *Eastern Pilbara Water Resources Management Plan* (EPWRMP) (BHP, 2018b), which manages surplus water from multiple BHP operations at a regional level. No changes are proposed to the approved EPWRMP (see Appendix 1and Appendix 2 for discussion on the Revised Proposal).

5.6.3 Rehabilitate

Rehabilitation at Jimblebar is addressed in the updated *Jimblebar Mine Closure Plan* (MCP) (BHP, 2019e) (Appendix 16). The MCP covers the Existing Project and BHP revised the 2016 version of the MCP to include this Project (BHP, 2019e).

The MCP continues to address how constructed landforms (principally OSAs) will be constructed and rehabilitated, to ensure they are safe, stable and non-polluting. Although the AMD risk is low at South Jimblebar, the MCP includes potential management strategies and processes for monitoring of risk indicators for AMD.

Management approaches identified in the MCP relating to water for the Project include:

- Design and construct drainage line realignments to achieve comparable hydraulic and geomorphological characteristics to the original systems.
- Design and construct flood protection to reduce the likelihood of creek capture post closure and prevent flood events from impacting the integrity of post-mining landforms.
- Design and construct OSAs to minimise erosion based on waste characteristics and control of surface water.
- Contain Potentially Acid Forming (PAF) material within OSAs to minimise oxidation and the potential to generate AMD.

5.7 Predicted outcome

Following mitigation (Section 5.6), BHP considers that there will not be any significant impacts on Inland Waters values from the Project.

Following the application of the mitigation hierarchy (Section 5.6) and applying the Residual Impact Significance Model in the *WA Offsets Guidelines* (Government of Western Australia, 2014), BHP considers that there is no significant residual impact to Inland Waters from the Project, as there will be no impacts to significant wetlands, waterways and TECs.

Below is a summary of the specific measures that BHP proposes to manage the potential impacts to this factor from the Project so that they would no longer be significant:

- Control the extent of surface water flow in Caramulla Creek from surplus water discharge through the authorised extent in Schedule 1 of the proposed implementation conditions and through measures in the draft *Jimblebar Water Management Plan*.
- Control groundwater level rise in the regional aquifer in the Caramulla area through the authorised extent in Schedule 1 of the proposed implementation conditions and through measures in the draft *Jimblebar Water Management Plan*.
- Continue to implement rehabilitation measures detailed in the *Jimblebar Mine Closure Plan*.

Following the application of the mitigation hierarchy (avoid, minimise, rehabilitate, offset) and BHP's commitment to implement the measures above, BHP considers that the predicted outcome in relation to the EPA's objective for Inland Waters is that hydrological regimes and quality of groundwater and surface water will be maintained so that environmental values are protected.

BHP has proposed authorised extents of proposal elements (wetting front extent and groundwater rise) and conditions relating to Inland Waters (Water Management Plan, Appendix 17), and Rehabilitation and Decommissioning (MCP, Appendix 16) for this Project, to ensure that the proposed measures above are implemented. These are included in the draft set of proposed implementation conditions for the Revised Proposal in Appendix 2. BHP considers that proposed implementation conditions are sufficient to manage the potential impacts of the Project, to meet the EPA's objective for Inland Waters.

6 Flora and Vegetation

6.1 EPA objective

The EPA's objective for Flora and Vegetation is:

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

6.2 Policy and guidance

BHP assessed this environmental factor consistent with the following relevant EPA policies and guidance:

- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2018e);
- *Environmental Factor Guideline - Flora and Vegetation* (EPA, 2016a); and
- *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (EPA, 2016b).

6.3 Receiving environment

6.3.1 Studies and surveys

A total of 27 flora and vegetation surveys have been undertaken wholly or partially within the proposed Development Envelope. These surveys comprise 19 Detailed surveys, four Reconnaissance surveys, three Targeted surveys and one Desktop assessment. A complete list and summary of these surveys is in Appendix 5.

All surveys were completed in accordance with the EPA requirements relevant at the time of surveying (Appendix 5) Additionally, surveys undertaken post-2009 have been undertaken in accordance with BHP's *Vegetation and Flora Survey Procedure* (BHP, 2018c) that was developed with the DBCA to ensure a consistent approach for all surveys undertaken for BHP.

Table 12 summarises the more recent and relevant surveys undertaken within and adjacent to the proposed Development Envelope, to support the assessment of Flora and Vegetation for the Project.

Table 12: Flora and Vegetation – recent studies and surveys

Title	Date	Summary	Appendix
East Jimblebar and Caramulla Flora and Vegetation Survey (Biologic, *in prep*)	Apr 2019	Single season detailed flora and vegetation survey of the eastern Jimblebar and Caramulla areas.	N/A
Caramulla Creek Flora and Vegetation Survey (Astron Environmental Services, 2018)	Oct 2018	Single season reconnaissance flora and vegetation survey of Caramulla Creek.	Appendix 6
Vegetation Survey and Desktop Assessment Caramulla Creek (Onshore Environmental, 2018a)	Jun 2018	Single season reconnaissance vegetation survey of Caramulla Creek.	Appendix 7
Reconnaissance Flora and Vegetation Survey Caramulla (Onshore Environmental, 2018b)	Feb and Jun 2018	Single season reconnaissance flora and vegetation survey of Caramulla area, with follow up targeted survey.	Appendix 8

Title	Date	Summary	Appendix
Shearers West Detailed Vegetation and Flora Survey (Onshore Environmental, 2018c)	May 2018	Single season detailed flora and vegetation survey of Shearers West area (south of Jimblebar).	Appendix 9

In addition to the abovementioned surveys, a regional study to consolidate vegetation mapping within BHP's Pilbara tenements was undertaken to support the assessment of flora and vegetation within the Pilbara: *Consolidated Vegetation Mapping* (Onshore Environmental, 2014a).

BHP considers that the surveys and regional studies meet the relevant EPA guidance and provide adequate survey coverage to support the assessment of flora and vegetation for the Project.

6.3.2 Project setting and environmental values

Vegetation

The Project is located on the boundary between the Pilbara and Gascoyne bioregions as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (DSEWPaC, 2012). The Fortescue Plains subregion (PIL2) and the Hamersley subregion (PIL3) of the Pilbara bioregion fall within the proposed Development Envelope, along with the Augustus subregion (GAS3) of the Gascoyne bioregion (Figure 12).

The Fortescue Plains subregion is described as alluvial plains and river frontage with extensive salt marsh, mulga-bunch grass, and short grass communities on alluvial plains in the east, and deeply incised gorge systems in the western part of the drainage (Kendrick, 2001a). River Gum (*Eucalyptus camaldulensis*) woodlands fringe the drainage lines and it contains the northern limit of Mulga. This subregion also contains an extensive calcrete aquifer (originating within a paleo-drainage valley) that feeds numerous permanent springs in the central Fortescue, supporting large permanent wetlands with extensive stands of River Gum and Cadjeput (*Melaleuca argentea*) woodlands (Kendrick, 2001a).

The Hamersley subregion is described as a mountainous area of Proterozoic sedimentary ranges and plateaux, dissected by gorges (basalt, shale and dolerite) (Kendrick, 2001b). It contains Mulga low woodland over bunch grasses on fine textured soils in valley floors, and *Eucalyptus leucophloia* over *Triodia brizoides* on skeletal soils of the ranges (Kendrick, 2001b).

The Augustus subregion is described as rugged low Proterozoic sedimentary and granite ranges divided by broad flat valleys (Desmond *et al*., 2001). The subregion includes the Narryera Complex and Bryah Basin of the Proterozoic Capricorn Orogen (on northern margin of the Yilgam Craton), as well as the Archaean Marymia and Sylvania Inliers. The Gascoyne River System provides the main drainage of this subregion; it is also the headwaters of the Ashburton River and Fortescue River. There are extensive areas of alluvial valley-fill deposits in this subregion. It contains Mulga woodland with *Triodia* on shallow stony loams on rises, while the shallow earthy loams over hardpan on the plains are covered by Mulga parkland (Desmond *et al*., 2001).

<u>Regional Vegetation Mapping</u>

According to broad scale regional vegetation mapping of the Pilbara, the proposed Development Envelope occurs within the Hamersley Botanical District, which is part of the Eremaean Botanical Province (Beard 1990). The Hamersley Botanical District is dominated by tree and shrub steppe communities consisting mainly of *Eucalyptus* and *Acacia* species; *Triodia pungens* and *Triodia wiseana* and some Mulga (*Acacia aptaneura*) occur within valley areas and short grass plains occur on alluvia.

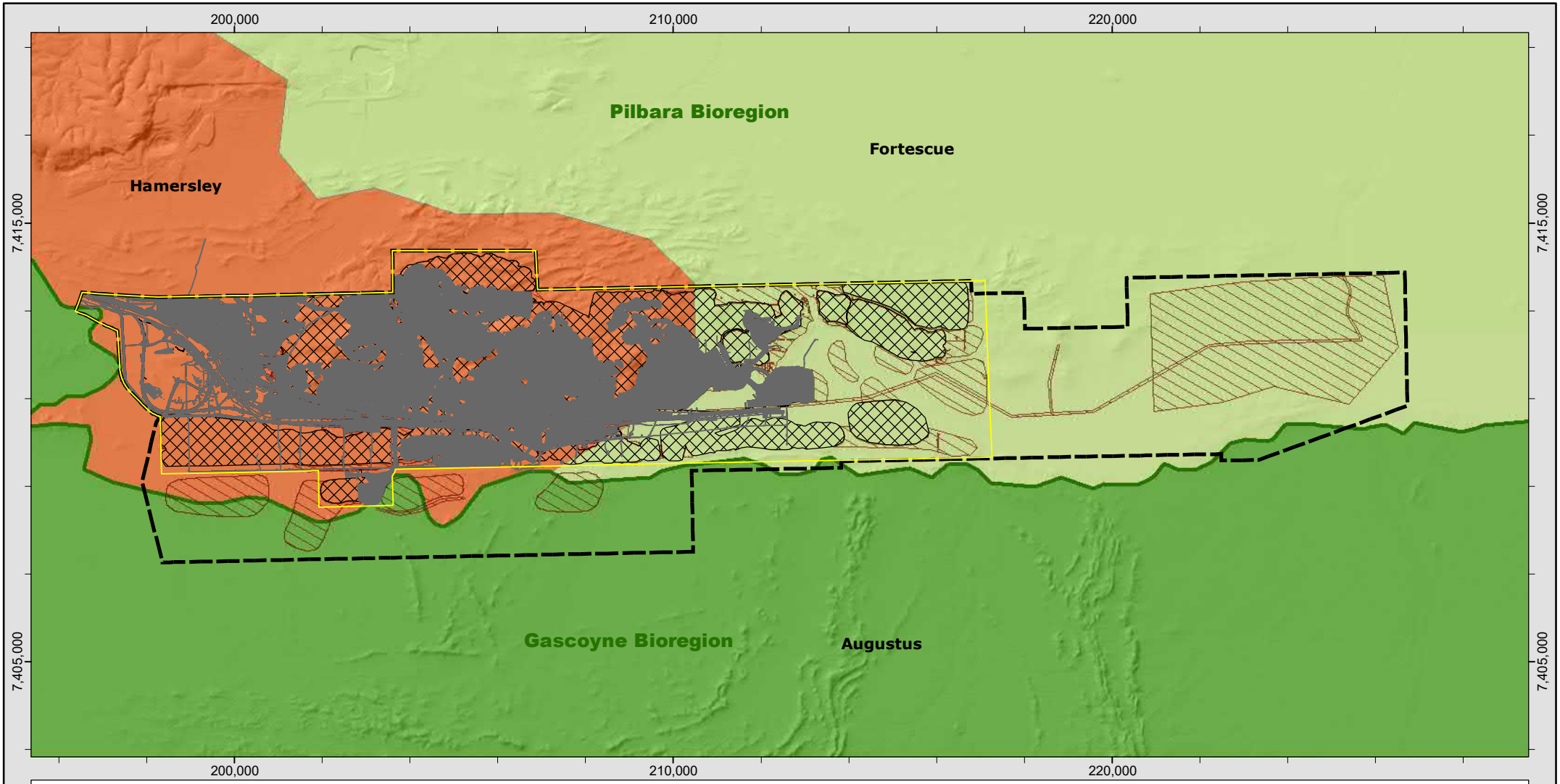
The vegetation of the proposed Development Envelope, as mapped by Beard (1975) and refined by Shepherd *et al.* (2002), is classified as the following five associations occurring across the Pilbara and Gascoyne bioregions (Figure 13):

- Association 18 – low woodland; mulga (*Acacia aneura*);
- Association 28 – open low woodland; mulga;
- Association 29 – sparse low woodland; mulga, discontinuous in scattered groups;
- Association 82 – hummock grasslands, low tree steppe; Snappy gum over *Triodia wiseana*; and
- Association 216 – low woodland; mulga (with spinifex) on rises.

The dominant vegetation associations in the additional area of the proposed Development Envelope (i.e. outside the Existing Project Boundary) are vegetation association 216 within the Gascoyne bioregion (south of the Existing Project Boundary) and vegetation association 29 in the Pilbara bioregion (east of the Existing Project Boundary) (Figure 13).

Conservation reserves

Conservation lands amount to approximately 7% of the total area of the Pilbara bioregion, with the major reserves being Karijini National Park and Millstream-Chichester National Park (BHP Billiton Iron Ore, 2017a). The nearest conservation reserve to the proposed Development Envelope, Karijini National Park, is located approximately 147 km northwest (Figure 1) and will not be impacted from the Project, and therefore will not be discussed further.



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT

Interim Biogeographic Regionalisation for Australia (IBRA) Sub Regions

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/030 REV 0
Date: 20/08/2019	Checked:	Figure: 12
Revision: REV 0	Reviewed: ENVIRO. A&I	

Interim Biogeographic Regionalisation for Australia (IBRA) V6.1

- IBRA Regions

Sub Regions

- Augustus
- Fortescue
- Hamersley

- Existing Project Boundary
- Proposed Development Envelope
- Indicative Previously Assessed Area
- Indicative Cleared Area as at FY2019
- Indicative Footprint

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Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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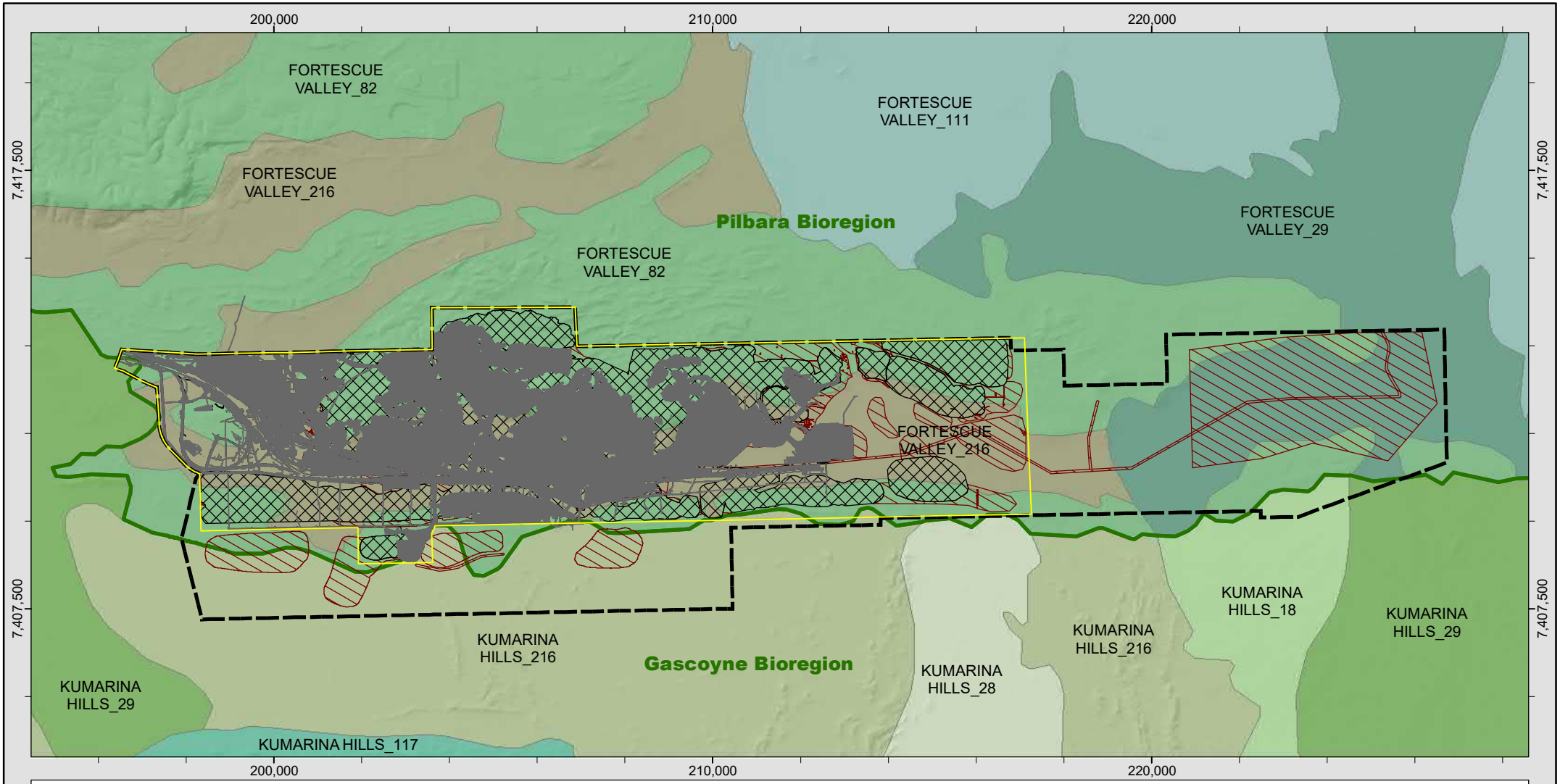

Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Beard Vegetation Associations

Scale @ A4: 1:125,000	Prepared: J.VIS	Project No: A949/044 REV 0
Date: 20/08/2019	Checked:	Figure: 13
Revision: REV 0	Reviewed: ENVIRO. A&I	

Beard's Pre-European Vegetation Classification V6 (Pilbara)

- FORTESCUE VALLEY_111
- FORTESCUE VALLEY_216
- FORTESCUE VALLEY_29
- FORTESCUE VALLEY_82
- KUMARINA HILLS_117
- KUMARINA HILLS_18
- KUMARINA HILLS_216
- KUMARINA HILLS_28
- KUMARINA HILLS_29

- Interim Biogeographic Regionalisation for Australia (IBRA) V6.1 - Regions
- Existing Project Boundary
- Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint

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Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
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Local vegetation

Detailed vegetation association mapping of the proposed Development Envelope has been completed as part of the numerous surveys undertaken over the area. The mapping was reviewed and consolidated across BHP tenements (including most of the proposed Development Envelope), with vegetation association descriptions (and codes) aligned between surveys undertaken across the Pilbara (Onshore Environmental, 2014a), and then regularly revised as new survey data became available.

A total of 58 vegetation associations, classified under 22 broad floristic formations (including one mosaic) on the basis of the dominant vegetation stratum, have been described and mapped within the proposed Development Envelope (Table 13, Figure 14). A portion of the remaining previously assessed area (approved under MS683 in 2005) is unmapped. The mine began operating in 1989, prior to BHP ownership and the introduction of survey requirements.

Table 13: Vegetation associations within the proposed Development Envelope

Broad Floristic Formation	Consolidated Vegetation Code	Vegetation Association Description
Acacia High Open Shrubland	FP ApaAa Erfr TsTp	High Open Shrubland of *Acacia paraneura* and *Acacia aptaneura* over Open Shrubland of *Eremophila fraseri* over Very Open Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* on red clay loam on floodplains and stony plains
	FS AteAsy SeglAsyAte Ercu	High Open Shrubland of *Acacia tetragonophylla* and *Acacia synchronicia* over Open Shrubland of *Senna glutinosa* subsp. *luerssenii*, *Acacia synchronicia* and *Acacia tetragonophylla* over Low Open Shrubland of *Eremophila cuneifolia* on brown silty loam on footslopes
	SP AsyAte SeahSeaoSegl SccnScctSol	High Open Shrubland of *Acacia synchronicia* and *Acacia tetragonophylla* over Open Shrubland of *Senna artemisioides* subsp. *helmsii*, *Senna artemisioides* subsp. *oligophylla* and *Senna glutinosa* subsp. *luerssenii* and Low Open Shrubland of *Sclerolaena cornishiana*, *Sclerolaena cuneata* and *Solanum lasiophyllum* on brown loam on stony plains
Acacia High Shrubland	FP AaAssAanc Tp	High Shrubland of *Acacia aptaneura*, *Acacia sclerosperma* subsp. *sclerosperma* and *Acacia ancistrocarpa* over Very Open Hummock Grassland of *Triodia pungens* on red brown sandy loam on floodplains and medium drainage lines
Acacia Low Woodland	FP AaAprAci RheAa CcChfArin	Low Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia citrinoviridis* over Open Shrubland of *Rhagodia eremaea* and *Acacia aptaneura* over Open Tussock Grassland of **Cenchrus ciliaris*, *Chrysopogon fallax* and *Aristida ingrata* on red loam on floodplains
Acacia Low Open Woodland	ME EvAci AmApyp	Low Open Woodland of *Eucalyptus victrix* and *Acacia citrinoviridis* over High Open Shrubland of *Acacia monticola* and *Acacia pyrifolia* var. *pyrifolia* on brown loamy sand on medium drainage lines
Acacia Low Open Forest	HP Aa AriEuaDib BbChsiEva	Low Open Forest of *Acacia aptaneura* over Open Tussock Grassland of *Aristida inaequiglumis*, *Eulalia aurea* and *Digitaria brownii* over Very Open Herbs of **Bidens bipinnata*, *Cheilanthes sieberi* and *Evolvulus alsinoides* on brown sandy clay loam on hardpan plains
	HS AcaoAaApr ScaErllAb TbrTw	Low Open Forest of *Acacia catenulata* subsp. *occidentalis*, *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Scaevola acacioides*, *Eremophila latrobei* subsp. *latrobei* and *Acacia bivenosa* over Open Hummock Grassland of *Triodia brizoides* and *Triodia wiseana* on red brown clay loam on breakaway scree slopes and steep hill slopes
	ME AaHall ErfrAteAsy AriTtDib	Low Open Forest of *Acacia aptaneura* and *Hakea lorea* subsp. *lorea* over High Open Shrubland of *Eremophila fraseri*, *Acacia tetragonophylla* and *Acacia synchronicia* over Open Tussock Grassland of *Aristida inaequiglumis*, *Themeda triandra* and *Digitaria brownii* on brown loamy sand on medium drainage lines

Broad Floristic Formation	Consolidated Vegetation Code	Vegetation Association Description
Acacia Low Open Forest and *Acacia* Low Open Woodland (Mosaic)	Mosaic HP Aa AriEuaDib BbChsiEva HP AaHallApt ArcAriEnpo SccnSol	Mosaic of Low Open Forest of *Acacia aptaneura* over Open Tussock Grassland of *Aristida inaequiglumis*, *Eulalia aurea* and *Digitaria brownii* over Very Open Herbs of **Bidens bipinnata*, *Cheilanthes sieberi* and *Evolvulus alsinoides* on brown sandy clay loam on hardpan plains and Low Open Woodland of *Acacia aptaneura*, *Hakea lorea* subsp. *lorea* and *Acacia pteraneura* over Very Open Tussock Grassland of *Aristida contorta*, *Aristida inaequiglumis* and *Enneapogon polyphyllus* over Scattered Low Shrubs of *Sclerolaena cornishiana* and *Solanum lasiophyllum* on brown sandy loam on hardpan plains
Acacia Low Open Woodland	FP AaAprCh ErfrAteDope AriChfArc	Low Open Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Corymbia hamersleyana* with Open Shrubland of *Eremophila fraseri*, *Acacia tetragonophylla* and *Dodonaea petiolaris* over Tussock Grassland of *Aristida inaequiglumis*, *Chrysopogon fallax* and *Aristida contorta* on red sandy loam on floodplains
	FP AcaoAaAci AaErfr ArlaArcErer	Low Open Woodland (to Low Woodland) of *Acacia catenulata* subsp. *occidentalis*, *Acacia aptaneura* and *Acacia citrinoviridis* over High Open Shrubland of *Acacia aptaneura* and *Eremophila fraseri* over Very Open (to Open) Tussock Grassland of *Aristida latifolia*, *Aristida contorta* and *Eragrostis eriopoda* on red brown silty clay on floodplains
	HP AaHallApt ArcAriEnpo SccnSol	Low Open Woodland of *Acacia aptaneura*, *Hakea lorea* subsp. *lorea* and *Acacia pteraneura* over Very Open Tussock Grassland of *Aristida contorta*, *Aristida inaequiglumis* and *Enneapogon polyphyllus* over Scattered Low Shrubs of *Sclerolaena cornishiana* and *Solanum lasiophyllum* on brown sandy loam on hardpan plains
Acacia Low Woodland	FP AaAprAcao ErffDopeSie ArcDiaAri	Low Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia catenulata* subsp. *occidentalis* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii*, *Dodonaea petiolaris* and *Sida ectogama* over Open Tussock Grassland of *Aristida contorta*, *Digitaria ammophila* and *Aristida inaequiglumis* on red orange clay loam on floodplains
	FS Apt AteAsyAr Segl	Low Woodland of *Acacia pteraneura* over High Open Shrubland of *Acacia tetragonophylla*, *Acacia synchronicia* and *Acacia rhodophloia* over Open Shrubland of *Senna glutinosa* subsp. *luerssenii* on brown sandy loam on footslopes and low hills
	MA AcpEvAa TtEuaCc EcEv	Low Woodland of *Acacia coriacea* subsp. *pendens*, *Eucalyptus victrix* and *Acacia aptaneura* over Open Tussock Grassland of *Themeda triandra*, *Eulalia aurea* and **Cenchrus ciliaris* with Open Woodland of *Eucalyptus camaldulensis* and *Eucalyptus victrix* on brown sand on major drainage lines
	SA AaAprHall Tb Erff	Low Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Hakea lorea* subsp. *lorea* over Open Hummock Grassland of *Triodia basedowii* with Open Shrubland of *Eremophila forrestii* subsp. *forrestii* on brown loamy sand on plains
Acacia Open Shrubland	SP AaAteSeah AriTrlErer Aa	Open Shrubland of *Acacia aptaneura*, *Acacia tetragonophylla* and *Senna artemisioides* subsp. *helmsii* over Very Open Tussock Grassland of *Aristida inaequiglumis*, *Tripogonella loliiformis* and *Eragrostis eriopoda* with Scattered Low Trees of Acacia aptaneura on brown loamy sand on plains
**Cenchrus* Open Tussock Grassland	FP CcAriTt ChApt AsApyApa	Open Tussock Grassland of **Cenchrus ciliaris*, *Aristida inaequiglumis*, and *Themeda triandra* with Low Open Woodland of *Corymbia hamersleyana* and *Acacia pteraneura* and High Open Shrubland of *Acacia sclerosperma*, *Acacia pyrifolia* and *Acacia pachyacra* on brown loamy sand on floodplains
**Cenchrus* Tussock Grassland	MA CcCs EvAciAthe	Tussock Grassland **Cenchrus ciliaris* and **Cenchrus setiger* with Low Woodland of *Eucalyptus victrix*, *Acacia citrinoviridis* and *Atalaya hemiglauca* on brown sandy loam on major drainage lines and adjacent flood plains

Broad Floristic Formation	Consolidated Vegetation Code	Vegetation Association Description
Corymbia Low Open Woodland	SP ChEoCd AancApaAads TbTscTs	Low Open Woodland of *Corymbia hamersleyana*, *Eucalyptus odontocarpa* and *Corymbia deserticola* subsp. *deserticola* over Open Shrubland of *Acacia ancistrocarpa*, *Acacia pachyacra* and *Acacia adsurgens* over Open Hummock Grassland of *Triodia basedowii, Triodia schinzii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) on red brown sandy loam on footslopes and stony plains
Eremophila High Open Shrubland	SP ErfrAte SeahErfr ArcCyaTrl	High Open Shrubland of *Eremophila fraseri* and *Acacia tetragonophylla* over Open Shrubland of *Senna artemisioides* subsp. *helmsii* and *Eremophila fraseri* over Very Open Tussock Grassland of *Aristida contorta*, *Cymbopogon ambiguus* and *Tripogonella loliiformis* on brown silty loam on stony plains
Eucalyptus Low Woodland	ME TtEuaEte ApypAtpPl EvCh	Tussock Grassland of *Themeda triandra*, *Eulalia aurea* and *Eriachne tenuiculmis* with High Shrubland of *Acacia pyrifolia* var. *pyrifolia*, *Acacia tumida* var. *pilbarensis* and *Petalostylis labicheoides* and Open Woodland of *Eucalyptus victrix* and *Corymbia hamersleyana* on red brown silty loam on medium drainage lines and flood plains
Eucalyptus Woodland	MA EcrEv AciApypMg CcEuaTt	Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Eucalyptus victrix* over High Open Shrubland of *Acacia citrinoviridis*, *Acacia pyrifolia* var. *pyrifolia* and *Melaleuca glomerata* over Tussock Grassland of **Cenchrus ciliaris*, *Eulalia aurea* and *Themeda triandra* on brown clay loam on banks of major drainage lines
	MA EvAciEcr TercCocrApyp CcEuaTt	Woodland of *Eucalyptus victrix*, *Acacia citrinoviridis* and *Eucalyptus camaldulensis* subsp. *refulgens* over Low Open Shrubland of *Tephrosia rosea* var. *clementii*, *Corchorus crozophorifolius* and *Acacia pyrifolia* var. *pyrifolia* over Very Open Tussock Grassland of **Cenchrus ciliaris*, *Eulalia aurea* and *Themeda triandra* on brown loamy sand on channels of major drainage lines
Frankenia Low Open Shrubland	SF Frs Cc	Low Open Shrubland of *Frankenia setosa* with Scattered Tussock Grasses of **Cenchrus ciliaris* on red brown clay loam on saline flats
Frankenia Low Shrubland	FS FrsErcu AaAp AsyAte	Low Shrubland of *Frankenia setosa* and *Eremophila cuneifolia* with Low Open Woodland of *Acacia aptaneura* and *Acacia paraneura* and High Open Shrubland of *Acacia synchronicia* and *Acacia tetragonophylla* on brown silty loam on footslopes
Maireana Low Shrubland	SP MatiErcuSesm ScctScdePth AsyAte	Low Shrubland of *Maireana triptera*, *Eremophila cuneifolia* and *Senna* sp. Meekatharra (E. Bailey 1-26) over Very Open Herbs of *Sclerolaena cuneata*, *Sclerolaena densiflora* and *Ptilotus helipteroides* with Scattered Tall Shrubs of *Acacia synchronicia* and *Acacia tetragonophylla* on brown sandy loam on footslopes
Senna Low Open Shrubland	FP SeahChptErln HlAmac ArcPaclErar	Low Open Shrubland of *Senna artemisioides* subsp. *helmsii*, *Chrysocephalum pterochaetum* and *Eremophila lanceolata* with Scattered Tall Shrubs of *Hakea lorea* var. *lorea* and *Acacia macraneura* over Scattered Tussock Grasses of *Aristida contorta*, *Paspalidium clementii* and *Eriachne aristidea* on red brown sandy loam on floodplains
Themeda Tussock Grassland	FP TtEuaCc ChEx AdAancAmac	Tussock Grassland of *Themeda triandra*, *Eulalia aurea* and **Cenchrus ciliaris* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus xerothermica* over High Open Shrubland of *Acacia dictyophleba*, *Acacia ancistrocarpa* and *Acacia macraneura* on brown silty clay loam on floodplains
Triodia Hummock Grassland	FP Tb AaApr Erff	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* on red sandy loam on floodplains
	FP Tp EtEg AbAancPl	Hummock Grassland of *Triodia pungens* with Very Open Mallee of *Eucalyptus trivalva* and *Eucalyptus gamophylla* over Shrubland of *Acacia bivenosa*, *Acacia ancistrocarpa* and *Petalostylis labicheoides* on red brown loam on unincised drainage tracts on floodplains

Broad Floristic Formation	Consolidated Vegetation Code	Vegetation Association Description
	HS TsTwTp EllCh AhiAaa	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia wiseana* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over Low Open Shrubland of *Acacia hilliana* and *Acacia adoxa* var. *adoxa* on red brown sandy loam on hill slopes
	HS Tw EllChHc AancAbAa	Hummock Grassland of *Triodia wiseana* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia*, *Corymbia hamersleyana* and *Hakea chordophylla* and Open Shrubland of *Acacia ancistrocarpa*, *Acacia bivenosa* and *Acacia aptaneura* on red sandy loam on hill slopes
	MI TsTp AancAmGrwh	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* with Shrubland of *Acacia ancistrocarpa*, *Acacia monticola* and *Grevillea wickhamii* subsp. *hispidula* on brown sandy loam on minor drainage lines
	SA Tb ChEg ScpBeKep	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Corymbia hamersleyana* and *Eucalyptus gamophylla* over Low Open Shrubland of *Scaevola parvifolia*, *Bonamia erecta* and *Kennedia prorepens* on red loamy sand on sand plains
	SP TbTp HlAancAi Ch	Hummock Grassland of *Triodia basedowii* and *Triodia pungens* with High Open Shrubland of *Hakea lorea* subsp. *lorea*, *Acacia ancistrocarpa* and *Acacia inaequilatera* and Scattered Low Trees of *Corymbia hamersleyana* on red brown loamy sand on stony plains
	SP TpTwTs ErfrSegpSeao	Hummock Grassland of *Triodia pungens*, *Triodia wiseana* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Open Shrubland of *Eremophila fraseri*, *Senna glutinosa* subsp. *pruinosa* and *Senna artemisioides* subsp. *oligophylla* on red brown loamy sand on stony plains and hill slopes
	HC TwTbrTp EllCh AmaGrwhAb	Hummock Grassland of *Triodia wiseana*, *Triodia brizoides* and *Triodia pungens* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Corymbia hamersleyana* over High Open Shrubland of *Acacia maitlandii*, *Grevillea wickhamii* subsp. *hispidula* and *Acacia bivenosa* on red brown sandy loam on hill crests and upper hill slopes
	HS Tp ApaAsyApyp Apr	Hummock Grassland of *Triodia pungens* with Scattered Tall Shrubs of *Acacia pachyacra*, *Acacia synchronicia* and *Acacia pyrifolia* var. *pyrifolia* with Scattered Low Trees of *Acacia pruinocarpa* on orange sandy clay loam on hill slopes
	HS TsTbrTb EllAa Ab	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia brizoides* and *Triodia basedowii* with Low Open Woodland of *Eucalyptus leucophloia* subsp. *leucophloia* and *Acacia aptaneura* over Open Shrubland of *Acacia bivenosa* on red loamy sand on hill slopes
	SA Tb AwApaSegl AaCh	Hummock Grassland of *Triodia basedowii* with Open Shrubland of *Acacia wanyu*, *Acacia pachyacra* and *Senna glutinosa* subsp. *luerssenii* and Scattered Low Trees of Acacia a*ptaneura* and *Corymbia hamersleyana* on red loamy sand on stony sand plains
	SA TbTscTp ChHallAa AdAsApa	Open Hummock Grassland of *Triodia basedowii*, *Triodia schinzii* and *Triodia pungens* with Low Open Woodland of *Corymbia hamersleyana*, *Hakea lorea* subsp. *lorea* and *Acacia aptaneura* over High Open Shrubland of *Acacia dictyophleba*, *Acacia sclerosperma* and *Acacia pachyacra* on red sand on sand plains and islands between river channels
	SP TpTb Eg PlAbAanc	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Open Mallee of *Eucalyptus gamophylla* and Shrubland of *Petalostylis labicheoides*, *Acacia bivenosa* and *Acacia ancistrocarpa* on red brown loamy sand on stony plains and footslopes
	FS TvTe Atru AbAanc	Hummock Grassland of *Triodia vanleeuwenii* and *Triodia epactia* mini with High Open Shrubland of *Acacia trudgeniana* and Open Shrubland of *Acacia bivenosa* and *Acacia ancistrocarpa* on brown sandy loam on footslopes

Broad Floristic Formation	Consolidated Vegetation Code	Vegetation Association Description
	HC TpTe Aa ErllAteSegl	Hummock Grassland of *Triodia pungens* or *Triodia epactia* with Low Open Woodland of *Acacia aptaneura* and Open Shrubland of *Eremophila latrobei* subsp. *latrobei*, *Acacia tetragonophylla* and *Senna glutinosa* subsp. *luerssenii* on brown sandy loam on hillcrests
	HC TsTb AprHcGrb SegpPtro	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia brizoides* with High Open Shrubland of *Acacia pruinocarpa*, *Hakea chordophylla* and *Grevillea berryana* and Open Shrubland of *Senna glutinosa* subsp. *pruinosa* and *Ptilotus rotundifolius* on brown sandy loam on hillcrests
	HS TeTv AbSegp AprChAa	Hummock Grassland of *Triodia epactia* and *Triodia vanleeuwenii* with Open Shrubland of *Acacia bivenosa* and *Senna glutinosa* subsp. *pruinosa* and Scattered Low Trees of *Acacia pruinocarpa*, *Corymbia hamersleyana* and *Acacia aptaneura* on brown loamy sand on hillslopes
	HS Ts	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) on red brown sandy loam on hill slopes
	HS TsTp AaAprAci AaErllSegl	Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) and *Triodia pungens* with High Open Shrubland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia citrinoviridis* and Open Shrubland of *Acacia aptaneura*, *Eremophila latrobei* subsp. *latrobei* and *Senna glutinosa* subsp. x *luerssenii* on red loamy sand on upper hill slopes
	SA Tb Hall ApaAmeAanc	Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Hakea lorea* subsp. *lorea* with High Open Shrubland of *Acacia pachyacra*, *Acacia melleodora* and *Acacia ancistrocarpa* on brown loamy sand on sandplains
	SA TpTb Eg AkAs	Hummock Grassland of *Triodia pungens* and *Triodia basedowii* with Open Mallee of *Eucalyptus gamophylla* and High Shrubland of *Acacia kempeana* and *Acacia sclerosperma* on red loamy sand on drainage zones
Triodia Open Hummock Grassland	GG Tp CfFibAcao DopAh	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Corymbia ferriticola*, *Ficus brachypoda* and *Acacia catenulata* subsp. *occidentalis* over High Open Shrubland of *Dodonaea pachyneura* and *Acacia hamersleyensis* on red sandy clay loam in gullies and on breakaway slopes
	HS TbTs AsyAaAte ErcuMagSol	Open Hummock Grassland of *Triodia basedowii* and *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835) with Open Shrubland of *Acacia synchronicia*, *Acacia aptaneura* and *Acacia tetragonophylla* over Low Open Shrubland of *Eremophila cuneifolia*, *Maireana georgei* and *Solanum lasiophyllum* on red sandy loam on floodplains and lower hill slopes
	HS Tp AaApr ErfrAmarSegl	Open Hummock Grassland of *Triodia pungens* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Eremophila fraseri*, *Acacia marramamba* and *Senna glutinosa* subsp. x *luerssenii* on red brown loam on undulating hills
	HS TsTpTb AaAprAw AteEreErll	Open Hummock Grassland of *Triodia* sp. Shovelanna Hill (S. van Leeuwen 3835), *Triodia pungens* and *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia wanyu* and Open Shrubland of *Acacia tetragonophylla*, *Eremophila exilifolia* and *Eremophila latrobei* subsp. *latrobei* on red sandy loam on hill slopes
	HS TvTaTp AwAsyAte Ercu	Open Hummock Grassland of *Triodia vanleeuwenii*, *Triodia angusta* and *Triodia pungens* with High Open Shrubland of *Acacia wanyu*, *Acacia synchronicia* and *Acacia tetragonophylla* and Low Open Shrubland of Eremophila cuneifolia on brown sandy loam on hillslopes
	SP Tl AancApa ApAprCh	Open Hummock Grassland of *Triodia lanigera* with Open Shrubland of *Acacia ancistrocarpa* and *Acacia pachyacra* and Scattered Low Trees of *Acacia paraneura*, *Acacia pruinocarpa* and *Corymbia hamersleyana* on red sandy loam on stony plains

Recent detailed surveying and mapping across the Caramulla area was undertaken (Biologic, in prep) which identified two vegetation associations as being sheetflow dependent, occurring within the additional area of the proposed Development Envelope and the Indicative Footprint. The mapping for these units was unavailable during assessment:

- Low open woodland of *Acacia pteraneura, Acacia catenulata* subsp. *occidentalis* and *Acacia pruinocarpa* over open hummock grassland of *Triodia basedowii* and *Triodia vanleeuwenii* with open shrubland of *Dodonaea petiolaris*, Sida ectogama and *Eremophila forrestii* on red silty loams on stony plains.
- Low open woodland of *Acacia aptaneura, Acacia pteraneura* and *Corymbia deserticola* subsp. *deserticola* over open shrubland of *Senna artemisioides* subsp. *oligophylla, Eremophila margarethae* and *Eremophila fraseri* over very open hummock grassland of *Triodia basedowii* on red loamy sand on hardpan plains and sand plains.

