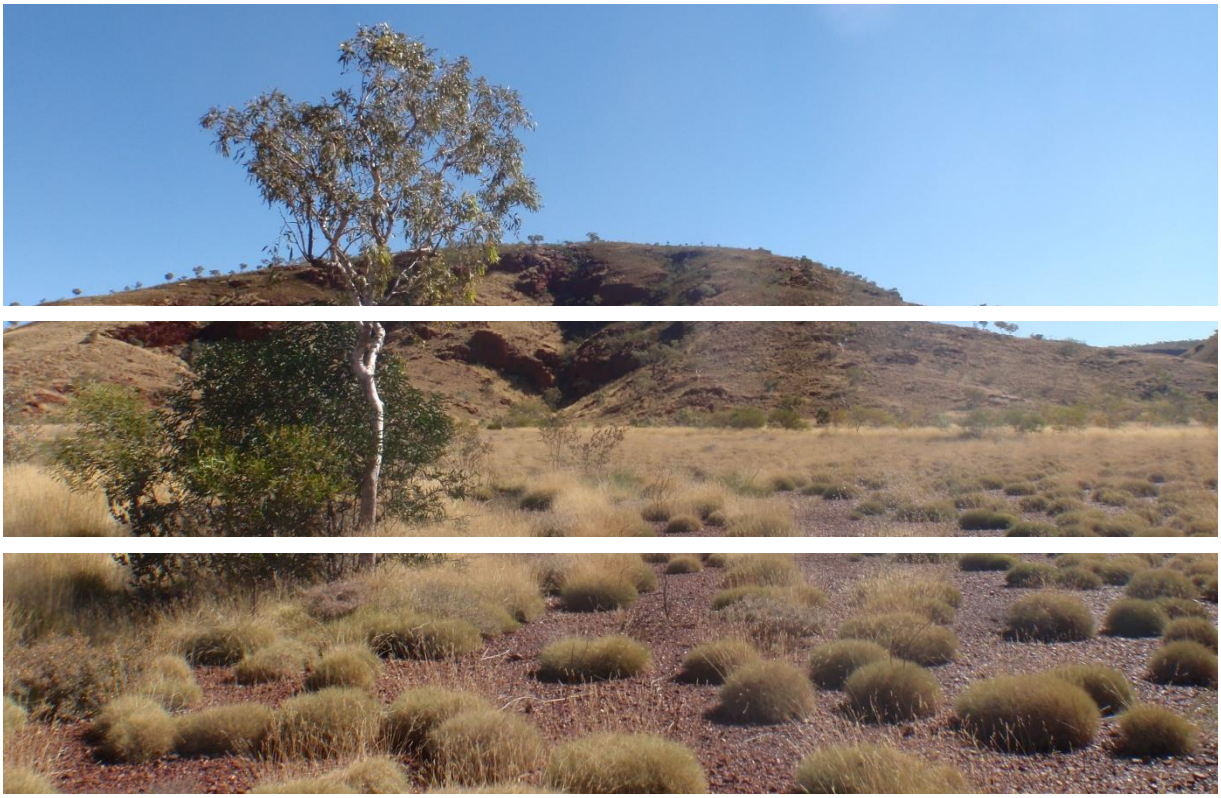
Environmental Review Document

Iron Valley Below Water Table



Environmental Review Document

Iron Valley Below Water Table

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1.0 Proponent and Key Proposal Characteristics

This proposal is seeking environmental approval for BC Pilbara Iron Ore Pty Ltd (BCP) to mine below the water table (BWT) at its Iron Valley Project. It represents the next step for Iron Valley, which was granted ministerial approval for above water table (AWT) mining in 2012 (under Ministerial Statement No. 933 (MS933)). This proposal is prepared as an amendment to the existing AWT approval and addresses all new attributes of the mine and its operations, and the subsequent potential key environmental impacts that may occur from those new attributes. BCP is a wholly owned subsidiary company for BC Iron Limited (BCI); a Perth based company with a number of iron ore projects within the Pilbara region.

The following terminology has been applied consistently throughout this supporting document:

- Iron Valley Above Water Table Project (AWT project): currently approved under MS933 and fully operational.
- Iron Valley Below Water Table Proposal (BWT proposal): the new attributes of the mine and its operations described in Section 2.0 of this supporting document, combined with the residual, unchanged components of the approved AWT project. It is this combined proposal, which is subject to approval by the minister under a new ministerial statement.

This Environmental Review (ER) document is prepared as supporting information to a Section 38 (of the *Environmental Protection Act 1986* (EP Act)) Referral to the Western Australian Environmental Protection Authority (EPA). The information provided within it also accords with the *Environmental Impact Assessment (Part IV Divisions 1 and 2) Administrative Procedures 2012.* Other broad policy and guidance applicable to this project are presented in Table 1. Study specific guidelines and policy that have been followed are presented at the beginning of the impact assessments sections for each environmental factor within Section 5 of this document. Other policy and guidelines prepared by the EPA (EPA 2016) were considered but not determined to be relevant.

Table 1 EPA policy applicable to the general preparation of this supporting document

Topic	Applicable policy	Reference within this document	Rationale in meeting policy
Preparation of environmental review document	*Environmental Assessment Guideline for Defining the Key Characteristics of a Proposal* (EAG 1) (EPA 2012).	Section 1.2	Content of section 1.2 identifies the key characteristics as per EAG1.
	Environmental Assessment Guideline for Referral of a proposal under s38 of the Environmental Protection Act 1986 (EAG16) (EPA 2015c)	The referral form and supporting information	The referral form and supporting information follows the content and applicability of EAG16.
	Environmental Assessment Guideline for Preparation of an API – Category A Environmental Review Document (EAG14a) (EPA 2015).	ER document as whole	This supporting document has been prepared in accordance with EAG14, with some additional information to provide additional context to help understanding of the impacts / outcomes being described.
	Environmental Assessment Guideline for Environmental principles, factors and objectives (EAG 8) (EPA 2015b).	Section 5	Content of Section 5, describes the key environmental factors applicable to the BWT project, and how they have been derived
Significance framework	*Environmental Assessment Guideline for Application of a significance framework in the environmental impact assessment process* (EAG9) (EPAb 2013)	Section 8.2	The work presented throughout the impact assessment section (Section 5) and the conclusions reached are based on the application of applying mitigation and management in the order of management hierarchy to demonstrate that the EPA objectives applicable to each of the environmental factors is likely to be achieved.

1.1 The Proponent

The proponent for the Project is:

BC Pilbara Iron Ore Pty Ltd

Level 1, 15 Rheola Street

West Perth, WA 6005

1.1.1 Key Contact

The key contact for the Project is:

Michael Klvac - Manager Approvals

T: 08 6311 3400 Email: michael.klvac@bciron.com.au

1.2 Key Proposal Characteristics

The BWT proposal expands the existing operations and introduces some new elements to the approved operations. Table 1 provides a summary of the proposal, while Table 2and Table 3specifically outline the changes. For completeness, details are provided of the components that were approved as part of AWT, but will remain for the combined proposal enabling a new MS to be prepared for the combined AWT and BWT components. For clarity, the new elements included in Table 3 and Table 4 in bolded typeface. This document is prepared in accordance with EPA's *Environmental Assessment Guideline 14* (EPA 2015) with respect to structure and content.