The vegetation association mapping in Table 13 and Figure 14, and in the sheetflow dependent mulga map (Figure 15) identify the associations for which the assessment has been undertaken. The associations mapped as FP AaAprAci RheAa CcChfArin and FP Tb AsApr Erff and are dominated by Mulga (*Acacia aptaneura*) and occur on sections of floodplains where the slope of the landscape produces a sheetflow of surface water, resulting in a patterned sequence of alternating grove and inter-groves.

- Association FP AaAprAci RheAa CcChfArin – Low Woodland of *Acacia aptaneura*, *Acacia pruinocarpa* and *Acacia citrinoviridis* over Open Shrubland of *Rhagodia eremaea* and *Acacia aptaneura* over Open Tussock Grassland of **Cenchrus ciliaris*, *Chrysopogon fallax* and *Aristida ingrata* on red loam on floodplains; and
- Association FP Tb AaApr Erff – Hummock Grassland of *Triodia basedowii* with Low Open Woodland of *Acacia aptaneura* and *Acacia pruinocarpa* over Open Shrubland of *Eremophila forrestii* subsp. *forrestii* on red sandy loam on floodplains.

Targeted surveying and mapping of the riparian vegetation along Caramulla Creek was undertaken by Onshore Environmental (2018a) and Astron Environmental Services (2018). The riparian vegetation along the main channel of the creek is characterised by *Eucalyptus camaldulensis* subsp. *refulgens* low open woodland over *Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* shrubs with scattered tussock grassland of **Cenchrus ciliaris* (Buffel Grass). The adjacent banks are dominated by tussock grasslands of **Cenchrus ciliaris* with low open woodland of *Corymbia hamersleyana.*

The detailed vegetation associations mapped along Caramulla Creek (Figure 16) are:

Main drainage channel:

- Association MA Mg AcpAci ThaEuaCc – High Shrubland of *Melaleuca glomerata* with Low Open Woodland of *Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* and Very Open Tussock Grassland of *Themeda avenacea*, *Eulalia aurea* and **Cenchrus ciliaris*;
- Association MA Ecr EcrAciAcp MgApy – Open Woodland of *Eucalyptus camaldulensis* subsp. *refulgens* over Low Open Woodland of *Eucalyptus camaldulensis* subsp. *refulgens*, *Acacia coriacea* subsp. *pendens* and *Acacia citrinoviridis* over High Open Shrubland of *Melaleuca glomerata* and *Acacia pyrifolia*;
- Association MA ApyPlMg EcrAciAcp CyaEuaCc – High Open Shrubland of *Acacia pyrifolia*, *Petalostylis labicheoides* and *Melaleuca glomerata* with Scattered Low Trees of *Eucalyptus camaldulensis* subsp. *refulgens*, *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* and Scattered Tussock Grasses of *Cymbopogon ambiguus*, *Eulalia aurea* and **Cenchrus ciliaris*;
- Association MA AciAcp CcCs MgAmac – Low Open Forest of *Acacia citrinoviridis* and *Acacia coriacea* subsp. *pendens* with Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and High Open Shrubland of *Melaleuca glomerata* and *Acacia macraneura*;

- Association MA Acp AciMg CcEua – Low open woodland of *Acacia coriacea* subsp. *pendens* over tall open shrubland of *Acacia citrinoviridis* and *Melaleuca glomerata* over very open tussock grassland of **Cenchrus ciliaris* and *Eulalia aurea*;
- Association MA Ecr Apy ChfEau Aci – Low open woodland of *Eucalyptus camaldulensis* subsp. *refulgens*, over open shrubland of *Acacia pyrifolia* var. *morrisonii* over very open tussock grassland of *Chrysopogon fallax* and *Eulalia aurea* with scattered tall shrubs of *Acacia citrinoviridis*; and
- Association MA EcrAcp MgAci CcChfEua – Low open woodland of *Eucalyptus camaldulensis* subsp. *refulgens* and *Acacia coriacea* subsp. *pendens* over tall open shrubland of *Melaleuca glomerata* and *Acacia citrinoviridis* over very open tussock grassland of **Cenchrus ciliaris*, *Chrysopogon fallax* and *Eulalia aurea*.

Adjacent banks:

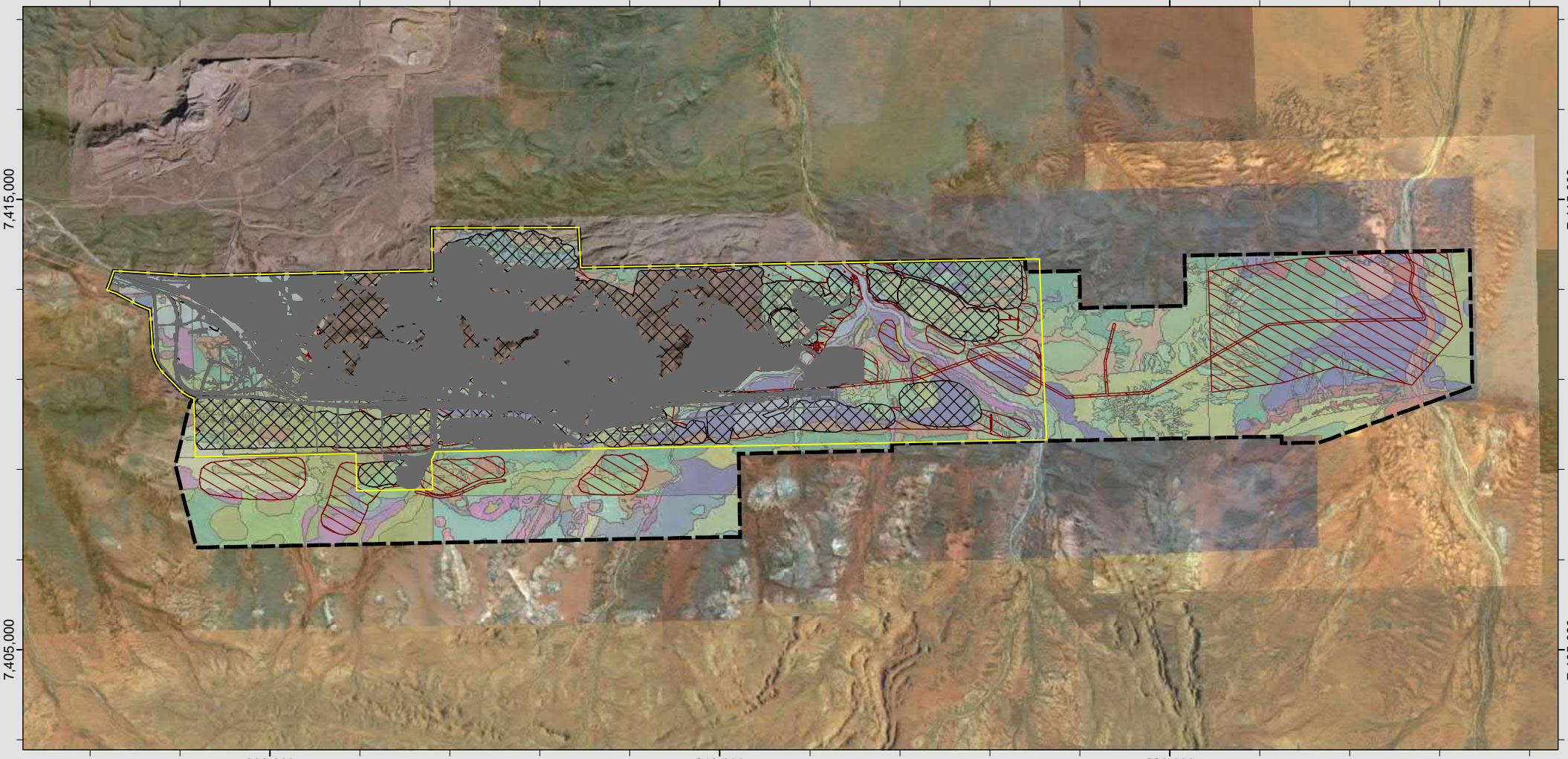
- Association FP CcCsChf ChCoasHall AdAs – Tussock Grassland of **Cenchrus ciliaris* and **Cenchrus setiger* and *Chrysopogon fallax* with Low Open Woodland of *Corymbia hamersleyana*, *Corymbia aspera* and *Hakea lorea* subsp. *lorea* and High Open Shrubland of *Acacia dictyophleba* and *Acacia sclerosperma*;
- Association FP CcCsEua AciAmacAw – Tussock Grassland of **Cenchrus ciliaris*, **Cenchrus setiger* and *Eulalia aurea* with High Shrubland of *Acacia citrinoviridis*, *Acacia macraneura* and *Acacia wanyu* and Low Open Woodland of *Acacia citrinoviridis*, *Corymbia hamersleyana* and *Acacia aptaneura*;
- Association FP CcCsTha AciAaCh As – Tussock Grassland of **Cenchrus ciliaris*, **Cenchrus setiger* and *Themeda avenacea* with Low Woodland of *Acacia citrinoviridis*, *Acacia aptaneura* and *Corymbia hamersleyana* with High Open Shrubland of *Acacia sclerosperma*; and
- Association MA Cc ChEcrAan Aci – Open tussock grassland of **Cenchrus ciliaris* with low open woodland of *Corymbia hamersleyana*, and/or *Eucalyptus camaldulensis* subsp. *refulgens* and *Acacia aneura* over tall open shrubland of *Acacia citrinoviridis*.

Threatened and Priority Ecological Communities

No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) have been recorded from within or adjacent, to the proposed Development Envelope. The nearest TEC is the Ethel Gorge TEC, with the buffer of this TEC occurring 10.5 km west of the proposed Development Envelope.

Vegetation condition

The mapped vegetation condition of the proposed Development Envelope (Figure 17) is based on the survey data from the most recent surveys undertaken for the area. The vegetation condition mapping data and descriptions for each survey were reviewed to align the condition scale with that described in the EPA's Technical Guidance (EPA, 2016b). Poorer vegetation condition within the proposed Development Envelope is primarily related to the Existing Project, and the occurrence of cattle grazing and weed species. As previously discussed, the unmapped area corresponds to the historical mining area, which commenced prior to the introduction of survey requirements.



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Vegetation Association Mapping

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/47 REV 0
Date: 26/08/2019	Checked:	Figure: 14
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Existing Project Boundary
- Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_047_E_VegetationMapping_Rev0.mxd

Vegetation Association

Cleared

Degraded

High Open Shrubland of Acacia paraneura and Acacia aptaneura over Open Shrubland of Eremophila fraseri over Very Open Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) and Triodia pungens on red clay loam on floodplains and stony plains

High Open Shrubland of Acacia synchronicia and Acacia tetragonophylla over Open Shrubland of Senna artemisioides subsp. helmsii, Senna artemisioides subsp. oligophylla and Senna glutinosa subsp. luerssenii and Low Open Shrubland of Sclerolaena cornishiana, Sclerolaena cuneata and Solanum lasiophyllum on brown loam on stony plains

High Open Shrubland of Acacia tetragonophylla and Acacia synchronicia over Open Shrubland of Senna glutinosa subsp. luerssenii, Acacia synchronicia and Acacia tetragonophylla over Low Open Shrubland of Eremophila cuneifolia on brown silty loam on footslopes

High Open Shrubland of Eremophila fraseri and Acacia tetragonophylla over Open Shrubland of Senna artemisioides subsp. helmsii and Eremophila fraseri over Very Open Tussock Grassland of Aristida contorta, Cymbopogon ambiguus and Tripogonella loliiformis on brown silty loam on stony plains

High Shrubland of Acacia aptaneura, Acacia sclerosperma subsp. sclerosperma and Acacia ancistrocarpa over Very Open Hummock Grassland of Triodia pungens on red brown sandy loam on floodplains and medium drainage lines

Hummock Grassland of Triodia basedowii and Triodia pungens with High Open Shrubland of Hakea lorea subsp. lorea, Acacia ancistrocarpa and Acacia inaequilatera and Scattered Low Trees of Corymbia hamersleyana on red brown loamy sand on stony plains

Hummock Grassland of Triodia basedowii with Low Open Woodland of Acacia aptaneura and Acacia pruinocarpa over Open Shrubland of Eremophila forrestii subsp. forrestii on red sandy loam on floodplains

Hummock Grassland of Triodia basedowii with Low Open Woodland of Corymbia hamersleyana and Eucalyptus gamophylla over Low Open Shrubland of Scaevola parvifolia, Bonamia erecta and Kennedia prorepens on red loamy sand on sand plains

Hummock Grassland of Triodia basedowii with Low Open Woodland of Hakea lorea subsp. lorea with High Open Shrubland of Acacia pachyacra, Acacia melleodora and Acacia ancistrocarpa on brown loamy sand on sandplains

Hummock Grassland of Triodia basedowii with Open Shrubland of Acacia wanyu, Acacia pachyacra and Senna glutinosa subsp. luerssenii and Scattered Low Trees of Acacia aptaneura and Corymbia hamersleyana on red loamy sand on stony sand plains

Hummock Grassland of Triodia epactia and Triodia vanleeuwenii with Open Shrubland of Acacia bivenosa and Senna glutinosa subsp. pruinosa and Scattered Low Trees of Acacia pruinocarpa, Corymbia hamersleyana and Acacia aptaneura on brown loamy sand on hill

Hummock Grassland of Triodia pungens and Triodia basedowii with Open Mallee of Eucalyptus gamophylla and High Shrubland of Acacia kempeana and Acacia sclerosperma on red loamy sand on drainage zones

Hummock Grassland of Triodia pungens and Triodia basedowii with Open Mallee of Eucalyptus gamophylla and Shrubland of Petalostylis labicheoides, Acacia bivenosa and Acacia ancistrocarpa on red brown loamy sand on stony plains and footslopes

Hummock Grassland of Triodia pungens or Triodia epactia with Low Open Woodland of Acacia aptaneura and Open Shrubland of Eremophila latrobei subsp. latrobei, Acacia tetragonophylla and Senna glutinosa subsp. luerssenii on brown sandy loam on hillcrests

Hummock Grassland of Triodia pungens with Scattered Tall Shrubs of Acacia pachyacra, Acacia synchronicia and Acacia pyrifolia var. pyrifolia with Scattered Low Trees of Acacia pruinocarpa on orange sandy clay loam on hill slopes

Hummock Grassland of Triodia pungens with Very Open Mallee of Eucalyptus trivalva and Eucalyptus gamophylla over Shrubland of Acacia bivenosa, Acacia ancistrocarpa and Petalostylis labicheoides on red brown loam on uninsised drainage tracts on floodplains

Hummock Grassland of Triodia pungens, Triodia wiseana and Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) with Open Shrubland of Eremophila fraseri, Senna glutinosa subsp. pruinosa and Senna artemisioides subsp. oligophylla on red brown loamy sand on stony plains and hill slopes

Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) and Triodia pungens with Shrubland of Acacia ancistrocarpa, Acacia monticola and Grevillea wickhamii subsp. hispidula on brown sandy loam on minor drainage lines

Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) on red brown sandy loam on hill slopes

Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) and Triodia brizoides with High Open Shrubland of Acacia pruinocarpa, Hakea chordophylla and Grevillea berryana and Open Shrubland of Senna glutinosa subsp. pruinosa and Ptilotus rotundifolius on brown sandy loam on hillcrests

Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) and Triodia pungens with High Open Shrubland of Acacia aptaneura, Acacia pruinocarpa and Acacia citrinoviridis and Open Shrubland of Acacia aptaneura, Eremophila latrobei subsp. latrobei and Senna glutinosa subsp. x luerssenii on red loamy sand on upper hill slopes

Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835), Triodia brizoides and Triodia basedowii with Low Open Woodland of Eucalyptus leucophloia subsp. leucophloia and Acacia aptaneura over Open Shrubland of Acacia bivenosa on red loamy sand on hill slopes

Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835), Triodia wiseana and Triodia pungens with Low Open Woodland of Eucalyptus leucophloia subsp. leucophloia and Corymbia hamersleyana over Low Open Shrubland of Acacia hilliana and Acacia adoxa var. adoxa on red brown sandy loam on hill slopes

Hummock Grassland of Triodia vanleeuwenii and Triodia epactia with High Open Shrubland of Acacia trudgeniana and Open Shrubland of Acacia bivenosa and Acacia ancistrocarpa on brown sandy loam on footslopes

Hummock Grassland of Triodia wiseana with Low Open Woodland of Eucalyptus leucophloia subsp. leucophloia, Corymbia hamersleyana and Hakea chordophylla and Open Shrubland of Acacia ancistrocarpa, Acacia bivenosa and Acacia aptaneura on red sandy loam on hill slopes

Hummock Grassland of Triodia wiseana, Triodia brizoides and Triodia pungens with Low Open Woodland of Eucalyptus leucophloia subsp. leucophloia and Corymbia hamersleyana over High Open Shrubland of Acacia maitlandii, Grevilllea wickhamii subsp. hispidula and Acacia bivenosa on red brown sandy loam on hill crests and upper hill slopes

Low Open Forest of Acacia aptaneura and Hakea lorea subsp. lorea over High Open Shrubland of Eremophila fraseri, Acacia tetragonophylla and Acacia synchronicia over Open Tussock Grassland of Aristida inaequiglumis, Themeda triandra and Digitaria brownii on brown loamy sand on medium drainage lines

Low Open Forest of Acacia aptaneura over Open Tussock Grassland of Aristida inaequiglumis, Eulalia aurea and Digitaria brownii over Very Open Herbs of *Bidens bipinnata, Cheilanthes sieberi and Evolvulus alsinoides on brown sandy clay loam on hardpan plains

Low Open Forest of Acacia catenulata subsp. occidentalis, Acacia aptaneura and Acacia pruinocarpa over Open Shrubland of Scaevola acacioides, Eremophila latrobei subsp. latrobei and Acacia bivenosa over Open Hummock Grassland of Triodia brizoides and Triodia wiseana on red brown clay loam on breakaway scree slopes and steep hill slopes

Low Open Shrubland of Senna artemisioides subsp. helmsii, Chrysocephalum pterochaetum and Eremophila lanceolata with Scattered Tall Shrubs of Hakea lorea var. lorea and Acacia macraneura over Scattered Tussock Grasses of Aristida contorta, Paspalidium clementii and Eriachne aristidea on red brown sandy loam on floodplains

Low Open Woodland (to Low Woodland) of Acacia catenulata subsp. occidentalis, Acacia aptaneura and Acacia citrinoviridis over High Open Shrubland of Acacia aptaneura and Eremophila fraseri over Very Open (to Open) Tussock Grassland of Aristida latifolia, Aristida contorta and Eragrostis eriopoda on red brown silty clay on floodplains

Low Open Woodland of Acacia aptaneura, Acacia pruinocarpa and Corymbia hamersleyana with Open Shrubland of Eremophila fraseri, Acacia tetragonophylla and Dodonea petiolaris over Tussock Grassland of Aristida inaequiglumis, Chrysopogon fallax and Aristida contorta on red sandy loam on floodplains

Low Open Woodland of Acacia aptaneura, Hakea lorea subsp. lorea and Acacia pteraneura over Very Open Tussock Grassland of Aristida contorta, Aristida inaequiglumis and Enneapogon polyphyllus over Scattered Low Shrubs of Sclerolaena cornishiana and Solanum lasiophyllum on brown sandy loam on hardpan plains

Low Open Woodland of Corymbia hamersleyana, Eucalyptus odontocarpa and Corymbia dereticola subsp. dereticola over Open Shrubland of Acacia ancistrocarpa, Acacia pachyacra and Acacia adsurgens over Open Hummock Grassland of Triodia basedowii, Triodia schinzii and Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) on red brown sandy loam on footslopes and stony plains

Low Open Woodland of Eucalyptus victrix and Acacia citrinoviridis over High Open Shubland of Acacia monticola and Acacia pyrifolia var. pyrifolia on brown loamy sand on medium drainage lines

Low Shrubland of Frankenia setosa and Eremophila cuneifolia with Low Open Woodland of Acacia aptaneura and Acacia paraneura and High Open Shrubland of Acacia synchronicia and Acacia tetragonophylla on brown silty loam on footslopes

Low Shrubland of Maireana triptera, Eremophila cuneifolia and Senna sp. Meekatharra (E. Bailey 1-26) over Very Open Herbs of Sclerolaena cuneata, Sclerolaena densiflora and Ptilotus helipteroides with Scattered Tall Shrubs of Acacia synchronicia and Acacia tetragonophylla on brown sandy loam on footslopes

Low Woodland of Acacia aptaneura, Acacia pruinocarpa and Acacia catenulata subsp. occidentalis over Open Shrubland of Eremophila forrestii subsp. forrestii, Dodonaea petiolaris and Sida ectogama over Open Tussock Grassland of Aristida contorta, Digitaria ammophila and Aristida inaequiglumis on red orange clay loam on floodplains

Low Woodland of Acacia aptaneura, Acacia pruinocarpa and Acacia citrinoviridis over Open Shrubland of Rhagodia eremaea and Acacia aptaneura over Open Tussock Grassland of *Cenchrus ciliaris, Chrysopogon fallax and Aristida ingrata on red loam on floodplains

Low Woodland of Acacia aptaneura, Acacia pruinocarpa and Hakea lorea subsp. lorea over Open Hummock Grassland of Triodia basedowii with Open Shrubland of Eremophila forrestii subsp. forrestii on brown loamy sand on plains

Low Woodland of Acacia coriacea subsp. pendens, Eucalyptus victrix and Acacia aptaneura over Open Tussock Grassland of Themeda triandra, Eulalia aurea and *Cenchrus ciliaris with Open Woodland of Eucalyptus camaldulensis and Eucalyptus victrix on brown sand on major drainage lines

Low Woodland of Acacia pteraneura over High Open Shrubland of Acacia tetragonophylla, Acacia synchronicia and Acacia rhodophloia over Open Shrubland of Senna glutinosa subsp. luerssenii on brown sandy loam on footslopes and low hills

Low Open Shrubland of Frankenia setosa with Scattered Tussock Grasses of *Cenchrus ciliaris on red brown clay loam on saline flats

Mosaic of Low Open Forest of Acacia aptaneura over Open Tussock Grassland of Aristida inaequiglumis, Eulalia aurea and Digitaria brownii over Very Open Herbs of *Bidens bipinnata, Cheilanthes sieberi and Evolvulus alsinoides on brown sandy clay loam on hardpan plains and Low Open Woodland of Acacia aptaneura, Hakea lorea subsp. lorea and Acacia pteraneura over Very Open Tussock Grassland of Aristida contorta, Aristida inaequiglumis and Enneapogon polyphyllus over Scattered Low Shrubs of Sclerolaena cornishiana and Solanum lasiophyllum on brown sandy loam on hardpan plains

Open Hummock Grassland of Triodia basedowii and Triodia sp. Shovelanna Hill (S. van Leeuwen 3835) with Open Shrubland of Acacia synchronicia, Acacia aptaneura and Acacia tetragonophylla over Low Open Shrubland of Eremophila cuneifolia, Maireana georgei and Solanum lasiophyllum on red sandy loam on floodplains and lower hill slopes

Open Hummock Grassland of Triodia basedowii, Triodia schinzii and Triodia pungens with Low Open Woodland of Corymbia hamersleyana, Hakea lorea subsp. lorea and Acacia aptaneura over High Open Shrubland of Acacia dictyophleba, Acacia sclerosperma and Acacia pachyacra on red sand on sand plains and islands between river channels

Open Hummock Grassland of Triodia lanigera with Open Shrubland of Acacia ancistrocarpa and Acacia pachyacra and Scattered Low Trees of Acacia paraneura, Acacia pruinocapra and Corymbia hamerselyana on red sandy loam on stony plains

Open Hummock Grassland of Triodia pungens with Low Open Woodland of Acacia aptaneura and Acacia pruinocarpa over Open Shrubland of Eremophila fraseri, Acacia marramamba and Senna glutinosa subsp. x luerssenii on red brown loam on undulating hills

Open Hummock Grassland of Triodia pungens with Low Open Woodland of Corymbia ferriticola, Ficus brachypoda and Acacia catenulata subsp. occidentalis over High Open Shrubland of Dodonea pachyneura and Acacia hamerselyensis on red sandy clay loam in gullies and on breakaway slopes

Open Hummock Grassland of Triodia sp. Shovelanna Hill (S. van Leeuwen 3835), Triodia pungens and Triodia basedowii with Low Open Woodland of Acacia aptaneura, Acacia pruinocarpa and Acacia wanyu and Open Shrubland of Acacia tetragonophylla, Eremophila exilifolia and Eremophila latrobei subsp. latrobei on red sandy loam on hill slopes

Open Hummock Grassland of Triodia vanleeuwenii, Triodia angusta and Triodia pungens with High Open Shrubland of Acacia wanyu, Acacia synchronicia and Acacia tetragonophylla and Low Open Shrubland of Eremophila cuneifolia on brown sandy loam on hillslopes

Open Shrubland of Acacia aptaneura, Acacia tetragonophylla and Senna artemisioides subsp. helmsii over Very Open Tussock Grassland of Aristida inaequiglumis, Tripogon loliformis and Eragrostis eriopoda with Scattered Low Trees of Acacia aptaneura on brown loamy sand on plains

Open Tussock Grassland of *Cenchrus ciliaris, Aristida inaequiglumis, and Themeda triandra with Low Open Woodland of Corymbia hamersleyana and Acacia pteraneura and High Open Shrubland of Acacia sclerosperma, Acacia pyrifolia and Acacia pachyacra on brown loamy sand on floodplains

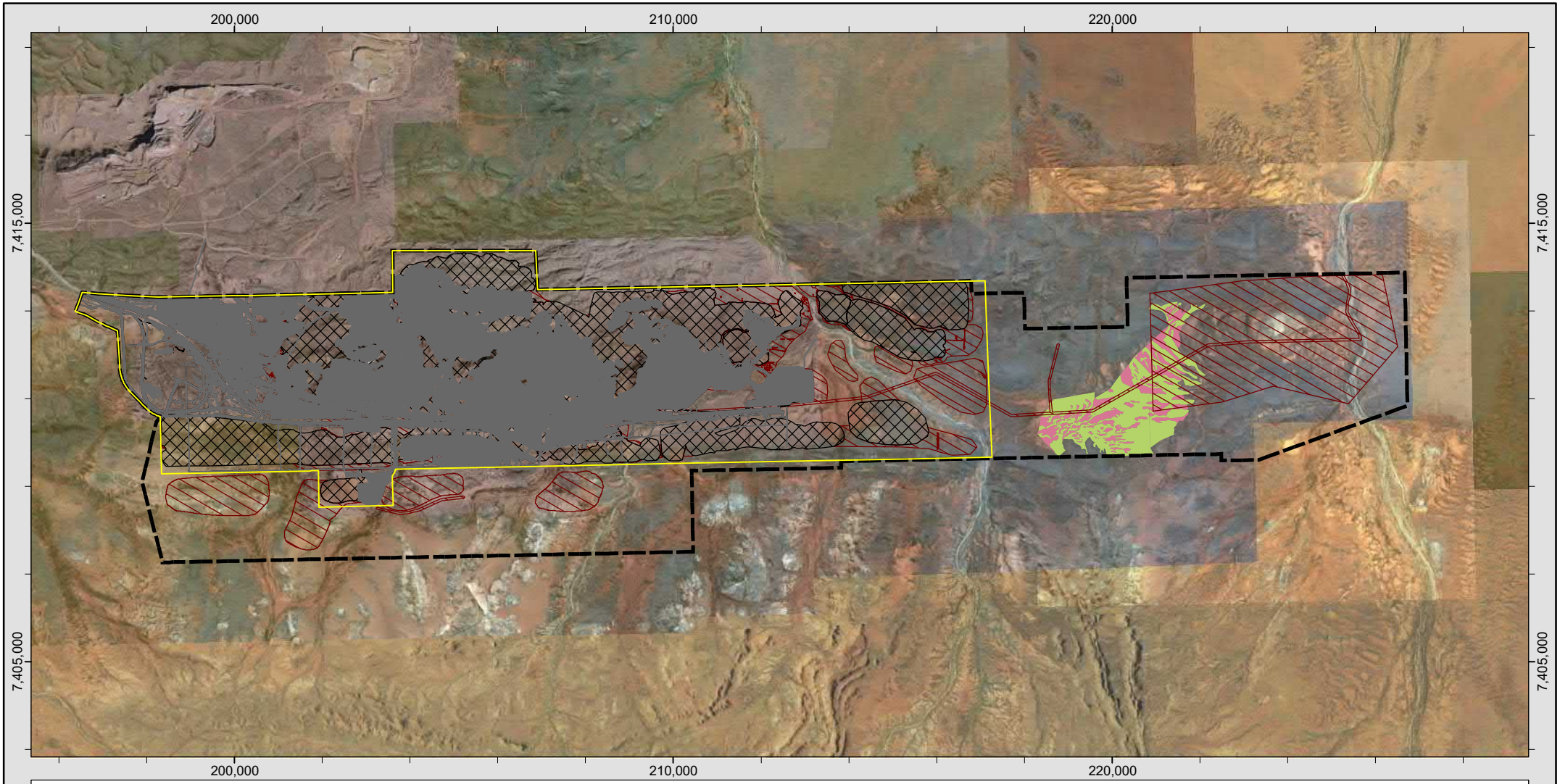
Tussock Grassland *Cenchrus ciliaris and *Cenchrus setiger with Low Woodland of Eucalyptus victrix, Acacia citrinoviridis and Atalaya hemiglauca on brown sandy loam on major drainage lines and adjacent flood plains

Tussock Grassland of Themeda triandra, Eulalia aurea and *Cenchrus ciliaris with Low Open Woodland of Corymbia hamersleyana and Eucalyptus xerothermica over High Open Shrubland of Acacia dictyophleba, Acacia ancistrocarpa and Acacia macraneura on brown silty clay loam on floodplains

Tussock Grassland of Themeda triandra, Eulalia aurea and Eriachne tenuiculmis with High Shrubland of Acacia pyrifolia var. pyrifolia, Acacia tumida var. pilbarensis and Petalostylis labicheoides and Open Woodland of Eucalyptus victrix and Corymbia hamersleyana on red brown silty loam on medium drainage lines and flood plains

Woodland of Eucalyptus camaldulensis subsp. refulgens and Eucalyptus victrix over High Open Shrubland of Acacia citrinoviridis, Acacia pyrifolia var. pyrifolia and Melaleuca glomerata over Tussock Grassland of *Cenchrus ciliaris, Eulalia aurea and Themeda triandra on brown clay loam on banks of major drainage lines

Woodland of Eucalyptus victrix, Acacia citrinoviridis and Eucalyptus camaldulensis subsp. refulgens over Low Open Shrubland of Tephrosia rosea var. clementii, Corchorus crozophorifolius and Acacia pyrifolia var. pyrifolia over Very Open Tussock Grassland of *Cenchrus ciliaris, Eulalia aurea and Themeda triandra on brown loamy sand on channels of major drainage lines



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JIMBLEBAR OPTIMISATION PROJECT
Sheetflow Dependent Vegetation

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/006 REV 0
Date: 20/08/2019	Checked:	Figure: 15
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Existing Project Boundary
- Proposed Development Envelope
- Indicative Previously Assessed Area
- Indicative Cleared Area as at FY2019
- Indicative Footprint

Sheetflow Dependent Vegetation

Vegetation Code

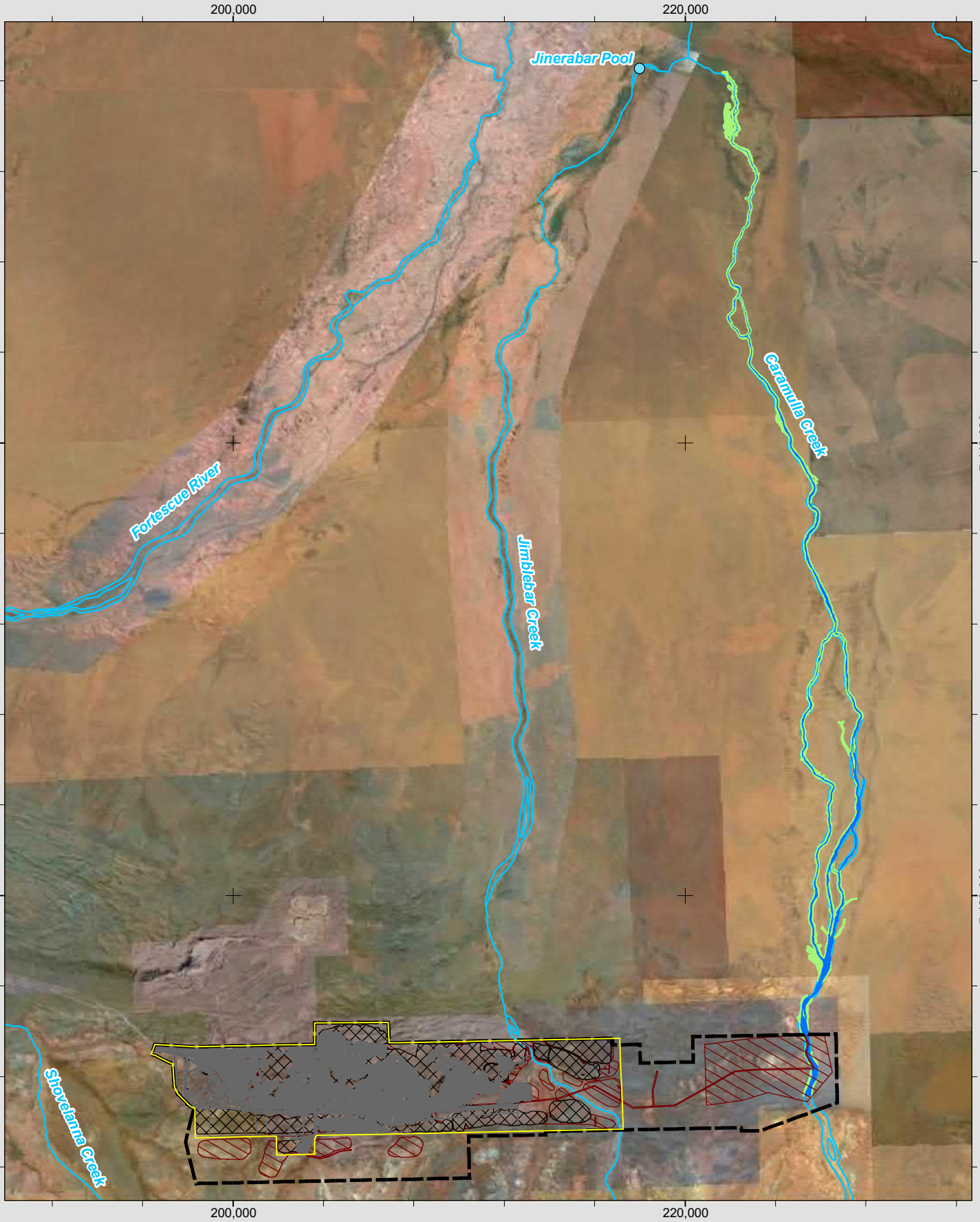
- FP AaAprAci RheAa CcChfArin
- FP Tb AaApr Erff

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_006_E_SheetflowDependentMulga_Rev0.mxd



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JIMBLEBAR OPTIMISATION PROJECT

Caramulla Riparian Vegetation

Scale @ A4: 1:230,000	Prepared: J.VIS	Project No: A949/031 Rev 0
Date: 20/08/2019	Checked:	Figure: 16
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Watercourse
- Existing Project Boundary
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint
- Proposed Development Envelope

Caramulla Creek Riparian Vegetation

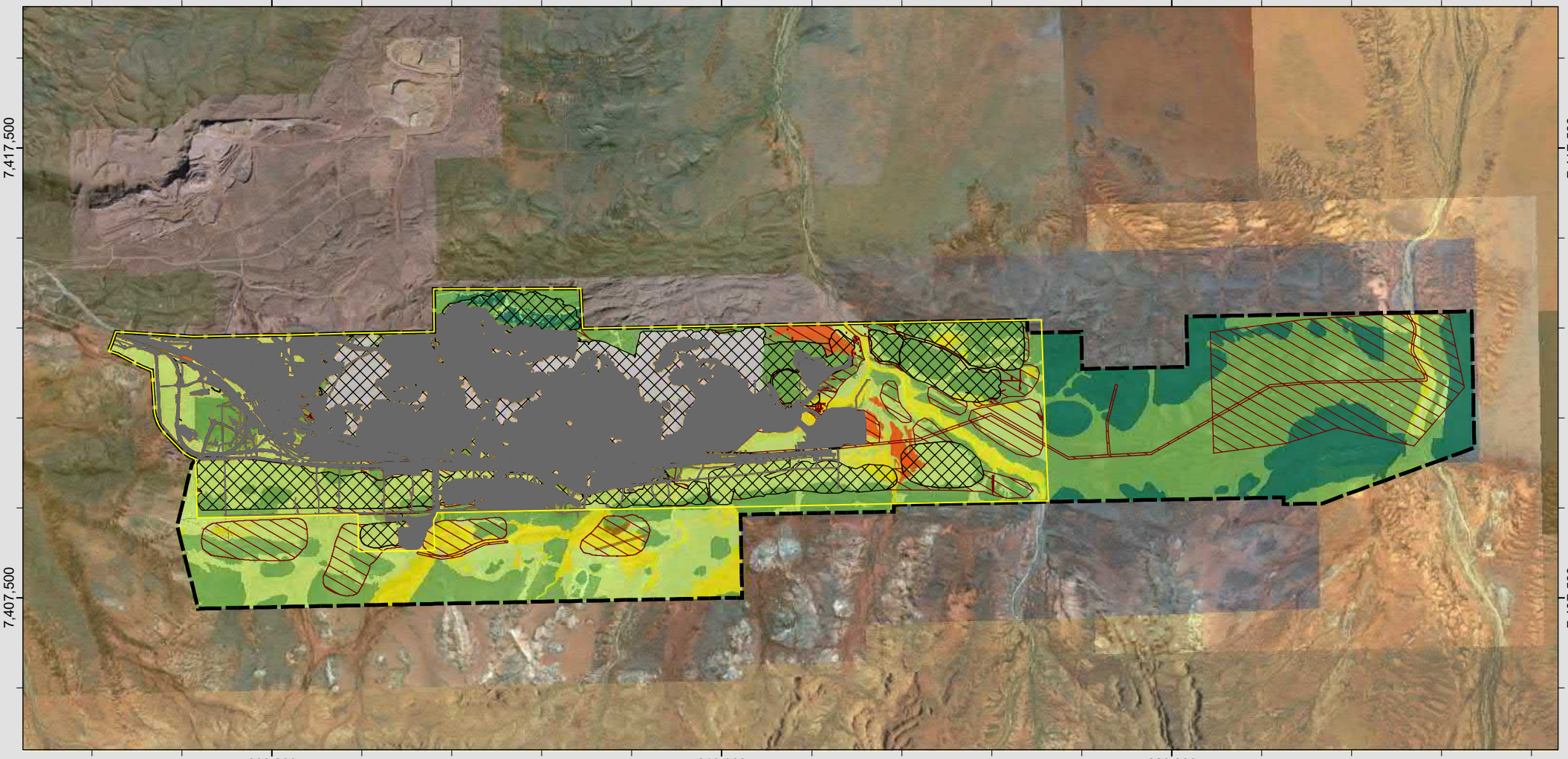
- Main channel
- Adjacent banks

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_031_E_CaramullaRiparianVegetation_Rev0.mxd



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BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Vegetation Condition

Scale @ A4: 1:125,000	Prepared: J.VIS	Project No: A949/046 REV 0
Date: 20/08/2019	Checked:	Figure: 17
Revision: REV 0	Reviewed: ENVIRO. A&I	

Vegetation Condition
- Excellent
- Very Good
- Good
- Poor
- Degraded
- Completely Degraded
- Unmapped

- Existing Project Boundary
- Proposed Development Envelope
- Indicative Previously Assessed Area
- Indicative Cleared Area as at FY2019
- Indicative Footprint

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_046_E_VegetationCondition_Rev0.mxd

Significant flora

Threatened flora

No plant taxon gazetted as Threatened Flora under the *Biodiversity Conservation Act 2016* (BC Act) or under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) have been recorded from within the proposed Development Envelope.