1.2.1 Summary of the Proposal

Table 2 Summary of the Proposal

Proposal Title	Iron Valley Below Water Table Proposal
Proponent Name	BC Pilbara Iron Ore Pty Ltd
Short Description	The Proposal is to develop and operate a below water table iron ore mine in the Pilbara as an amendment to the Iron Valley AWT project. The drill and blast and hydraulic shovel proposal intends to develop one new pit and extend two existing pits below the water table. Associated mine infrastructure will include beneficiation (if required), waste rock landforms, encapsulated tailing storage facilities (if beneficiation process implemented) waste management facilities, dewatering bores, multiple water discharge points and modifications to existing surface water infrastructure. The proposals location is approximately 90 km north-west of Newman and 150 km east of Tom Price, within the East Pilbara Shire and the Eastern Pilbara Region of Western Australia (Figure 1).

1.2.2 Physical Elements

The physical elements of the BWT Proposal which require approval are given in Table 3 and the operational elements in Table 4. The locations of the proposed elements are shown on Figure 3.

Table 3 Physical Elements of the Project

Element	Description (refer to Figure 2)	Proposed extent
Mine Pits	Extension in depth of Pit E	Within existing pit surface boundary.
	Extension in depth of Pit N	Within existing pit surface boundary.
	Extension in depth and surface of Pit C	Additional increase of up to approximately 8 ha.
	New Pit S	Disturbance area of up to approximately 76 ha.
		Additional area for pits, approximately 84 ha, existing as approved pit areas 280 ha, total required for combined project approximately 364 ha

Element	Description (refer to Figure 2)	Proposed extent
Waste Rock Landform (WRL)	Extension in height of WRL 1	No additional disturbance area. Existing waste dump expanded from 30 m height to a revised height of up to approximately 150 m.
	Extension in height and area of WRL 2	Additional disturbance area for WRL, 230 ha with revised height up to approximately 150 m. Existing area for WRL as approved 137 ha with height up to 30 m.
	Integrated Tailing Storage Facility. Located within multiple WRLs	Multiple cells integrated into the WRL. No additional disturbance area.
Infrastructure	18 MW gas turbine power supply (within existing infrastructure area).	No additional disturbance area.
Disturbance footprint	Additional disturbance footprint to accommodate BWT proposal.	Additional 314 ha; Existing as approved 674 ha; Total required for combined project 988 ha out of a total tenement 1,094 ha. See Figure 2

1.2.3 Operational Elements

Table 4 Operational Elements of the Proposal

Element	Description	Proposed Extent
Ore Processing (waste)	Encapsulated Tailings Storage Facility	Storage of up to 3.2 Mtpa of tailings.
Ore Processing	Existing crushing and screening plant producing coupled with new beneficiation plant.	Total throughput not to exceed 24 Mtpa.
Dewatering	Over the life of the mine, the project requires up to 19 different bores which comprise a combination of in-pit and ex-pit pumping.	Extraction of no more than 23 GL per annum. Approximately 6 GL per annum to be used in processing.
Water discharge and water management infrastructure	The project will require pit dewatering for dry mining. Excess water to be discharged to Weeli Wolli Creek (WWC) at three locations (DL1, DL4 and DL5 shown on Figure 2). These are the points where the on tenure discharges will enter WWC. Water for operations will be reused and entrained in tailings. Pit dewatering and excess surface water (during high rainfall events) will be discharged. Pumps and pipe network will deliver dewatering to on tenure discharge points and process water to beneficiation plant. Water courses will be retained on their current alignment and creek diversions approved in AWT will be implemented. An exclusion zone is applied to an unnamed minor water course to the south of the tenement which will facilitate water traversing the site towards WWC unimpeded (shown on Figure 2).	Three discharge points into WWC. Discharge of approximately 17 GL per annum.
Waste Management Facility	This facility has been approved and is operational as part of the AWT, it will remain unchanged for the amended proposal. Ablution facilities are integrated with packaged treatment plants (with a capacity of 140 kL/day) at strategic locations around the site. Processed effluent will be disposed of through subsoil irrigation in a suitable area adjacent to the facility. A fenced landfill site has been prepared to handle non-hazardous solid waste disposal. This is within the infrastructure area shown on Figure 2.	No changes are proposed to this operational facility.

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2.0 General Description of the Project

2.1 Project Description

The BWT Proposal will extend the AWT project, as approved under MS 933 to mine ore below the water table. The BWT Proposal is located in the East Pilbara Shire within the Eastern Pilbara Region of Western Australia, approximately 90 km north-west of Newman and 150 km east of Tom Price (see Figure 1). The nearest operating iron ore mines includes the Rio Tinto Iron Ore (RTIO) Yandicoogina (5 km to the west) and Hope Downs operations (45 km to the south west), BHP Billiton (BHPB) Iron Ore Yandi operation (35 km to the West) and Fortescue Metals Group (FMG) Cloudbreak operations (55 km to the north).

The proposal is a BWT, blast and hydraulic shovel open pit mining operation. The mining operations will predominantly use the disturbance area granted for the AWT project with an additional 314 ha required to enable BWT mining operations. The ore will be mined from multiple pits through multiple stages and sent to the Run of Mine (ROM) pad where the ore may be blended. The ore will then be crushed and screened and sent to the beneficiation plant (as appropriate) before being transported via road to market (gate sale).

BCP would mine the expected reserve of 140 million tonnes (Mt) lying below the water table, over an anticipated operational mining life of 10 years. Approximately 350 Mt of waste rock / low grade ore is expected to be generated and stored in WRLs, which will be allocated to surface ex-pit and backfilled pit locations.

No additional ancillary infrastructure is proposed other than a beneficiation plant, and reconfiguration of the existing infrastructure such as surface water management and access haul roads which are still undergoing design iterations. Water will be supplied through the mine dewatering activities, with excess proposed to be discharged via multiple points on tenure and subsequently enter the WWC system. The site configuration will allow for a future alternative bulk ore transport system. This transport system is not included within this proposal.

The footprint and proposed broad layout of the combined Iron Valley Proposal is best represented in Figure 2. This clearly demarcates the AWT project component and the BWT proposed clearing component. The additional area required for the BWT proposal is then separated out and shown in Figure 3.

The BWT Proposal will entail the following works to be undertaken:

1) Extending the AWT Project pits to be deeper and cover a wider area;
2) Mining of an additional pit in the south of the tenement, M47/1439;
3) Increasing the size and number of WRLs;
4) Placing WRL material as backfill to mined out pits as they become available to minimise clearing;
5) Incorporating multiple encapsulated tailings storage facility (TSF) cells within the WRLs
6) Dewatering of the underlying aquifer for safe, dry pit excavation via a combination of up to 19 bores across the lifetime of the project; and
7) Disposing of excess pit dewatering into WWC.