Priority flora

Seven Priority flora species, as listed by the DBCA, have been recorded from within the proposed Development Envelope (Figure 18):

- *Aristida jerichoensis* var. *subspinulifera* (Priority 3);
- *Eremophila capricornica* (Priority 1);
- *Euphorbia inappendiculata* var. *inappendiculata* (Priority 2);
- *Goodenia nuda* (Priority 4);
- *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3);
- *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (Priority 3); and
- *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (Priority 1).

Most of the records are located in the additional area of the proposed Development Envelope and east of existing operations within the Existing Project Boundary (Figure 18).

Aristida jerichoensis var. *subspinulifera* is a compactly tufted perennial grass ranging in height from 0.3-0.8 m (Western Australian Herbarium (WAH), 2019). The habitat for this species was described as sandplains, flat to open depressions with ironstone and well drained red sandy loam soil, or large groves in hardpan plains (WAH, 2019). This species is known from a single record in in the additional area of the proposed Development Envelope, south of the Existing Project Boundary (Figure 18), recorded from vegetation dominated by Mulga (Syrinx Environmental, 2014).

There are 22 records from six populations of *Eremophila capricornica* occurring within the proposed Development Envelope (Figure 18). Within the proposed Development Envelope, all of the records are located in the additional area east of the Existing Project Boundary. Local populations of this species also occur directly to the north of the proposed Development Envelope and approximately 17 km to the east. *Eremophila capricornica* is a newly described species following a taxonomic review (Buirchell and Brown, 2016) and was listed as a Priority flora taxa in 2017 (Onshore Environmental, 2018b). This species grows to 0.75 m tall and produces mauve to lilac flowers between June and August. Buirchell and Brown (2016) recently conducted an analysis of new and geographically restricted *Eremophila* taxa from Western Australia, resulting in 13 new taxa being described, including *Eremophila capricornica*. This species is restricted to the northeast Gascoyne, east of Newman across to Jigalong with scattered populations over a narrow geographical range (Buirchell and Brown, 2016).

Euphorbia inappendiculata var. *inappendiculata* is a small annual herb 1 cm high growing in clayey silty soils associated with tussock grasslands on cracking clay (Syrinx Environmental, 2014). This species is uncommon in Western Australia where it is known from two areas in the Hamersley subregion of the Pilbara, and west of Halls Creek in the Kimberley (BHP Billiton Iron Ore, 2016b). Within the proposed Development Envelope, it is known from a single record associated with the tussock grasses of *Eriachne* species growing on cracking clays (Syrinx Environmental, 2014) occurring in the additional area of the proposed Development Envelope, immediately south of the Existing Project Boundary) (Figure 18). This record is approximately 240 km from the nearest known population in the Hamersley subregion and as such represents a range extension to the south-eastern extent of the range of

this species (Syrinx Environmental, 2014), along with a record north of Mount Whaleback (Onshore Environmental, 2013).

Goodenia nuda occurs on drainage levees, flood plains and sand plains as an erect annual or biennial herb to 0.5 m in height. It is widespread throughout the Pilbara, with records also from the northern Carnarvon and eastern Gascoyne bioregions. This species is typically recorded from relatively mesic habitats, such as floodplains and drainage areas (Onshore Environmental, 2018b). It has been recorded from the majority of BHP tenements in the southeast Pilbara. *Goodenia nuda* has been recorded from 18 records (seven populations) on floodplains, hardpan plains and sand plains. Within the proposed Development Envelope, most records are located within the Existing Project Boundary (Figure 18).

Rhagodia sp. Hamersley (M. Trudgen 17794) is a perennial chenopod growing to a height of 2 m and occurring in orange to red loam soils on flood plains. The current known distribution is restricted to the Pilbara bioregion with increasing numbers of populations recorded in recent years between Tom Price and Newman. *Rhagodia* sp. Hamersley (M. Trudgen 17794) has previously been recorded from numerous BHP tenements in the southeast Pilbara (Onshore Environmental, 2018b). This species has been recorded as scattered plants (total of 121 records from four populations) from a variety of habitats throughout the eastern section of the proposed Development Envelope, with all except one record located east of the Existing Project Boundary (Figure 18).

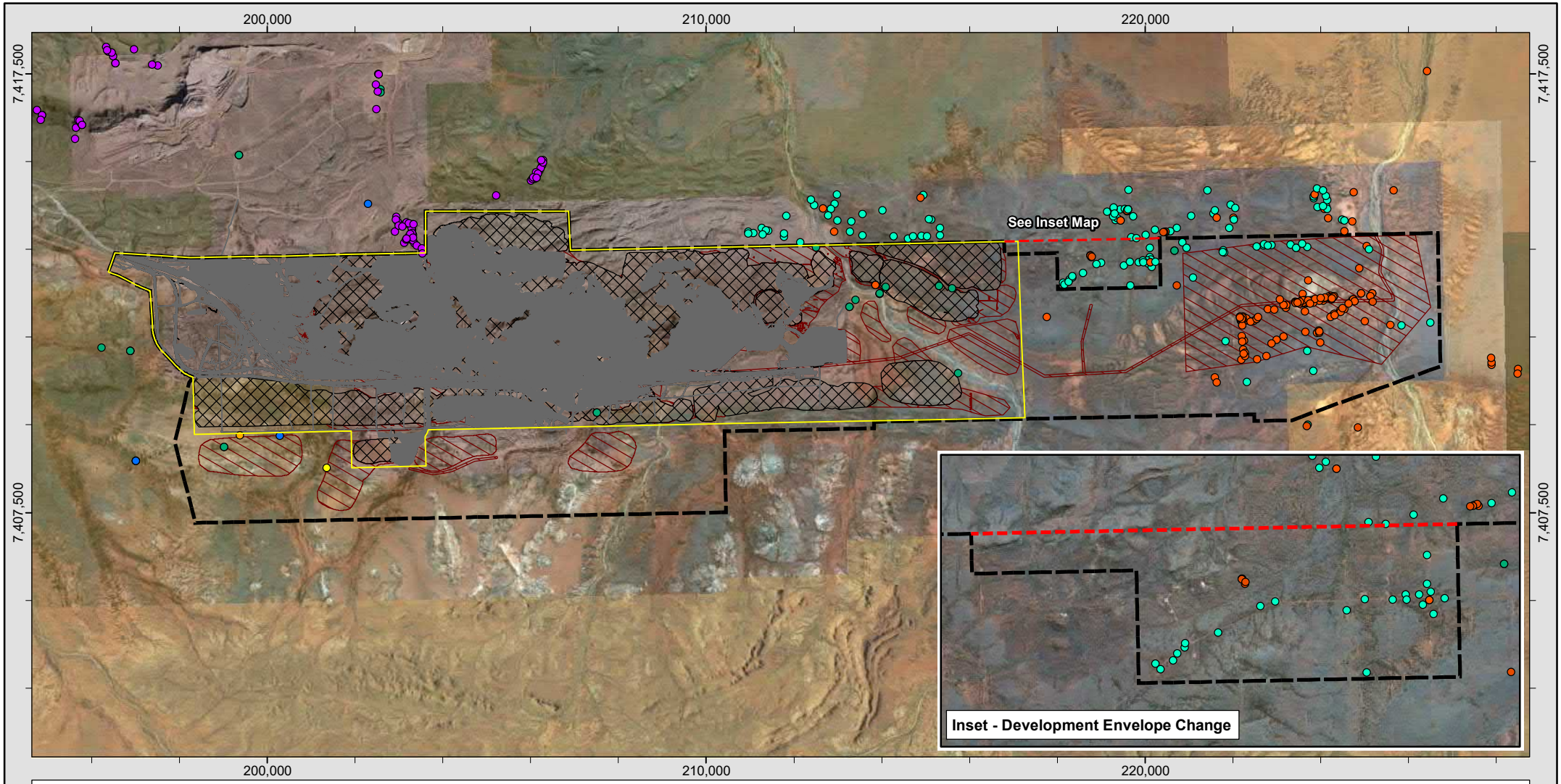
There is a single record of *Triodia* sp. Mt Ella (M.E. Trudgen 12739) from the northern most section of the proposed Development Envelope (within the Existing Project Boundary) belonging to a population that extends north beyond the boundary (Figure 18). This undescribed *Triodia* species was first discovered on Mt Ella (west of Mining Area C) in 1995, where it occurs on upper hill slopes below mulga and in an east to southeast facing gully (Trudgen and Casson, 1998). It is a perennial hummock grass to 1 m in height. It occurs amongst rocks and outcrops on hill slopes and gullies on light orange brown pebbly loam (Onshore Environmental, 2014b).

Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684) is an annual bushy herb from the family Asteraceae with cream flowers flowering in July to August (WAH, 2019). The habitat of this species is generally connected to plains with red clay loams dominated by Mulga open woodland over tussock grassland predominantly from the *Aristida* genus (Syrinx Environmental, 2014). This species has a scattered distribution east of Karijini National Park and within and around the Coondewanna Flats. Within the proposed Development Envelope, this species is known from a single record in the southwest of the additional area of proposed Development Envelope (Figure 18).

Introduced flora (weeds)

A total of 23 introduced flora (weed) species have been recorded from within the proposed Development Envelope (Figure 19). The most commonly recorded species during baseline and targeted weed surveys at Jimblebar are **Aerva javanica* (Kapok Bush), **Cenchrus ciliaris* (Buffel Grass) and **Rumex vesicarius* (Ruby Dock). The introduced flora species largely occur along drainage channels (namely, Jimblebar Creek) or adjacent to existing operations within the Existing Project Boundary of the proposed Development Envelope.

None of the introduced flora species are listed as a Declared Pest under the *Biosecurity and Agriculture Management Act 2007* (BAM Act).



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BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Significant Flora Species

Scale @ A4: 1:125,000	Prepared: J.VIS	Project No: A949/045 REV 0
Date: 20/08/2019	Checked:	Figure: 18
Revision: REV 0	Reviewed: ENVIRO. A&I	

Priority Flora
- Aristida jerichoensis var. subspinulifera (Priority 3)
- Eremophila capricornica (Priority 1)
- Euphorbia inappendiculata var. inappendiculata (Priority 2)
- Goodenia nuda (Priority 4)
- Rhagodia sp. Hamersley (M. Trudgen 17794) (Priority 3)
- Triodia sp. Mt Ella (M.E. Trudgen 12739) (Priority 3)
- Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684) (Priority 1)

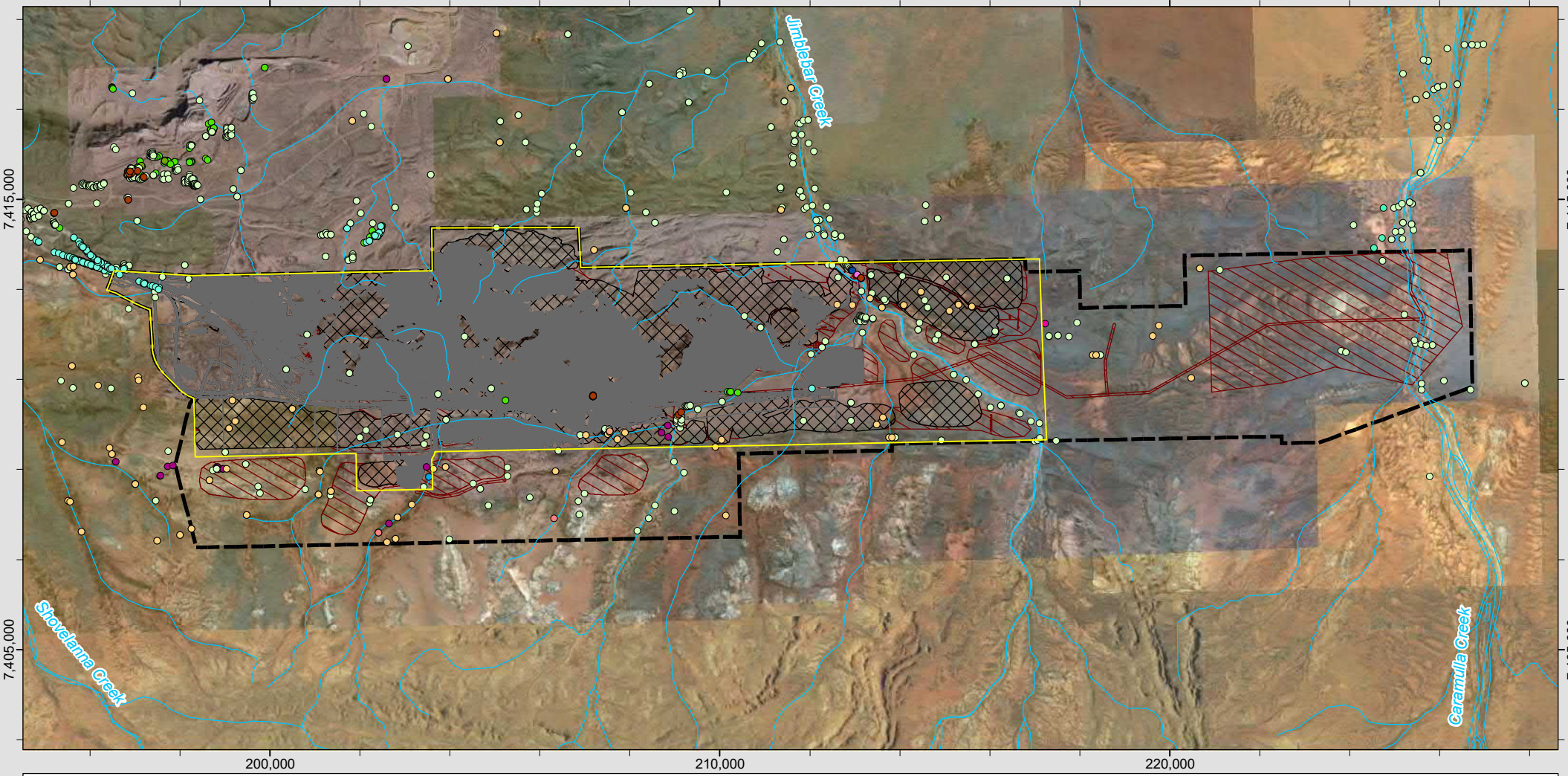
- Existing Project Boundary
- Proposed Development Envelope
- Initial Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_045_E_PriorityFloraSpecies_Rev0.mxd



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Weed Mapping

Scale @ A4: 1:125,000	Prepared: J.VIS	Project No: A949/57 REV 0
Date: 21/08/2019	Checked:	Figure: 19
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Existing Project Boundary
- Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed
- Indicative Footprint
- Watercourse

Weed Locations

- Aerva javanica
- Bidens bipinnata
- Cenchrus ciliaris
- Cenchrus setiger
- Chloris barbata
- Chloris virgata
- Citrullus amarus
- Cynodon dactylon
- Echinochloa colona
- Eragrostis cilianensis
- Flaveria trinervia
- Lactuca serriola
- Malvastrum americanum
- Rumex vesicarius
- Solanum nigrum
- Sonchus oleraceus
- Tribulus terrestris
- Vachellia farnesiana

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_057_E_WeedLocations_Rev0.mxd

6.4 Potential impacts

The implementation of the Project will result in both direct and indirect potential impacts. BHP has considered the potential impacts outlined in the EPA's Flora and Vegetation Guideline (2016a) and considers that those relevant to the Project are:

- removal of vegetation (direct);
- changes to vegetation from changes to water regimes (indirect);
- changes to vegetation or impacts to flora species from fire (indirect); and
- changes to vegetation from weeds (indirect).

As discussed in Section 2.3.3, a large proportion of the proposed Development Envelope is within the Existing Project Boundary (Figure 3), where impacts have already been assessed and approved. Therefore, BHP has focused the discussion on potential impacts of the Project in the Indicative Footprint and in the additional areas within the proposed Development Envelope to the south and east of the Existing Project Boundary. The discussion of cumulative impacts considers existing impacts, including from the Existing Project.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation and/or management measures are applied, if required).

6.4.1 Removal of vegetation

The proposed activities will result in the direct impact to flora and vegetation through the removal of up to 2,000 ha within the proposed Development Envelope (Section 2.3.3).

Vegetation

Direct clearing of native vegetation for the Project has the potential to:

- Affect the ecological integrity of vegetation (at the regional and local scale) and ecological communities.
- Reduce the condition of vegetation, particularly where the existing vegetation is in Good to Excellent condition.

Regional vegetation

Five vegetation associations (as described by Beard) are located within the proposed Development Envelope (Table 14, Figure 13).

Table 14 shows the area of each association within the Indicative Footprint and within the proposed Development Envelope. As previously discussed, the Indicative Footprint area (2,712 ha) is greater than the proposed clearing of 2,000 ha. Therefore, Table 14 shows the maximum area of any vegetation association that may be impacted, but the total impact to all vegetation associations would be limited to 2,000 ha. Assuming disturbance occurs within the Indicative Footprint, the potential impact of the Project on any association (as a percentage of the current extent) is less than 0.2% except vegetation association 216 within the Pilbara bioregion (less than 2%). Cumulatively, assuming disturbance occurs within the Indicative Footprint, all associations will have more than 99% remaining, except vegetation association 216 within the Pilbara bioregion, which will have 97% remaining.

Table 14: Potential impacts to Beard vegetation units

Beard Vegetation Association	Pre-European Extent (ha)[1]	Current Extent (ha)	% of Association Remaining	Area within proposed Development Envelope (ha)			Area within Indicative Footprint (ha)	% of Association Remaining (Current Extent minus Indicative Footprint as % of Pre-European Extent)
				Existing Project Boundary area (ha)	Additional area (ha)	Total (ha)		
Pilbara Bioregion								
29	1,133,220	1,131,712	99.87%	0	1,906	1,906	1,219	99.76%
82	2,563,583	2,550,888	99.50%	4,125	1,512	5637	710	99.48%
216	26,670	26,373	98.89%	4,100	338	4438	439	97.24%
Gascoyne Bioregion								
18	3,273,580	3,271,339	99.93%	0	119.5	119.5	0	99.93%
28	153,280	153,264	99.99%	0.15	1.42	1.56	0	99.99%
29	3,802,460	3,799,636	99.93%	16.6	27.6	44.2	0	99.93%
216	254,089	252,864	99.52%	73.7	1985	2,058	344	99.38%
Total				**8,315.6**	**5,889.8**	**14,205.4**	**2,712**	

1. Pre-European Extent and Current Extent based on current DBCA data for the Pilbara and Gascoyne bioregions (Government of Western Australia, 2019).

Local vegetation

Detailed vegetation association mapping was completed for the proposed Development Envelope, with 58 vegetation associations mapped. Of these vegetation associations, 33 occur within the Indicative Footprint of which six represent over 70% of the Indicative Footprint (Table 15). The remaining associations contribute less than 4% each of the Indicative Footprint.

Broad scale mapping at the detailed vegetation association level occurs over a limited extent within the Pilbara, so inference of vegetation associations regionally at a fine scale is not possible. However, the consolidation of vegetation mapping within BHP's Pilbara tenure (Onshore Environmental, 2014a) provides a unique database from which to undertake a preliminary assessment of representation at the vegetation association level.

Table 15 shows the area within the Indicative Footprint and within the proposed Development Envelope for the six vegetation associations that contribute to more than 4% each of the Indicative Footprint and together cover 71% of the Indicative Footprint. As previously discussed, the Indicative Footprint area (2,712 ha) is greater than the proposed clearing of 2,000 ha. Therefore, Table 15 shows the maximum area of the six detailed vegetation associations that may be impacted but the total impact to all detailed vegetation associations would be limited to 2,000 ha. Assuming disturbance occurs within the Indicative Footprint, the potential impact to any detailed vegetation association (as a percentage of the mapped extent of the vegetation associations within the consolidated database) is less than 26% (Table 15).

Table 15: Potential impacts to dominant vegetation associations

Detailed Vegetation Association	Area within Development Envelope (ha)			Area within Indicative Footprint (ha)	Area within BHP Consolidated Mapping (ha)	Area within Indicative Footprint as % of Area of BHP Consolidated Mapping
	Existing Project Boundary area (ha)	Additional area (ha)	Total			
FP ApaAa Erfr TsTp	576	626	1,201	253	5,602	4.5%
FP Tb AaApr Erff	272	859	1,132	208	1,680	12%
FP AaAprAci RheAa CcChfArin	238	239	477	154	590	26%
HS TsTpTb AaAprAw AteEreErll	674	1,091	1,766	654	3,861	17%
HS Ts	1,084	353	1,437	168	1,627	10%
SA Tb ChEg ScpBeKep	599	686	1,285	489	2,771	18%
Total				**1,925 (71% of Indicative Footprint)**		

Threatened and Priority Ecological Communities

As discussed in Section 6.3.2, no TECs or PECs have been recorded from within or adjacent to the proposed Development Envelope. The Project will have no impacts on TECs or PECs.

Vegetation Condition

Figure 17 shows that most of the uncleared area remaining in the proposed Development Envelope (including the additional area within the proposed Development Envelope) has been mapped as being in Good to Excellent condition (65% of the proposed Development Envelope) (Table 16). Areas in Poor or Degraded condition (6.7% of the proposed Development Envelope) are generally along and adjacent to creek lines (due to impacts from cattle grazing) or adjacent to mining operations.

Most of the vegetation (89%) within the Indicative Footprint (Table 16, Figure 17) is mapped as being in Good to Excellent condition. Therefore, BHP assumes that the impact of the Project will be the clearing of up to 2,000 ha of native vegetation in Good to Excellent condition.

Table 16: Potential impacts to vegetation condition

Vegetation Condition	Area within Development Envelope (ha)[1]	% of Development Envelope	Area within Indicative Footprint (ha)	% of Indicative Footprint
Excellent	1,426	10%	305	11%
Very Good	4,634	33%	1,544	57%
Good	3,082	22%	579	21%
Poor	824	5.8%	208	8%
Degraded	133	0.9%	60.9	2%
Completely Degraded/ Cleared	3,345	24%	15.9	1%
Unmapped	672	4.7%	0.05	0%
TOTAL	**14,205.4**	**100%**	**2,712**	**100%**

1. Proposed Development Envelope (14,205.4 ha) includes Existing Project Boundary area (8,315.6 ha)

Significant flora

The Project has the potential to affect the representation and distribution of significant flora species as a result of direct clearing native vegetation.

Threatened flora

As discussed in Section 6.3.2, no Threatened Flora have been recorded from within or outside the proposed Development Envelope. The Project will have no direct impacts on Threatened Flora.

Priority flora

Seven Priority flora species are known to occur within the proposed Development Envelope (Table 17, Figure 18). Figure 18 shows that most records are located within or adjacent to the Indicative Footprint. Table 17 shows the potential impact on each species occurring within the proposed Development Envelope.

Eremophila capricornica (Priority 1) is known from 22 records (six populations) within the proposed Development Envelope, 17 of which occur within the Indicative Footprint (Figure 18). All records occur in the additional area of the proposed Development Envelope, east of the Existing Project Boundary. Based on current confirmed records of

Eremophila capricornica (following the taxonomic review), the potential impact from the Project (as a percentage of known records) is 11% assuming disturbance is within the Indicative Footprint and 14% assuming disturbance occurs anywhere within the proposed Development Envelope (Table 17). There are no known existing impacts to this species from other projects (likely due to this species being newly described); therefore there are no known cumulative impacts to this species.

One record of *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (Priority 1) was recorded within the Indicative Footprint in the additional area of the proposed Development Envelope, south of the Existing Project Boundary (Figure 18). The potential impact from the Project (as a percentage of known records) is 3.1%. There are no known existing impacts to this species from other projects; therefore there are no known cumulative impacts to this species.

One record (one population) of *Euphorbia inappendiculata* var. *inappendiculata* (Priority 2) was recorded adjacent to the Indicative Footprint in the additional area of the proposed Development Envelope, immediately south of the Existing Project Boundary (Figure 18). The potential impact from the Project (as a percentage of known records) is 13%. There are no known existing impacts to this species from other projects; therefore there are no known cumulative impacts to this species.

The potential impact (as a percentage of known records) to *Aristida jerichoensis* var. *subspinulifera* (Priority 3), *Goodenia nuda* (Priority 4), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (Priority 3) and *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (Priority 3) is less than 10% for any of these species (Table 17). The cumulative impact (existing impacts from other projects and potential impacts within the proposed Development Envelope) is also less than 10% for any of these species (Table 17).

Table 17: Potential impacts to significant flora

Species	Known records (and populations) within WA[1]	Records (and populations) within Development Envelope	Records within Development Envelope as % of Known records	Records within Indicative Footprint	Records within Indicative Footprint as % of Known records	Existing impacts to Records from other projects[2]	% Possible impact to Records (Cumulative of Development Envelope and Existing)
Aristida jerichoensis var. *subspinulifera* (Priority 3)	231 (127 populations)	1 (1 population)	0.4%	1	0.4%	1	0.9%
Eremophila capricornica (Priority 1)	156 (31 populations)	22 (6 populations)	14%	17	11%	0	14%
Euphorbia inappendiculata var. *inappendiculata* (Priority 2)	8 (6 populations)	1 (1 population)	13%	0	0%	0	13%
Goodenia nuda (Priority 4)	555 (243 populations)	18 (7 populations)	3.2%	4	0.7%	25	7.7%
Rhagodia sp. Hamersley (M. Trudgen 17794) (Priority 3)	1,486 (214 populations)	121 (4 populations)	8.1%	117	7.9%	7	8.6%
Triodia sp. Mt Ella (M.E. Trudgen 12739) (Priority 3)	421 (70 populations)	1 (1 population)	0.2%	0	0%	3	1.0%
Vittadinia sp. Coondewanna Flats (S. van Leeuwen 4684) (Priority 1)	32 (30 populations)	1 (1 population)	3.1%	1	3.1%	0	3.1%

1. A population is defined as a spatially discrete individual or group of individuals of a taxon that is separated by more than 500 m from the nearest spatially discrete individual or group of individuals (as defined by DBCA).
2. Based on BHP database and data presented in BHP Billiton Iron Ore Pilbara Strategic Proposed Flora and Vertebrate Fauna Screening Assessment (BHP Billiton Iron Ore 2017a).

6.4.2 Changes to water regimes

Sheetflow dependent vegetation

The proposed surplus water pipeline running east from the mine to the MAR area and creek discharge point intersects the Mulga vegetation identified as being sheetflow dependent (Section 6.3.2 and Figure 15), and has potential to interfere with the natural sheetflow of water through the area. The disruption of sheetflow (particularly via linear infrastructure) may result in indirect impacts to Mulga vegetation by reducing water availability in areas downslope, or ponding of water upslope, resulting in declined vegetation health or potential loss of individual plants.

Mulga has an extensive shallow root system that efficiently utilises ephemeral surface water. Mulga communities that occur in a patterned sequence of alternating grove and inter-groves are considered likely to be dependent on sheetflow water for resource (nutrient and water) capture (Greene, 1992). This type of Mulga has been identified as an 'ecosystems at risk' in the Pilbara bioregion by Kendrick (2001a, 2001b) due to its sensitivity to disturbance.

All of the Mulga vegetation identified as sheetflow dependent is located in the additional area of the proposed Development Envelope (east of the Existing Project Boundary), where the surplus water infrastructure is planned to be located. Within the proposed Development Envelope, there is 244.8 ha of association FP AaAprAci RheAa CcChfArin and 722.4 ha of association FP Tb AaApr Erff that has the potential to be impacted from sheetflow alteration (Figure 15). This represents 41% and 43%, respectively, of the known mapped extent of each vegetation association from within BHP's consolidated database (i.e. from within BHP tenure).

Riparian vegetation and surplus water discharge

Proposed surplus water discharge may result in indirect impacts to riparian vegetation (vegetation health) due to continuous inundation. Discharge of surplus water may also indirectly impact on riparian vegetation by creating a dependency on permanent surface water flow, which has the potential to alter the composition of the ecological community and vegetation health.

Altered water regimes resulting from surplus water discharge into Caramulla Creek may cause indirect impacts to the riparian vegetation of Caramulla Creek (Section 6.3.2, Figure 16). The vegetation is at an elevated risk of decline from waterlogging due to the occurrence of *Acacia citrinoviridis* and large riparian trees (namely, *Eucalyptus camaldulensis* subsp. *refulgens*). *Acacia citrinoviridis* has an extensive shallow root system that utilises ephemeral flow of surface water, and are particularly susceptible to waterlogging, while riparian *Eucalyptus* trees have been found to decline in health when they are permanently inundated (Delton, 1990).

The action of discharging surplus water will also artificially increase water availability to vegetation downstream of the discharge location. This has the potential to cause localised changes to the composition and/or density of vegetation within the wetting front (e.g. increase in weed species).

BHP modelled several wetting front scenarios to assess the wetting extent from the proposed surface water discharge (as detailed in Section 5; BHP, 2019b). The assessment indicated there is the potential for inundation from surface water discharge to occur up to 34 km downstream from the modelled discharge point. This wetting front extent is likely to remain within the main flow channel of the creek and is estimated to be up to 20 m in width (BHP, 2019b), resulting in an estimated area of inundation of 71 ha.

This area of inundation can impact the riparian vegetation of the creek due to water logging in low-lying areas and water levels rising to the extent that the entire vadose zone becomes saturated for long periods of time. Riparian vegetation along the main channel (where inundation will occur) occurs over approximately 590 ha (Figure 16). The potential impact from inundation is approximately 12% of the area of riparian vegetation mapped along the main channel of Caramulla Creek. Indirect impacts may also occur to the vegetation of the adjacent banks from the increase water supply. The riparian vegetation on the adjacent banks has been mapped as occurring across approximately 607 ha (Figure 16). Given that the extent of the wetting front is likely to remain within the main flow

channel of the creek and is estimated to be up to 20 m in width (compared to the main channel width of 100 – 200 m), there are unlikely to be impacts to the riparian vegetation on the banks.

Vegetation and managed aquifer recharge

The injection of surplus water through the operation of a MAR scheme has the potential to indirectly impact on vegetation through groundwater level rise (groundwater mounding), which has the potential to inundate root systems affecting vegetation health.

The MAR scheme to inject surplus water into the regional aquifer at Caramulla will result in groundwater mounding, which has the potential to affect vegetation in the area of mounding. Negative impacts to vegetation can arise due to groundwater levels rising to an extent that it envelops a large proportion of the root system of vegetation, resulting in declined vegetation health.

As discussed in Section 5.3.2, the groundwater level at Caramulla in the eastern end of the proposed Development Envelope, where the proposed Caramulla MAR Scheme will be developed in the Caramulla Valley, is approximately 50 mbgl.

Root systems from facultative phreatophyte[1] species (i.e. *Eucalyptus victrix* and *E. camaldulensis*) occurring in the Pilbara bioregion are estimated to be able to access groundwater at depths of 21 mbgl or less (Muir Environmental, 1995). Therefore the tree species within the proposed MAR area are currently not utilising the groundwater (as current groundwater levels in the area are approximately 50 mbgl). BHP conservatively estimates that there will not be an impact on vegetation from groundwater mounding if groundwater levels do not rise further than 25 mbgl.

As discussed in Section 5.4.2, the injection modelling for 15 ML/d and 30 ML/d shows that for some scenarios, groundwater levels will rise higher than 495 mAHD i.e. within 25 m of the ground level. Figure 11 shows that for Run 1 after 10 years of injection, groundwater mounding within 25 mbgl (495 mAHD) may extend approximately 1 km west of the proposed MAR area and 15 km east of the proposed Development Envelope. As discussed in Section 5.4.2, there is uncertainty with the modelling results, due to uncertainty of the extent of the clay layer and the hydraulic parameters. Therefore, BHP has not quantified the potential impacts to facultative phreatophyte species. However, BHP has proposed to control groundwater mounding so that groundwater does not rise within 25 mbgl (see Section 6.6), and therefore will not impact on vegetation.

6.4.3 Fire

There is the potential to change the frequency of fire by actively extinguishing fires or by causing them through mining activities. This may result in fire in certain parts of the landscape being too frequent or in other parts being not frequent enough, which may result in fire being intensified when it does occur. Changed fire regimes can encourage weeds at a landscape level and alter the ecological characteristics of communities through the dominance of early successional species.

There were no fire sensitive species or communities identified from within the proposed Development Envelope. BHP considers that there will not be a significant impact to vegetation or flora from the potential alteration of fire regimes from the Project.

6.4.4 Weeds

A total of 23 introduced flora species (weeds) have been recorded from within the proposed Development Envelope. None of the weeds are listed as a Declared Pest under the BAM Act.

Domestic stock such as cattle are significant vectors for weeds within lowland areas of the Pilbara including the proposed Development Envelope. Cattle are typically found on floodplains and along ephemeral drainage lines and

[1] Facultative phreatophytes are species capable of functioning as both a vadophyte and a phreatophyte

levees in low-lying areas supporting palatable grasses. Another factor influencing weed establishment is access. Increasing vehicular access combined with disturbance such as clearing for roads and other infrastructure, has the potential to introduce and/or spread weed species. The current distribution of introduced flora species largely reflect this, with higher weed occurrences present along drainage areas and existing infrastructure.

The presence of introduced flora species within the proposed Development Envelope is not expected to impact on any significant vegetation (as none occur within or adjacent to the proposed Development Envelope), or the regional representation of conservation significant flora species.

6.5 Assessment of impacts

BHP has considered the significance of flora and vegetation and relevant issues outlined EPA's Flora and Vegetation Guideline (2016a) in assessing the significance of the impacts to Flora and Vegetation from the Project. As for Section 6.4, unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation and/or management measures are applied, if required).

6.5.1 Removal of vegetation

Vegetation

As discussed in Section 6.4.1, BHP estimated the cumulative impact of the Project and existing impacts on the seven regional vegetation associations (as described by Beard) mapped within the proposed Development Envelope. Assuming disturbance is within the Indicative Footprint, more than 99% of each vegetation association will remain, except vegetation association 216 within the Pilbara bioregion (Table 14), where more than 97% will remain (decreased from 98.89%). BHP considers that the Project will not affect the ecological integrity of vegetation association 216, as this vegetation association occurs outside of the Pilbara bioregion and is a common association that is generally widespread in the Pilbara bioregion. Therefore, BHP considers that the impact on regional vegetation associations will not be significant.

Broad scale mapping at the detailed vegetation association level occurs over a limited extent within the Pilbara, so inference of vegetation associations regionally at a fine scale is not possible. However, the potential impact to any detailed vegetation association (as a percentage of the mapped extent of the vegetation associations within the consolidated database) is less than 20%, except for FP AaAprAci RheAa CcChfArin (26%) (Table 15). This vegetation association is well represented in the MAR borefield area, where the required clearing is estimated to be approximately 400 ha within an indicative area of 1,455 ha. Therefore, the actual impact is likely to be less than 26% Based on land system and regional vegetation mapping (i.e. Beard vegetation associations), the vegetation associations are expected to occur more broadly within the local area beyond the extent of the consolidated mapping database, which is limited to BHP tenure. Additionally, none of the associations have been identified as locally significant and all are considered to be widespread in the Pilbara bioregion. Therefore, BHP considers that the Project will not significantly reduce the representation of any of the associations and the impact on detailed vegetation associates will not be significant.

As discussed in Section 6.4.1, there will be no impacts to TECs and PECs.

The Project will result in the clearing of up to 2,000 ha of native vegetation. As discussed in Section 6.4.1, approximately 89% of the Indicative Footprint is mapped as being in Good to Excellent condition, so BHP has assumed that the 2,000 ha of the vegetation proposed to be cleared will be in Good to Excellent condition. In its advice on the cumulative impacts of development in the Pilbara (EPA, 2014), the EPA considered that, without intervention, the increasing cumulative impacts of development and land use in the Pilbara (IBRA) region will significantly impact on biodiversity and environmental values. Based on the EPA's advice, BHP considers that the contribution of the Project clearing in the Pilbara bioregion to the cumulative impacts of development in the Pilbara is significant (see Section 6.7).