2.1.1 Project Additional Disturbance Area

The additional disturbance area required for the BWT Proposal is 314 ha. The combined disturbance area for the AWT and BWT is 988 ha. The combined area is shown on Figure 2 and the BWT disturbance area is shown on Figure 3.

2.1.2 The Existing Operation – AWT Project

To place the above information into context, the following offers a brief description of the current activities approved under Part IV of the *Environmental Protection Act 1986* (EP Act) by MS933:

1) Blast and hydraulic shovel open pit mining wholly above the water table;
2) Three pits mining above the water table;
3) Dry crushing and screening;
4) Waste management facility;
5) 7.5 million tonnes per annum (Mtpa) mining rate;
6) Water demand 760 Million Litres per annum (Mlpa)
7) Seven year operating mine life;
8) Total disturbance area of up to 674 ha;
9) WRL up to 30m high, with a disturbance footprint of 137 ha; and
10) Ore is transported via road for mine gate sale.

2.1.3 Current Licences

The Proponent holds the following licences for the AWT Project:

- Operating licence for prescribed premises with categories for processing or beneficiation of metallic or non-metallic ore, mine dewatering, used tyre storage (general) and a putrescible landfill site (L8859/2014/1)
- Licence permitting abstraction of groundwater for dust suppression, drilling operations, potable water and road construction (GWL175109).

2.2 Proposal Tenure

The BWT proposal and the combined Iron Valley Project are within Mining Lease M47/1439 shown in Figure 3. The co-ordinates of M47/1439 are as follows:

- NW Corner 22º 42’ 05”S 119º 19’ 02”E
- NE Corner 22º 43’ 02”S 119º 20’ 30”E
- SE Corner 22º 46’ 33”S 119º 17’ 56”E
- SW Corner 22º 45’ 35”S 119º 16’ 28”E.

The Project area is located within the Marillana (pastoral) Station and the site has historically been used for pastoral use and more recently mining. The Project area is currently accessed via the BHPB rail access road and RTIO access road. The northernmost discharge point requires a miscellaneous licence to access. The miscellaneous licence L47757 application is currently in progress.

2.2.1 Native Title and Agreements

The Project is located within the Nyiyaparli Native Title Claim area; the Land Access Deed is with the Nyiyaparli group and has been executed by the relevant elders (Nyiyaparli) and company directors (BCI – formerly Iron Ore Holdings pty ltd). The access agreement was signed 20 December 2011.

3.0 Stakeholder Consultation

Consultation with relevant Decision Making Authorities (DMAs) and other stakeholders has been ongoing since operations commenced and has included the following government agencies and non-government agencies. A summary of stakeholder consultation is given in Table 5.

- Government Agencies:
  - Department of Water (DoW)
  - Department of the Environment (DoTE)
  - Department of Mines and Petroleum (DMP)
  - Office of the Environmental Protection Authority (OEPA)
  - Department of Parks and Wildlife (Parks and Wildlife)
- Local government
  - Shire of East Pilbara
- Adjacent Mining Companies
  - Fortescue Mining Group
  - Rio Tinto Iron Ore Operations
  - BHP Billiton Iron Ore.
- Traditional Owners:
  - Nyiyaparli Group

Table 5 Stakeholder Consultation Table

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
Department of Water	18/11/2014 – S45c Application for the Iron Valley Project, including discussions on DoW requirements for the BWT.	Discuss potential discharge of dewatering to WWC - Preference is to discharge to WW Creek. DoW asked if any additional studies are required other than what was presented so far. DoW asked for specific volumes, exact water disposal locations and emphasised that baseline knowledge along with what impact the proposal will have downstream e.g. on groundwater dependent vegetation (GDV), drawdown, seasonal variation. - Fortescue Marsh won't likely factor into the API (IV BWT) at all due to distance from the project and that Weeli Wolli will be the driver. - DOW KH stated an update to the existing GWOS for IV AWT following the 45C approval of the SWMP change will be required to allow for the surface water inflow into the pits.	- A discharge options assessment has been prepared and included in Appendix C. This concludes that there are tangible benefits in discharging directly to WWC, as well as constraints involved with other options such as groundwater injection. - Specifics are now included regarding the volumes, specific discharge points and how they are intended to vary over the life of mine (LOM). - Wetting front positions at different times during the project are also presented in Section 5.3.
Department of Water	17/02/2015 – Preliminary meeting	- Provide DoW with an overview of the proposed BWT proposal at Iron Valley. - Provide an overview of the proposed Hydrogeology and Hydrology Assessment planned to be conducted in 2015. - Discuss assessment and obtain feedback from DoW regarding the proposed assessment methodology.	The department agreed in principle to the approach described for the Iron Valley BWT water assessment, but BCP was to arrange a further meeting with DoW after water modelling has been completed.
Department of Water	26/03/15 – Further meeting on Iron Valley BWT approvals	- Iron Valley BWT approvals discussed. Would discharge to WWC have an impact on fauna / flora of national significance? - Discussion on Nullagine federal EPBC approvals and alignment to state NVCP approvals. - NIOP NQMP reviewed by DotE.	Limited impact to nationally significant fauna is included in Section 5.6. No response required.

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
Department of Water	21/12/15 - Second of two meetings to discuss below water project, status and expectations. BCP presented details on the history and current status of the Iron Valley project.	- Project background - Hydrogeology conceptual model - Groundwater drawdown contours - Proposed pit pumping coordination backfilling and pit lakes - Stream effects from dewatering and discharge.	DoW requested to review final groundwater reports and have a further presentation of the numerical modelling prior to a submitting referral to the EPA. Meeting was subsequently held on 22/02/2016 – see below.
Department of Water	22/02/16 meeting, DoW offices.	1. Is there evidence to show that the dyke doesn't continue through beyond the eastern boundary of the site?	Aero MAG surveys were not able to detect the dyke during surveys in the vicinity of the eastern pits.
		2. Is there seepage or inflow into the system from layer 5 of your groundwater model? As this would dictate the extent of inflow.	No. This means that the recharge of the system may be faster than has been modelled. Therefore the 10 years in which the recovery is expected may be conservative.
		3. Can you describe in which order you think the geology formed? Was it dyke then fault or fault then dyke?	The dolerite appears to be younger than the fault and older than the alluvium / colluvium sitting over the top.
		4. What was the purpose of the current vegetation monitoring (GDV monitoring)?	To comply with MS933 provided with the approval. To monitor the change in GDV effects from the drawdown, but drawdown only appears to be in the order of 3 m not the 8 m predicted in AWT. There has been negligible impact identified to date.
		5. Contesting the connectivity of the Stygofauna habitat. At the moment you haven't provided any evidence that the other species are located south and north of the dyke. This would be helpful information to understanding the hypothesis put forward. This coupled with the evidence that the dyke stops to the east of the tenement.	Additional information has been provided in the subterranean fauna section (section 5.7) provided in this supporting document to the referral

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
		6. The WRM report suggested that there was potential for Carbonate armouring of WWC. This doesn't seem to have been addressed.	Understood and additional information is provided in this supporting document to the referral. Carbonate armouring tends to occur when the solubility limit of Ca ions is reached. The extent of the armouring is likely to be localised near the outfall locations, should it occur, and likely to be disrupted during high rainfall storm or cyclone events. Explanation now included in Section 5.6.2 and the aquatic fauna report in Appendix E.
		7. Some description of the rate of change of the water table should be provided as this will affect the survivability of the GDV.	The return of water levels to equilibrium is within 10 years from ceasing pumping. Proposal design modified pumping and it is now staged across LOM. This accounts for the cumulative effects with the RTIO discharge scenario.
		8. There is no detailed design in the WRL or rock armouring for the WRLs in the south of the site. There is no indication of the effect of larger flood events, and the precautions that would be made to ensure that the WRLs didn't end up in WWC	The details of the specific type of rock armouring to be applied to the WRLs that are adjacent to the creek line in the south of the tenement will be provided in the mine closure plan and the mining proposal. In locations where scouring velocities have the potential to occur, rock, geofabric, cement-stabilization or other scour protection measures will be utilised, where required.
		9. Need to explain why no more surface water modelling was done.	Surface water flood modelling has not been updated from the assessment included in 2012. The application of rock armouring and WRL protection will be included in the mining proposal and in accordance with the guidelines for preparing mine closure plans (EPA 2015)
Commonwealth Department of the Environment	26/03/2015 - meeting in Canberra.	Iron Valley BWT proposal was discussed in relation to matters of national environmental significance. Query was raised whether discharge to WWC would have an impact on fauna / flora of national significance?	BCP to undertake relevant studies to determine whether BWT project would impact MNES and therefore decide if they need to re-refer. Additional desktop study, building on the 2012 fauna studies, accounting for additional direct and indirect disturbance to MNES species habitat has been included in Appendix E and Section 5.6.2 of this document.

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
Commonwealth Department of the Environment	15/12/15 - meeting in Canberra	Purpose of meeting was to show update of IV BWT proposal to demonstrate that all current EPBC approvals are relevant and still applicable to IV AWT project and BWT proposal. - History of approvals for Iron Valley – BCI provided a history of the AWT and BWT approval history including EPBC approvals. - Approved and revised project descriptions – DoTE expressed concerns with the EPBC approval in that it provided approval for only the AWT component and was not applicable to BWT. BC Iron explained that the EPBC approval document refers to the initial technical study assessment documentation which was applicable to combined Iron Valley Project, inclusive of both AWT and BWT. - Potential environmental impacts on MNES – no issues with AWT process. BC Iron to respond to DoTE further outlining the completed studies which show no further issues on MNES from the BWT proposal component.	Agreed outcomes – Meeting held with Shane Geddes DoTE to discuss way forward. DoTE (M. Whitting) drafted email to BC Iron outlining DoTE stance on approval to enable BC Iron to officially respond and garner clarity on BWT approvals. Outcome is for DoTE to agree that no further approvals required. Actions agreed: - a) DoTE (M. Whitting) drafted email to BC Iron outlining DoTE stance on approval to enable BC Iron to officially respond and garner clarity on BWT approvals. - b) BC Iron to officially respond to DoTE email outlining BC Iron's position on BWT approvals and to provide further evidence / clarity that BWT component will have no further impact on MNES.
Department of Mines and Petroleum	16/09/2015 - Preliminary meeting to discuss BWT proposal, status and expectations. BCP presented details on the history and current status of the Iron Valley project. The DMP raised key issues as described in topics raised.	Potential for Pit Lakes Pits will either be backfilled with waste rock or out of pit in WRLs. DMP has preference for avoiding pit lakes. DMP would prefer to see 'strong evidence' regarding the fate of pit lakes. If backfilled, then assessment will be required on pits with regards to water quality/quantity and movement and fauna. Sterilisation report should be included with the Mining Proposal.	Proponent to further consider fate of pits. Sterilisation report will be included in Mining Proposal. Geochemistry work to be undertaken as to fate of pit lakes.

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
		Geochemistry DMP questioned which metals may be leached as part of the waste rock. Requested that spatial distribution of sampling both horizontally and vertically should be made clear.	Points to be incorporated when planning sampling programme.
		Post Closure DMP requires post closure landscape to be clearly defined. Predictions of flooding should account for long term effects on post closure landform. Mining proposal should provide clarity on design of TSF and how it is integrated into the WRLs. Detail what precautions have been undertaken in safeguarding TSF from long term erosion (rock armouring, flood protection, surface water management).	Points detailed to be taken into account for mine closure plan.
		Submission of Mining Proposal DMP to receive and assess mining proposal but not release a decision until Ministerial approval has been received. DMP open to further meeting.	Comments noted. Second consultation meeting to be arranged.
Office of the Environmental Protection Authority	31/08/15 - Pre-referral meeting 1. Presentation provided background to the work at Iron Valley and described the components, attributes and preliminary environmental factors for the BWT proposal.	General Comments OEPA considers factors well placed, with some overlap, such as impacts to environment quality could fall within rehabilitation and decommissioning. Re-injection of groundwater is the preferred approach for water disposal. OEPA questioned SRE's.	It is still the intention of BCP to dispose of water to WWC and an assessment will be included in the submission to EPA. Further work has been undertaken on SREs. The results are included in this supporting document Section 5.6, which concludes that the animals previously detected are confirmed non-SREs. Appendix E presents a letter from the EPA removing the condition for further SRE work on tenement.

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
		Subterranean Fauna Assessment of subterranean fauna must robustly comply with EAG12 (EPA 2013c). In recent past, the contiguous habitat rule had been applied too loosely. Technical advice given to the OEPA is that it should be considering habitat (pore spaces, soil moisture, geology, water) not simply geology, as it has been caught out recently where the adequacy of the study has been insufficient to approve.	All subterranean fauna to take account of EAG12 (EPA 2013c) and Detailed Guidance Statement 54a. (EPA 2007) The subterranean fauna assessment has been undertaken in accordance with both of these guidance documents, and stated as such in the technical report (Appendix E)
		Environmental Management Plan EMP to take account of EAG17 (EPA 2015d).	Future EMPs, as required, will be undertaken with regards to EAG17 (EPA 2015d).
		Next Steps Second pre-referral meeting to be undertaken once water studies have been completed. Consideration should be given as to approach of assessment – all aspects of BWT and AWT or limited to BWT aspects. OEPA indicated that timescale of June 2016 unlikely.	Assessment will only be undertaken for BWT aspects.
Office of the Environmental Protection Authority	1/10/2015 - Letter from OEPA. Ministerial Statement 933 Condition 8-1 and 8-2. Short range endemic fauna.	BC Iron have commissioned a further assessment of *Aganippe MYG086* – confirming that it should not be considered an SRE. This assessment has been confirmed by the Western Australian Museum, and acknowledged by the OEPA. The OEPA have confirmed that *Aganippe MYG086* is no longer considered an SRE.	*Aganippe MYG086* is no longer to be considered an SRE for the purposes of this environmental approval.