Significant flora

As discussed in Section 6.41., there will be no impacts to Threatened flora.

As discussed in Section 6.4.1, all records of *Eremophila capricornica* (Priority 1) occur in the additional area of the proposed Development Envelope, east of the Existing Project Boundary, where the surplus water infrastructure will be located. The potential impact of the Project is up to 11% of the known records of *Eremophila capricornica* assuming all records within the Indicative Footprint are removed and up to 14% assuming all records within the proposed Development Envelope are removed. The potential impact within the proposed Development Envelope was reduced by modifying the proposed Development Envelope east of the proposed MAR area to avoid 23 locations of the species (Figure 18). There are no known cumulative impacts to this species and the species has been recorded outside the proposed Development Envelope. However, as this species has a narrow geographical range, BHP considers that the impact of the Project on the species at a local and regional scale may potentially be significant. BHP has proposed management and mitigation measures in addition to the avoidance (see Section 6.6).

As discussed in Section 6.4.1, the potential impact from the Project (and the cumulative impact from the Project and existing impacts) is less than 10% each of known records of the four Priority 3 and Priority 4 species that occur within the Development Envelope. Along with the Priority 1 species *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684), these species are considered to have wide distributions throughout the Pilbara bioregion at a local and regional scale (WAH, 2019). The Project is not expected to have a significant impact on these species (as detailed in Section 6.4.1).

The Project has the potential to impact one record *of Euphorbia inappendiculata* var. *inappendiculata* (Priority 2), representing a 13% impact to the known records of this species. It was recorded adjacent to the Indicative Footprint in the additional area of the proposed Development Envelope, immediately south of the Existing Project Boundary. The species is only known from one population in the local area, approximately 40 km northwest of the proposed Development Envelope. The Project may be considered to have a significant impact on the species at a local scale due to this species being infrequently recorded during surveys in the area. However, this species is known more broadly from the Hamersley subregion (approximately 240 km away) and as such the Project is not considered to have a significant impact on this species at a regional scale.

6.5.2 Changes to water regimes

As discussed in Section 6.4.2, the Project may have an impact on Mulga vegetation (decline in vegetation health) from surplus water infrastructure causing the disruption of sheetflow. The potential unmitigated impact from the Project is up to 41% of the mapped occurrence of association FP AaAprAci RheAa CcChfArin and 43% of association FP Tb AaApr Erff. While not considered a significant ecological community, this type of Mulga has been identified as an ‘ecosystems at risk’ in the Pilbara bioregion by Kendrick (2001a; 2001b) due to its sensitivity to disturbance. Therefore, BHP considers that the unmitigated impact of the Project on Mulga vegetation may potentially be significant. To minimise impacts to mulga, BHP has proposed mitigation measures for the design and construction of surface water infrastructure (see Section 6.6).

As discussed in Section 6.4.2, it is estimated that approximately 71 ha (12%) of the area of riparian vegetation along Caramulla Creek may be inundated from surface water discharge. The vegetation community throughout the main channel of the creek is largely comprised of scattered large trees and shrubs (vegetation coverage mapped as 20-40%) (Onshore Environmental, 2018a; Astron Environmental Services, 2018) with very limited understorey, therefore actual impacts to vegetation along the main channel are likely to be less than the predicted 71 ha or 12%. It is unlikely that the increased water supply will significantly change the vegetation composition of the adjacent banks, as the vegetation largely consists of tussock grasslands of **Cenchrus ciliaris* (Buffel Grass), which is known to dominate in high moisture areas. However, as discussed in Section 5.4.1, the wetting front extent is uncertain, due to uncertainty associated with infiltration rates. Therefore, BHP considers that the unmitigated impact of the Project on riparian vegetation may potentially be significant. To ensure that impacts are not greater than predicted, BHP has proposed management and mitigation measures (see Section 6.6).

As discussed in Section 6.4.2, the root systems of the facultative phreatophytes species will not be inundated nor will they be able to access groundwater if groundwater levels do not rise within 25 mbgl. However, as discussed in Section 6.4.2, the injection modelling results at 15 ML/d and 30 ML/d (i.e. lower than the planned surplus discharge rate of 75 ML/d) show that groundwater levels may rise within 25 mbgl. Therefore, BHP considers that the unmitigated impact of the Project on facultative phreatophytes may potentially be significant. To avoid impacts to facultative phreatophytes, BHP has proposed mitigation measures related o groundwater level rise (see Section 6.6).

6.5.3 Fire

The indirect impacts associated with the potential alteration of fire regimes from the implementation of the Project is not considered a significant risk to the flora or vegetation of the proposed Development Envelope or surrounds, as there were no fire sensitive species or communities identified from within the proposed Development Envelope.

6.5.4 Weeds

The presence of introduced flora species within the proposed Development Envelope is not expected to impact on any vegetation or flora species of significance, and is therefore not considered a significant risk to the flora or vegetation of the proposed Development Envelope or surrounds.

6.5.5 Summary

Table 18 summarises the potential unmitigated impacts from the Project on flora and vegetation values and whether BHP considers that the potential impact is significant. Where an impact (unmitigated) is potentially significant, BHP has proposed specific mitigation measures (Section 6.6) and offsets, where relevant (Section 6.7).

Table 18: Summary of potential significant impacts on Flora and Vegetation

Potential impact (unmitigated)	Value	Potentially significant
Removal of vegetation (direct)	Regional vegetation associations (Beard)	No
	Local vegetation associations (detailed mapping)	No
	Vegetation in Good to Excellent condition in the Pilbara	**Yes**
	Conservation significant flora	**Yes**
Changes to water regimes (indirect)	Sheetflow dependent vegetation	**Yes**
	Riparian vegetation	**Yes**
	Facultative phreatophytic vegetation	**Yes**
Alteration of fire regime (indirect)	Vegetation and flora species	No
Spread/introduction of weeds (indirect)	Vegetation and flora species	No

6.6 Mitigation

6.6.1 Avoid

As discussed in Section 6.5.1, BHP modified the proposed Development Envelope to avoid 23 locations of the Priority 1 species *Eremophila capricornica* (Figure 18). This reduced the potential direct impact to this species from 29% to up to 14%, assuming disturbance occurs anywhere within the proposed Development Envelope and all records are impacted.

BHP will also implement the Project (MAR scheme groundwater injection) to avoid impacts to facultative phreatophytes from groundwater mounding. BHP has proposed that groundwater level rise from the MAR scheme is limited to 25 mbgl in the authorised extent for the Revised Proposal (Table 5 and Appendix 2). BHP has also proposed specific management and mitigation measures relating groundwater level rise in the *Jimblebar Water Management Plan* (BHP, 2019d) (Appendix 17), which includes outcome-based provisions relating to:

- Monitoring of groundwater rise and a trigger and threshold for groundwater level rise.
- Response actions (including modifying the groundwater injection regime or ceasing injection) and reporting if the trigger and threshold are reached.

BHP considers that with this mitigation there will be no impacts to vegetation (facultative phreatophytes) within the area of groundwater mounding.

6.6.2 Minimise

Existing infrastructure at the Jimblebar mining operations will be utilised where practicable to minimise the amount of clearing required for infrastructure to support the Project.

While BHP has avoided 23 locations of *Eremophila capricornica*, there is still the potential for up to 11% of the records of the species to be impacted by the Project (assuming disturbance is within the Indicative Footprint), or 14% (assuming disturbance occurs anywhere within the proposed Development Envelope). All of the records are located in or adjacent to the MAR borefield area where there is flexibility in the location of the infrastructure, as the required clearing is estimated to be approximately 400 ha within an indicative area of 1,455 ha. BHP commits to avoiding, where practicable, all known records of this species within the proposed Development Envelope (22 known locations; Figure 18). BHP has proposed specific management and mitigation measures relating to this species in the *Jimblebar Flora and Vegetation Management Plan* (BHP, 2019f) (Appendix 15), which includes management-based provisions relating to:

- Undertaking further targeted survey of *Eremophila capricornica* to confirm locations within the proposed Development Envelope and/or the extent of the species outside the proposed Development Envelope.
- Designing the surplus water infrastructure to minimise impacts to known records of *Eremophila capricornica*.

The Project has the potential to impact sheetflow dependent Mulga from the disruption of natural sheet flow resulting from the construction of surplus water infrastructure (i.e. pipelines). To mitigate this impact, infrastructure through areas identified as sheetflow dependent Mulga (Figure 15) will be constructed to maintain sheetflow and minimise potential impacts to Mulga. BHP has commenced geotechnical studies to understand the excavation conditions along the pipeline route. Where feasible, BHP anticipates that the pipeline will be buried at a shallow depth (less than 1.8 m). Where the pipeline is buried, the land will be contoured to mimic the topography prior to excavation. If excavation conditions are not suitable, the pipeline will be designed and installed to minimise impacts to sheetflow. This may include raising sections of the pipeline above the ground with adequate scour protection to allow sheetflow under the pipeline and/or placing environmental culverts at adequate distances to maintain sheetflow. BHP considers that with this mitigation the potential impacts to sheetflow dependent Mulga will not be significant.

The Project has the potential to impact riparian vegetation along Caramulla Creek as a result of surface water discharge. Due to the uncertainty associated with the discharge modelling, and the importance of riparian vegetation within the Pilbara region, BHP commits to monitoring the health of the riparian vegetation along Caramulla Creek to ensure actual impacts are not greater than predicted. BHP has proposed specific management and mitigation measures relating to riparian vegetation in the *Jimblebar Flora and Vegetation Management Plan* (BHP, 2019f) (Appendix 15) which includes management-based provisions relating to:

- Reviewing the approach for vegetation health monitoring, considering approaches currently undertaken by BHP and other relevant approaches suitable for the Pilbara.
- Developing a methodology for vegetation health considering on-ground and remote techniques

- Implementing an appropriate tree health monitoring program.

6.6.3 Rehabilitate

Rehabilitation at Jimblebar is addressed in the updated *Jimblebar Mine Closure Plan* (MCP) (BHP, 2019e) (Appendix 16). The MCP covers the Existing Project and BHP revised the 2016 version of the MCP to include this Project (BHP, 2019e).

The revised MCP addresses the rehabilitation of the additional areas that will be disturbed. Management approaches relating to flora and vegetation for the Project include:

- Review and optimise pit backfill strategy to minimise disturbance, particularly for OSAs.
- Progressively rehabilitate OSAs.
- Design the revegetation program to establish native vegetation that blends with the surrounding areas.
- Undertake growth media management in accordance with standard business procedures.
- Use specified seed mix, including the use of local provenance native seed.

6.7 Predicted outcome

Following mitigation (Section 6.6), BHP considers that there will not be any significant impacts on Flora and Vegetation values from the Project. However, as discussed in Section 6.5, BHP assessed the contribution of the Project clearing (of Good to Excellent condition vegetation) to the cumulative impacts of development in the Pilbara (IBRA) region as significant. Following the application of the mitigation hierarchy (Section 6.6) and noting the EPA's advice on cumulative impacts in the Pilbara (EPA, 2014), BHP considers that there will be a significant residual impact associated with the cumulative clearing of native vegetation in the Pilbara (IBRA) bioregion.

Applying the Residual Impact Significance Model in the *WA Offsets Guidelines* (Government of Western Australia 2014), significant residual impacts require an offset where the cumulative impact is already at a critical level. Therefore, an offset is required for the cumulative clearing of native vegetation in the Pilbara (IBRA) region. Of the Good to Excellent condition vegetation within the Indicative Footprint boundary, approximately 87% is in the Pilbara IBRA region and approximately 13% is in the Gascoyne IBRA region (Figure 12). BHP considers that an offset is required for the clearing of Good to Excellent condition vegetation (up to 2,000 ha) in the Pilbara (IBRA) region only, as the cumulative impact from development in the Gascoyne (IBRA) region is not significant. Consistent with the EPA's approach for offsetting the clearing of native vegetation in Good to Excellent condition in the Pilbara IBRA region, BHP has proposed a monetary contribution to the Pilbara Environmental Offsets Fund. The proposed offset is discussed in further detail in Section 9.

Below is a summary of the specific measures that BHP proposes to manage the potential impacts to this factor so that they will no longer be considered significant:

- Control clearing to minimise impacts to native vegetation, through the authorised extent in Schedule 1 of the proposed implementation conditions.
- Control the extent of surface water flow in Caramulla Creek to minimise impacts to riparian vegetation through the authorised extent in Schedule 1 of the proposed implementation conditions and measures in the draft *Jimblebar Water Management Plan* and the draft *Jimblebar Flora and Vegetation Management Plan*.
- Design and construct the surplus water discharge pipeline to minimise impacts on sheetflow dependent vegetation.
- Control groundwater rise to avoid impacts to facultative phreatophytes through the authorised extent and measures in the draft *Jimblebar Water Management Plan*.

- Implement measures to avoid and minimise impacts on flora and vegetation (*Eremophila capricornica* (Priority 1) and riparian vegetation) including those in the draft *Jimblebar Flora and Vegetation Management Plan*.
- Implement the *Jimblebar Mine Closure Plan* so that the Project is rehabilitated in an ecologically appropriate and sustainable manner.
- Implement offsets for the clearing of vegetation in Good to Excellent condition in the Pilbara (IBRA) region, to counterbalance the significant residual impact of the cumulative clearing of native vegetation in the Pilbara.

Following the application of the mitigation hierarchy (avoid, minimise, rehabilitate, offset) and BHP's commitment to implement the measures above, BHP considers that the predicted outcome in relation to the EPA's objective for Flora and Vegetation is that flora and vegetation will be protected so that biological diversity and ecological integrity are maintained.

BHP has proposed authorised extents of proposal elements (clearing, wetting front extent, and groundwater rise) and conditions relating to Flora and Vegetation (Management Plan, Appendix 15), Rehabilitation and Decommissioning (MCP, Appendix 16) and Offsets for this Project, to ensure that the proposed measures are implemented. These are included in the draft set of proposed implementation conditions for the Revised Proposal in Appendix 2. BHP considers that proposed implementation conditions are sufficient to manage the potential impacts of the Project, to meet the EPA's objective for Flora and Vegetation.

7 Terrestrial fauna

7.1 EPA objective

The EPA's objective for this environmental factor is:

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

7.2 Policy and guidance

BHP assessed this environmental factor consistent with the following relevant EPA policies and guidance:

- *Statement of Environmental Principles, Factors and Objectives* (EPA, 2018e);
- *Environmental Factor Guideline - Terrestrial Fauna* (EPA, 2016c);
- *Technical Guidance - Sampling Methods for Terrestrial Vertebrate Fauna* (EPA, 2016d);
- *Technical Guidance - Terrestrial Fauna Surveys* (EPA, 2016e); and
- *Technical Guidance - Sampling of Short Range Endemic Invertebrate Fauna* (EPA, 2016f).

7.3 Receiving environment

7.3.1 Studies and surveys

A total of 18 vertebrate fauna surveys and five short-range endemic (SRE) invertebrate fauna surveys have been undertaken wholly or partially within the proposed Development Envelope. These surveys comprise 16 Level 2 surveys, five Level 1 surveys, and two targeted surveys. A complete list and summary of these surveys is provided in Appendix 10.

All surveys were completed in accordance with the EPA requirements relevant at the time of surveying (Appendix 10). Additionally, surveys undertaken post-2009 have been undertaken in accordance with BHP Billiton's *Guidance for Terrestrial Vertebrate Fauna Surveys in the Pilbara* (BHP Billiton Iron Ore, 2017c) or *Short-range Endemic Invertebrate Fauna Assessment Methods Procedure* (BHP Billiton Iron Ore, 2017d), which were developed with the DBCA to ensure a consistent approach for all surveys undertaken for BHP.

As part of the recent Level 2 surveys completed within the proposed Development Envelope, targeted surveying for relevant Program Matters (MNES) species was undertaken (GHD, 2019; Biologic, 2018 and 2019). A focus of the targeted surveying was on the presence of the Ghost Bat (*Macroderma gigas*) and the Greater Bilby (*Macroderma gigas*), due to historical records of these species in the Project area.

Table 19 summarises the more recent and relevant surveys undertaken within and adjacent to the proposed Development Envelope, to support the assessment of Terrestrial Fauna for the Project.

Table 19: Terrestrial Fauna – recent studies and surveys

Title	Date	Summary	Appendix
East Jimblebar and Caramulla Short-range Endemic Invertebrate Fauna Survey (Biologic, *in prep*)	May and Sep 2019	Two season Level 2 survey of short-range endemic invertebrate fauna of east Jimblebar and Caramulla area.	N/A
Jimblebar East and Caramulla Fauna Survey (GHD, 2019)	Apr-May 2019	Single season Level 2 survey of vertebrate fauna of east Jimblebar and Caramulla area.	Appendix 11
Shearers West Targeted Vertebrate and Short-range Endemic Invertebrate Fauna Assessment (Biologic, 2019)	Apr-May 2018	Single season Level 2 survey of vertebrate and SRE fauna of Shearers West area (south of Jimblebar).	Appendix 12
Caramulla Level 1 Vertebrate Fauna Assessment (Biologic, 2018)	Feb 2018	Single season Level 1 of Caramulla area.	Appendix 13

In addition to the abovementioned surveys, a regional study to consolidate fauna habitat mapping within BHP's Pilbara tenements was undertaken to support the assessment of terrestrial fauna within the Pilbara: *Consolidated Fauna Habitat Mapping* (Biologic, 2014). Pre-clearing targeted surveys for the Greater Bilby were undertaken in 2019 within the eastern portion of and to the east of the proposed Development Envelope as a requirement of the Native Vegetation Clearing Permit (NVCP) for the Caramulla drilling program.

BHP considers that the surveys and regional study meet the relevant EPA guidance and provides adequate survey coverage to support the assessment of terrestrial fauna for the Project.

7.3.2 Project setting and environmental values

Regional setting

As described in Section 6.3.2, the Project is located on the boundary between the Pilbara and Gascoyne bioregions, and falls within the Fortescue and Hamersley subregions of the Pilbara bioregion and the Augustus subregion of the Gascoyne bioregion (Figure 12). The closest conservation reserve, Karijini National Park, is located approximately 147 km northwest of the proposed Development Envelope (Figure 1).

Fauna habitats

Local fauna habitats

Detailed fauna habitat mapping of the proposed Development Envelope has been completed as part of the numerous surveys undertaken for the area. Previous habitat mapping was reviewed and consolidated across BHP tenements (including most of the proposed Development Envelope), with habitat descriptions aligned between surveys undertaken across the Pilbara (Biologic, 2014), and then regularly revised as new survey data became available.

Based on this consolidation of mapping, and subsequent surveys, nine major habitat types have been described and mapped within the proposed Development Envelope (Table 20, Figure 20). A portion of the remaining previously assessed area (approved under MS683 in 2005) is unmapped. The mine began operating in 1989, prior to BHP ownership and the introduction of survey requirements.

Three water features have been mapped within the proposed Development Envelope (Figure 20). One was recorded as a dry water feature in the additional area of the proposed Development Envelope (south of the Existing Project Boundary) (Biologic, 2019) and the others as small pools within drainage lines following heavy rainfall (Ecologia, 2006a and 2006b) within the Existing Project Boundary.

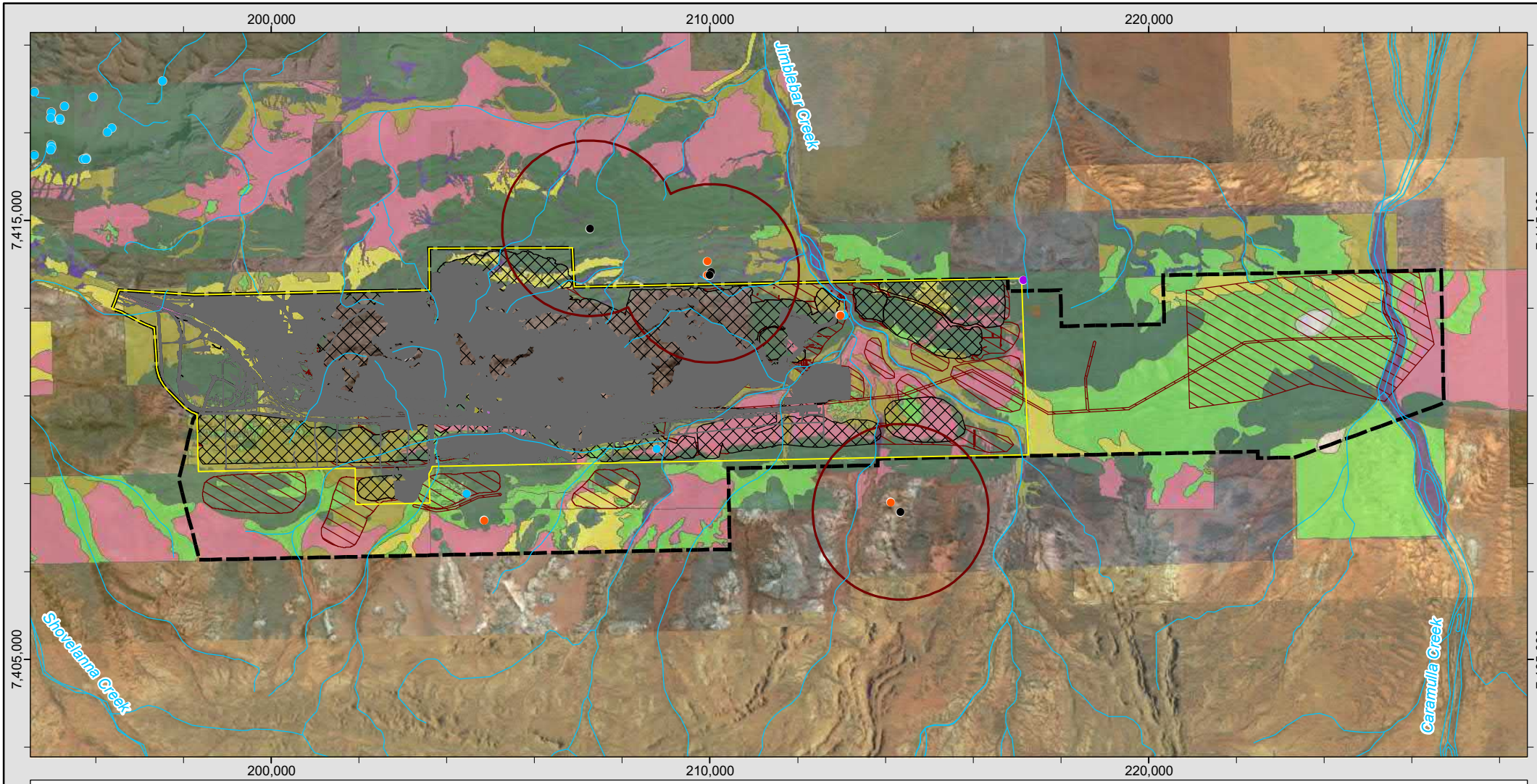
Two cave structures have been mapped within the proposed Development Envelope that have been identified as potential Ghost Bat day roosts (Figure 20). One is an adit, located in the north of the proposed Development Envelope, within the Existing Project Boundary. While it appears likely to be deep enough to provide roosting opportunities, the entrance may be too small to allow larger bats to enter (Biologic, 2018). The second, located in the additional area of the proposed Development Envelope (south of the Existing Project Boundary), is a shallow cave located on the upper slopes of a hillside (Biologic, 2019).

Table 20: Fauna habitats mapped within the proposed Development Envelope

Habitat Type	Description
Drainage Area/ Floodplain	Characterised by a low woodland over *Acacia* shrubland on sandy loam soils sometimes with exposed rocky areas. This habitat is low in relief and has been shaped by the presence and movement of surface water. These can have high vegetation density, complexity and diversity, and because they tend to occur on depositional areas, often have deeper and richer soils than other fauna habitats. Grasses tend to be dominated by tussock grasses, and commonly Buffel Grass (**Cenchrus ciliaris*).
Gorge/ Gully	Rugged, steep-sided valleys incised into the surrounding landscape. Gorges tend to be deeply incised, with vertical cliff faces, while gullies are more open. Caves and rock pools are most often encountered in this habitat type. Vegetation can be dense and complex in areas of soil deposition or sparse and simple where erosion has occurred.
Claypan (also referred to as Gilgai Plain)	Often associated with tussock grasses. Cracking clay soils, usually containing weak crabhole (gilgai) micro-relief, and which are generally saline at depth. Surface mantles are absent or common to abundant as pebbles and cobbles of ironstone, basalt and other rocks.
Hillcrest/ Hillslope	Tend to be dominated by *Triodia* hummock grasses with *Eucalyptus* woodlands and *Acacia* scrublands. The habitat is more open and structurally simple due to their position in the landscape than other fauna habitats. A common feature of this habitat is a rocky substrate, often with exposed bedrock, and skeletal red soils. This habitat may also contain minor drainage line features associated with minor gullies and depressions.
Major Drainage Line	Characterised by mature River Red Gums and/or Coolabahs over dry river pools, with open, sandy or gravelly. In non-grazed areas, the vegetation adjacent to the main channel or channels is denser, taller and more diverse than adjacent terrain. Buffel Grass (**Cenchrus ciliaris*) occurs in varying densities along the banks of the major drainage line. May hold temporary waterbodies (days to weeks) following significant rainfall.
Minor Drainage Line	Located within the minor depressions, generally through the Hillcrest/ Hillslope habitat. Consists primarily of *Acacia* low shrubland. The understorey generally lacks density and often consists solely of sparse tussock grassland, often including the weed Buffel Grass (**Cenchrus ciliaris*) where it has been introduced. The substrate can be sandy in places but generally consists of a skeletal loam gravel or stone.
Mulga Woodland	This habitat includes woodlands and other ecosystems in which Mulga is dominant. It consists of broad groves on stony or sandy soils, with little undergrowth.
Sand Plain	Characterised by relatively deep sandy soils supporting dense spinifex grasslands and sparse low shrubs. This habitat transitions into patches of Mulga in places.
Stony Plain	This habitat is erosional surfaces of gently undulating plains, ridges and associated foot slopes. Mainly support hard spinifex (and occasionally soft spinifex) with a mantle of gravel and pebbles. This habitat may also contain minor drainage line features associated with minor gullies and depressions.

Threatened and Priority Ecological Communities

As discussed in Section 6.3.2, no TECs or PECs have been recorded from within or adjacent to the proposed Development Envelope. The nearest TEC is the Ethel Gorge TEC, with the buffer of this TEC occurring 10.5 km west of the proposed Development Envelope.



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Fauna Habitat Mapping

Scale @ A4: 1:125,000	Prepared: J.VIS	Project No: A949/56 REV 0
Date: 26/08/2019	Checked:	Figure: 20
Revision: REV 0	Reviewed: ENVIRO. A&I	

Habitat Type
- Breakaway/ Cliff
- Calcrete Plain
- Claypan
- Drainage Area/ Floodplain
- Gorge/ Gully
- Hillcrest/ Hillslope
- Major Drainage Line
- Medium Drainage Line
- Minor Drainage Line
- Mulga Woodland
- Sand Plain
- Stony Plain

- Existing Project Boundary
- Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint
- Watercourse

Habitat Feature
- Cave with evidence of Ghost Bat
- Cave with no evidence of Ghost Bat
- Cave unable to be accessed
- Water features
- Ghost Bat foraging range

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_056_E_FaunaHabitatMappingCaveBuffer_Rev0.mxd

Significant Fauna

Threatened Fauna

One fauna species gazetted as Threatened Fauna under the State BC Act and the Commonwealth EPBC Act has been recorded from within the proposed Development Envelope (Figure 21); the Ghost Bat (*Macroderma gigas*), listed as Vulnerable under the BC Act and EPBC Act. The Ghost Bat is a Commonwealth MNES.

Ghost Bats roost in deep, complex caves beneath bluffs of low, rounded hills, granite rock piles and abandoned mines. These features often occur within habitat types including Gorge/ Gully, Hillcrest/ Hillslope and Low Hills (Armstrong and Anstee, 2000).

The Ghost Bat was recorded from within the proposed Development Envelope as a sighting of an individual traversing over the Hillcrest/ Hillslope habitat type (Ecologia, 2006a), east of Jimblebar Creek within the Existing Project Boundary (Figure 21). A subsequent review of recordings taken from the nearby adit during the Ecologia (2006a) survey determined that this survey falsely recorded the Ghost Bat (Outback, 2009; Specialised Zoological, 2009) and therefore this historical record is considered unconfirmed.

There are two potential day roosts (one adit and one cave) located within the proposed Development Envelope (Figure 20). Despite surveys occurring over a number of years, neither structure has any evidence of use by Ghost Bats, i.e. scats, feeding remains or acoustic records (Biologic, 2018 and 2019; GHD, 2019). Additionally, the entrance to the adit has been assessed as potentially being too small to allow Ghost Bats to enter (Biologic, 2018).

A number of caves have been recorded outside of the proposed Development Envelope in two locations to the north and one location to the south (Figure 20). Five caves recorded to the north have been classified as potential day roosts, based on the structure and features of the cave and its suitability to support ghost bats. Of these, three have evidence of ‘old’ or ‘very old’ Ghost Bat scats and the remaining two caves have no evidence of use (GHD, 2019). A small amount of feeding evidence (assessed as potentially from Ghost Bats) was recently recorded under an overhang (GHD, 2019) north of the proposed Development Envelope (Figure 21). Approximately 70 m from the feeding evidence is a potential cave in the rock face that was not possible to be investigated safely (GHD, 2019). To the south, two caves have been recorded; one as a potential day roost with no evidence of use and the other as a large potential day roost or potential maternity roost (GHD, 2019). Recent scats from the Ghost Bat have been recorded at this cave.

Due to the likely presence of Ghost Bats in these nearby caves, there is the potential that Ghost Bats may forage over suitable habitat within the proposed Development Envelope. Studies on Ghost Bat foraging found that the species move up to 2 km from a roost cave utilising large trees as vantage points to hunt (Churchill, 1998; GHD, 2019). Within the proposed Development Envelope, the species may forage within the Gorge/ Gully, Major Drainage Line or Minor Drainage Line habitat types, which support large trees (e.g. along Jimblebar and Caramulla Creek) or along the valleys with deep gullies (GHD, 2019). The small areas of breakaway within the Hillslope/ Hillcrest habitat type provide potential foraging habitat for the Ghost Bat but typically, the low hills of the Hillslope/ Hillcrest in the proposed Development Envelope do not have the vegetation structure to support the species’ foraging habits (GHD, 2019).

Figure 20 shows the estimated foraging areas for Ghost Bats (based on 2 km radius from caves known to have evidence of Ghost Bat use), most of which is located within the Existing Project Boundary. Within the foraging areas, there is minimal suitable foraging habitats for the Ghost Bat within the proposed Development Envelope, as a large portion of the areas are already cleared for the Existing Project. Most of the remaining areas consist of the Hillcrest/ Hillslope and Sand Plain habitat types, with only small portions of Breakaway, Minor and Major Drainage Line habitat types (Figure 20).

No other evidence of fauna species gazetted as Threatened fauna has been recorded from within the proposed Development Envelope. The closest record of another Threatened fauna species is of the Greater Bilby (*Macrotis lagotis*), which is listed as Vulnerable under the BC Act and EPBC Act, and is a Commonwealth MNES. The record

of the Greater Bilby is from an historical inactive burrow located over 5.5 km to the east of the proposed Development Envelope (Biologic, 2018). Recent targeted surveys were undertaken within, and adjacent to, the proposed Development Envelope in its preferred habitat (i.e. Sand Plain and Mulga Woodland habitat types) (Biologic, 2018; GHD, 2019). No new or recent evidence of this species was recorded. A sand goanna recorded on camera at the historical burrow was presumed to utilise the burrow (with tail drags present around the entrance) (GHD, 2019).

Priority Fauna

Three Priority fauna species, as listed by the DBCA, have been recorded from within the proposed Development Envelope (Figure 21):

- Western Pebble-mound Mouse (*Pseudomys chapmani*) (Priority 4);
- Brush-tailed Mulgara (*Dasycercus blythi*) (Priority 4); and
- Spotted Ctenotus (*Ctenotus uber johnstonei*) (Priority 2).

The Western Pebble-mound Mouse is known to occur from 22 records within the Hillcrest/ Hillslope and Stony Plain habitat types of the proposed Development Envelope (Figure 21). There are records in the Existing Project Boundary (northwest and south) and in the additional area of the proposed Development Envelope (east of the Existing Project Boundary). This Pilbara endemic species is known to occur on the gentler slopes of rocky ranges where the ground is covered with a stony mantle and vegetated by hard spinifex, often with a sparse overstorey of eucalypts and scattered shrubs (Start *et al*., 2000).

The Brush-tailed Mulgara inhabits areas of *Triodia* grasslands on sand plains and the swales between low dunes (Woolley, 2006), with mature spinifex hummocks important for protection from introduced predators. Evidence of the Brush-tailed Mulgara (i.e. burrows) has been recorded within the Sand Plain habitat type from 23 records from two areas within the proposed Development Envelope; in the south-western and far eastern section of the additional area of the proposed Development Envelope (Figure 21).

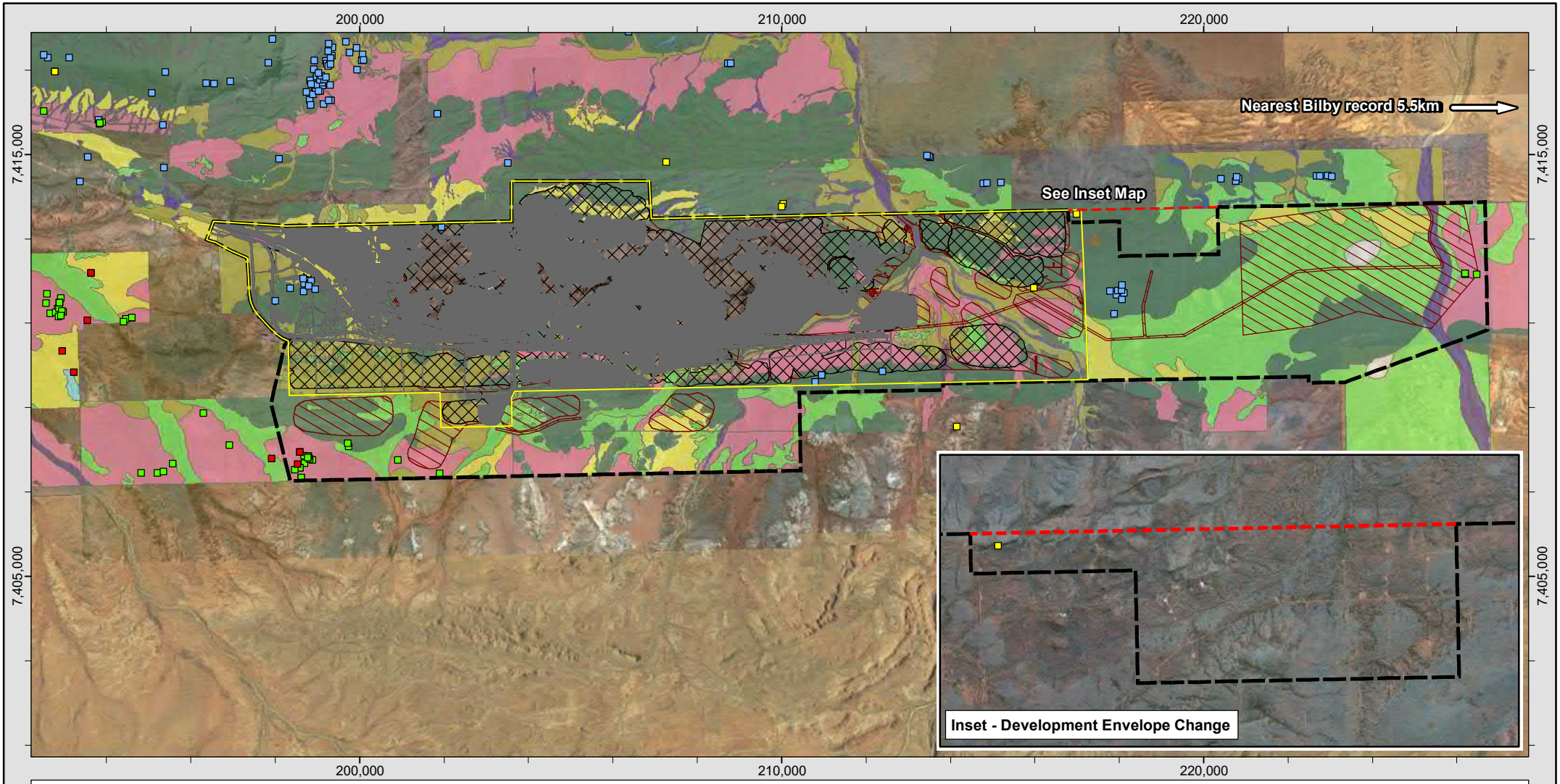
The subspecies of Spotted Ctenotus was first described in 1980 from Balgo Hill in the far northeast of Western Australia (Storr, 1980), and with little known of this taxon it was listed as Priority 2 by the DBCA. This species has been recorded from four records in the south-western section of the additional area of the proposed Development Envelope from within the Sand Plain habitat type (Figure 21). Within the Pilbara, this species has also been recorded from *Triodia* hillslopes with tall *Acacia* shrubs, Mulga woodland and stony plains (Biologic, 2013).

Short-range Endemic Invertebrate Fauna

One confirmed and six potential SRE invertebrate fauna species have been recorded from within the proposed Development Envelope (Figure 22):

- *Buddelundia* sp. '10NM' (Potential SRE);
- *Buddelundia* sp. '14CR' (Potential SRE);
- *Buddelundia* sp. '36NM' (Potential SRE);
- *Buddelundia* sp. '49' (Potential SRE);
- *Karaops* ARA004-DNA (Confirmed SRE);
- *Lychas* sp. 'bituberculatus group' (Potential SRE); and
- *Synsphyronus* sp. indet. (Potential SRE).

All records are within the Existing Project Boundary (north) and in the additional area of the proposed Development Envelope south of the Existing Project Boundary. All species are known to occur from rocky microhabitats of the Hillslope/ Hillcrest habitat type from within the proposed Development Envelope and adjacent areas (Figure 22).



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Significant Fauna Species

Scale @ A4: 1:130,000	Prepared: J.VIS	Project No: A949/51 REV 0
Date: 21/08/2019	Checked:	Figure: 21
Revision: REV 0	Reviewed: ENVIRO. A&I	

- Existing Project Boundary
- Proposed Development Envelope
- Original Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint

Significant Fauna Species
- Brush-tailed Mulgara (Priority 4)
- Ghost Bat (Vulnerable)
- Spotted Ctenotus (Priority 2)
- Western Pebble-mound Mouse (Priority 4)

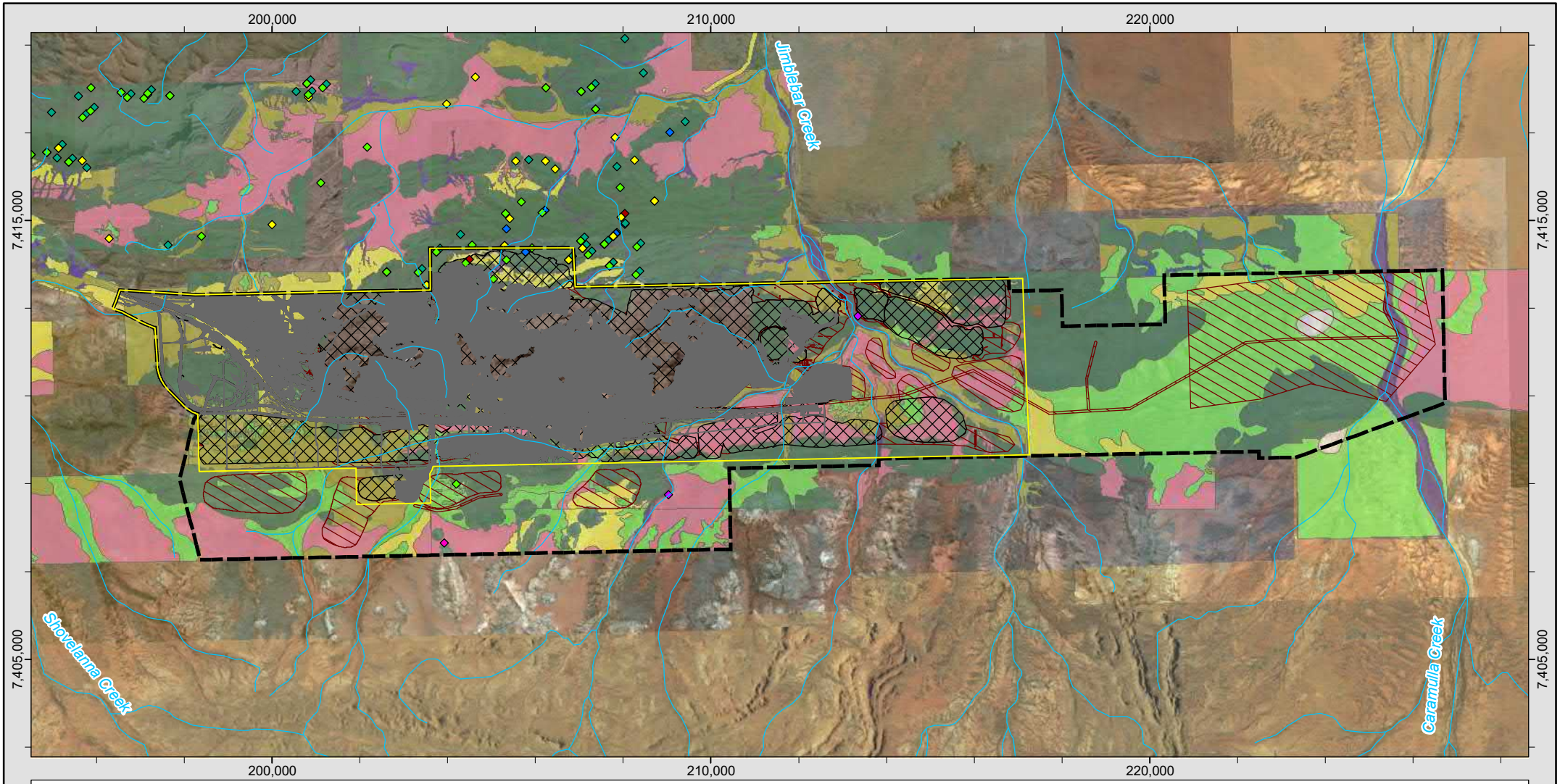
Habitat Type
- Breakaway/ Cliff
- Calcrete Plain
- Claypan
- Drainage Area/ Floodplain
- Gorge/ Gully
- Hardpan Plain
- Hillcrest/ Hillslope
- Major Drainage Line
- Medium Drainage Line
- Minor Drainage Line
- Mulga Woodland
- Sand Plain
- Stony Plain

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_051_E_SignificantFaunaSpecies_Rev0.mxd



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Short-range Endemic Invertebrate Fauna Species

Scale @ A4: 1:125,000	Prepared: J.VIS	Project No: A949/50 REV 0
Date: 21/08/2019	Checked:	Figure: 22
Revision: REV 0	Reviewed: ENVIRO. A&I	

Habitat Type
- Breakaway/ Cliff
- Calcrete Plain
- Claypan
- Drainage Area/ Floodplain
- Gorge/ Gully
- Hillcrest/ Hillslope
- Major Drainage Line
- Medium Drainage Line
- Minor Drainage Line
- Mulga Woodland
- Sand Plain
- Stony Plain

- Watercourse
- Existing Project Boundary
- Proposed Development Envelope
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint

Short-range Endemic Invertebrate Fauna Species
- Lychas sp. bituberculatus group
- Synsphyronus sp. indet.
- Buddelundia sp. `14CR`
- Buddelundia sp. `49`
- Buddelundia sp. `10NM`
- Buddelundia sp. `36NM`
- Karaops ARA004-DNA

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_050_E_SRE_FaunaMapping_Rev0.mxd

7.4 Potential impacts

The implementation of the Project will result in both direct and indirect potential impacts. BHP has considered the potential impacts outlined in the EPA's Terrestrial Fauna Guideline (2016c) and considers that those relevant to the Project are:

- removal of fauna habitats (direct);
- changes to fauna habitat from changes to water regimes (indirect);
- interactions with mining-related infrastructure (direct);
- interactions with and changes to fauna habitat from introduced species (direct and indirect); and
- changes to fauna habitat from fire (indirect).

As discussed in Section 2.3.3, a large proportion of the proposed Development Envelope is within the Existing Project Boundary (Figure 3), where impacts have already been assessed and approved. Therefore, BHP has focused the discussion on potential impacts of the Project on fauna habitats in the Indicative Footprint and to the additional areas to the south and east of the Existing Project Boundary. As fauna are mobile, BHP has also considered the impacts to fauna within the proposed Development Envelope. The discussion of cumulative impacts considers existing impacts, including from the Existing Project.

Unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation and/or management measures are applied, if required).

7.4.1 Removal of fauna habitats

The proposed activities will result in the direct impact to fauna habitat through the clearing of up to 2,000 ha of vegetation within the proposed Development Envelope (as described under Section 6.4.1). This has the potential to impact on the representation of habitat, and on conservation significant fauna species and SRE invertebrate fauna species. The proposed clearing and construction of infrastructure has the potential to result in habitat fragmentation and/or barriers to the movement of fauna species.

Fauna habitats

Local fauna habitats

Detailed habitat mapping completed for the proposed Development Envelope identified ten major fauna habitat types, with all but one habitat type (Minor Drainage Line) occurring within the Indicative Footprint (Table 21).

Broad scale mapping at the same detailed level of the habitat type mapping occurs over a limited extent within the Pilbara. However, the consolidation of fauna habitat mapping completed within BHP's Pilbara tenure (Biologic, 2014) provides a unique database on which to undertake preliminary assessment of the representation of the habitats across the Pilbara.

Table 21 shows the area of each habitat type within the Indicative Footprint and the proposed Development Envelope. As previously discussed, the Indicative Footprint area (2,712 ha) is greater than the proposed clearing of 2,000 ha. Therefore, Table 21 shows the maximum area of any habitat type that may be impacted but the total impact to all habitat types would be up to 2,000 ha. Assuming disturbance occurs within the Indicative Footprint, the potential impact to any fauna habitat type (as a percentage of the mapped extent of the habitat types within the consolidated database) is 2.4% or less.

Potential foraging habitat for the Ghost Bat within the proposed Development Envelope was identified as the Gorge/ Gully, Minor or Major Drainage Line habitat types, which support large trees (e.g. along Jimblebar and Caramulla Creek) or within the Breakaway and along the valleys with deep gullies (GHD, 2019). As discussed in Section 7.3.2, the Ghost Bat is known to forage up to 2 km from a roost. Based on roosts that have evidence of use by Ghost Bats

(Figure 20), the estimated foraging area within the Project area is calculated to be 3,599 ha. Based on this area, there is 29.4 ha of suitable foraging habitat for this species within the Indicative Footprint and 48.9 ha within the proposed Development Envelope, almost all of which occurs within the Existing Project Boundary. Therefore, the potential impact to foraging habitat is estimated to be less than 1% of the estimated foraging area, assuming disturbance occurs within the Indicative Footprint. (Figure 20; Table 22).

The Mulga Woodland and Sand Plain and habitat types located in the east of the proposed Development Envelope represent potential Bilby habitat for burrowing and foraging (GHD, 2019). These habitat types are located within the proposed MAR borefield area where the required clearing is estimated to be approximately 400 ha within an indicative area of 1,455 ha.

Of the three water features mapped within the proposed Development Envelope (Figure 20), one is located in the previously assessed area to the south within the Existing Project Boundary. The other two are located in the Indicative Footprint. A water feature which was recorded as a small pool within a drainage line following heavy rainfall (Ecologia, 2006b) is located within Existing Project Boundary, adjacent to a previously assessed area in the north. The water feature recorded as a dry water feature is located in the area identified for OSAs in the additional area of the proposed Development Envelope to the south of the Existing Project Boundary.

Of the two cave structures mapped within the proposed Development Envelope (Figure 20), one is located within the Indicative Footprint. The adit located in the north of the proposed Development Envelope, within the Existing Project Boundary, is in an area proposed for infrastructure (Figure 20). Based on the Indicative Footprint, the adit will be impacted. The potential day roost (cave) mapped from within the additional area of the proposed Development Envelope (south of the Existing Project Boundary) is located outside the Indicative Footprint and is not expected to be impacted.

Table 21: Potential impacts to fauna habitat types

Habitat Type	Area within Development Envelope (ha)			Area within Indicative Footprint (ha)	Area within BHP Consolidated Mapping (ha)	Area within Indicative Footprint as % Area of Consolidated Mapping
	Existing Project Boundary area (ha)	Additional area (ha)	Total (ha)			
Drainage Area/ Floodplain	1518	158	1,676	264	38,507	0.7%
Gorge/ Gully	4.51	0	4.51	0.77	5,453	0.0%
Claypan/ Gilgai Plain	0	57.3	57.3	40	2,564	1.6%
Hillcrest/ Hillslope	2527	1747	4,274	660	233,788	0.3%
Major Drainage Line	88.9	121	210	90	14,889	0.6%
Minor Drainage Line	31.3	0	31.3	0	10,678	0%
Mulga Woodland	308	2357	2,665	1,121	47,247	2.4%
Sand Plain	921	914	1,836	330	65,965	0.5%
Stony Plain	537	536	1,073	206	48,636	0.4%
Cleared/ Unmapped	2379	0	2,379	0	N/A	N/A
Total	**8,315.6**	**5,889.8**	**14,205.4**	**2,712**		

Table 22: Potential impacts to Ghost Bat foraging habitat

Habitat type	Area of foraging habitat within Development Envelope (ha)			Foraging area in Development Envelope as % of estimated foraging area	Area of foraging habitat within Indicative Footprint (ha)	Foraging area in Indicative Footprint as % of estimated foraging area
	Existing Project Boundary area (ha)	Additional area (ha)	Total (ha)			
Drainage Area/ Floodplain	37.1	0	37.1	1.03%	25.0	0.69%
Gorge/ Gully	1.2	0	1.2	0.03%	0.77	0.02%
Major Drainage Line	9.5	1.1	10.5	0.29%	3.55	0.10%
Total	**47.7**	**1.1**	**48.8**	**1.36%**	**29.4**	**0.82%**

Threatened and Priority Ecological Communities

As discussed in Section 6.3.2, no TECs or PECs have been recorded from within or adjacent to the proposed Development Envelope. The Project will have no impacts on TECs or PECs.

Significant Fauna

Four significant fauna species are known to occur within the proposed Development Envelope (Table 23, Figure 21). Table 23 shows the number of records of each species occurring within the proposed Development Envelope and the Indicative Footprint.

Threatened Fauna

As discussed in Section 7.3.2, there is one record of a Threatened species (Ghost Bat, unconfirmed record) in the proposed Development Envelope. The record of an individual traversing the area is located in an area proposed for infrastructure within the Indicative Footprint, within the Existing Project Boundary (Figure 21). The potential impact to this species, based on individual records, is less than 1% of the known records of this species (assuming disturbance occurs within the Indicative Footprint or anywhere within the proposed Development Envelope) (Table 23). When considering cumulative impacts (existing impacts from other projects and potential impacts within the Development Envelope), the potential impact is estimated to be 2% of known records (Table 23).

As discussed in Section 7.3.2, the closest record of another Threatened fauna species is of the Greater Bilby, located 5.5 km east of the proposed Development Envelope. Due to the lack of evidence of this species within or adjacent to the proposed Development Envelope, BHP considers that it is unlikely that the species will be impacted by the Project.

Priority Fauna

The Brush-tailed Mulgara (Priority 4 species) is known from 23 records within the proposed Development Envelope, all from the south-western and eastern extent of the additional area of the proposed Development Envelope. There are four records (active and inactive burrows) of the Brush-tailed Mulgara within the Indicative Footprint, all within the proposed MAR borefield area. The potential impact to these species, based on individual records, is less than 1% of the known records of this species (assuming disturbance occurs within the Indicative Footprint or anywhere within the proposed Development Envelope) (Table 23). The cumulative impact (existing impacts from other projects and potential impacts within the Development Envelope) is estimated to be less than 1% (Table 23).

The Western Pebble-mound Mouse (Priority 4 species) is known from 22 records within the proposed Development Envelope. The species was recorded in the northwest and southeast of the Existing Project Boundary and in the additional area of the proposed Development Envelope, east of the Existing Project Boundary. There are no records of the Western Pebble-mound Mouse within the Indicative Footprint, so there would be no impacts to known records of Western Pebble-mound Mouse assuming disturbance occurs within the Indicative Footprint. The potential impact to this species, based on individual records, is less than 1%, assuming disturbance occurs anywhere within the proposed Development Envelope (Table 23). The cumulative impact (existing impacts from other projects in the Pilbara and potential impacts within the Development Envelope) is estimated to be less than 6.1% (Table 23).

The Spotted Ctenotus (Priority 2) is known from four records in the southwest corner of the additional area of the proposed Development Envelope (Figure 21). The records of this species are located outside the Indicative Footprint (Figure 21), so there would be no impacts to known records of this species assuming disturbance occurs within the Indicative Footprint. The potential impact to this species, based on individual records, is 8.9%, assuming disturbance occurs anywhere within the proposed Development Envelope (Table 23). There are no known existing impacts to this species from other projects; therefore there are no known cumulative impacts to this species (Table 23).

Table 23: Potential impacts to significant fauna

Species	Known records within WA[1]	Records within Development Envelope	Records within Development Envelope as % Known records	Records within Indicative Footprint	Records within Indicative Footprint as % Known records	Existing impacts from other projects[4]	% Possible impact to Records (Cumulative of Development Envelope and Existing)
Threatened Fauna							
Ghost Bat (*Macroderma gigas*)	1,824	1 (unconfirmed animal sighting)	0.05%	1	0.05%	35	2.0%
Priority Fauna							
Western Pebble-mound Mouse (*Pseudomys chapmani*)	3,531	22 (mounds)	0.6%	0	0%	194	6.1%
Brush-tailed Mulgara (*Dasycercus blythi*)	2,537	23 (burrows, scats or tracks)	0.9%	4	0.2%	1	0.9%
Spotted Ctenotus (*Ctenotus uber johnstonei*)	45	4 (animal sighting)	8.9%	0	0%	0	8.9%

1. Based on BHP database and data presented in BHP Billiton Iron Ore Pilbara Strategic Proposed Flora and Vertebrate Fauna Screening Assessment (BHP 2017).

SRE Invertebrate Fauna

Table 24 shows the number of records of each species occurring within the proposed Development Envelope and the Indicative Footprint. One confirmed (*Karaops* ARA004-DNA) and six potential SRE invertebrate fauna species have been recorded within the proposed Development Envelope (Table 24, Figure 22).

One record of *Buddelundia* sp. '14CR', one record of *Lychas* sp. bituberculatus group and one record of *Synsphyronus* sp. indet are located within the additional area of the proposed Development Envelope, south of the Existing Project Boundary. All other records are located in the Existing Project Boundary area of the proposed Development Envelope and of these all except one record of *Lychas* sp. bituberculatus group are located in the north of the Existing Project Boundary, which has been assessed and approved for OSAs.

Only one potential SRE species (*Buddelundia* sp. '14CR') has been recorded within the Indicative Footprint (one record). Assuming disturbance occurs within the Indicative Footprint, the potential impact to this species, based on individual records, is 5.8% of the known records of this species. There would be no impacts to known records of other SRE species.

Assuming disturbance occurs anywhere within the proposed Development Envelope, the potential cumulative impact (existing impacts from other projects in the Pilbara and potential impacts within the proposed Development Envelope) to the records of the potential SRE invertebrate fauna species, *Buddelundia* sp. '10NM', *Buddelundia* sp. '14CR' and *Buddelundia* sp. '49', is estimated to be less than 15% (Table 24). For the remaining species, the potential cumulative impact is 20% to 50% (Table 24).

Most of the fauna habitat types occurring within the proposed Development Envelope is rated as low to moderate suitability for SRE invertebrate fauna. The habitats occurring in the proposed Development Envelope considered to be of greatest likelihood to support SRE invertebrate fauna species are the Gorge/ Gully (high suitability for gorges and south-facing gullies, and moderate to high suitability for north-facing gullies) and Hillcrest/ Hillslope (moderate to high suitability).

The extent of the Gorge/ Gully habitat type within the proposed Development Envelope is restricted to less than 5 ha occurring across small isolated pockets adjacent to the existing operations in the Existing Project Boundary) (Table 21). Approximately 4,274 ha of the Hillcrest/ Hillslope habitat type has been mapped from within the proposed Development Envelope, of which 660 ha occurs within the Indicative Footprint (Table 21).

Table 24: Potential impacts to SRE fauna

Species	Known records within Pilbara[1]	Records within Development Envelope	Records within Indicative Footprint	Records within Indicative Footprint as % Known records	Records within Existing Project Boundary area of Development Envelope (Impact assessed and approved)	Existing impacts from other projects	% Possible impact to Records (Cumulative of Development Envelope and Existing)
Karaops ARA004-DNA	10	2	0	0%	2	0	20%
Buddelundia sp. '10NM'	49	3	0	0%	3	4	14%
Buddelundia sp. '14CR'	173	9	1	5.8%	8	2	6.4%
Buddelundia sp. '36NM'	4	1	0	0%	1	0	25%
Buddelundia sp. '49'	72	3	0	0%	3	1	5.6%
Lychas sp. 'bituberculatus group'	8	2	0	0%	0	0	25%
Synsphyronus sp. indet.	2	1	0	0%	1	0	50%

1. Based on BHP internal database.

7.4.2 Changes to water regimes

Discharge of surplus water into Caramulla Creek has the potential to alter the composition of the vegetation, which may change the structure of fauna habitats present. As discussed under Section 6.4.2, the proposed discharge may impact the health of up to 71 ha of riparian vegetation along the creek. The potential reduction in the health of riparian vegetation is not expected to result in substantial changes to the habitat features of the creek or impact on the species that may utilise the creek for foraging or dispersal.

As discussed in Section 6.4.2, injection modelling for the Caramulla MAR scheme shows that for some scenarios, groundwater levels will rise to within 25 m of the ground level. Due to the uncertainty of the modelling results, BHP has not quantified the potential impacts to facultative phreatophyte species. However, BHP has proposed to control groundwater mounding so that there is no impact on vegetation (see Section 6.6). If there were impacts to facultative phreatophyte species (i.e. reduced tree health), the impacts would not be substantial and would be unlikely to impact on terrestrial fauna habitats or species.

7.4.3 Interactions with mining-related infrastructure

During construction activities associated with the Project, ground-disturbance (i.e. clearing) may result in the direct loss of fauna individuals through collision and burial. During operations, increased vehicle movements within the proposed Development Envelope may also result in an increase in vehicle collisions with wildlife, particularly nocturnal species foraging or travelling near roads at night and species that tend to be active on roads during daytime (e.g. basking).

7.4.4 Introduced species

Mining activities have the potential to introduce and spread invasive weed species that can potentially alter the fauna habitats of the area through changes in the vegetation composition. There is also potential for the introduction or increase of feral animals resulting from the increased human activity in the area. Introduced fauna species may affect native fauna through a range of factors including predation, competition for food and shelter, habitat destruction and the spread of diseases.

7.4.5 Fire

There is the potential to change the frequency of fire by actively extinguishing fires or by causing them through mining activities within the Pilbara region. An increased risk of fire could impact on terrestrial fauna directly through injury or death, or indirectly through loss or alteration of fauna habitats. There were no flora species or vegetation communities identified from the proposed Development Envelope that are considered to be sensitive to fire.

7.5 Assessment of impacts

BHP has considered the significance of terrestrial and relevant issues outlined EPA's Terrestrial Fauna Guideline (2016c) in assessing the significance of the impacts to Terrestrial Fauna from the Project. As for Section 7.4, unless specified otherwise, the potential impacts discussed in this section are unmitigated (i.e. potential impacts before mitigation and/or management measures are applied, if required).

7.5.1 Removal of fauna habitats

Fauna habitats

As discussed in Section 7.4.1, potential impact to any fauna habitat type (as a percentage of the mapped extent of the habitat types within BHP's consolidated database) is 2.4% or less. Based on the consolidated mapping, and further analysis of the likely occurrence of habitats beyond their known mapped extent, none of the fauna habitats

occurring within the proposed Development Envelope have been assessed as being regionally under-represented or of local importance. All habitats are known to be widespread in the Pilbara bioregion.

As discussed in Section 7.4.1, three water features and two cave structures have been mapped within the proposed Development Envelope. The potential impact within the Indicative Footprint is to one water feature (ephemeral drainage line pool) and one cave classified as a potential day roost (with no evidence of Ghost Bat).

None of the habitat types or the habitat features (i.e. water features or caves) mapped from within the proposed Development Envelope are considered critical habitat for species of significance and no isolated habitats known to support populations of conservation significant fauna species have been identified within the proposed Development Envelope. Therefore, BHP considers that direct impacts on vertebrate fauna habitats will not be significant.

As discussed in Section 6.4.1, there will be no impacts to TECs and PECs.

Significant fauna

Threatened Fauna

As discussed in Section 7.4.1, one Threatened species (Ghost Bat, unconfirmed record) has been recorded from one occurrence in the proposed Development Envelope. The potential impact to this species (based on individual records) from the Project is less than 1% of the known records of this species and the cumulative impact (including impacts from other projects) is estimated to be 2%. Due to the lack of records of Ghost Bats utilising the habitat types (and cave and adit) within the proposed Development Envelope despite recent targeted surveys (Biologic, 2018 and 2019; GHD, 2019), the Project is not expected to impact on any individuals, with impacts restricted to loss of potential foraging habitat.

Caves classified as potential day roosts that have evidence of use by Ghost Bats have been recorded to the north and south of the proposed Development Envelope (as discussed in Section 7.3.2). Potential foraging habitat within the proposed Development Envelope has been identified as Drainage Area/ Floodplain, Gorge/ Gully and Major Drainage Line habitat occurring within the foraging range of the known roost caves (Figure 20). As discussed in Section 7.4.1, the potential foraging habitat of the Ghost Bat within the Indicative Footprint is 29.4 ha. Assuming all of the habitat is removed within the Indicative Footprint, the impact would be 29.4 ha.

There are no important breeding or roosting populations, or critical habitat for the Ghost Bat within the proposed Development Envelope, therefore BHP considers that the Project will not have a significant impact on this species at a local or regional scale. As discussed under Section 1.3.3, the Ghost Bat is one of the Program Matters (MNES) that is covered by the Commonwealth strategic approval. Potential impacts to this species from the Project will be addressed in the Validation Notice that BHP is preparing as a requirement of the Commonwealth strategic approval (see also Section 7.6).

As discussed in Section 7.4.1, the Mulga Woodland and Sand Plain and habitat types located in the east of the proposed Development Envelope (within the proposed MAR borefield area) represent potential Bilby habitat for burrowing and foraging (GHD, 2019). The potential impact to these habitat types in the eastern area of the Indicative Footprint is considered to be low as only a portion of this area will be cleared (approximately 400 ha within an indicative area of 1,455 ha). The Sand Plain habitat is continuous and extensive to the east of the proposed Development Envelope. The Mulga Woodland habitat type extends west of the Indicative Footprint within the proposed Development Envelope and extends south of the proposed Development Envelope (Figure 20).

Priority Fauna

As discussed in Section 7.4.1, the Project has the potential to impact four records of Brush-tailed Mulgara (Priority 4) (inactive and active burrows), representing less than 1% of the known records of the species, assuming disturbance is within the Indicative Footprint or occurs anywhere within the proposed Development Envelope. Evidence of the Brush-tailed Mulgara (Priority 4) has been recorded within the Sand Plain habitat type from two areas within the proposed Development Envelope (southwest corner and eastern boundary). The preferred habitat for this species

extends well outside the proposed Development Envelope with numerous records of this species from surrounding areas. This species is widespread in a regional context, and is known from approximately 680 records in the Pilbara bioregion (BHP Billiton Iron Ore, 2016b). BHP considers that the Project will not have a significant impact on this species or the representation of its preferred habitat (i.e. Sand Plain) at the local or regional level.

As discussed in Section 7.4.1, disturbance within the Indicative Footprint will not impact on known records of the Western Pebble-mound Mouse. The Western Pebble-mound Mouse is known from the Hillcrest/ Hillslope and Stony Plain habitat types within the proposed Development Envelope, both of which occur extensively in the local area and in the Pilbara region. There are numerous records of this species in adjacent areas and beyond (including records from within conservation reserves), with over 3,000 records of this species known from the Pilbara region (BHP Billiton Iron Ore, 2016b). Assuming disturbance occurs anywhere within the Development Envelope, the potential impact to this species from the Project is less than 1% of the known records of the Western Pebble-mound Mouse and the cumulative impact (including impacts from other projects) is estimated to be 6%. BHP considers that the Project will not have a significant impact on this species at a local or regional scale.

The Spotted Ctenotus (Priority 2) has been recorded from four records within the southwest corner of the proposed Development Envelope from within Sand Plain habitat type. This species has been recorded from a number of locations within the Sand Plain habitat extending to the west beyond the boundary of the proposed Development Envelope (Figure 21). Within the Pilbara bioregion there are 22 known records of this species and 45 from within WA (BHP Billiton Iron Ore, 2016b). As discussed in Section 7.4.1, disturbance within the Indicative Footprint will not impact on known records of the Spotted Ctenotus. Assuming disturbance occurs anywhere within the Development Envelope, the potential impact to this species is 8.9% of the known records. Based on disturbance occurring within the Indicative Footprint and the known occurrence of this species (and its habitat) outside the proposed Development Envelope in the surrounding area, BHP considers that the Project will not have a significant impact on this species at a local or regional scale.

SRE invertebrate fauna

As discussed in Section 7.4.1, assuming disturbance is within the Indicative Footprint, there would be a potential impact to one record of the potential SRE species (*Buddelundia* sp. '14CR') or 5.8% of the known records of this species. There would be no impacts to known records of other SRE species from the Project.

Most records are located in the northern section of the Existing Project Boundary of the proposed Development Envelope, which has been assessed and approved for OSAs. Assuming disturbance occurs anywhere within the proposed Development Envelope, the potential cumulative impact to the potential SRE invertebrate fauna species, *Buddelundia* sp. '10NM', *Buddelundia* sp. '14CR' and *Buddelundia* sp. '49', is estimated to be less than 15% and for the remaining species, the potential cumulative impact is 20% to 50%. This is a reflection of the species being infrequently recorded during survey within the Pilbara. However, these species are all located outside the Indicative Footprint (Figure 22). Therefore, BHP considers that the potential direct impacts to SRE invertebrate fauna species from the Project are not significant.

As discussed in Section 7.4.1, most of the fauna habitats occurring within the proposed Development Envelope have been assessed as being of low to moderate or low suitability for SRE invertebrate fauna. The habitats provide little or limited protection and complexity, and are often widespread and continuous through the landscape, thus allowing easy dispersal for invertebrate taxa that occupy such habitats. The habitats occurring in the proposed Development Envelope considered to be of greatest likelihood to support SRE invertebrate fauna species are the Gorge/ Gully (high suitability for gorges and south-facing gullies, and moderate/high suitability for north-facing gullies) and Hillcrest/ Hillslope (moderate/high suitability). The Gorge/ Gully habitat type is known to provide the highest level of protection, isolation and complexity, with a higher persistence of moisture, while Hillcrest/ Hillslope habitat types may act as terrestrial islands, providing suitable rocky habitats and microhabitats for a number of SRE taxa.

As discussed in Section 7.4.1, the extent of Gorge/ Gully habitat within the proposed Development Envelope is restricted to less than 5 ha occurring across small isolated pockets adjacent to the existing operations in the Existing

Project Boundary. This reduces the suitability of these areas as habitat for SRE species within the proposed Development Envelope. Although not directly connected, Gorge/ Gully habitat has been mapped adjacent to the proposed Development Envelope, especially to the north.

Approximately 4,274 ha of Hillcrest/ Hillslope habitat has been mapped from within the proposed Development Envelope, of which 660 ha occurs within the Indicative Footprint. The Hillcrest/ Hillslope habitat is known to occur extensively beyond the proposed Development Envelope extending to the north, in particular in the area adjacent to and east of BHP's Orebody 18 operations. Approximately 3,095 ha of Hillcrest/ Hillslope habitat has been mapped from the area to the north of the proposed Development Envelope (and east of Orebody 18), and is continuous with the habitat of the proposed Development Envelope. However, not all of its mapped extent would provide suitable habitat for species as they rely on specific microhabitats within this habitat type.

Due to the extensive and continuous occurrence of habitat outside of the proposed Development Envelope, BHP considers that the Project will not have a significant impact on the local availability of habitats considered highly suitable for SRE invertebrate fauna species.

7.5.2 Changes to water regimes

As discussed in Section 7.4.2, the potential reduction in the health of riparian vegetation or change in vegetation composition from surplus water discharge in Caramulla Creek is not expected to result in substantial changes to the habitat features of the creek or impact on the species that may utilise the creek for foraging or dispersal. Groundwater level rise (mounding) from the MAR groundwater injection is unlikely to significantly alter the habitats for fauna species. Therefore, BHP considers that the proposed discharge of surplus water into is not expected to have a significant impact on the fauna habitat along Caramulla Creek or fauna habitat within the MAR mounding area.

7.5.3 Interactions with mining-related infrastructure

Construction and operational activities may result in an increase in vehicle collisions with wildlife with certain species being at a higher risk than others (e.g. nesting birds or smaller mammals). The risk to conservation significant fauna from interactions with mining-related infrastructure has been assessed as low with conservation significant fauna species recorded from the proposed Development Envelope occurring at low densities (based on known records within the proposed Development Envelope, compared to surrounding areas). It is considered that the risk of interactions with mining-related infrastructure from the Project will not significantly increase from that of the Existing Project. Therefore, BHP considers that there will not be a significant impact to fauna from interactions with mining-related infrastructure.

7.5.4 Introduced species

The occurrence and potential increase of introduced flora species within the proposed Development Envelope are not expected to alter fauna habitats to an extent that would result in an impact to any fauna species of significance. The activities associated with the implementation of the Project are not expected to increase the numbers or presence of introduced fauna species beyond current observations. Therefore, BHP considers that there will not be a significant impact to native fauna from introduced fauna species.

7.5.5 Fire

There were no flora species or vegetation communities identified from the proposed Development Envelope that are considered to be sensitive to fire, with native fauna and fauna habitats in the Pilbara being adaptive to natural fire regimes (BHP Billiton Iron Ore, 2016b). BHP considers that there will not be a significant impact to native fauna from the potential alteration of fire regimes from the implementation of the Project.

7.5.6 Summary

Table 25 summarises the potential unmitigated impacts from the Project on terrestrial fauna values. BHP has concluded that there are no potential significant impacts on terrestrial fauna values from the Project. General mitigation measures that also relevant to terrestrial fauna are discussed in Section 7.6.

Table 25: Summary of potential significant impacts on Terrestrial Fauna

Potential impact (unmitigated)	Value	Potentially significant
Removal of fauna habitats (direct)	Local fauna habitats (detailed mapping)	No
	Suitability of SRE habitats	No
	Conservation significant fauna	No
	SRE invertebrate fauna	No
Changes to water regimes (indirect)	Fauna habitats	No
Interactions with mining-related infrastructure (direct)	Conservation significant fauna	No
Introduced species (direct and indirect)	Fauna habitats and significant fauna	No
Alteration of fire regime (indirect)	Fauna habitats and significant fauna	No

7.6 Mitigation

7.6.1 Avoid

BHP modified the proposed Development Envelope to avoid the overhang (Figure 21) where feeding evidence (assessed as potentially from Ghost Bats) was recently recorded. This reduced the potential direct impact to this species from two records to one unconfirmed record, assuming disturbance is within the Indicative Footprint or occurs anywhere within the proposed Development Envelope. The Project will avoid direct impacts to cave structures (classified as potential day roosts) that are known to be used by Ghost Bats. All caves with evidence of Ghost Bat use (i.e. historical or recent scats) occur outside of the proposed Development Envelope.

7.6.2 Minimise

Existing infrastructure at the Jimblebar mining operations will be utilised where practicable to minimise the amount of clearing required for infrastructure to support the Project. BHP will design and construct infrastructure according to standard internal practices, to minimise clearing of habitat types utilised by conservation significant fauna.

BHP considers that no specific management measures are required in relation to potential impacts on terrestrial fauna, as there are no significant habitat types or features, and only minor potential impacts to significant fauna species or SRE invertebrate fauna species.

There will only be minimal direct impacts to potential Ghost Bat foraging habitat occurring within the proposed Development Envelope. As discussed in Section 7.5.1, potential impacts to this species from the Project will be addressed in the Validation Notice that BHP is preparing as a requirement of the Commonwealth Strategic Approval.

7.6.3 Rehabilitate

Rehabilitation at Jimblebar is addressed in the updated *Jimblebar Mine Closure Plan* (MCP) (BHP, 2019e) (Appendix 16). The MCP covers the Existing Project and BHP revised the 2016 version of the MCP to include this Project (BHP, 2019e).

The revised MCP addresses the rehabilitation of the additional areas that will be disturbed. Management approaches relating to terrestrial fauna for the Project, particularly in relation to fauna habitat (and in addition to those for flora and vegetation (Section 6.6.3)), include:

- Integrate fauna habitats (e.g. large rocks) into landform design.
- Design the revegetation program to establish native vegetation that blends with the surrounding areas and will provide habitat and foraging areas for native fauna.
- Choose appropriate surface treatments, including selective placement of logs or smaller woody debris and/or boulders (if available) across the re-profiled surface and/or constructing rocky cliff features (where potential exists) to provide additional habitat areas for fauna species.

7.7 Predicted outcome

BHP considers that there will not be any significant impacts on Terrestrial Fauna values from the Project.

Following the application of the mitigation hierarchy (Section 7.6) and applying the Residual Impact Significance Model in the *WA Offsets Guidelines* (Government of Western Australia, 2014), BHP considers that there is no significant residual impact to Terrestrial Fauna from the Project, as there will be not be a significant impact to habitat of fauna species that are specially protected under the BC Act or are listed as threatened species under the EPBC Act.

Below is a summary of the measures that BHP proposes to manage the potential impacts to vegetation (Section 7.7), which are also relevant for Terrestrial Fauna habitat, so that the impacts to Terrestrial Fauna are not significant:

- Control clearing to minimise impacts to fauna habitat, through the authorised extent in Schedule 1 of the proposed implementation conditions.
- Implement the *Jimblebar Mine Closure Plan* so that the Project is rehabilitated in an ecologically appropriate and sustainable manner.
- Implement offsets for the clearing of vegetation in Good to Excellent condition (which includes habitat for terrestrial fauna), to counterbalance the significant residual impact of the cumulative clearing of native vegetation in the Pilbara.

Following the application of the mitigation hierarchy (avoid, minimise, rehabilitate, offset) and BHP's commitment to implement the measures above, BHP considers that the predicted outcome in relation to the EPA's objective for *Terrestrial Fauna* is that terrestrial fauna will be protected so that biological diversity and ecological integrity are maintained.

BHP has proposed authorised extents of proposal elements (clearing) and conditions relating to Rehabilitation and Decommissioning (MCP, Appendix 16) and Offsets for this Project, to ensure the proposed measures above are implemented. These are included in the draft set of proposed implementation conditions for the Revised Proposal in Appendix 2. BHP considers that proposed implementation conditions are sufficient to manage the potential impacts of the Project, to meet the EPA's objective for Terrestrial Fauna.

8 Other environmental factors

Table 26 presents BHP's evaluation of 'other factors' is summarised in Section 8. This includes justification as to why BHP considers that they are not preliminary key environmental factors. To support BHP's position that an environmental factor is not a preliminary key environmental factor for this Project, BHP has included supporting information as appendices, where relevant.