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
Office of the Environmental Protection Authority	18/12/2015 - Second pre-referral meeting held after hydrogeological modelling results became available.	Update on the proposal based on groundwater modelling results becoming available. Cumulative effects – OEPA confirmed that the proposal to include the recently submitted PER for Yandicoogina was good for the purposes of cumulative impacts to the hydro/hydrogeological system in the vicinity of Iron Valley. This is useful for understanding the wetting front as well as the effects on riparian vegetation and GDEs in a system that is not in a natural state. The assessment should demonstrate that the proposal will not have unacceptable impacts on WWC. Presence of pit lakes to the north of the tenement likely. Preliminary key environmental factors likely to be: - Hydrology and inland waters - Flora and vegetation in relation to offsets and GDEs - Subterranean fauna - And rehabilitation and decommissioning.	Cumulative impacts from RTIO's Yandicoogina expansion project currently under EPA assessment have been incorporated into this Iron Valley impact assessment, Sections 5.2, 5.3, 5.5, 5.6, 5.7
Office of the Environmental Protection Authority	26/02/2016 – final pre-referral meeting, held at BCP offices.	The presentation outlined the impact assessment and its findings for each of the environmental factors. From this, some commentary was provided as follows: Water was deemed to be the key issue as it sets the secondary impacts for the sensitive receptors in the vicinity of the mine. Demonstration of stakeholder consultation was essential as is the demonstration that EPA policy has been followed for each of the factors.	This consultation table summarises and cross references the topics raised through the consultation process and includes BCP's response and intention with respect to the comment. The document also includes relevant cross referencing and clear statements on how EPA policy has been followed in the preparation of this supporting document, particularly under each of the environmental factors presented.
Department of Parks and Wildlife	19/02/2016 –meeting at Parks and Wildlife offices	Is it the intention of the new BWT project to have a separate MS combining the expanded project	A new MS is proposed that covers the combined AWT and BWT aspects of the project, to become the Iron Valley Below Water Table proposal

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
		What is the orebody – CID or BIF	The orebody is Mineralised Brockman Iron Formation.
		Has access of stygofauna data been acquired reviewed from Nyidinghu	No access to this data has been provided
		Ensure that the proposal specifically references the EAGs	Noted
Shire of East Pilbara	30/01/15 – Meeting with members of the Shire of East Pilbara.	High level discussions on business and Nullagine operations.	- Water usage - Currently being used in the operations process i.e. Dust suppression, moisture in ore. Nothing is being discharged off site at the moment AWT. - Opportunities for local businesses / people - MRLs business model was discussed i.e. MRL undertake all work internally, no opportunities currently available, BCI happy to bring specific capabilities to MRL if needed. - BWT water discharge - BCI will commence studies soon into water quality and usage, extraction and discharge plans to be developed, will be done consistent with discussions with regulators and the traditional owners. - Allen Cooper suggested contact with DAFWA re: the Pilbara hinterland Agricultural initiative, results due in June 2016. https://www.agric.wa.gov.au/r4r/pilbara-hinterland-agricultural-development-initiative-phadi - Next briefing to be provided 12 months during BWT approval process.
Adjacent mining companies (FMG/Rio Tinto Operations/ BHP Billiton Iron Ore)	07/12/15 – Meeting with Rio Tinto Operations	Discussions held regarding cumulative impacts and monitoring results for groundwater dependent ecosystem assessments. Project overview provided by BC Iron and RTIO.	No specific response.
	08/06/15 – Meeting with Fortescue Metals Group.	Project overview for BWT discussed.	Execution of agreement for BCP to access mining tenements E47/1320 and M47/1461 for monitoring of water bores for BWT assessments.

Stakeholder	Date and Description of Communication	Topics/Issued Raised	Proponent Response/Outcomes
Nyiyaparli People	Consultation with representatives of the Nyiyaparli people occurs on a regular 6 monthly basis, dates of recent meetings are 14 May 2014 December 2014 May 2015 December 2015	Provide Nyiyaparli People with an overview of the below water table project	Nyiyaparli people are interested in contracting opportunities at the project. Nyiyaparli people would like to review the environmental review document and the mining proposal when available

4.0 Environmental Studies and Survey Effort

This supporting document relies on new environmental studies as well as relevant and previously reported data and findings from the AWT project. Table 6 outlines the extent of the surveys conducted and makes the distinction of whether it is new or previously held information. The technical appendices which were considered relevant from the AWT have been used and are accompanied by a covering letter from the original consulting author outlining the relevance of the report content with the BWT proposal, see appendices.

Table 6 Summary of Environmental Studies and Surveys

Factor	Consultant	Survey	Study Area, Type and Timing	Study Standard/ Guidance and Limitations	Appendix/Reference
Hydrological Processes and Inland Waters Surface Water	AQ2	**New** Increase in Groundwater Abstraction at Iron Valley – Impact Assessment. Desktop Assessment dated February 2015.	Desktop assessment including: - Review of historical aquifer testing - Review of groundwater monitoring data - Use of calibrated model to predict drawdowns at specific locations - New predictions of water table decline. - Groundwater discharge options assessment. - Water balance assessment.	- Government of Western Australia – Department of Water. (2009). - Operational policy no. 5.12 – Hydrological reporting associated with a groundwater well licence. Limitation: None of note	Appendix C
	AQ2	**New** Groundwater bore field sampling, aquifer pump testing and numerical modelling, including cumulative assessment associated with RTIO Yandicoogina expansion proposal.	Fieldwork - Installation of groundwater test and monitoring wells - Permeability testing - Groundwater logging - Aquifer tests on production bores. Modelling work - Surface water management assessment - Groundwater model development and modelling of inflows, drawdown and changes to groundwater system. - Excess water assessment (volume and disposal options). - Additional modelling of water management options. - Consideration of the water aspects of mine closure and in particular assessing the implications of adopted closure strategies.	- ANZECC & ARMCANZ, 2004. Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. Canberra, ACT. - CSIRO Land and Water, 2015. Water Resource Assessment for the Pilbara, A report to the Government of Western Australia and industry partners from the CSIRO Pilbara Water Resources Assessment, Don McFarlan (ed), 7 October 2015. - Department of Water, 2011. Managed aquifer recharge in Western Australia, Operational Policy 1.01, Government of Western Australia, January 2011. - Department of Water, 2013a. Western Australian water in mining guideline, Water licensing delivery series report No 12, Government of Western Australia, May 2013. - Department of Water, 2013b. Strategic policy 2.09: use of mine dewatering surplus, Government of Western Australia, May 2013. - Environmental Protection Authority (EPA), 2013. Environmental and water assessments relating to mining and mining-related activities in the Fortescue Marsh management area, Report and recommendations of the Environmental Protection Authority, Report 1484, July 2013. - Hydrogeologic Inc. MODHMS MODFLOW SURFACT A Comprehensive Modflow Based Hydrologic Modelling System. 1996. Limitation: The groundwater flow model was developed consistent with the available data and includes the results of hydrogeological investigations to date. As with all models, there are limitations associated with data availability, conceptualisation and representation of hydrogeological processes. The model includes the known features of the system and is calibrated to available data. However, the predictions are simulations only based on available information, including the current mine plan.	Appendix C