Table 26: Other environmental factors

Relevant activities for the Project	Potential impacts	Justification for why factor is not considered to be a preliminary key environmental factor
LAND		
Subterranean Fauna EPA objective: *To protect subterranean fauna so that biological diversity and ecological integrity are maintained*		
MAR scheme to inject surplus water into the regional aquifer in the Caramulla Valley	Loss of troglofauna habitat resulting from the mounding of groundwater Reduction in quality of stygofauna habitat resulting from changes to water quality	**Significance considerations** Consistent with the considerations outlined in *Environmental factor guideline – Subterranean Fauna* (EPA, 2016g), BHP assessed the potential impacts of the Project on subterranean fauna (BHP 2019g; Appendix 14) with the findings summarised below. • There is no excavation of mine pits or groundwater abstraction (including dewatering) associated with the Project. • Twenty-four holes have been sampled for troglofauna within the proposed MAR area and fifteen species were collected. Despite the relatively widespread ranges of most species in the community, five troglofauna species are currently known only from collections within or in the immediate surrounds of the proposed MAR borefield area. These known ranges are likely to under-represent the true distributions of the species because of few records and limited sampling effort (BHP, 2019g). • No stygofauna sampling has been undertaken at Caramulla as the Project does not include any potential direct impacts on stygofauna (there is no excavation of mine pits or groundwater abstraction) (BHP, 2019g). Due to the depth of groundwater in the proposed MAR area, it is considered unlikely that the aquifer would host a significant stygofauna community. Based on sampling undertaken throughout the wider Jimblebar area, stygofauna are rarely present (<3% of samples) at groundwater depths greater than 40 mbgl. • No conservation significant species or communities are known to, or are expected to occur, within the proposed MAR area in the Caramulla Valley. The Ethel Gorge TEC occurs 40 km west of the proposed MAR area and will not be impacted by the proposed MAR. • The proposed Caramulla MAR site is characterised by a roughly East-West trending palaeovalley (filled with Tertiary detritals) underlain by the Paraburdoo Dolomite Member of the Wittenoom Formation. Drilling undertaken within the proposed MAR area suggests that the Tertiary detrital sequence extends from 0 m to approximately 85 mbgl). The Tertiary detrital contains a clay unit from 20 to 70 mbgl, which appears to be behaving as a confining unit on the aquifers beneath it. A vuggy breccia unit is intersected beneath the clay. This forms the detrital base unit, has a variable thickness and was found to extend to over 100 mbgl in places. It is hydraulically connected to the underlying Dolomite (BHP, 2019c). • Prospective habitat for troglofauna is the Tertiary detritals. It is generally considered that subterranean species in detritals tend to be widespread owing to more extensive habitat connectivity. Geological information in the Caramulla MAR area suggests that the Tertiary detritals in the Caramulla area are continuous and widespread (BHP, 2019g). • Natural groundwater levels in the area are approximately 50 mbgl. Assuming that the clay layer acts as a confining unit, potentially suitable troglofauna habitat is likely to be constrained to the Tertiary detrital unit above the clay layer. As a result, any potentially suitable troglofauna habitat in the Tertiary detrital unit is unlikely to be impacted by injection of groundwater into the aquifer beneath the clay layer (BHP, 2019g). • The water quality of the source aquifer (Jimblebar) and the receiving aquifer (Caramulla) are similar for key analytes relevant to stygofauna (e.g. salinity, pH, nutrients, metals). Therefore, BHP considers that the risk of impacts to stygofauna from changes to water quality from injection is low (BHP, 2019g). • The Tertiary detritals are likely to be laterally continuous and a vertical extent of at least 25 m of unsaturated Tertiary detritals (potentially suitable troglofauna habitat) would be maintained. Therefore, it is considered likely that species present would be widespread and would occur beyond the area of potential impact (i.e. mounding) or be able to co-occur with the mounding. Therefore, the impact to troglofauna from mounding is not considered to be significant. (BHP, 2019g). **Proposed Management** • In areas where the clay layer may be absent or not continuous, the vertical extent of mounding will be limited to 25 mbgl, as BHP has committed to operate the MAR scheme to a 25 mbgl (495 mAHD) threshold, as a mitigation measure related to vegetation. As discussed in Section 5.6, BHP proposes that this would be controlled through the authorised extent of the Revised Proposal (Appendix 2) and through provisions in the proposed draft Water Management Plan (Appendix 17).
Landforms: EPA objective: *To maintain the variety and integrity of significant physical landforms so that environmental values are protected*		
Ground disturbance and earthworks Drainage and stormwater management	Removal and modification of existing landforms Erosion affecting the stability of surrounding landforms	**Significance considerations** • No significant landforms (consistent with the description in *Environmental factor guideline – Landforms* (EPA, 2018g)) are located within the proposed Development Envelope. • There is no excavation of mine pits associated with the Project. • No major modifications to creeks with be undertaken. **Proposed Management** • BHP has updated the Jimblebar Mine Closure Plan (BHP, 2019e). The updated Mine Closure Plan addresses the potential impacts on natural landforms. This includes interface with constructed landforms and managing surface water flows to limit sheet and rill erosion from rehabilitated constructed landforms.

Relevant activities for the Project	Potential impacts	Justification for why factor is not considered to be a preliminary key environmental factor
Terrestrial Environmental Quality EPA objective: *To maintain the quality of land and soils so that environmental values are protected*		
Waste storage (OSAs)	Erosion, including of waste structures Contamination of land, through the generation of AMD	**Significance considerations** • The Jimblebar area contains both Brockman Iron and Marra Mamba Iron formations. The Brockman Iron formation may contain potential AMD material, whilst the Marra Mamba Iron formation is considered highly erodible. • Studies undertaken (consistent with information required for EIA outlined in *Environmental factor guideline – Terrestrial Environmental Quality* (EPA, 2016h), indicate that the AMD source risk within the South Jimblebar, Hashimoto and Wheelarra Hill deposits is low to moderate. The proposed OSAs to the south will receive waste from South Jimblebar which has a low AMD risk. **Proposed Management** • BHP has existing management measures to ensure erosion and AMD is considered in the design, scheduling and construction of overburden storage areas and other waste landforms. • BHP has updated the Jimblebar Mine Closure Plan (BHP, 2019e). The updated Mine Closure Plan addresses the potential impacts on soils (structure, stability and quality) and details how waste storage areas (principally overburden storage areas) will be constructed and rehabilitated, to ensure they are safe, stable and non-polluting. • BHP continues to undertake studies of the geochemical and physical properties of Brockman Iron and Marra Mamba Iron waste material to confirm the appropriate erosion and AMD management requirements.
AIR		
Air quality EPA objective: *To maintain air quality and minimise emissions so that environmental values are protected*		
Waste handling and transport Ore handling and transport Construction and operation of infrastructure (haul roads, surplus water transfer)	Particulate emissions (dust) reducing ambient air quality at sensitive receptors Emissions of greenhouse gases contributing to Climate Change	**Significance considerations** Consistent with the considerations outlined in *Environmental factor guideline – Air Quality* (EPA, 2016i), BHP assessed the potential impacts of the Project on air quality: ***Dust*** • Existing high levels of dust are present within the Pilbara region and windblown dust is expected to be a significant contributor to the ambient dust levels in the area. • No sensitive receptors will be affected by the Project. The nearest sensitive receptor (Sylvania Homestead) is located 19 km south of the Project. • Dust emissions from the operations of the existing Jimblebar Mine have been assessed under Part V of the EP Act, as part of the Wheelarra Hill (Jimblebar) Iron Ore Mine Operating Licence L5415/1988/9. The licence assessment of dust emissions indicated that the distance to the nearest sensitive receptor (19 km) and the current controls are appropriate to manage the increase in dust emissions associated with the increase in iron ore throughput. No additional regulatory controls were required to mitigate the risk of dust impacts on sensitive receptors. ***Greenhouse gases*** • The Project will result in no net annual increase in greenhouse gas emissions from the Scope 1 emissions Jimblebar Operations for the Existing Project (0.414 Mt CO_2-e per annum (SKM, 2009). There are no longer any scope 2 emissions associated with the Jimblebar operations, since power is now sourced from BHP's Yarnama power station. Therefore, BHP considers that the Project would not significantly increase the state's greenhouse gas emissions, which totalled 88.5 Mt CO_2-e per annum in 2017, as outlined in State and Territory Greenhouse Inventories 2017 (DoEE, 2019). • BHP has reduced the emissions intensity of greenhouse gas emissions from iron ore operations from 9.65 tCO2-e/kt to 8.17 tCO2-e/kt between 2013 and 2016. This is comparable to the average for the iron ore industry of 11.9 tCO2-e/kt (CSIRO, 2010). The greenhouse gas emissions resulting from the Project will not increase the current emission intensity. **Proposed Management** Consistent with the principle of waste minimisation, and considerations outlined in *Environmental factor guideline – Air Quality* (EPA, 2016i), BHP has applied reasonable and practicable measures to minimise harmful emissions to air. ***Dust*** • Examples of existing dust management measures at the operating Jimblebar mine include the following (BHP, 2011a): – Water tankers are used to apply water to sites within areas of operation, including unsealed roads, haul roads and construction areas. – Chemical suppressants will be used for general site dust suppression where practicable. – Major traffic thoroughfares will be sealed and kerbing or bunding will be installed to discourage off-road passage where practicable. – Areas of exposed soil (land disturbance) are minimised and disturbed areas are rehabilitated as they become available. – Dust controls (e.g. water sprays/cannons, belt scrapers) will be installed and maintained on stackers, reclaimers and long conveyors. ***Greenhouse gas emissions*** • Mitigation of greenhouse gas emissions will be undertaken during implementation of the Project, through design, technology and operations to minimise greenhouse gas emissions.

Relevant activities for the Project	Potential impacts	Justification for why factor is not considered to be a preliminary key environmental factor
PEOPLE		
Social Surroundings EPA objective: *To protect social surroundings from significant harm*		
Aboriginal heritage and culture		
Ground disturbance and earthworks for mine infrastructure (including overburden storage areas and surplus water/ drainage management) Discharge of surplus water to Caramulla Creek Ongoing implementation of rehabilitation and decommissioning activities	Direct disturbance of heritage (Aboriginal, natural and/ or historical) sites Indirect disturbance of heritage sites through changes to water regimes, changes in public access, and impacts on vegetation and fauna	**Significance considerations** • The Project is located within the Nyiyaparli native title determination area. • Most of the proposed Development Envelope and all of the Indicative Footprint have been ethnographically and archaeologically surveyed, with the most recent surveys conducted in 2018 to cover the south Jimblebar area (where the additional OSAs are proposed). • BHP has identified a number of sites within the Development Envelope and within the 200 m buffer zone surrounding the Development Envelope, which could be impacted via secondary impacts (e.g. dust and vibration). There is also a known heritage site (Nunga Soak) which is located along the Caramulla Creek around 15 km north of the proposed Development Envelope. • In March 2018, BHP with Onshore Environmental and four Nyiyaparli representatives undertook an ethno-botanical survey to better understand the presence and cultural values associated with the flora traditionally used for bush tucker and bush medicine in the Jimblebar area (Onshore, 2018d). All species identified during the survey are common in the Pilbara and regionally widespread in the region, and will not be significantly impacted by the Project. • As discussed in Section 5, there will be no directs impacts on the identified river pools - Innawally Pool and Jinerabar Pool. **Proposed Management** • The existing land use agreement between BHP and the Nyiyaparli People, defines the management requirements for all heritage sites within the agreement area. • BHP's current *Cultural Heritage Management Plan*, which covers the Existing Project, includes the following strategies to manage heritage sites: – actively avoiding areas through infrastructure design; or – consultation with Traditional Owner representatives and submission of an application for consent (under Section 18 of the *Aboriginal Heritage Act 1972*) to disturb sites. • Surplus water discharge is likely to remain within the main channel of Caramulla Creek. BHP plans to undertake archaeological and ethnographic surveys along the wetting front footprint in late 2019. • All identified heritage sites within the Development Envelope will be managed in accordance with the *Aboriginal Heritage Act 1972*, BHP's *Cultural Heritage Management Plan* and BHP's Comprehensive Agreement with the Nyiyaparli People. • As the Project is located within the Nyiyaparli native title determination area, BHP recognises that the Nyiyaparli people have a strong interest in closure and the post-mining landscape when mining at Jimblebar is finished. The updated Mine Closure Plan details the proposed management actions for rehabilitating disturbed areas to safe, stable, non-polluting landforms. Consultation with the Nyiyaparli People on closure and post-closure land-use is undertaken through the ongoing stakeholder engagement process.
Amenity		
Ground disturbance and earthworks for mine infrastructure (including overburden storage areas and surplus water/ drainage management) Discharge of surplus water to Caramulla Creek Ongoing implementation of rehabilitation and decommissioning activities	Dust and noise emissions, and visual changes to the landscape	**Significance considerations** • The nearest sensitive receptor (Sylvania Homestead) is located 19 km south of the Project. • The Project will not impact on any significant landforms. The scale of constructed landforms will be similar to existing constructed landforms at Jimblebar. • The Project will not be in the viewshed of locations with high amenity values (panoramic viewpoints, lookouts, gorges and rockpools). **Proposed Management** • The Mine Closure Plan details how new landforms (principally overburden storage areas) will be constructed and rehabilitated, including contouring, incorporation of screening structures and revegetation of waste rock landforms.

9 Offsets

Following application of the mitigation hierarchy (Sections 5.6, 6.6., 6.7 and 7.6) BHP concluded that offsets are required for the following significant residual impacts:

- Clearing of up to 2,000 ha of Good to Excellent condition vegetation in the Pilbara IBRA region (Section 6.7).

Figure 23 shows the areas of Good to Excellent Vegetation within the Pilbara IBRA region and subregions and the likely areas of significant residual impact (i.e. within the Indicative Footprint). As the Project is located on the southern boundary extent of the Pilbara bioregion, BHP notes that a portion of the proposed Development Envelope is situated within the Gascoyne bioregion (Augustus IBRA subregion). As concluded in Section 6.7, BHP considers that offsets would not apply to clearing within the Gascoyne bioregion, as the cumulative impact from development in the Gascoyne (IBRA) region is not significant. As concluded in Section 7.7, BHP considers that there is no significant residual impact to Terrestrial Fauna from the Project, as there will be not be a significant impact to habitat of fauna species that are specially protected under the BC Act or are listed as threatened species under the EPBC Act. Therefore, BHP has not proposed offsets specific to significant habitat for the Project.

BHP proposes to contribute funds to the Pilbara Environmental Offsets Fund (PEOF) at the following rates, calculated on the 2017-2018 financial year:

- $805 AUD (excluding GST) per hectare of 'Good' to 'Excellent' condition native vegetation cleared within Development Envelope within the Hamersley IBRA subregion; and
- $1611 AUD (excluding GST) per hectare of 'Good' to 'Excellent' condition native vegetation cleared within Development Envelope within the Fortescue IBRA subregion.

BHP has proposed a condition relating to Offsets for this Project, which is included in the draft set of proposed implementation conditions for the Revised Proposal in Appendix 2.

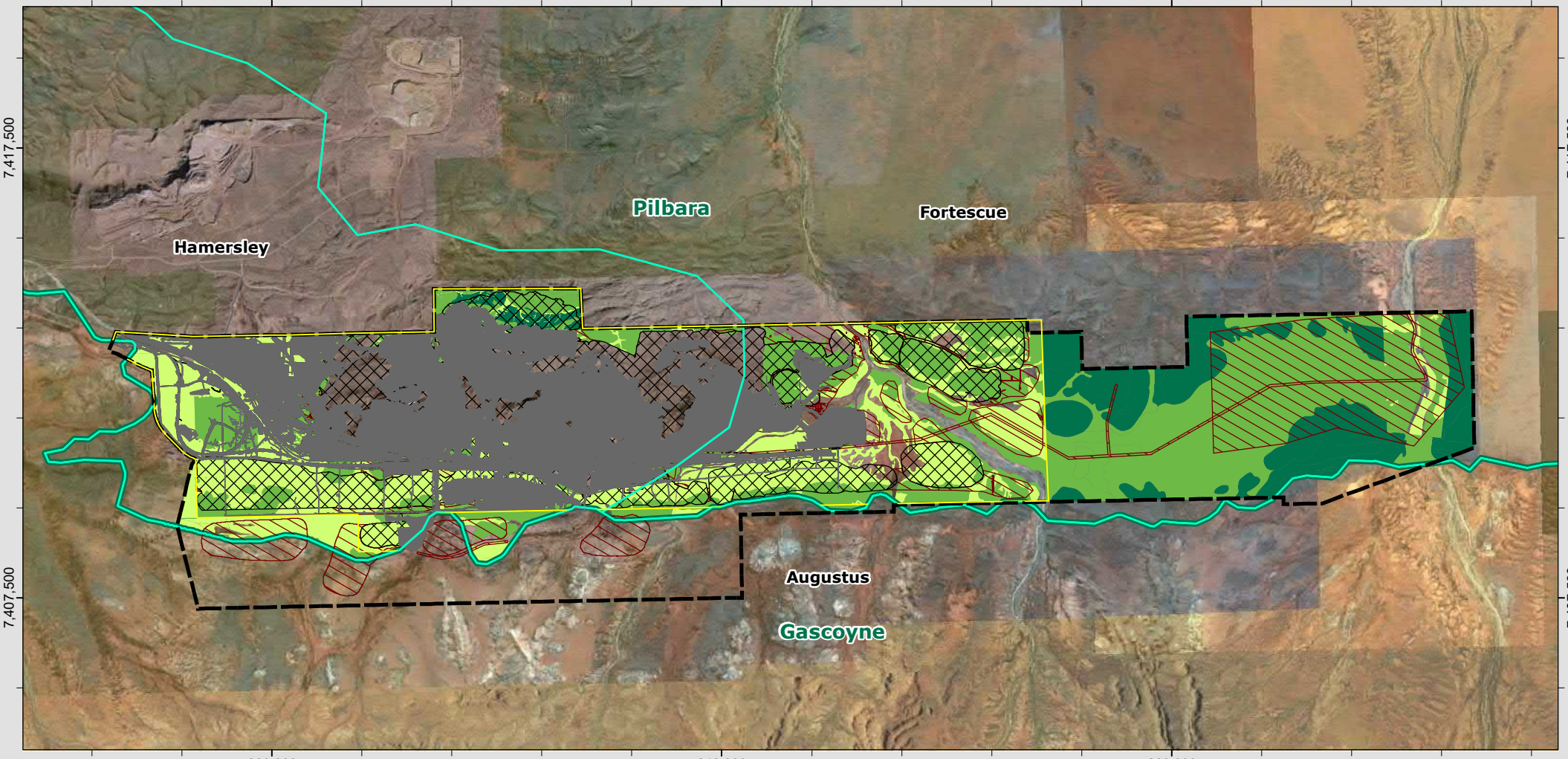
BHP has considered the six principles in the *WA Environmental Offsets Policy* (Government of WA, 2011), to determine the proposed offset and to demonstrate that is appropriate to counterbalance the significant residual impact (Table 27).

Table 27: Consideration of offset against offset policy principles

Offset principle	Consideration
1. **Environmental offsets will only be considered after avoidance and mitigation options have been pursued**	BHP has discussed avoidance and mitigation options in Sections 5.6, 6.6 and 7.6, for potential significant impacts to the preliminary key environmental factors. These option include avoiding a population of the flora species *Eremophila capricornica* (Priority 1) (Section 6.6) and avoiding Ghost Bat foraging habitat (Section 7.6). The significant residual impact that remains is the unavoidable impact of the clearing of native vegetation.
2. Environmental offsets are not appropriate for all projects	Consistent with other projects in the Pilbara, BHP considers that offsets (for the cumulative impact of clearing) are appropriate for this Project.
3. Environmental offsets will be cost-effective, as well as relevant and proportionate to the significance of the environmental value being impacted	Consistent with offsets applied to recent Pilbara mining projects, BHP's proposed offset is to contribute funds to the PEOF. BHP considers that the standard contribution rates are appropriate and proportionate to counterbalance the significant residual impact of the cumulative clearing of native vegetation in the Pilbara.

Offset principle	Consideration
4. Environmental offsets will be based on sound environmental information and knowledge	The WA Government will make decisions on specific offsets projects proposed through the PEOF, focusing on on-ground projects. The operation of the fund will use relevant environmental information and knowledge from the WA and Commonwealth governments, natural resource management groups, Tradition Owners, conservation groups, industry and the research sector. As outlined in the *Pilbara Conservation Strategy*, a monitoring and evaluation process will involve periodic reviews to ensure the latest science and lessons learnt from on-ground projects inform management priorities and appropriate implementation actions (Government of WA, 2017).
5. Environmental offsets will be applied within a framework of adaptive management	Adaptive management is one of the principles of the *Pilbara Conservation Strategy*. BHP understands that the operation of the PEOF will be consistent the *Pilbara Conservation Strategy,* to ensure that offsets projects delivered through the PEOF improve native vegetation condition and habitat for threatened species, and deliver enhance species and ecosystem resilience (Government of WA, 2017).
6. Environmental offsets will be focused on longer term strategic outcomes	BHP will contribute funding to the PEOF. The PEOF allows for multiple offset payments to be combined to deliver larger conservation projects or expand successful initiatives in the region to maximise the value of financial offsets. This approach enables strategic landscape scale projects with much greater environmental benefits to be implemented, rather than multiple smaller activities (DWER, 2019).

A completed *Offsets Template* is provided in Appendix 18. As part of the Commonwealth strategic validation process, if required, BHP will also prepare an Offsets Proposal to address residual adverse impacts on relevant Program Matters (MNES).



BHP

Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Pilbara IBRA Region Good to Excellent Vegetation

Scale @ A4: 1:125,000	Prepared: J.VIS	Project No: A949/063 REV 0
Date: 20/08/2019	Checked:	Figure: 23
Revision: REV 0	Reviewed: ENVIRO. A&I	

Interim Biogeographic Regionalisation for Australia (IBRA) V6.1
- Regions
- Sub Regions

Vegetation Condition (Pilbara Region)
- Excellent
- Very Good
- Good

- Proposed Development Envelope
- Existing Project Boundary
- Indicative Cleared Area as at FY2019
- Indicative Previously Assessed Area
- Indicative Footprint

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_063_E_PilbaraIBRA_GoodtoExcellentVegCondition_Rev0.mxd

10 Holistic impact assessment

BHP has presented an environmental review of the Jimblebar Optimisation Project (the Project) in this Environmental Review Document and supporting appendices. The Project is a change to the existing operations at Jimblebar, which are approved under Part IV Ministerial Statements 857 (as amended by MS1029), MS809 and MS683 (Existing Project). The main elements of the Project are additional waste storage and new surplus water management options. This will result in the activities of clearing of up to 2,000 ha of native vegetation and the discharge of up to 75 ML/d surplus water to the Caramulla area via creek discharge and/or MAR. The Project does not include excavation or dewatering of mine pits, or discharge to Ophthalmia Dam.

The Project is located within and adjacent to (south and east) of the Existing Project. BHP's Orebody 18 and Orebody 31 operations are north of Jimblebar in the Jimblebar Creek and Caramulla Creek catchments. There are no third-party mining operations nearby (the closest is 55 km away). Innawally Pool, a semi-permanent pool on Jimblebar Creek, is located within the proposed Development Envelope, near the northern boundary. Other identified sensitive environmental receptors (including Ophthalmia Dam and Ethel Gorge TEC) are at least 20 km from the Project.

BHP considers that the Project elements and activities could have a potential significant impact on the environmental factors of Inland Waters, Flora and Vegetation and Terrestrial Fauna, from removal of native vegetation and fauna habitat, and changes to vegetation health from the discharge of surplus water to Caramulla Creek and the regional aquifer in the Caramulla area. BHP has considered the principles of the EP Act and the EPA's objectives for the environmental factors in designing and modifying the Project. BHP has undertaken biodiversity surveys and hydrological studies to understand the environmental values of the area and has applied the mitigation hierarchy to avoid and minimise the impacts on the environment. These measures include reducing the proposed Development Envelope to avoid significant flora (Priority 1 species) and habitat for a significant fauna species (Ghost Bat), and limiting the extent of surface water flow and groundwater level rise from surplus water discharge.

Due to its location away from other third-party operations, cumulative impacts relate to other existing BHP operations in the Jimblebar Hub – Jimblebar, Orebody 31 and Orebody 18. The main cumulative impact is disturbance and clearing of native vegetation. BHP has minimised cumulative impacts to water resources in the area by proposing additional surplus water management options, which provide flexibility in managing potential impacts to Ophthalmia Dam, Jimblebar and Caramulla creeks, and the regional aquifer. The Mine Closure Plan addresses rehabilitation and closure of the Existing Project and has been updated to include this Project, which will result in additional disturbance for waste storage and infrastructure.

Following the application of the mitigation hierarchy to avoid, minimise and rehabilitate impacts, BHP considers that there will be a significant residual impact from the Project for the clearing of up to 2,000 ha of native vegetation, which contributes to the cumulative clearing of native vegetation in the Pilbara region, which will require an offset. BHP has proposed a financial contribution to the Pilbara Environmental Offsets Fund to counterbalance the significant residual impact of the cumulative clearing of native vegetation in the Pilbara.

BHP considers that the outcome of the Project is that the impacts to the preliminary key environmental factors are manageable and that there will be no significant environmental impacts from the Project, provided the proposed mitigation and offset measures discussed in this Environmental Review Document are implemented, including those in the proposed management plans. Therefore, BHP considers that the EPA's objectives for the preliminary key environmental factors will be met and the Project is environmentally acceptable.

The Revised Proposal is the Jimblebar Optimisation Project and the Existing Project. BHP has reviewed the Ministerial Statements (MS857 (as amended by MS1029), MS809 and MS683) and other relevant approvals (Part V licence and RiWI abstraction licence) for the Existing Project. BHP proposes to continue to manage impacts to flora and vegetation from weeds, to surface and groundwater (including Ophthalmia Dam and Innawally Pool) to

subterranean fauna (Ethel Gorge TEC) and rehabilitation and closure, through the proposed *Jimblebar Water Management Plan* (draft) and *Jimblebar Flora and Vegetation Management Plan* (draft), approved *Eastern Pilbara Water Resource Management Plan*, updated *Jimblebar Mine Closure Plan* and the existing Part V and RiWI licences (and any amendments to the licences, if required). Therefore, BHP considers that the EPA's objectives for the key environmental factors will be met and the Revised Proposal is environmentally acceptable.

If the decision is that the Revised Proposal may be implemented, BHP requests that one Ministerial Statement be issued for the Revised Proposal, which supersedes the current Ministerial Statements (MS683, MS809 and MS857 (as amended by MS1029)). BHP has provided a draft set of proposed implementation conditions for the Revised Proposal, which includes the relevant management and mitigation measures for this Project and the Existing Project.

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Appendices

Appendix 1 Review of Existing Project Ministerial Statements

Review of authorised extents

Table A1-1: Jimblebar Iron Ore Project, 40 Kilometres east of Newman, Shire of East Pilbara. MS857 (Attachment 2)

Element	Authorised Extent	Revised Proposal
Life of mine	Mining and processing up to 2037.	Removed as not a proposal characteristic relevant to the environment.
Ore processing rate	Up to 30 million tonnes per annum.	Removed as regulated under Part V Licence.
Total production	Up to 450 million tonnes.	Removed as no longer included in contemporary Ministerial Statement characteristics tables.
Total overburden	Not more than 1,225 million tonnes.	
Overburden storage areas	• Continued placement in existing approved out of pit Overburden Storage Areas (OSAs) at the Wheelarra Hill mine and placement in additional out of pit OSAs adjacent to the Wheelarra Hill, South Jimblebar and Hashimoto deposit pits. • Infill dumping in mined out pits.	Included in **Table 1: Summary of the Proposal** (Appendix 2, Schedule 1).
Mine and associated infrastructure land disturbance area	Not more than 2,300 ha within the 8,324 ha Development Envelope and not more than 14 ha outside the Development Envelope for the pipeline.	Included in **Table 2: Location and authorised extent of physical and operational elements** (Appendix 2, Schedule 1).
Mine dewatering	Mine dewatering from the following pits: • Wheelarra Hill (W1/2, W3 East and W5/6 pit extensions); • Hashimoto (H1 West, H1 East, H2, H3 and H4); and • South Jimblebar (JS West, JS Central and JS East).	Included in **Table 1: Summary of the Proposal** (Appendix 2, Schedule 1).
Water supply source	• Continued groundwater abstraction from the Jimblebar borefield and dewatering operations to supply raw and potable water; and • Installation of new and/or replacement bores in the Jimblebar borefield as required.	

Element	Authorised Extent	Revised Proposal
Water supply network	• Construction of pipeline extensions and continued distribution through the existing water supply system; and • Construction of a 45 megalitres per day pipeline within existing disturbance corridors to convey excess dewatering discharge to the Ophthalmia Dam.	Included in **Table 1: Summary of the Proposal** (Appendix 2, Schedule 1). Included in **Table 2: Location and authorised extent of physical and operational elements** (Appendix 2, Schedule 1).
Water demand	Up to 10.2 megalitres per day.	Removed as no longer included in contemporary Ministerial Statement characteristics tables.
Off-site transport of ore	Use of existing Wheelarra Hill mine rail loading facilities to transport ore to the Newman Hub or Port Hedland for blending prior to shipping.	Removed as not a proposal characteristic relevant to the environment.

Table A1-2: Wheelarra Hill Mine Modification. MS809 (Schedule 1)

Element	Description	Revised Proposal
Project Life	Approximately 13 years.	Removed as no longer included in contemporary Ministerial Statement characteristics tables.
Total Area of Disturbance	An additional 580 ha (maximum).	Included in **Table 2: Location and authorised extent of physical and operational elements** (Appendix 2, Schedule 1).
Production Rate	Approximately 45 million tonnes per annum.	Removed as regulated under Part V Licence.
Power Requirements	Update to existing 66 kilovolt power line and installation of second line.	Removed as not a proposal characteristic relevant to the environment.
Water Supply	An additional 8,050 kilolitres per day (maximum).	Removed as no longer included in contemporary Ministerial Statement characteristics tables.
Additional Infrastructure	Rail spur and loop, Train load out facilities, Primary crushing facility, Overland conveyor, Ore Handling Plant with primary, secondary and tertiary crushing.	Included in **Table 1: Summary of the Proposal** (Appendix 2, Schedule 1).
Ore Transport	An additional 95 trains per week.	Removed as not a proposal characteristic relevant to the environment.

Table A1-3: Wheelarra Hill Iron Ore Mine Extension, Life-of-Mine Proposal, Mining Lease 266SA, 40 km East of Newman, Shire of East Pilbara. MS683 (Schedule 1 and Attachment)

Characteristic	Quantities/Description	Revised Proposal
Location	Jimblebar, 40 kilometres east of Newman, on Sylvania Station, East Pilbara Region.	Included in **Table 1: Summary of the Proposal** (Appendix 2, Schedule 1).
Main activity	Continue mining in currently approved W4 deposit, and extend the pit beyond the currently approved area.	
	Progressively develop other hard rock mining areas designated W1, W2, W3, W5 and W6 over the life of the mine, as well as previously approved and new, detrital deposits.	
	Increase production to approximately 12 million tonnes per annum iron ore.	Removed as regulated under Part V Licence.
Contingent activities	Extend existing, and create new, overburden dumps adjacent to new hard rock pits. Some overburden material will be placed in mined out pits.	Included in **Table 1: Summary of the Proposal** (Appendix 2, Schedule 1).
	Progressively construct access and haul roads to proposed mine areas, overburden dumps and other infrastructure.	
	Replace the existing ore processing facility (crushing and screening).	Removed as not a proposal characteristic relevant to the environment.
	Upgrade the ore-train loading facilities.	
	Staged increase of ore-train movements to Newman from 14 to 40 a week.	
	Increase water uptake from the Jimblebar Wellfield, from the current 1,500 kilolitres per day to approximately 3,750 kilolitres per day.	Removed as regulated under RiWI groundwater abstraction licence.
	Periodically relocate the administration and workshop facilities to remain close to active mining areas.	Removed as not a proposal characteristic relevant to the environment.
	Bituminise the access road from Newman.	
Area disturbed	2,022 hectares.	Included in **Table 2: Location and authorised extent of physical and operational elements** (Appendix 2, Schedule 1).
Power supply	750kVA from Newman Power Station.	Removed as not a proposal characteristic relevant to the environment.

Characteristic	Quantities/Description	Revised Proposal
Duration	Approximately 50 years.	Removed as no longer included in contemporary Ministerial Statement characteristics tables.
Employment	Approximately 110 personnel.	Removed as not a proposal characteristic relevant to the environment.

Review of implementation conditions

Table A1-4: Jimblebar Iron Ore Project, 40 Kilometres east of Newman, Shire of East Pilbara. MS857 (as amended by MS1029)

Condition	Revised Proposal proposed condition (or justification if not required)
1 Proposal Implementation	**Condition 1 Proposal Implementation** (Appendix 2).
2 Proponent Nomination and Contact Details	**Condition 2 Contact Details** (Appendix 2).
3 Time Limit of Authorisation	Not required. The proposal has commenced.
4 Compliance Reporting	**Condition 3 Compliance Reporting** (Appendix 2).
5 Conservation of Significant Flora and Fauna	**Condition 5 Condition Environmental Management Plans** and **Condition 6 Flora and Vegetation Environmental Management Plan** (Appendix 2). BHP proposes to continue to manage significant flora (Priority 1 *Eremophila capricornica*) according to the new *Jimblebar Flora and Vegetation Management Plan* (draft) BHP, 2019f, Appendix 15), which will replace the *Significant Species Management Plan* (2011) and the *Jimblebar Hub Weed Management Plan* (2011). BHP has proposed to continue the management required by Condition 6 and has included these measures in the draft *Jimblebar Flora and Vegetation Management Plan*. As discussed in Section 7, BHP has not proposed a management plan for terrestrial fauna for the Project as BHP concluded that the impacts to conservation significant fauna would not be significant (Section 7.5). The *Significant Species Management Plan* did not contain specific management measures for threatened fauna because there were no records of threatened fauna within the approved Development Envelope at that time. Therefore, BHP considers that a terrestrial fauna management plan is not required for the Revised Proposal.
6 Weeds	
7 Trapped Fauna	Not required. The surplus water pipeline to Ophthalmia Dam is no longer required. Standard construction methodology and management would be implemented during the construction phase of the Caramulla surplus water pipeline should excavation be required.

Condition	Revised Proposal proposed condition (or justification if not required)
8 Ethel Gorge Aquifer Stygobiont Community Threatened Ecological Community (TEC)	**Condition 5 Condition Environmental Management Plans** and **Condition 7 Subterranean Fauna Environmental Management Plan** (Appendix 2). BHP will continue to manage the Ethel Gorge TEC according to the approved *Eastern Pilbara Water Resources Management Plan* (Rev 6.0, Schedule 1c, 2018b).
9 Stratification and/or Algal Blooms in and Downstream of Ophthalmia Dam	**Condition 5 Condition Environmental Management Plans** and **Condition 8 Water Environmental Management Plan** (Appendix 2). BHP proposes to continue to manage water quality in Ophthalmia Dam according to the approved *Eastern Pilbara Water Resources Management Plan* (Rev 6.0, Schedule 3, 2018b). The key risk from stratification events is the development of potentially toxic blue-green algae blooms that may come in contact with people or livestock (i.e. a health risk). As outlined in the EPWRMP, To address this risk, BHP has developed and implemented a management plan *Protection of Human Health Posed by Any Recreational Use of Ophthalmia Dam*, which details monitoring and management requirements to deal with the occurrence of blue-green algae in the dam. This management plan was developed in accordance with the National Health and Medical Research Council's *Guidelines for Managing Risks in Recreational Water* (2008) (BHP, 2018b). BHP considers that there is not a significant impact to water quality in Ophthalmia Dam due to weak stratification processes, no significant algal blooms to date, and regular freshening and mixing events from rainfall (EPWRMP; BHP, 2018b). From the knowledge gained since BHP began monitoring associated with the current condition, BHP also considers that it is not practical to determine if stratification (and hence algal blooms) are attributable to BHP's operations. BHP intends to review the obligations relating to stratification and algal blooms in a future review of the EPWRMP.
10 Surface Water Diversions	Not required. All surface water diversions associated with the proposal have been constructed. The Project will not require additional major surface water diversions. Only one minor drainage line in the southern OSA area has been identified within the Indicative Footprint which may require diversion. BHP has concluded that the changes to surface water regimes from the construction of infrastructure are not considered to be significant (Section 5.5).
11 Acid and Metalliferous Drainage	**Condition 9 Rehabilitation and decommissioning** (Appendix 2). The *Jimblebar Mine Closure Plan* (Rev 1, 2016) addresses the requirements of Conditions 11, 12 and 13. The MCP amalgamated the *Jimblebar Progressive Rehabilitation Management Plan* (2011) required by Condition 12 and the *Jimblebar Decommissioning and Final Rehabilitation Plan* (2011) required by Condition 13. The MCP was endorsed (March 2017) to satisfy Condition 11. At this time, BHP requested confirmation from the then Office of the Environmental Protection Authority that the MCP also satisfied the requirement for the Progressive Rehabilitation Management Plan and the Decommissioning and Final Rehabilitation Plan (i.e. Conditions 12 and 13). BHP will continue to manage rehabilitation, decommissioning and closure according to the MCP, which BHP has updated for the Revised Proposal (Rev 2, 2019d – Appendix 16).
12 Rehabilitation	
13 Final Closure and Decommissioning Plan	
14 Offsets	**Condition 10 Offsets** (Appendix 2). Clearing of native vegetation approved prior to 22 October 2015 continues to be exempt from offsets.

Condition	Revised Proposal proposed condition (or justification if not required)
	MS1029 Condition 14 required offsets for the clearing of 'Very Good to Excellent' condition vegetation. Consistent with contemporary implementation conditions, BHP proposes that offsets apply to the clearing of 'Good to Excellent' condition vegetation in the Pilbara IBRA bioregion.

Table A1-5: Wheelarra Hill Mine Modification. MS809

Condition	Revised Proposal proposed condition (or justification if not required)
1 Proposal Implementation	**Condition 1 Proposal Implementation** (Appendix 2).
2 Proponent Nomination and Contact Details	**Condition 2 Contact Details** (Appendix 2).
3 Time Limit of Authorisation	Not required. The proposal has commenced.
4 Compliance Reporting	**Condition 3 Compliance Reporting** (Appendix 2).
5 Performance Review and Reporting	
6 Rehabilitation and Closure	**Condition 9 Rehabilitation and decommissioning** (Appendix 2). The *Jimblebar Mine Closure Plan* (Rev 1, 2016) addresses the requirements of Condition 6. The MCP amalgamated the *Jimblebar Progressive Rehabilitation Management Plan* (2011) and the *Jimblebar Decommissioning and Final Rehabilitation Plan* (2011) required by Condition 6. In March 2017, BHP requested confirmation from the then Office of the Environmental Protection Authority that the MCP also satisfied the requirement for the Progressive Rehabilitation Management Plan and the Decommissioning and Final Rehabilitation Plan (i.e. Condition 6). BHP will continue to manage rehabilitation, decommissioning and closure according to the Jimblebar Mine Closure Plan, which BHP has updated for the Revised Proposal (Rev 2, 2019d – Appendix 16).

Table A1-6: Wheelarra Hill Iron Ore Mine Extension, Life-of-Mine Proposal, Mining Lease 266SA, 40 km East of Newman, Shire of East Pilbara. MS683

Condition	Revised Proposal condition (or justification if not required)
1 Implementation	**Condition 1 Proposal Implementation** (Appendix 2).
2 Proponent Commitments	The proponent commitments relate to the management of soil resources, landforms, surface water, groundwater, flora, fauna, air quality, noise, waste, dangerous goods and hazardous materials, and Aboriginal heritage. **Proposed Implementation Conditions**: • **Condition 5 Condition Environmental Management Plans** • **Condition 6 Flora and Vegetation Environmental Management Plan** (flora) • **Condition 7 Subterranean Fauna Environmental Management Plan** (subterranean fauna) • **Condition 8 Water Environmental Management Plan** (surface water and groundwater) • **Condition 9 Rehabilitation and decommissioning** (soil resources and landforms). BHP proposes to manage soil resources, landforms, surface water, groundwater, flora, fauna according to the approved *Eastern Pilbara Water Resources Management Plan*, the new *Jimblebar Flora and Vegetation Management Plan* and *Jimblebar Water Management Plan,* and the revised *Jimblebar Mine Closure Plan*. As discussed in Section 7, BHP has not proposed a management plan for terrestrial fauna for the Project. The *Significant Species Management Plan* did not contain specific management measures for threatened fauna because there were no records of threatened fauna within the approved Development Envelope at that time. Therefore, BHP considers that a terrestrial fauna management plan is not required for the Revised Proposal as BHP concluded that the impacts to conservation significant fauna would not be significant (Section 7.5). BHP will continue to manage air quality, noise, waste, dangerous goods and hazardous materials, and Aboriginal heritage according to the following: • Air Quality: Existing Part V Licence • Noise: Existing Part V Licence • Waste: Existing Part V Licence • Dangerous goods and hazardous materials: Existing Part V Licence (L5415/1988/9) and *Dangerous Goods Safety Act 2004.* • Aboriginal heritage: existing land use agreement between BHP and the Nyiyaparli people, *Aboriginal Heritage Act 1972* and the Cultural Heritage Management Plan.
3 Proponent Nomination and Contact Details	**Condition 2 Contact Details** (Appendix 2).

Condition	Revised Proposal condition (or justification if not required)
4 Commencement and Time Limit of Authorisation	Not required. The proposal has commenced.
5 Compliance Audit and performance Review	**Condition 3 Compliance Reporting** (Appendix 2).
6 Water	**Condition 5 Condition Environmental Management Plans** and **Condition 8 Water Environmental Management Plan** (Appendix 2). BHP proposes to continue to manage groundwater according to the approved *Eastern Pilbara Water Resources Management Plan* and new *Jimblebar Water Management Plan* (draft) BHP, 2019d; Appendix 17) which will replace the *Jimblebar Hub Water Management Plan* (2011). Note: Condition 6 primarily relates to the Jimblebar Wellfield. BHP will continue to manage groundwater abstraction according to the current RiWI licence and the associated approved Groundwater Operating Strategy.
7 Stygofauna	Not required. Condition 7 relates to stygofauna within the mine and wellfield areas. The Stygofauna Investigation Plan required by the Condition was prepared and implemented. Since MS683 was issued in 2005, BHP undertook an extensive Stygofauna sampling programme as part of the environmental review for the Jimblebar Iron Ore Project (BHP Billiton Iron Ore, 2010) (which supported the impact assessment and subsequent approval for MS857). The results showed the following: • relatively few stygal taxa present in the groundwater drawdown area predicted for the Jimblebar Hub (BHP Billiton Iron Ore, 2010); and • the species within the predicted groundwater drawdown area are also known to occur outside of the predicted groundwater drawdown area (i.e. no stygofauna species is restricted to the predicted groundwater drawdown area (BHP Billiton Iron Ore, 2010).
8 Conservation of Significant Flora and Fauna	**Condition 5 Condition Environmental Management Plans** and **Condition 6 Flora and Vegetation Environmental Management Plan** (Appendix 2). BHP proposes to continue to manage significant flora (Priority 1 *Eremophila capricornica*) according to the new *Jimblebar Flora and Vegetation Management Plan* (draft) BHP, 2019f, Appendix 15), which will replace the *Significant Species Management Plan* (2011) and the *Jimblebar Hub Weed Management Plan* (2011). BHP has proposed to continue the management required by Condition 6 and has included these measures in the draft *Jimblebar Flora and Vegetation Management Plan*. As discussed in Section 7, BHP has not proposed a management plan for terrestrial fauna for the Project as BHP concluded that the impacts to conservation significant fauna would not be significant (Section 7.5). The *Significant Species Management Plan* did not contain specific management measures for threatened fauna because there were no records of threatened fauna within the approved Development Envelope at that time. Therefore, BHP considers that a terrestrial fauna management plan is not required for the Revised Proposal.
9 Weeds	
10 Progressive Rehabilitation	**Condition 9 Rehabilitation and decommissioning** (Appendix 2).

Condition	Revised Proposal condition (or justification if not required)
11 Decommissioning and Final Rehabilitation	The *Jimblebar Mine Closure Plan* (Rev 1, 2016) addresses the requirements of Conditions 11, 12 and 13. The MCP amalgamated the *Jimblebar Progressive Rehabilitation Management Plan* (2011) required by Condition 12 and the *Jimblebar Decommissioning and Final Rehabilitation Plan* (2011) required by Condition 13. The MCP was endorsed (March 2017) to satisfy Condition 11. At this time, BHP requested confirmation from the then Office of the Environmental Protection Authority that the MCP also satisfied the requirement for the Progressive Rehabilitation Management Plan and the Decommissioning and Final Rehabilitation Plan (i.e. Conditions 12 and 13). Rehabilitation, decommissioning and closure will continue to be managed according to the Jimblebar Mine Closure Plan, which BHP has updated for the Revised Proposal (Rev 2, 2019d – Appendix 16).

Appendix 2 Revised Proposal: Proposed implementation conditions

BHP has provided a draft set of proposed implementation conditions for the Revised Proposal below, in the form of a draft Ministerial Statement.

BHP's strategic approach is to manage the environment at the subregional or hub level. As future expansions to the Jimblebar Hub are identified in the Pilbara Expansion Strategic Proposal, BHP has proposed relevant conditions from the Strategic Proposal MS1105, amended only to allow for the Existing Project. This will allow for consistency of conditions (and management) at Jimblebar, for the Revised Proposal and any future proposals that may be declared as Derived Proposals.

Table A2-1 below summarises BHP's selection of the relevant conditions from MS1105 and any proposed changes to these conditions. For clarity, proposed changes or additions to the MS1105 conditions are highlighted.

Table A2-1: Applicable conditions from Pilbara Expansion Strategic Proposal MS1105

Condition	Applicable (or justification if not required)
1 Derived Proposals	No Standard proposal implementation condition proposed
2 Contact Details	Yes
3 Time Limit for Substantial Commencement	No Proposal has commenced
4 Compliance Reporting	Yes
5 Public Availability of Data	Yes
6 Condition Environmental Management Plans	Yes
7 Flora and Vegetation Environmental Management Plan	Yes (part) and additional clause Subclauses 7-1(1)(a)(b)(d) are removed as they are not relevant to the Revised Proposal as there are no DRF, specially protected species, TECs or PECs. BHP has added a clause to allow BHP to continue to implement the current EMPs until the CEO approves the EMP required by the condition.
8 Terrestrial Fauna Environmental Management Plan	No No significant impacts to Terrestrial Fauna from the Revised Proposal warranting specific management under Part IV of the EP Act.
9 Subterranean Fauna Environmental Management Plan	Yes (part) Subclauses 9-1(1)(a)(b)(c) are removed as they are not relevant to the Revised Proposal as there are no populations of subterranean fauna known to have a restricted distribution and no known specially protected species. BHP has proposed a clause requiring continued implementation of the approved *Eastern Pilbara Water Resources Management Plan* (April 2018) which addresses potential impacts to Ethel Gorge at a regional level from BHP's operations, including Jimblebar.
10 Water Environmental Management Plan	Yes (part) and additional clauses Subclauses 10-1(1)(a)(c)(d)(f)(h)(i)(j) are removed as not relevant to the Revised Proposal as the proposal will not impact these hydrological values. The relevant subclauses are:

Condition	Applicable (or justification if not required)
	• (b) hydrological regimes that support threatened and priority ecological communities (Ethel Gorge); and • (g) wetland types which may be poorly represented (Innawally Pool – semi-permanent, perched pool) Caramulla Creek and the Caramulla regional aquifer fall under 10-1(1) generally. BHP has proposed a clause requiring continued implementation of the approved *Eastern Pilbara Water Resources Management Plan* (April 2018) which addresses potential impacts to the Ethel Gorge aquifer (addressing 10-1(b)) at a regional level from BHP's operations, including Jimblebar. BHP has amended the clause requiring preparation of a plan to clarify that it applies only to 10-1(1)(g). BHP has amended the relevant clauses to clarify that one or more plans may meet the requirements of the condition. BHP has added a clause to allow BHP to continue to implement the current EMP until the CEO approves the EMP required by the condition (to address 10-1(1)(g)).
11 Air Quality Environmental Management Plan	No. No significant impacts to Air Quality from the Revised Proposal warranting specific management under Part IV of the EP Act
12 Greenhouse Gas Management Plan	No. No significant impacts from Greenhouse Gases from the Revised Proposal warranting specific management under Part IV of the EP Act
13 Cultural Heritage Management Plan	No. No significant impacts to Social Surroundings (Heritage) from the Revised Proposal warranting specific management under Part IV of the EP Act
14 Conservation Reserve Impact Avoidance Plan	No. No impacts to conservation reserves from the Revised Proposal
15 Rehabilitation and decommissioning	Yes (part) BHP has proposed a condition requiring implementation of the *Jimblebar Mine Closure Plan* (August 2019) provided with the referral, as BHP considers that the MCP meets the requirements of the condition. BHP has added a clause to allow BHP to continue to implement the current MCP until the CEO approves the EMP required by the condition. BHP has amended relevant clauses to allow for the implementation of the MCP provided with the referral.
16 Offsets	Yes (part). Subclauses 16-2(1) is amended to remove reference to Chichester IBRA subregion as there are no impacts to this subregion. Subclauses 16-2(2) and 16-2(4) are removed as there are no important or specialised environmental values that will be impacted by the Revised Proposal. BHP has removed clause 16-6 and amended clause 16-8, as it is a Revised Proposal and ground-disturbance has already occurred within the proposed Development Envelope. BHP has proposed a clause to exempt clearing authorised under MS683, MS809 and MS857 (prior to 22 October 2015) from the requirement for offsets, consistent with other Revised Proposals.

DRAFT ENVIRONMENTAL CONDITIONS

STATEMENT THAT A REVISED PROPOSAL MAY BE IMPLEMENTED
(*Environmental Protection Act 1986*)

JIMBLEBAR IRON ORE MINE

Proposal: Proposal to mine orebodies and undertake associated activities at Jimblebar, located approximately 40 km east of Newman.

The proposal is a revision of:

- the Wheelarra Hill Iron Ore Mine Extension, Life-of-Mine Proposal, Mining Lease 266SA, 40 km East of Newman, Shire of East Pilbara, the subject of Statement No. 683 dated 16 August 2005;
- the Wheelarra Hill Mine Modification Shire of East Pilbara, the subject of Statement No. 809 dated 07 October 2009; and
- the Jimblebar Iron Ore Project, 40 Kilometres east of Newman, Shire of East Pilbara, the subject of Statement No. 857 dated 18 February 2011 (as amended by Statement No. 1029 dated 01 June 2016).

Proponent: BHP Billiton Iron Ore Pty Ltd
Australian Company Number: 008 700 981

Proponent Address: 125 St Georges Terrace, PERTH WA 6000

Assessment Number: XXXX

Report of the Environmental Protection Authority: XXXX

Previous Assessment Numbers: 1558, 1796, 1847 and 2071

Previous Reports of the Environmental Protection Authority: 1168, 1335, 1371 and 1564

Previous Statement Numbers: 683, 809, 857 and 1029

Pursuant to section 45, read with section 45B of the *Environmental Protection Act 1986*, it has been agreed that:

1. The proposal described and documented in Table 2 of Schedule 1 of this Statement may be implemented.

2. This Statement supersedes Statements 683, 809, 857 and 1029, and from the date of this Statement each of the implementation conditions in Statements 683, 809, 857 and 1029 no longer apply in relation to the Revised Proposal.

3. The implementation of the proposal, is subject to the following implementation conditions:

1 Proposal Implementation

1-1 When implementing the proposal, the proponent shall not exceed the authorised extent of the proposal as defined in Table 2 in Schedule 1, unless amendments to the proposal and the authorised extent of the proposal have been approved under the EP Act.

2 Contact Details

2-1 The proponent shall notify the CEO of any change of its name, physical address or postal address for the serving of notices or other correspondence within twenty-eight (28) days of such change. Where the proponent is a corporation or an association of persons, whether incorporated or not, the postal address is that of the principal place of business or of the principal office in the State.

3 Compliance Reporting

3-1 The proponent shall prepare, and maintain a Compliance Assessment Plan which is submitted to the CEO at least six (6) months prior to the first Compliance Assessment Report required by condition 3-6.

3-2 The Compliance Assessment Plan shall indicate:

(1) the frequency of compliance reporting;

(2) the approach and timing of compliance assessments;

(3) the retention of compliance assessments;

(4) the method of reporting of potential non-compliances and corrective actions taken;

(5) the table of contents of Compliance Assessment Reports; and

(6) public availability of Compliance Assessment Reports.

3-3 After receiving notice in writing from the CEO that the Compliance Assessment Plan satisfies the requirements of condition 3-2 the proponent shall assess compliance with conditions in accordance with the Compliance Assessment Plan required by condition 3-1.

3-4 The proponent shall retain reports of all compliance assessments described in the Compliance Assessment Plan required by condition 3-1 and shall make those reports available when requested by the CEO.

3-5 The proponent shall advise the CEO in writing of any potential non-compliance including exceedance of threshold criteria and/or failure to implement management actions in an Environmental Management Plan within seven (7) days of that potential non-compliance being known.

3-6 The proponent shall submit to the CEO a Compliance Assessment Report annually by 1 October each year addressing compliance in the previous financial year, or as otherwise agreed in writing by the CEO.

3-7 The Compliance Assessment Report shall:

(1) be endorsed by the proponent's CEO or a person delegated to sign on the CEO's behalf;

(2) include a statement as to whether the proponent has complied with the conditions;

(3) identify all potential non-compliances and describe corrective and preventative actions taken;

(4) be made publicly available in accordance with the approved Compliance Assessment Plan; and

(5) indicate any proposed changes to the Compliance Assessment Plan required by condition 3-1.

4 Public Availability of Data

4-1 Subject to condition 4-2, within a reasonable time period approved by the CEO after the issue of this Statement and for the remainder of the life of the proposal, the proponent shall make publicly available, in a manner approved by the CEO, all validated environmental data (including sampling design, sampling methodologies, empirical data and derived information products (e.g. maps)), management plans and reports relevant to the assessment of this proposal and implementation of this Statement.

4-2 If any data referred to in condition 4-1 contains particulars of:

(1) a secret formula or process; or

(2) confidential commercially sensitive information;

the proponent may submit a request for approval from the CEO to not make these data publicly available. In making such a request the proponent shall provide the CEO with an explanation and reasons why the data should not be made publicly available.

5 Condition Environmental Management Plan(s)

5-1 The proponent shall prepare, to the satisfaction of the CEO, a Condition Environmental Management Plan(s) within six (6) months of this Statement being issued. This plan shall demonstrate that the environmental objectives specified in condition 6-1 (Flora and Vegetation) condition 7-1 (Inland Waters) and condition 8-1 (Subterranean Fauna) for the proposal will be met.

5-2 The Condition Environmental Management Plan(s) shall:

(1) specify environmental outcomes that achieve the environmental objectives, as specified in conditions 7-1 and 8-1;

(2) specify trigger criteria that will provide early warning for the implementation of trigger level actions if exceeded;

(3) specify threshold criteria that provides a limit beyond which the environmental outcome is not achieved;

(4) specify monitoring to determine if trigger criteria and threshold criteria are exceeded;

(5) specify trigger level actions to be implemented in the event that trigger criteria have been exceeded;

(6) specify threshold contingency actions to be implemented in the event that threshold criteria are exceeded;

(7) provide the format and timing for the reporting of monitoring results against trigger criteria and threshold criteria to demonstrate that conditions 7-1 and 8-1 have been met over the reporting period in the Compliance Assessment Report required by condition 3-6;

(8) provide for reporting of exceedances of the trigger and threshold criteria.

Or where it is not possible to specify environmental outcomes for the proposal:

(9) specify the environmental objectives to be achieved, as specified in condition 6-1;

(10) specify risk-based management actions that will be implemented to demonstrate compliance with the environmental objectives specified in condition 6-1;

(11) specify measurable management target(s) to determine the effectiveness of the risk-based management actions;

(12) specify monitoring to measure the effectiveness of management actions against management targets, including but not limited to, parameters to be measured, baseline data, monitoring locations, and frequency and timing of monitoring;

(13) specify a process for revision of management actions and changes to proposal activities, in the event that the management targets are not achieved. The process shall include an investigation to determine the cause of the management target(s) not being achieved;

(14) provide the format and timing to demonstrate that the objective in condition 6-1 has been met for the reporting period in the Compliance Assessment Report required by condition 3-6 including but not limited to.

(a) verification of the implementation of management actions; and

(b) reporting on the effectiveness of management actions against management target(s).

5-3 The failure to implement one or more management actions, the exceedance of a threshold criteria (regardless of whether threshold contingency actions have been or are being implemented in accordance with condition 5-7(2)), and/or comply with the requirements of a Condition Environmental Management Plan(s) represents non-compliance with these conditions.

5-4 After receiving notice in writing from the CEO that the Condition Environmental Management Plan(s) satisfies the requirements of conditions 5-1 and 5-2 the proponent shall:

(1) implement the Condition Environmental Management Plan(s), or any subsequent approved versions; and;

(2) continue to implement the Condition Environmental Management Plan(s) until the CEO has confirmed by notice in writing that the proponent has demonstrated the objectives specified in condition 6-1, 7-1 and 8-1 have been met;

5-5 If monitoring, tests, surveys or investigations indicate non-achievement of management target(s) specified in a Condition Environmental Management Plan(s), the proponent shall:

(1) report the non-achievement in writing to the CEO within twenty-one (21) days of the non-achievement being identified;

(2) investigate to determine the cause of the management target(s) not being achieved;

(3) provide a report to the CEO within ninety (90) days of the nonachievement being reported as required by condition 5-5(1). The report shall include:

(a) the cause(s) of the management targets not being achieved;

(b) the findings of the investigation required by conditions 5-5(2) and 5-5(3);

(c) details of revised and/or additional management actions to be implemented to prevent non-achievement of the management target(s); and

(d) relevant changes to proposal activities.

5-6 If monitoring, tests, surveys or investigations indicate that one or more management actions specified in a Condition Environmental Management Plan(s) has not been implemented, the proponent shall:

(1) report the failure to implement the management action(s) in writing to the CEO within seven (7) days of identification;

(2) investigate to determine the cause of the management action(s) not being implemented;

(3) investigate to provide information for the CEO to determine potential environmental harm that occurred due to the failure to implement the management action(s); and

(4) provide a report to the CEO within twenty-one (21) days of the reporting required by condition 5-6(1). The report shall include:

(a) the cause of the failure to implement the management actions;

(b) the findings of the investigations required by conditions 5-6(2) and 5-6(3);

(c) relevant changes to proposal activities; and

(d) measures to prevent, control or abate the environmental harm or alteration of the environment which may have occurred.

5-7 In the event that monitoring, tests, surveys or investigations indicates exceedance of trigger criteria and/or threshold criteria specified in a Condition Environmental Management Plan(s), the proponent shall:

(1) report the exceedance in writing to the CEO within seven (7) days of the exceedance being identified;

(2) immediately implement the trigger level actions and/or threshold contingency actions specified in the Condition Environmental Management Plan(s) and continue implementation of those actions until the trigger criteria and/or threshold criteria are being met and implementation of the trigger level actions and/or threshold contingency actions are no longer required;

(3) investigate to determine the cause of the trigger criteria and/or threshold criteria being exceeded;

(4) identify additional measures required to prevent the trigger criteria and/or 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. The report shall include:

(a) details of any trigger level actions or threshold contingency actions implemented;

(b) the effectiveness of the trigger level actions or threshold contingency actions implemented, monitored and measured against trigger criteria and threshold criteria;

(c) the findings of the investigations required by conditions 5-7(3) and 5-7(5);

(d) additional measures to prevent the trigger or 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.

5-8 The proponent:

(1) may review and revise the Condition Environmental Management Plan(s), or

(2) shall review and revise the Condition Environmental Management Plan(s) as and when directed by the CEO.

5-9 The proponent shall implement the latest revision of the Condition Environmental Management Plan(s), which the CEO has confirmed by notice in writing, satisfies the requirements of condition 5-4.

6 Flora and Vegetation Environmental Management Plan

6-1 The proponent shall manage the implementation of the proposal to meet the following environmental objective:

(1) protect flora and vegetation so that biological diversity and ecological integrity are maintained, and in particular:

(a) avoid and minimise direct and indirect impacts on flora taxa listed as priority flora.

6-2 The proponent shall prepare a Flora and Vegetation Management Plan required by condition 5-1 that satisfies the requirements of condition 5-2, to meet the objective specified in condition 6-1, in consultation with the agency responsible for administration of the *Wildlife Conservation Act 1950* and the *Biodiversity Conservation Act 2016*.

6-3 The Flora and Vegetation Management Plan required by condition 5-1 shall include provisions required by condition 5-2 to address impacts on conservation significant flora and vegetation, where relevant, including from, but not limited to: changes to groundwater levels and groundwater quality; changes to surface water flows and quality; dust; fire regimes, and weeds.

6-4 The proponent shall continue to implement the version of the Flora and Vegetation Management Plan most recently approved by the CEO until the CEO has confirmed by notice in writing that the plan required by condition 5-1 satisfies the requirements of condition 5-2 to meet the objective specified in condition 6-1.

6-5 The proponent shall continue to implement the *Jimblebar Hub Significant Species Management Plan* (Version 4, 2011) and the *Jimblebar Hub Weed Management Plan* (Version 3, 2011), until the CEO has confirmed by notice in writing that the plan required by 5-1 satisfies the requirements of condition 5-4 to meet the objective specified in condition 6-1.

7 Subterranean Fauna Environmental Management Plan

7-1 The proponent shall manage the implementation of the proposal to meet the following environmental objective:

(1) protect subterranean fauna so that biological diversity and ecological integrity are maintained, and in particular:

(a) avoid and minimise direct and indirect impacts on the occurrences of threatened and priority ecological communities, and their habitat, which are recognised as having conservation significant subterranean fauna values, including, but not limited to;

(i) Ethel Gorge aquifer stygobiont community Threatened Ecological Community.

7-2 The proponent shall continue to implement the *Eastern Pilbara Water Resource Management Plan* (Version 6, April 2018), to satisfy the requirements of condition 5-2 to meet the objective specified in condition 7-1.

7-3 The proponent shall continue to implement the version of the Subterranean Fauna Management Plan most recently approved by the CEO until the CEO has confirmed by notice in writing that the plan required by condition 5-1 satisfies the requirements of condition 5-2 to meet the objective specified in condition 7-1.

8 Water Environmental Management Plan

8-1 The proponent shall manage the implementation of the proposal to meet the following environmental objective:

(1) maintain the hydrological regimes and quality of groundwater and surface water so that environmental values are protected, including where relevant avoiding and minimising direct and indirect impacts of the proposal, on:

(a) hydrological regimes that support threatened and priority ecological communities; and

(b) wetland types which may be poorly represented.

8-2 The proponent shall continue to implement the *Eastern Pilbara Water Resource Management Plan* (Version 6, April 2018), to satisfy the requirements of condition 5-2 to meet the objective of condition 8-1(1)(a).

8-3 The proponent shall prepare a Water Management Plan required by condition 5-1 that satisfies the requirements of condition 5-2, to meet the objectives specified in condition 8-1(1)(b), in consultation with the agency responsible for administration of the *Wildlife Conservation Act 1950* and the *Biodiversity Conservation Act 2016*.

8-4 The Water Management Plan(s) required by condition 5-1 shall include provisions required by condition 5-2 to address impacts on hydrological regimes and water quality, where relevant, including from, but not limited to: water abstraction; managed aquifer recharge; disposal of mine dewater to surface water systems; diversion of surface water systems; discharge of wastes to storage or evaporative basins and dewatering of aquifers and exposure of potentially acid forming material or the creation of acid and metalliferous drainage.

8-5 The proponent shall continue to implement the *Jimblebar Hub Water Management Plan* (Revision 3, 2011), until the CEO has confirmed by notice in writing that the plan required by 5-1 satisfies the requirements of condition 5-2 to meet the objectives specified in condition 8-1(1)(b).

8-6 The proponent shall continue to implement the version of the Water Management Plan(s) most recently approved by the CEO until the CEO has confirmed by notice in writing that the plan(s) required by condition 5-1 satisfies the requirements of condition 5-2 to meet the objectives specified in condition 8-1.

9 Rehabilitation and decommissioning

9-1 The proponent shall manage the implementation of the proposal to meet the following environmental objective:

(1) ensure that the proposal is decommissioned and the site of the proposal rehabilitated to be safe, stable and non-polluting and in an ecologically appropriate and sustainable manner.

9-2 The proponent shall implement the *Jimblebar Mine Closure Plan* (Version 2, August 2019) to meet the objective specified in condition 9-1.

9-3 The proponent shall review and revise the Mine Closure Plan required by condition 9-2 at intervals not exceeding five (5) years, or as otherwise specified by the CEO, and submit the plan to the CEO at the agreed interval.

9-4 The review and revision of the Mine Closure Plan required by condition 9-3 shall be in accordance with the Guidelines for Preparing Mine Closure Plans, May 2015 (or any subsequent revisions of the guidelines), on advice of the Department of Mines, Industry Regulation and Safety and, where the proposal impacts on land managed pursuant to the *Conservation and Land Management Act 1984*, the Department of Biodiversity, Conservation and Attractions.

9-5 Following the review and revision of the plan required by condition 9-3, the proponent shall continue to implement the version of the Mine Closure Plan, which the CEO has confirmed by notice in writing satisfies the requirements of condition 9-4, to meet the objective of condition 9-1.

10 Offsets

10-1 In view of the significant residual impacts as a result of the implementation of the proposal identified in condition 10-2, the proponent shall contribute funds to the Pilbara Environmental Offsets Fund.

10-2 The significant residual impacts are:

(1) clearing of 'Good' to 'Excellent' condition native vegetation, including habitat for threatened fauna species, within the Hamersley IBRA subregion.

(2) clearing of 'Good' to 'Excellent' condition native vegetation, including habitat for threatened fauna species, within the Fortescue IBRA subregion.

10-3 The proponent shall contribute funds to the Pilbara Environmental Offsets Fund calculated pursuant to conditions 10-4 and 10-5, subject to any reduction approved by the CEO under condition 10-11.

10-4 The proponent's contribution to the Pilbara Environmental Offsets Fund shall be paid biennially, with the amount to be contributed calculated based on the clearing undertaken in each year of the biennial reporting period in accordance with the following calculation:

C = R x H Where:

C = the contribution to the fund for clearing done in the relevant year

R = contribution rate for the year in which the clearing is undertaken as published for the Pilbara Environmental Offsets Fund by the CEO for each significant residual impact identified in condition 10-2.

H = number of hectares of land cleared in the relevant year for each significant residual impact referred to in condition 10-2.

10-5 The first biennial reporting period shall commence at the beginning of the financial year that ground-disturbing activities causing one or more of the significant residual impacts identified in condition 10-2 are undertaken.

10-6 The Impact Reconciliation Procedure required pursuant to condition 10-5 shall:

(1) state that clearing calculations for each biennial reporting period will commence on 1 July of the required reporting period, unless otherwise agreed by the CEO;

(2) include a methodology to calculate the amount of clearing undertaken during each year of the biennial reporting period for each of the significant residual impacts identified in condition 10-2; and

(3) indicate the timing and content of the Impact Reconciliation Reports.

10-7 Within three months of the issue of this Statement, the proponent shall prepare and submit an Impact Reconciliation Procedure to the CEO, for the CEO to confirm in writing that the Impact Reconciliation Procedure satisfies the requirements of condition 10-6.

10-8 The proponent shall submit Impact Reconciliation Reports in accordance with the Impact Reconciliation Procedure approved in condition 10-7.

10-9 The Impact Reconciliation Reports required pursuant to condition 16-9 shall provide the location and spatial extent of the clearing undertaken within each biennial reporting period.

10-10 The proponent may seek the written approval of the CEO to reduce all or part of the contribution payable under condition 10-4 where:

(1) a payment has been made to satisfy a condition of an approval under the *Environment Protection and Biodiversity Conservation Act 1999* in relation to the proposal;

(2) the payment counterbalances impacts of the proposal on matters of national environmental significance; and

(3) the payment counterbalances the significant residual impacts to the environmental values identified in condition 10-2.

10-11 The clearing of 4,644 ha of native vegetation previously authorised under Ministerial Statements 683 (2,022 ha), 809 (580 ha) and 857 prior to 22 October 2015 (2,042 ha) is exempt from the requirement to offset under condition 10-1.

Schedule 1

Table 1: Summary of the Proposal

Proposal title	Jimblebar Iron Ore Mine
Short description	The Revised Proposal is for mining operations at Jimblebar, located approximately 40 km east of the town of Newman. Mining of iron ore deposits will be undertaken above and below the water table. Mining operations will include open pits, overburden storage areas and the construction and operation of associated mine, processing and rail infrastructure. Groundwater will be abstracted for water supply and to dewater the orebodies. Surplus water management will include transfer to Ophthalmia Dam, controlled creek discharge and managed aquifer recharge.

Table 2: Location and authorised extent of physical and operational elements

Element	Location	Authorised Extent
Mine and associated infrastructure	Figure 1	Clearing of no more than 6,902 ha of native vegetation within the Development Envelope of 14,206 ha.
Surplus water management		Surplus water management including any or all of the following options: • Discharge of up to 16.425 GL/a to Ophthalmia Dam. • Controlled discharge along Caramulla Creek to extend no further than 34 km from the northern boundary of the Development Envelope under natural, no-flow conditions. • Managed aquifer recharge in the Caramulla area to limit groundwater level rise to 25 m below ground level.

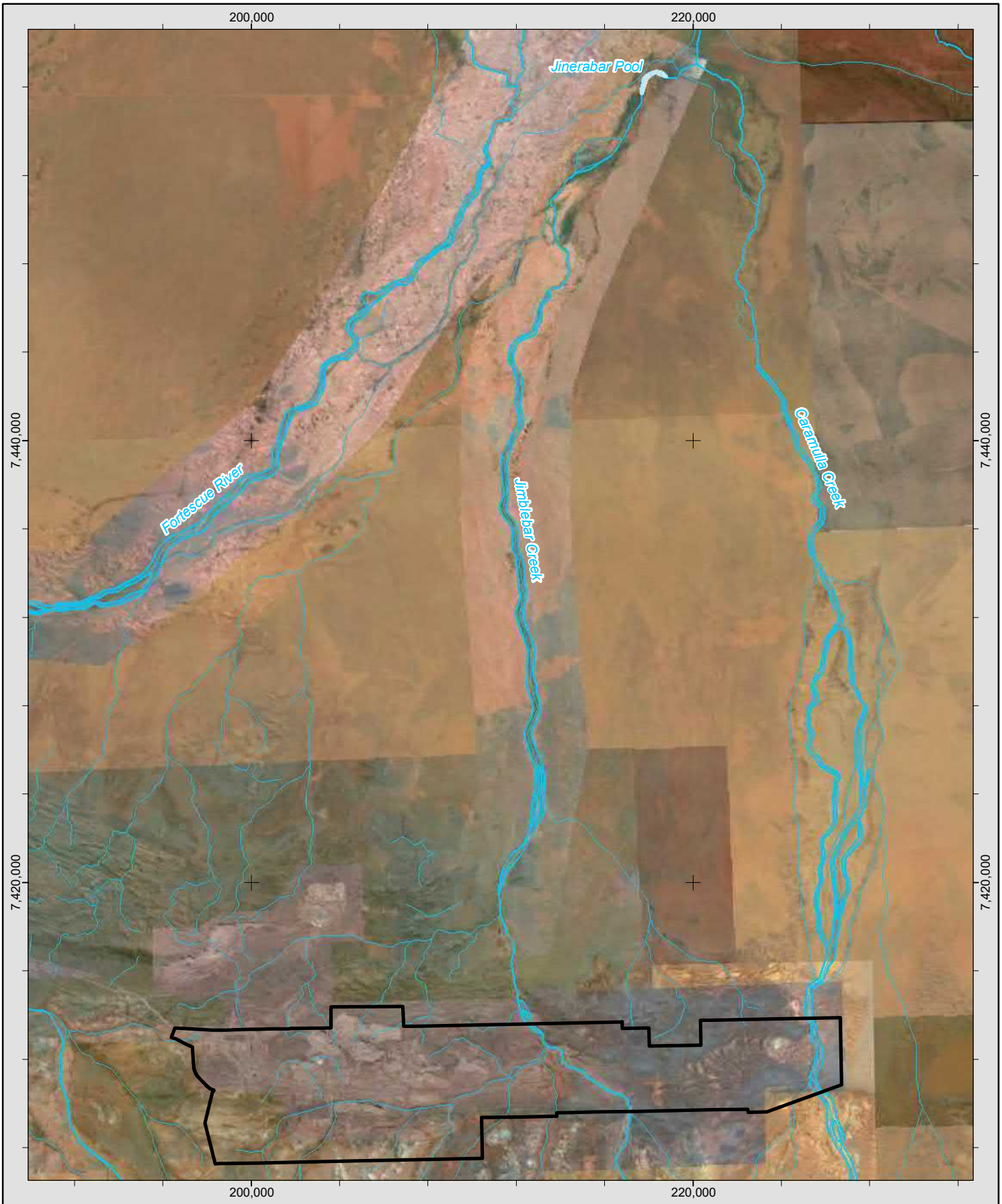
Table 3: Abbreviations and Definitions

Acronym or Abbreviation	Definition or Term
CEO	The Chief Executive Officer of the Department of the Public Service of the State responsible for the administration of section 48 of the Environmental Protection Act 1986, or his delegate.
EPA	Environmental Protection Authority
EP Act	*Environmental Protection Act 1986*
'Good' to 'Excellent' condition native vegetation	Means the condition of native vegetation rated in accordance with the EPA's *Technical Guidance - Flora and Vegetation Surveys for Environmental Impact Assessment* (December, 2016), including any revision to this technical guidance.
ha	Hectare
IBRA	Interim Biogeographic Regionalisation for Australia
Pilbara Environmental Offsets Fund	A special purpose account created pursuant to section 16(1)(d) of the *Financial Management Act 2006* by the Department of Water and Environmental Regulation.

Figures (attached)

Figure 1 Development Envelope

Coordinates defining the Development Envelope are provided electronically.



BHP

Spatial Data - Studies Planning & Access
BHP IRON ORE

DRAFT MINISTERIAL STATEMENT
Jimblebar Iron Ore Mine
Development Envelope

Scale @ A4: 1:230,000	Prepared: J.VIS	Project No: A949/066 Rev 0
Date: 28/08/2019	Checked:	Figure: 1
Revision: REV 0	Reviewed: ENVIRO. A&I	

Development Envelope
Watercourse

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_066_E_WettingFrontExtent_Rev0.mxd

Appendix 3 Caramulla MAR Injection Modelling Report

Appendix 4 Caramulla Creek Discharge Modelling Report

Appendix 5 Summary of Flora and Vegetation studies and surveys

Table A5 presents a summary of Flora and Vegetation information used in the assessment of the Project. Figure A5 shows the survey coverage for the studies and surveys presented in Table A5.

Table A5: Flora and Vegetation studies and surveys

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora[2]	Introduced Flora	Appendix
East Jimblebar and Caramulla Flora and Vegetation Survey (Biologic, *in prep*)	Single season detailed	63 quadrats 14 releves	7-18 Apr 2019	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016). Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).	46 vegetation associations classified into 13 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from Degraded to Excellent.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority flora were recorded: *Eremophila capricornica* (P1), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) and *Goodenia nuda* (P4)	Six introduced taxa were recorded, none listed as a Declared Pest under the BAM Act.	N/A
Caramulla Creek Flora and Vegetation Survey (Astron Environmental Services, 2018)	Single season reconnaissance	63 releves	22-31 Oct 2018	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016). Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).	27 vegetation associations classified into 13 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from excellent to poor.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority listed flora was recorded: *Crotalaria smithiana* (P3).	Seven introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Appendix 6
Vegetation Survey and Desktop Assessment Caramulla Creek (Onshore Environmental, 2018a)	Single season reconnaissance	60 releves	18-22 Jun 2018	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016). Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).	21 vegetation associations, with two supporting groundwater dependent vegetation and 16 associations that supported stands of Mulga and/or *Acacia citrinoviridis*. None aligned with Federal or State listed TECs, or State listed PECs. Vegetation condition ranged from very good to degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Two Priority listed flora were opportunistically recorded: *Eremophila capricornica* (P1) and *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3).	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Appendix 7
Reconnaissance Flora and Vegetation Survey Caramulla (Onshore Environmental, 2018b)	Single season reconnaissance	115 releves	17-21 Feb 2018 23 Jun 2018	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016). Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).	30 vegetation associations classified into 12 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from excellent to good.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Five Priority flora taxa were recorded: *Eremophila capricornica* (P1), *Ipomoea racemigera* (P2), *Crotalaria smithiana* (P3), *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) and *Goodenia nuda* (P4). Two species of interest were recorded: *Indigofera* sp. indet and *Tephrosia* sp. Willowra (G.M. Chippendale 4809).	Five introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Appendix 8

[2] Based on currently conservation status of taxa.