Factor	Consultant	Survey	Study Area, Type and Timing	Study Standard/ Guidance and Limitations	Appendix/Reference
Terrestrial Fauna	Wetland Research and Management	**New** - Potential impacts to Aquatic Systems literature review - Iron Valley Project. Baseline Aquatic Fauna Survey: WWC. Wet Season 2015. March 2015. - Cumulative impact assessment findings	Aquatic fauna survey incorporating water quality sampling. At each site, water quality readings were taken as well as sampling for aquatic fauna. Baseline fauna survey of the WWC adjacent to the Project area. The objectives of the baseline study were: - Sample aquatic fauna (macroinvertebrates, hyporheic fauna, fish). - Sample water quality at sites within and adjacent to WWC. - Identify invertebrate specimens to species level. - Analyse fauna data to assess spatial variability. - Assess the conservation status of recorded aquatic fauna. - The baseline survey was undertaken in late March 2015. - The sampling targeted two main ecosystem types: • Pools/riffle zones within the main channel. • Off channel pools – likely to be perched/semi-permanent pools.	- Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC/ARMCANZ 2000). - EPA Guidance No. 20, Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (EPA 2009). - EPA Position Statement No. 3, Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA 2002). - EPA Guidance No. 56, Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA 2004c). - Pinder et al. (2010). An arid zone awash with diversity: patterns in the distribution of aquatic invertebrates in the Pilbara region of Western Australia. - Fishers licence EXEM 2314 (Instruments of Exemption to the Fish Resources Management Act 1994 for Scientific Purposes. - DPaW licence SF010240 (reg. 17; Licence to Take fauna for Scientific Purposes). Limitation: Results based on single field sampling in March 2015 following high rainfall event, which may have influenced the species richness levels between upstream (more permanent flows) and downstream. The downstream pools would have only recently been filled, therefore only providing limited time for macroinvertebrate colonisation of downstream pools.	Appendix E
	Dalcon Environmental	Terrestrial Short-Range Endemic Invertebrate Fauna Survey	Development envelope and neighbouring tenements to the east, north east and south east. - Targeted surveys with pitfall traps were undertaken between May and June 2011. - Additional invertebrate sampling was undertaken between 3 and 8 June 2011.	- EPA Guidance Statement 20. - Consultation with the DEC (now Parks and Wildlife). Limitation: The timing of the survey was just outside the preferred timing as stated in EPA Guidance Statement 20. However, DEC (now Parks and Wildlife) confirmed that a May to June survey would be acceptable. Additional rainfall during this period increased the yield of targeted species. Potential SRE (*Aganippe MYG086*) found but confirmation of SRE status inconclusive without DNA sampling because specimen was juvenile.	Appendix D
	Phoenix Environmental Services	**New** The Distribution of *Aganippe 'MYG086'* (*Araneae: Idiopidae*) in Western Australia. Desktop assessment.	Desktop assessment of the SRE status of the potential SRE *Aganippe MYG086*. This involved a search of the WA Museum databases to determine if new populations have been discovered. This was based on a search area of 200 km from the Project area. The following works were undertaken: - DNA sequencing on unidentified species encountered during historical surveys. - Re-assessing the SRE status and impact on *Aganippe* within the Project area.	- EPA Guidance Statement 20 and discussions with OEPA resulting in removal of AWT SRE condition. Limitation: None of note	Appendix E
	Bamford Consulting Ecologists	Vertebrate Fauna Assessment of the Iron Valley Project Area	Development envelope and surrounds (1,102 ha, entirety of mining tenement M47/1439 and 17 ha of exploration lease E47/1385). Two surveys were undertaken. - Survey 1 undertaken May 2011. - Survey 2 undertaken September 2011.	- EPA Guidance Statement No. 56. - DEC (now Parks and Wildlife) Regulation 17 licence number SF007970. Limitation: First seasonal survey experienced cool weather conditions which may have affected the presence and/or abundance of some species.	Appendix E

Factor	Consultant	Survey	Study Area, Type and Timing	Study Standard/ Guidance and Limitations	Appendix/Reference
	Bamford Consulting Ecologists	**New** Desktop Assessment to update existing survey information for the BWT	Desktop Assessment on the new development envelope. Using the findings from the 2011 survey and the mapped habitats, these findings were applied to the revised / expanded disturbance footprint and the habitats affected re-calculated. Riparian vegetation affected through secondary effects from drawdown and groundwater mounding included.	- EPA Guidance Statement No. 56. Limitation: None of note	Appendix E
Subterranean Fauna	Bennelongia Environmental Consultants	Iron Valley Subterranean Fauna Assessment	Field sampling for troglofauna and stygofauna from surface and existing boreholes. Field survey was undertaken as follows: - Troglofauna • Round 1: 13 to 18 May 2009. • Round 2: 3 to 6 November 2009. • Round 3: 11 October and return trip on 6 December 2011. - Stygofauna • Round 1: 13 to 15 May 2009. • Round 2: 3 to 6 November 2009. • Off tenement sampling: 10 to 13 October 2011. Development envelope below ground to within a few meters of the water table (1,102 ha, entirety of mining tenement M47/1439 and 17 ha of exploration lease E47/1385). Species were also collected from other nearby BC Iron ore deposits on neighbouring tenements).	- The subterranean fauna survey at Iron Valley was conducted in accordance with EPA Guidance Statements Nos 54a and EPA assessment guideline 12. Limitation: Sampling was not possible north of the tenement, due to access restrictions and absence of boreholes.	Appendix E
	Bennelongia Environmental Consultants	**New** Iron Valley targeted Subterranean Fauna Assessment	Site work involving sampling for stygofauna in 14 previously un-sampled and off tenement boreholes at Iron Valley. Site survey undertaken during December 2015.	- The subterranean fauna survey at Iron Valley was conducted in accordance with EPA Guidance Statements Nos 54a and EPA assessment guideline 12. Limitation: Monitoring was restricted to the existing bores off-tenement that were available to be sampled through the access agreements. This included 4 to the south of Iron Valley and 10 to the north.	Appendix E
Flora and vegetation	Astron Environmental Services	Iron Valley Project Flora and Vegetation Survey.	Level 2 Flora and Vegetation Survey. Development envelope and surrounds (1,102 ha, entirety of mining tenement M47/1439 and 17 ha of exploration lease E47/1385). Desktop review and two field surveys. Survey 1 undertaken April 2011. Survey 2 undertaken July to August 2011. Annual groundwater dependent vegetation surveys have also been produced as part of MS933 conditions 6, these were submitted in 2013 – Baseline, with follow ups in 2014 and 2015	- EPA Guidance Statement 51. Limitation: While above average rainfall prior to the survey meant that the sampling conditions were adequate, the post fire succession may have variable species richness and diversity than what typically may be found in that part of the Survey Area.	Appendix D