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora[2]	Introduced Flora	Appendix
Shearers West Detailed Vegetation and Flora Survey (Onshore Environmental, 2018c)	Single season detailed	49 quadrats	7-13 May 2018	Poor	Environmental Factor Guideline Flora and Vegetation (EPA 2016). Technical Guidance Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016).	18 vegetation associations classified into nine broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from very good to completely degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Six introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Appendix 9
Level 2 Riparian and Aquatic Flora and Vegetation Survey Jimblebar Creek and Innawally Pool (Onshore Environmental 2016)	Single season detailed	15 quadrats 75 releves	25-29 May 2016	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004). Technical Guide - Flora and Vegetation Surveys for Environmental Impact Assessment (EPA and DPaW 2015).	11 vegetation associations classified into five broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from excellent to good.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Two Priority flora taxa were recorded: *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3) and *Goodenia nuda* (P4).	Five introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey (Onshore Environmental, 2015a)	Single season detailed	29 quadrats 142 releves	23 Feb-1 Mar 2015	Good	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	26 vegetation associations classified into 12 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition of the majority of the area rated as very good.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority flora taxa were recorded: *Ipomoea racemigera* (P2), *Goodenia nuda* (P4) and *Goodenia berringbinensis* (P4).	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Targeted Survey for Acacia sp. East Fortescue (surrounding OB31) (Onshore Environmental, 2015b)	Targeted	Not applicable	25-31 Mar 2015 2-6 Aug 2015	Not reported	None reported	Not recorded	Three populations of Acacia corusca (P1) (previously known as A. sp. East Fortescue) recorded.	Not recorded	Not attached

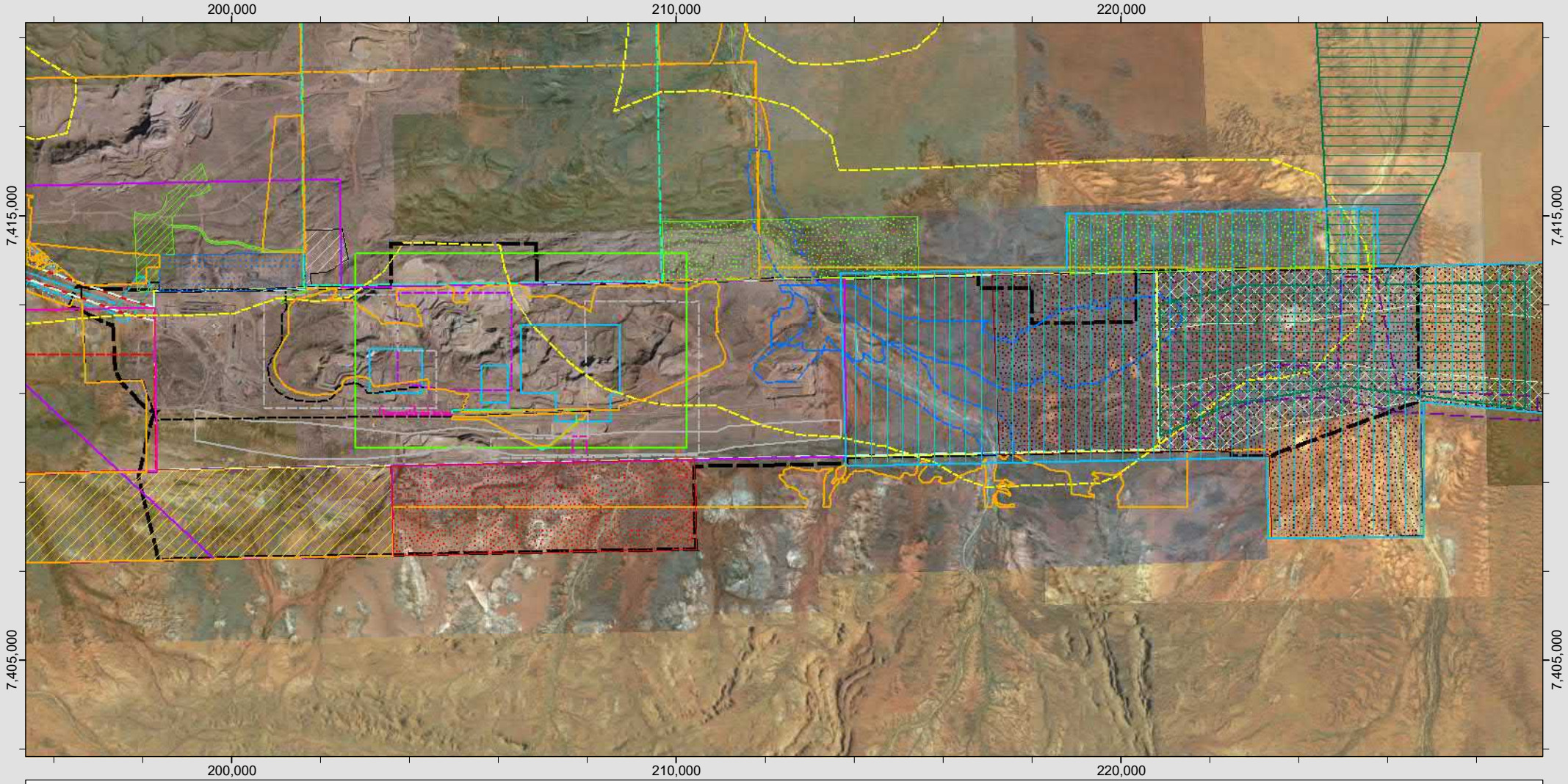
Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora[2]	Introduced Flora	Appendix
Orebody 31 - Targeted Significant Flora Survey June 2014 (Onshore Environmental, 2014b)	Targeted	Not applicable	24-30 Apr 2014	Excellent	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	Not recorded	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Four Priority flora taxa were recorded: *Acacia corusca* (P1) (previously known as A. sp. nov.) *Rhagodia* sp. Hamersley (M. Trudgen 17794) (P3), *Triodia* sp. Mt Ella (M.E. Trudgen 12739) (P3) and *Goodenia nuda* (P4).	Not recorded	Not attached
South West Jimblebar Level 2 Flora and Vegetation Survey (Syrinx Environmental 2014)	Two season detailed	38 quadrats	14-18 Mar 2011 27 Aug-4 Sep 2013	Good	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	13 vegetation associations classified into nine broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from excellent to good.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. Three Priority flora taxa were recorded: *Aristida jerichoensis* var. *subspinulifera* (P3), *Vittadinia* sp. Coondewanna Flats (S. van Leeuwen 4684) (P1) and *Euphorbia inappendiculata* var. *inappendiculata* (P2).	Seven introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Wheelarra Hill North Level 2 Flora and Vegetation Assessment (Syrinx Environmental 2012)	Two season detailed	83 quadrats 19 releves	17-29 May 2011 4-12 Oct 2011	Poor	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	25 vegetation associations classified into nine broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition of the majority of the area rated as very good to excellent.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Jimblebar Iron Ore Project Flora and Vegetation Assessment (Outback Ecology 2010)	Multiple season detailed	128 quadrats	12-18 Jul 2008 24-29 Sep 2008 24-26 Jan 2009 17-25 Mar 2009	Good	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	21 vegetation associations classified into 12 broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from excellent to degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa were recorded: Goodenia nuda (P4).	Six introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora[2]	Introduced Flora	Appendix
Jimblebar Iron Ore Project Ophthalmia Dam (and downstream) Phreatophytic Vegetation Assessment (Astron Environmental Services 2010)	Desktop	Not applicable	Not applicable	Not applicable	None reported	Six vegetation associations associated with the dam. No Federal or State listed TECs or State listed PECs.	Not recorded	Not recorded	Not attached
Jimblebar Linear Development Flora and Vegetation Assessment (Outback Ecology 2009)	Two season detailed	66 quadrats 17 releves	30 Oct-4 Nov 2008 17-25 Mar 2009	Poor	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	16 vegetation associations classified into seven broad floristic formations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition ranged from excellent to degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa were recorded: *Aristida jerichoensis* var. *subspinulifera* (P3).	11 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment (Outback Ecology 2009)	Two season detailed	22 quadrats	30 Oct-4 Nov 2008 24-26 Jan 2009	Good	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	Five broad vegetation associations. None aligned with Federal or State listed TECs or State listed PECs.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	One introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Caramulla Exploration Area Flora and Vegetation and Fauna Assessment (GHD Australia 2009)	Single season detailed	26 quadrats	1-8 Dec 2008	Excellent	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	16 vegetation associations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as pristine to completely degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa were recorded: *Crotalaria smithiana* (P3).	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora[2]	Introduced Flora	Appendix
Newman to Jimblebar Transmission Line and Newman Town Substation Flora and Vegetation Assessment (ENV Australia 2009)	Single season detailed	48 quadrats 19 releves	23-28 Apr 2009	Excellent	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	21 vegetation associations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as pristine to completely degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa were recorded: *Goodenia nuda* (P4).	15 introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification Goodenia hartiana (GHD Australia 2008)	Targeted	Not applicable	25-26 Sept 2004	Excellent	None reported	Not recorded	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Not recorded	Not attached
Hashimoto Exploration Project Flora and Vegetation (Ecologia Environment 2007)	Two season detailed	44 sites	24 Aug-1 Sep 2005 15-21 Feb 2006	Poor- Good	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	Nine vegetation associations classified into seven landscape types. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as excellent to degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa were recorded: *Goodenia nuda* (P4).	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Jimblebar RGP4 Rail Loop Flora and Vegetation Assessment (ENV Australia 2007)	Single season detailed	Four quadrats	27 Nov-1 Dec 2006	Good	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	Four vegetation associations classified into three broad associations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as excellent to completely degraded.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Two introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora[2]	Introduced Flora	Appendix
Jimblebar Stage 2 - Levee Banks and Communications Tower Redevelopment (ENV Australia 2007)	Single season detailed	Not reported	16-17 Apr 2007 6 Jun 2007	Excellent	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	Six vegetation associations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as excellent to poor.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Five introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
West Jimblebar Exploration Lease Flora and Vegetation Assessment (ENV Australia 2007)	Single season detailed	29 quadrats 33 releves	14-18 May 2007	Excellent	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	31 vegetation associations classified into 12 broad habitats. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as excellent to very good.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa were recorded: *Goodenia nuda* (P4).	Three introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Jimblebar Marra Mamba Exploration Biological Survey (Ecologia Environment 2006)	Single season detailed	105 quadrats	22-28 May 2006	Excellent	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	Four vegetation associations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition not reported.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act. One Priority flora taxa were recorded: *Goodenia nuda* (P4).	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
East Jimblebar Exploration Project Biological Survey (Ecologia Environment 2005)	Single season reconnaissance	45 quadrats	8-14 Feb 2005	Poor	Guidance for the Assessment of Environmental Factors: Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia, No. 51 (EPA 2004).	Seven vegetation associations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as pristine to good.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	One introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	Season	EPA Guidance (Referred to in survey report and applicable at time of survey)	Vegetation	Significant Flora[2]	Introduced Flora	Appendix
Jimblebar- Wheelarra Hill 3 Flora and Fauna Assessment (Biota Environmental Sciences 2004)	Single season detailed	2 quadrats Revisited 8 sites	28-29 Aug 2003	Poor	None reported	Six vegetation associations. None aligned with Federal or State listed TECs or State listed PECs. Vegetation condition was rated as excellent to very good.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	One introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Jimblebar Flora and Soil Survey (Ecologia Environment 1999)	Single season detailed	36 sites	11-16 Jun 1998	Poor	Survey undertaken prior to EPA guidelines being available.	Nine broad vegetation associations. TECs and PECs not reported. Vegetation condition was generally in good condition.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	Four introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached
Jimblebar Mine Site Biological Survey (BHP Billiton Iron Ore 1994)	Single season detailed	20 plotless sites	11-22 Jun 1994	Poor	Survey undertaken prior to EPA guidelines being available.	Five broad vegetation associations. TECs and PECs not reported. Vegetation condition not reported.	No plant taxa gazetted as Threatened Flora pursuant to the BC Act or listed under EPBC Act, and no Priority flora taxa, were recorded.	One introduced species were recorded, none listed as a Declared Pest under the BAM Act.	Not attached



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Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Flora and Vegetation Survey Coverage

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/059 REV 0
Date: 23/08/2019	Checked:	Figure: A5
Revision: REV 0	Reviewed: ENVIRO. A&I	

Proposed Development Envelope

N

0 1 2 3
Kilometres

Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_059_E_FloraVeg_SurveyCoverage_Rev0.mxd

Flora and Vegetation Survey Coverage

- South West Jimblebar Flora and Vegetation Assessment, Syrinx (2012)
- Caramulla Creek Vegetation Survey and Desktop Assessment, Onshore (2018)
- Carramulla Exploration Area Flora and Vegetation and Fauna Assessment, GHD (2009)
- East Jimblebar Exploration Project Biological Survey, Ecologia (2011)
- Jimblebar Iron Ore Project Opthalmia Dam (and downstream) Phreatophytic Vegetation Assessment, Astron (2009)
- Consolidation of Regional Vegetation Mapping BHP Billiton Iron Ore Pilbara Tenure, Onshore (2014)
- Tenement E52/2238 Level 1 Flora & Vegetation and Vertebrate Fauna Survey, Onshore (2014)
- Shearers West Detailed Vegetation and Flora Survey, Onshore (2018)
- North Jimblebar Reconnaissance Flora and Vegetation Survey and Level 1 Vertebrate Fauna Survey, Onshore (2018)
- South West Jimblebar Level 2 Flora and Vegetation Survey, Syrinx (2014)
- Caramulla Reconnaissance Flora and Vegetation Survey, Onshore (2018)
- Jimblebar Ammonium Nitrate Storage Facility Flora and Vegetation Assessment, ENV (2009)
- Jimblebar Spur 2 Flora and Vegetation Assessment, ENV (2009)
- Jimblebar Biological Survey, BHPBIO (1994)
- Jimblebar Flora and Soil Survey, Ecologia (1999)
- Jimblebar - Wheelarra Hill 3 Flora and Fauna Assessment, Biota (2004)
- Wheelarra Hill (Jimblebar Mine Site) Priority Species Verification Goodenia hartiana, GHD (2004)
- Jimblebar Marra Mamba Exploration Biological Survey, Ecologia (2006)
- West Jimblebar Lease Flora and Vegetation Assessment, ENV (2007)
- Jimblebar RGP4 Rail Loop Flora and Vegetation Assessment, ENV (2007)
- Hashimoto Exploration Project Biological Survey Flora and Vegetation, Ecologia (2007)
- Jimblebar Stage 2 - Levee Banks and Communications Tower Redevelopment, ENV (2007)
- Newman to Jimblebar Transmission Line and Newman Town Substation, ENV (2009)
- Jimblebar Construction Water Supply Pipeline and Ammonium Nitrate Storage Facility, ENV (2009)
- Jimblebar Iron Ore Project Flora and Vegetation Assessment , Outback Ecology (2009)
- Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment, Outback Ecology (2009)
- Jimblebar Linear Development Flora and Vegetation Assessment, Ecologia (2009)
- RGP 6 Jimblebar Hub (Water Pipeline) , ENV (2010)
- Eastern Mines Weed Survey Jimblebar, Astron (2011)
- Wheelarra Hill North Level 2 Flora and Vegetation Assessment, Syrinx (2012)
- Orebody 31 - Targeted Significant Flora Survey, Onshore (2014)
- Dynasty and West Jimblebar Level 2 Flora and Vegetation Survey, Onshore (2015)
- Targeted Survey for Acacia sp. East Fortescue (surrounding OB31), Onshore (2015)
- Level 2 Riparian & Aquatic Flora & Vegetation Survey Jimblebar Creek & Innawally Pool, Onshore (2016)
- East Jimblebar and Caramulla Flora and Vegetation Survey

Appendix 6 Caramulla Creek Flora and Vegetation Survey

Appendix 7 Vegetation Survey and Desktop Assessment Caramulla Creek

Appendix 8 Reconnaissance Flora and Vegetation Survey Caramulla

Appendix 9 Shearer's West Detailed Flora and Vegetation Survey

Appendix 10 Summary of Terrestrial Fauna studies and surveys

Table A10 presents a summary of Terrestrial Fauna information used in the assessment of the Project. Figures A10-1 and A10-2 show the survey coverage for the studies and surveys presented in Table A10 for vertebrate fauna and SRE fauna respectively.

Table A10: Summary of Terrestrial Fauna studies and surveys

Title/ Reference	Survey Level	Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna[3]	Appendix
Vertebrate Fauna							
Jimblebar East and Caramulla Fauna Survey (GHD, 2019)	Single season Level 2	Eight trap sites	29 Apr-10 May 2019	Technical Guidance Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016). Technical Guidance Terrestrial Fauna Surveys (EPA 2016).	Seven habitat types identified: Major Drainage Line, Hillcrest/ Hillslope, Sand Plain, Mulga Woodland, Minor Drainage Line, Stony Plain and Claypan.	One Threatened fauna listed under the EPBC Act and the BC Act recorded: Ghost Bat (*Macroderma gigas*) (Vu). Two Priority fauna species recorded: Brush-tailed Mulgara (*Dasycercus blythi*) (P4) and Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Appendix 11
Shearers West Targeted Vertebrate and Short-range Endemic Invertebrate Fauna Assessment (Biologic, 2019)	Single season Level 2	Five trap sites	29 Apr-4 May 2018	Technical Guidance Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016). Technical Guidance Terrestrial Fauna Surveys (EPA 2016).	Five habitat types identified: Major Drainage Line, Stony Plain, Hillcrest/ Hillslope, Mulga, and Sand Plain.	No Threatened fauna listed under the EPBC Act or the BC Act, and no Priority fauna species recorded.	Appendix 12
Caramulla Level 1 Vertebrate Fauna Assessment (Biologic, 2018)	Single season Level 1	21 sites	17-21 Feb 2018	Technical Guidance Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016). Technical Guidance Terrestrial Fauna Surveys (EPA 2016).	Nine habitat types identified: Claypan, Breakaway/ Cliff, Minor Drainage Line, Major Drainage Line, Stony Plain, Drainage Area/ Floodplain, Hillcrest/ Hillslope, Mulga Woodland and Sand Plain.	One Threatened fauna listed under the EPBC Act and the BC Act recorded: Greater Bilby (*Macrotis lagotis*) (Vu). One Priority fauna species recorded: Brush-tailed Mulgara (*Dasycercus blythi*) (P4).	Appendix 13
South West Jimblebar Vertebrate Fauna Survey (Biologic 2013)	Single season Level 2	Four trap sites	4-17 Mar 2013	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004). Technical Guide Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA-DEC 2010).	Five broad habitat types identified: Major Drainage Line, Sand plain, Stony plain, Rocky outcrops and hill, and Mulga and mixed *Acacia* woodland.	No Threatened fauna listed under the EPBC Act or the BC Act. Two Priority fauna species recorded: Brush-tailed Mulgara (*Dasycercus blythi*) (P4), and Spotted Ctenotus (*Ctenotus uber johnstonei*) (P2).	Not attached
Wheelarra Hill North Fauna Assessment (ENV Australia 2011)	Two season Level 2	Seven trap sites	7-18 Apr 2011 4-13 Oct 2011	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004). Technical Guide Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA-DEC 2010).	Four main habitat types identified: Alluvial Plain, Drainage Line, Gorge, and Hills.	No Threatened fauna listed under the EPBC Act or the BC Act. One Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Not attached

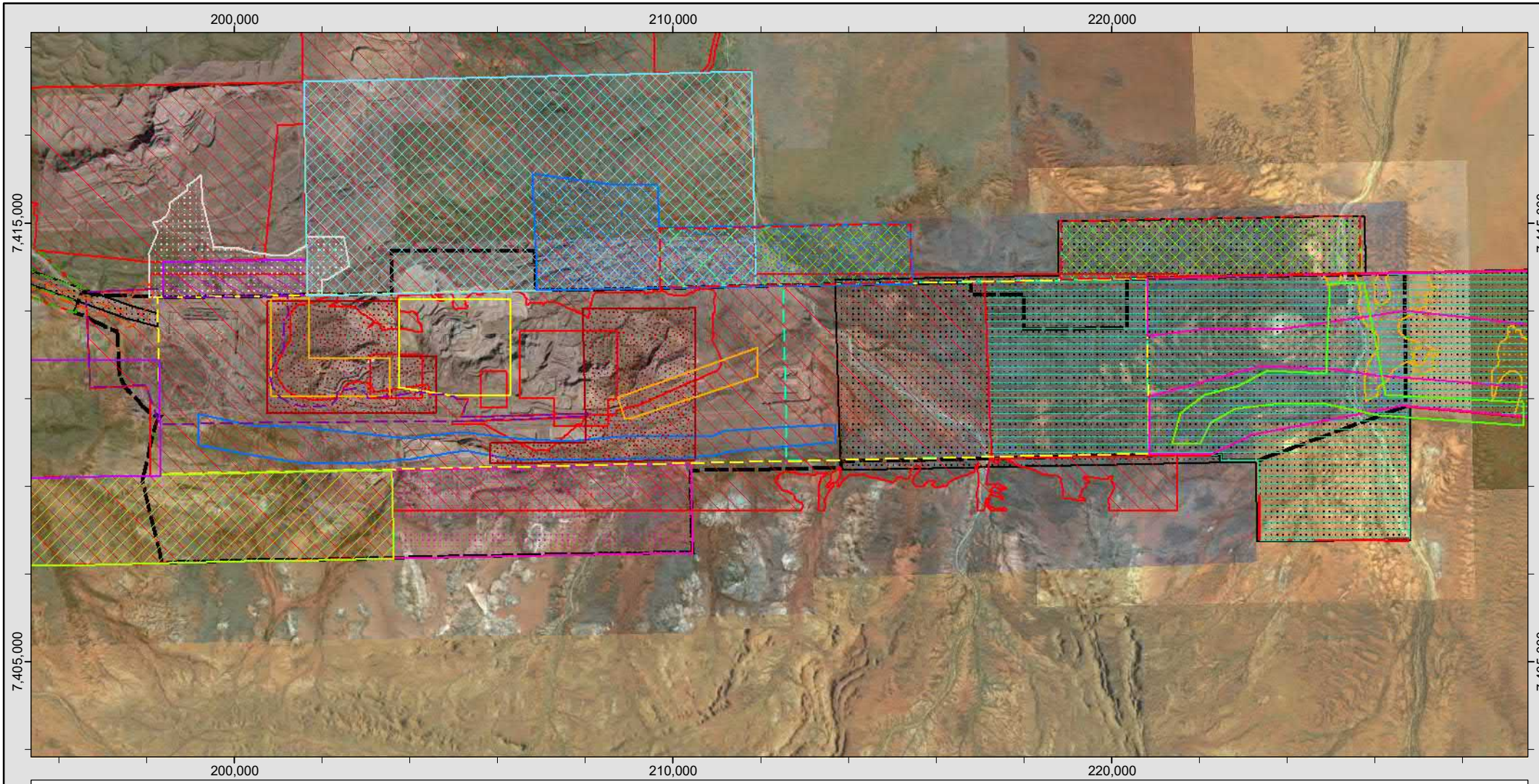
[3] Based on current conservation status of taxa.

Title/ Reference	Survey Level	Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna[3]	Appendix
Carramulla Exploration Area Flora and Vegetation and Fauna Assessment (GHD 2009)	Single season Level 1	22 sites	1-8 Dec 2008	Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Seven habitat types identified: Creeklines and minor drainage channels, Low hills and slopes including rocky outcrops and breakaways, Mulga woodlands, Sandplain, Floodplain, Open stony ground, and Calcrete outcrops.	No Threatened fauna listed under the EPBC Act or the BC Act, and no Priority fauna species recorded.	Not attached
Newman to Jimblebar Transmission Line and Newman Town Substation terrestrial Fauna Assessment (ENV Australia 2009)	Single season Level 1	Five sites	21-27 Apr 2009	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Five habitat types identified: Mulga plain, Low hills, Riverine, Floodplain, and Hilltop/ breakaway.	No Threatened fauna listed under the EPBC Act or the BC Act, and no Priority fauna species recorded.	Not attached
Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment (Outback 2009)	Two season Level 2	Nine trap sites	4-15 Jun 2008 27 Sep-3 Oct 2008	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Five habitat types identified: Open shrub plain, Mulga and mixed *Acacia* woodland, Riverine, Rocky gorge, and Hillcrest/ slopes.	No Threatened fauna listed under the EPBC Act or the BC Act. One Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Not attached
Jimblebar Linear Development Vertebrate Fauna Assessment (Outback 2009)	Two season Level 2	Six trap sites	22 Sep-4 Oct 2008 3-11 Apr 2009	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Six habitat types identified: Alluvial Plain, Hillcrest, Riverine, Drainage Line, Spinifex Shrubland, and Mulga Woodland.	No Threatened fauna listed under the EPBC Act or the BC Act. Two Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4) and Gane's Blind Snake (*Anilios ganei*) (P1).	Not attached
Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment (Outback 2009)	Two season Level 2	Four trap sites	4-15 Jun 2008 25 Sep-2 Oct 2008	Environmental Protection of Native Vegetation in Western Australia: Clearing of Native Vegetation with Particular Reference to Agricultural Areas, Position Statement No. 2 (EPA 2000). Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Three broad habitat types identified: Mulga and Mixed Acacia Woodland, Open Shrub Plain, and Breakaway.	No Threatened fauna listed under the EPBC Act or the BC Act. One Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Not attached
West Jimblebar Lease Fauna Assessment (ENV Australia 2007)	Single season Level 2	Four trap sites	14-21 May 2007	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Five major habitat types identified: Loamy flats and floodplains, Sandplains, Breakaway, Drainage line, and Scree slopes.	No Threatened fauna listed under the EPBC Act or the BC Act, and no Priority fauna species recorded.	Not attached

Title/ Reference	Survey Level	Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna[3]	Appendix
BHPBIO Hashimoto Terrestrial Vertebrate Fauna Assessment (Ecologia 2006)	Two season Level 2	Six trap sites	26 Aug-16 Sep 2005 6-15 Feb 2006	Terrestrial Biological Surveys as an Element of Biodiversity Protection, Position Statement No. 3 (EPA 2002). Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Six habitat types identified: Low ridge top, Rocky gully, Riverine, Scree slope and Hillslope, Minor Drainage Line and Alluvial Plain.	Two Threatened fauna listed under the EPBC Act or the BC Act recorded: Pilbara Leaf-nosed Bat (*Rhinonicteris aurantia*) (Vu) and Ghost Bat (*Macroderma gigas*) (Vu)[4]. No Priority fauna species recorded.	Not attached
Jimblebar Marra Mamba Exploration Biological Survey (Ecologia 2006)	Single season Level 2	59 sites	22-28 May 2006	Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Four major habitat types identified: Mulga woodland and sometimes snappy gum over mixed open herbs and spinifex grass, *Acacia* open low woodland over open low *Aristida* and *Enneapogon* grassland, Scattered *Corymbia* trees over open low *Acacia* shrubs over spinifex hummock grassland, and Scattered *Grevillea* with *Acacia* and *Hakea* shrubs over spinifex grass.	No Threatened fauna listed under the EPBC Act or the BC Act. One Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Not attached
East Jimblebar Exploration Project Biological Survey (Ecologia 2005)	Single season Level 1	45 sites	8-14 Feb 2005	Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2004).	Three major habitat types identified: *Acacia* open low woodland on gravel plain, *Corymbia* scattered trees, and *Acacia* open low woodland over spinifex on sandplain.	No Threatened fauna listed under the EPBC Act or the BC Act, and no Priority fauna species recorded.	Not attached
Jimblebar- Wheelarra Hill 3 Flora and Fauna Assessment (Biota 2004)	Single season Level 1	Not applicable	28-29 Aug 2003	None reported	Five major habitat types identified: Range crest, Range slopes, Footslopes, Gorges, and Minor Drainages.	No Threatened fauna listed under the EPBC Act or the BC Act, and no Priority fauna species recorded.	Not attached
Jimblebar- Wheelarra Hill Biological Survey (Ecologia 2004)	Single season Level 2	Five trap sites	9 Feb-13 Mar 2004	Guidance for the Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA 2003).	Five major habitat types identified: Mesa top, Rocky gully, Riverine, Alluvial plain, and Screes.	No Threatened fauna listed under the EPBC Act or the BC Act. One Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Not attached
Jimblebar Iron Ore Project Pebble-mound Mouse (*Pseudomys chapmani*) Site Survey (Ecologia 1996)	Targeted	Not applicable	7-18 Dec1995	Survey undertaken prior to EPA guidelines being available.	Not recorded	One Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Not attached
Jimblebar Mine Site Biological Survey (BHP Billiton Iron Ore 1994)	Single season Level 2	18 trap sites	11-22 Jun 1994	Survey undertaken prior to EPA guidelines being available.	Four major habitat types identified: Gorges, Hills and ridges, Drainage lines and Spinifex slopes.	No Threatened fauna listed under the EPBC Act or the BC Act. One Priority fauna species recorded: Western Pebble-mound Mouse (*Pseudomys chapmani*) (P4).	Not attached
Short-range Endemic Invertebrate Fauna							
East Jimblebar and Caramulla Short-range Endemic Invertebrate Fauna Survey (Biologic, *in prep*)	Two season Level 2	101 total sites (46 sample sites)	1-6 May 2019 and (proposed) Sept 2019	Technical Guidance Sampling of Short-range Endemic Invertebrate Fauna (EPA 2016).	Major of habitats assessed as low or moderate/low suitability for SRE fauna.	Results still pending.	Not attached

[4] Subsequent review of data determined that this survey falsely recorded the Pilbara Leaf-nosed Bat and Ghost Bat (Outback 2009 and Specialised Zoological 2009).

Title/ Reference	Survey Level	Survey Effort	Timing	EPA Guidance (Applicable at time of survey)	Habitats	Significant Fauna[3]	Appendix
Shearer's West Targeted Vertebrate and Short-range Endemic Invertebrate Fauna Assessment (Biologic 2019)	Targeted	15 sample sites	29 Apr-4 May 2018	Technical Guidance Sampling of Short-range Endemic Invertebrate Fauna (EPA 2016).	Hillcrest/ Hillslope habitat assessed as moderate suitability for SRE fauna.	No confirmed SRE taxa. Three potential SRE taxa: *Synsphyronus* sp. indet, *Lychas* 'bituberculatus complex', and *Buddelundia* sp. '14CR'	Appendix 12
OB19-31 Short-range Endemic Invertebrate Fauna (Biologic 2014)	Two season Level 2	277 total sample sites	18-27 Mar 2013 27 Aug-9 Sep 2013	Guidance for the Assessment of Environmental Factors: Sampling of Short Range Endemic Fauna for Environmental Impact Assessment in Western Australia, No. 20 (EPA 2009).	Gorges/ deep gullies, Ridges/ breakaways, Rocky outcrops, and Shallow/ open gullies assessed as high suitability for SRE fauna. Vegetation groves and Drainage foci assessed as moderate suitability for SRE fauna.	No confirmed SRE taxa. 10 potential SRE taxa: *Aganippe* 'sp. MYG384-DNA', *Karaops* 'ARA003-DNA', *Karaops* 'ARA004-DNA', *Synsphyronus* 'sp. indet. (juv.)', *Xenolpium* 'sp. PSE079', *Antichiropus* 'sp. indet. (juv.)', *Buddelundia* '36NM', *Buddelundia* '10NM', *Buddelundia* '49', and Buddelundiinae 'WN'.	Not attached
South-West Jimblebar Short Range Endemic Invertebrate Survey (Biologic 2013)	Single season Level 2	32 sample sites	14-19 Feb 2013	Guidance for the Assessment of Environmental Factors: Sampling of Short Range Endemic Fauna for Environmental Impact Assessment in Western Australia, No. 20 (EPA 2009).	Mulga woodlands associated with drainage lines or isolated groves were assessed as most prospective habitat type for SRE fauna.	No confirmed SRE taxa. One potential SRE taxa: *Buddelundia* sp. nov.	Not attached
Jimblebar Iron Ore Project Terrestrial Invertebrate Short Range Endemic Assessment (Outback 2009)	Two season Level 2	14 sample sites	19-28 Aug 2008 5-12 Feb 2009	Guidance for the Assessment of Environmental Factors: Sampling of Short Range Endemic Fauna for Environmental Impact Assessment in Western Australia, No. 20 (EPA 2009).	All habitats assessed as low suitability or unsuitable for SRE fauna.	No SRE taxa identified.	Not attached



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Vertebrate Fauna Survey Coverage

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/059 REV 0
Date: 21/08/2019	Checked:	Figure: A10-1
Revision: REV 0	Reviewed: ENVIRO. A&I	

Proposed Development Envelope

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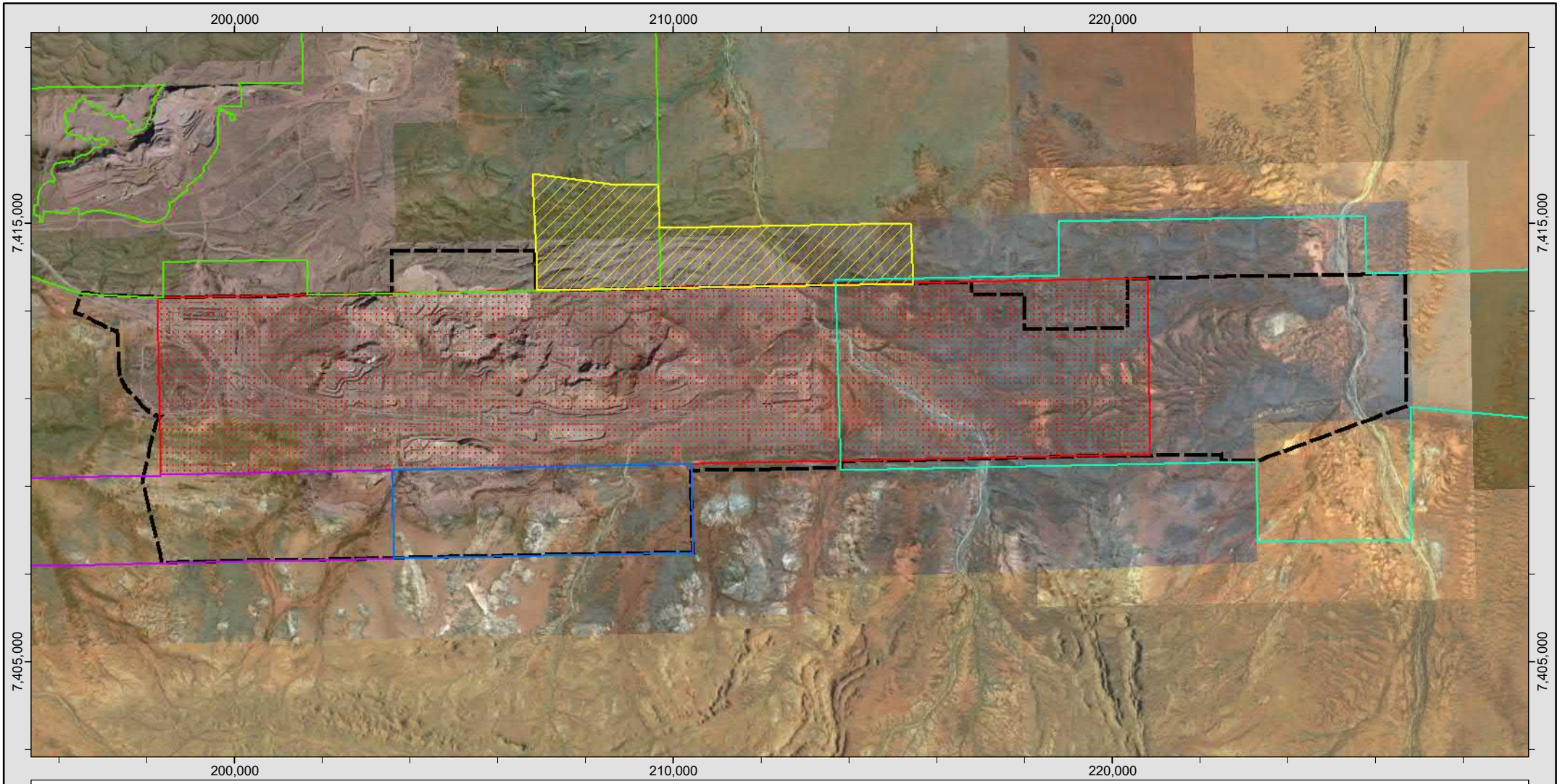
Projection: Transverse Mercator
Datum: GDA 1994

Document Path: Y:\Jobs\A501_A1000\A949\3Project\A949_061_E_VertebrateFauna_SurveyCoverage_Rev0.mxd

Vertebrate Fauna Survey Coverage

- Caramulla NVCP Training Package Searching for Mulgara and Bilby Burrows, GHD (2019)
- Shearer's West Targeted Vertebrate and Short-range Endemic Invertebrate Fauna Assessment, Biologic (2019)
- Caramulla Level 1 Vertebrate Fauna Assessment, Biologic (2018)
- North Jimblebar Reconnaissance Flora and Vegetation Survey and Level 1 Vertebrate Fauna Survey, Onshore (2018)
- Consolidated Fauna Habitat Mapping 2017, Biologic (2018)
- Tenement E52/2238 Level 1 Flora & Vegetation and Vertebrate Fauna Survey, Onshore (2014)
- South West Jimblebar Vertebrate Fauna Survey., Biologic (2013)
- Wheelarra Hill North Fauna Assessment, ENV (2011)
- Construction water supply pipeline and ammonium nitrate storage facility fauna assessment., ENV (2010)
- Carramulla Exploration Area Flora and Vegetation and Fauna Assessment , GHD (2009)
- Newman to Jimblebar Transmission Line and Newman Town Substation terrestrial Fauna Assessment , ENV (2009)
- Jimblebar Spur 2 Fauna Assessment, ENV (2009)
- Jimblebar Iron Ore Project Terrestrial Vertebrate Fauna Assessment , Outback Ecology (2009)
- Wheelarra Hill Iron Ore Mine Modification Flora and Fauna Assessment , Outback Ecology (2009)
- Jimblebar Linear Development Vertebrate Fauna Assessment , Outback Ecology (2009)
- West Jimblebar Lease Fauna Assessment, ENV (2007)
- BHPBIO Hashimoto Terrestrial Vertebrate Fauna Assessment , Ecologia (2006)
- Jimblebar Marra Mamba Exploration Biological Survey, Ecologia (2006)
- East Jimblebar Exploration Project Biological Survey, Ecologia (2005)
- Jimblebar- Wheelarra Hill Biological Survey, Ecologia (2004)
- Jimblebar- Wheelarra Hill 3 Flora and Fauna Assessment , Biota (2004)
- Jimblebar iron Ore Project Pebble-mound Mouse (Pseudomys chapmani) Site Survey , Ecologia (1996)
- Jimblebar Biological Survey , BHPBIO (1994)
- East Jimblebar and Caramulla Vertebrate Fauna Survey, (2019)
- Jimblebar North Level 1 Vertebrate Fauna Survey, Onhore (2019)
- Single season level 2 vertebrate fauna survey of Jimblebar North (2019)



Spatial Data - Studies Planning & Access
BHP IRON ORE

JIMBLEBAR OPTIMISATION PROJECT
Short-range Endemic Survey Coverage

Scale @ A4: 1:125,000	Prepared: J. VIS	Project No: A949/059 REV 0
Date: 26/08/2019	Checked:	Figure: A10-2
Revision: REV 0	Reviewed: ENVIRO. A&I	

Proposed Development Envelope

SRE Surveys

- Jimblebar Iron Ore Project Terrestrial Invertebrate Short Range Endemic Assessment, Outback Ecology (2009)
- South-West Jimblebar Short Range Endemic Invertebrate Survey, Biologic (2013)
- Orebody 31 targeted SRE survey, Biologic (2014)
- Shearer's West Targeted Vertebrate and Short-range Endemic Invertebrate Fauna Assessment, Biologic (2014)
- East Jimblebar and Caramulla Level 2 SRE survey (2019)
- Jimblebar North SRE Survey (2019)

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Coordinate System: GDA 1994 MGA Zone 51
Projection: Transverse Mercator
Datum: GDA 1994

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Appendix 11 Jimblebar East and Caramulla Fauna Survey

Appendix 12 Shearer's West Targeted Vertebrate Fauna and Short-range Endemic Invertebrate Fauna Assessment

Appendix 13 Caramulla Level 1 Vertebrate Fauna Assessment

Appendix 14 Caramulla subterranean fauna supplementary information

Appendix 15 Jimblebar Flora and Vegetation Management Plan

Appendix 16 Jimblebar Mine Closure Plan

Appendix 17 Jimblebar Water Management Plan

Appendix 18 WA Environmental Offsets Template

Appendix 19 IBSA data package

The following biodiversity data and reports are provided as part of the IBSA data package, consistent with the EPA's *Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA)* (EPA, 2018h):

- All recent surveys except the following:
    - East Jimblebar and Caramulla Flora and Vegetation Survey (Biologic): Report (and data) in preparation.
    - East Jimblebar and Caramulla Short-range Endemic Invertebrate Fauna Survey (Biologic): Survey to be completed – second season of SRE survey is planned for September 2019.