Factor	Consultant	Survey	Study Area, Type and Timing	Study Standard/ Guidance and Limitations	Appendix/Reference
	Astron Environmental Services	**New** Iron Valley BWT Proposal GDE assessment	Desktop investigation incorporating study of aerial imagery and remote sensing analysis and ground based truthing on the potential impact of future groundwater drawdown on GDE vegetation associated with the BWT proposal. The assessment was targeted at three indicator species *Eucalyptus victrix*, *Eucalyptus camaldulensis*, and *Melaleuca argentea* throughout an area with a 10 km radius (31,416 ha) from the tenement. The field study was conducted 22-24 November 2015.	No specific standard is applicable to this desk-top and ground truthing exercise. The following outlines the methods used in the study. Aerial imagery sources, Google Earth, Landgate and BC Iron sourced imagery was compiled and visually inspected for presence of GDV. Remote sensing analysis, using Landsat satellite imagery across a number of spectral bands including visible, near infrared and shortwave infrared wavelengths, for the determination of 'greeness' and 'wetness' ratings over time. The Normalised Difference Vegetation Index (NDVI) was used for this purpose, enabling water stress to be identified. Ground truthing was focused on the Marillana / WWC system, and covered 19 selected sites of interest along 25km of the combined creek system. Limitation: - Coarse spatial and temporal resolution of projected groundwater drawdown contours associated with BWT. - Exact rate of groundwater drawdown not applied to study - Natural state - depth to the water table not known - Assessment is based on Iron Valley BWT proposal discharge and dewatering, cumulative impacts accounting for discharge into Marillana and Weelli Wolli Creeks from adjacent mines and the effect of discharge on GDV within the assessment area has not been applied	Appendix D
Terrestrial Environmental Quality	URS Australia Ltd.	Soils and Landforms Preliminary Study	Soil and landforms study undertaken on entirety of tenement. Desktop assessment and site inspection undertaken in 2012.	Fieldwork and interpretation completed with guidance from - Moore, G. (2001). Soil Guide: A Handbook for Understanding and Managing Agricultural Soils. - Bruce, R.C. and Rayment, G.E. (1982). Analytical Methods and Interpretations Used by the Agricultural Chemistry Branch for Soil and Land Use Surveys. Queensland Department of Primary Industries Bulletin No. QB2004, Brisbane. - National Committee on Soil and Terrain (2009). Australian Soil and Land Survey Field Handbook (3rd Edition). CSIRO Publishing, Collingwood, Victoria. Limitation: None of note	Appendix F URS (2012). Iron Valley Project – Above Water Table Mining. Soils and Landforms Preliminary Study. Report ref. 42908158/xxx/1.
Heritage	URS Australia Ltd.	Desktop searches. Undertaken August 2015.	Desktop searches of Project tenement using the Department of Indigenous Affairs online database. Accessed 31/08/15.	- Aboriginal heritage inquiry system. Government of Western Australia Department of Indigenous Affairs Databases. Limitation: None of note	Appendix G

Factor	Consultant	Survey	Study Area, Type and Timing	Study Standard/ Guidance and Limitations	Appendix/Reference
Rehabilitation and Closure	Soilwater Group	**New** Iron Valley Below Water Table Project – Geochemical Investigation. Dated 29/06/15.	The study area incorporates the potential waste to be generated from the site operations and the remaining geochemical risk. The following works were undertaken: - Review of existing data - Geochemical testing of selected samples. - Geochemical assessment of previous data, incorporating new sampling information.	Assessment undertaken with guidance from - AMIRA (2002) ARD Test Handbook. Project 387A. Prediction and Kinetic Control of Acid Mine Drainage. AMIRA International. Melbourne, Australia. - ANZECC & ARMCANZ (2000) Australian and New Zealand Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment Conservation Council and Agriculture and Resource Management Council of Australia and New Zealand. Canberra, ACT. - DEC (2010) Contaminated Sites Management Series: Assessment Levels for Soils, Sediment and Water, Version 4, Revision 1. February. Department of Environment and Conservation, Government of Western Australia. Perth WA. - Stone, Y., Ahern, C. R. and Blunden, B. (1998) Acid Sulfate Soils Manual 1998. Acid Sulfate Soils Advisory Committee. In. Wollongbar, NSW. Limitation: None of note	Appendix H

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5.0 Assessment of Preliminary Key Environmental Factors

5.1 Preliminary Key Environmental Factors

In 2012, BCP (then Iron Ore Holdings) submitted a Section 38 Referral to the EPA. This referral included both the above and below water table components of the Iron Valley Project and the EPA applied an API level of assessment. As part of that process, BCP was given a scoping guideline covering the environmental factors that needed to be included in the environmental review document. Subsequent to the scoping guideline being prepared, BCP made the economic decision to submit the API for AWT only, which received approval in 2012 under MS933. Although the environmental review document only addressed AWT issues, the scoping guideline was considered still valid for BWT, and this provided the basis of environmental factors that needed to be addressed for this current proposal. The following applicable preliminary key environmental factors are the result of that initial 2012 scoping guideline and subsequent discussions with the OEPA and other DMA / stakeholders:

- Hydrological processes;
- Inland waters environmental quality;
- Flora and vegetation;
- Subterranean fauna;
- Terrestrial fauna;
- Environmental offsets; and
- Rehabilitation and closure.

The environmental factor, the project activity which affects that factor, the environmental aspect or pathway mechanism and the potential impacts for the BWT proposal are presented in Table 7. The impact assessment is then further elaborated in Table 11 incorporating mitigation and management which when applied will achieve the proposed outcome. This outcome is supported by a statement explaining how the EPA's objective applicable to the environmental factor is considered to have been achieved.

BCP considers that the proposal will not result in any significant impact to the remaining environmental factors included in EAG8. These factors are either not applicable to the proposal or can be adequately managed using existing regulatory mechanisms and are therefore categorised as 'other factors' and are discussed in Section 6 of this document.

Additionally, no assessment is included in this ER for matters of National Environmental Significance, because through consultation with the Department of the Environment, the likely effects on the species listed under the EPBC Act were considered negligible and no referral was considered necessary. The fauna species have been incorporated into the vertebrate fauna section of this supporting document.

Table 7 Summary of Preliminary Key Environmental Factors

Environmental Factor	Project Aspect / Activity	Environmental Aspect	Impact
Hydrological processes (Water Quantity)	Mine pit	Dewatering aquifer for dry mining conditions	Prolonged depletion of aquifer, resulting in depleted water supplies for existing ecosystems and end users.
	Water Discharge	Dewatering discharge to WWC	Increase in quantity of water within WWC extending wetting front downstream. Discharge also resulting in localised groundwater mounding.
	TSF	Infiltration from TSF.	Localised groundwater mounding.
	Mine Infrastructure	Interception of surface water flows across the tenement to WWC.	Potential for changes to hydrological regime and subsequent changes in water quantity to downstream environments. Potential for increased sediment loads in stormwater runoff generated from site.

Environmental Factor	Project Aspect / Activity	Environmental Aspect	Impact
Inland Waters (Water Quality)	Mine Pit	Dewatering of aquifer.	Depletion of aquifer potentially assisting the intrusion of a saline wedge and subsequent degradation of groundwater quality from north of the tenement boundary. Some mine pits have the potential to develop into contamination sources or groundwater sinks if not backfilled.
	Mine Pit	Discharge of pit dewatering to WWC.	Potential change of inland water quality in WWC from the discharge of waters from Iron Valley operations likely to be noticeable at the wetting front. This may be in the form of evapo-concentration of salts.
	TSF	Infiltration from TSF.	Degradation of water quality within aquifer through seepage from integrated TSF cells.
Flora and Vegetation	Mine Pit and Infrastructure	Direct clearance of vegetation.	Clearance of an additional 314 ha of which 313.15 ha is considered in good to excellent vegetation condition.
	Mine Pit	Dewatering of aquifer.	Change in groundwater availability for dependant ecosystem (vegetation).
	Mine pit water discharge	Discharge of water to WWC.	Potential changes to riparian vegetation from periods of inundation. Flourishing of vegetation in some areas due to increased water permanency within WWC system.
Subterranean Fauna	Mine Pit	Pit excavation and dewatering of aquifer.	Removal of habitat / organisms directly within the pit from direct mining excavation. Changes in habitat quantity from localised lowering and mounding of groundwater levels during operations.
Terrestrial Fauna	Mine Pit Infrastructure	Clearance for pit and mine infrastructure.	Direct removal of habitat from clearance for pit and mine infrastructure.
	Mine Pit discharge	Discharge of excess water into WWC.	Increased surface water and changes to groundwater levels may affect vegetation comprising fauna habitat, within or bordering the creek adjacent to the site as well as downstream.
Environmental Offsets	Mine Pit and infrastructure	Clearance of native vegetation.	Likely residual impacts from the clearance of good to excellent vegetation.
Rehabilitation and Closure	Site closure	Placement and construction of TSF and WRLs, success of rehabilitation and pit backfilling.	Potential for site not to meet its closure objectives leading to post closure impact on the environment to surface and groundwater, quality and re-establishment of vegetation communities and viable fauna habitat.

5.2 Cumulative Impacts

The EPA considers that the cumulative environmental impact from the growth in mining in the Pilbara needs to be addressed so that conservation management actions can be implemented proactively and the costs associated with these are divided between all users of the region (not just the last comers). The area around Fortescue Marsh, Marillana Creek and Weeli Wolli Springs/Creek is recognised for its State and Nationally significant environmental assets and as such it is important to assess the cumulative impacts.

There are several mining operations discharging water to the WWC, located upstream from the Iron Valley proposal area. This has resulted in an artificial or non-natural state of baseline surface and groundwater conditions, particularly in relation to the quantity of surface water and the groundwater levels. While the technical studies for this ER use the existing situation as the baseline, they also apply the assessment cumulatively including one future proposal that is reasonably foreseeable and that is likely to influence the environmental factors that are being considered in this BWT proposal.

The RTIO Yandicoogina mine expansion is one such proposal (submitted to the EPA in November 2015) which is likely to influence the hydrological processes and inland waters in the vicinity of Iron Valley. As requested by the OEPA in the pre-referral meetings, the water, terrestrial fauna, subterranean fauna, and flora and vegetation studies for the BWT proposal have taken this RTIO proposal into account in each respective assessment. Table 8 presents the EPA policy applicable to the assessment of cumulative impacts.

Table 8 Application of EPA policy to cumulative impacts

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Cumulative impacts	Cumulative environmental impacts of development in the Pilbara region (EPA 2014) Section 16e of EP Act 1986	Section 5.2 Section 5.3 Section 5.5 Section 5.6 Section 5.7	The application of cumulative impacts is in the form of reasonably foreseeable projects likely to affect the Iron Valley project. The surface and groundwater experiences the key change which affects other receiving environments downgradient.

5.3 Hydrological processes

5.3.1 EPA objective

Hydrological process: to maintain the hydrological regimes of groundwater and surface water so that existing and potentials uses, including ecosystem maintenance are protected.

Application of EPA policy to hydrological processes is presented in Table 9.

Table 9 Application of EPA policy to hydrological processes

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Hydrological processes	EPA policy guidelines for hydrological processes Position Statement 4 (environmental protection of wetlands) (EPA 2014b)	Section 5.3 and technical appendix C	The studies identify the environmental values and functions of WWC and the hydrological balance between surface and groundwater in terms of quantity. The EPA principles are applied in the derivation of the residual impacts likely from the proposal.
Inland waters environmental quality	EPA policy guidelines for hydrological processes Position Statement 4 (environmental protection of wetlands) (EPA 2014b)		The studies identify the environmental values and functions of WWC and the hydrological balance between surface and groundwater in terms of quality. The EPA principles are applied in the derivation of the residual impacts likely from the proposal.

5.3.2 Context and key survey findings

The proposal will require dewatering in order to advance the existing mine pits below the groundwater table. This will lower the surrounding groundwater level directly adjacent to the site and in the surrounding area. AQ2 has undertaken field drilling, permeability tests and aquifer tests to inform a numerical groundwater model which predicts the changes likely to occur with the Proposal's contribution of drawdown (Appendix C). The following provides a description of the likely effects on groundwater levels from dewatering and groundwater discharge. The information below is sourced from the AQ2 report included in Appendix C.

Groundwater

The general hydrogeological setting indicates that the valley-fill successions act as the main regional aquifer. A component of this aquifer comprises the mineralised zones that are known to be associated with fracturing in the Brockman Formation. The massive shales and banded iron formations within the Brockman and Weeli Wolli Formations are likely to have moderate to low hydraulic conductivities, while the mineralised zones are likely to have higher hydraulic conductivities due to fault-related fracturing and brecciation. Mineralised zones within the main orebody are generally the highest yielding and most transmissive aquifers in the proposal area. The following are the key features of the Iron Valley hydrogeology:

- A transmissive, mineralised orebody aquifer;
- Saturated, leaky alluvium above the orebody;
- Orebody aquifer is surrounded to the east and west by low permeability shales and BIFs;
- A dyke that limits groundwater flow to the north;
- Connection of the orebody to the Weekly Wolli Creek via the East Fault;
- Northern extension of the orebody aquifer connected to the WWC;
- Prevailing groundwater conditions have been altered by historical and ongoing excess water disposal from upstream mines (RTIO and BHPB); and
- Maximum discharge modelled at 21Gl/per annum.

Regionally, the direction of groundwater flow in the Proposal area is from south to north. Further drilling and testing has indicated that there is saturated alluvium overlying the transmissive orebody, and that groundwater flow will preferentially follow a fault line running from beneath WWC into the underlying aquifer (AQ2, Appendix C). This is expected to deliver high recharge rates, requiring correspondingly high dewater pumping rates.

One key feature of the hydrology of the Project area is a dolerite dyke which partly traverses the northern section of the orebody, with groundwater levels dropping by 30 to 40m across the dyke (a geological cross section is shown on Figure 5). The dyke extends from the western boundary of the tenement to the western side of the eastern pits. Aero mag surveys have not detected the dyke beyond this point, suggesting that there is currently access for water movement around this eastern end of the dyke. According to Iron Valley geological borelogs, the valley floor is overlain by a layer of alluvial/colluvial soils approximately 30 m deep, with it thinning to about 10 m above the dyke. This provides a pathway for water to overspill the dyke during periods of elevated rainfall, such as during cyclonic activity. The dyke will be removed by the pit excavation, resulting in a water level rise to the north. Drawdown cones from dewatering are predicted to be elongated north south, due to lower permeability at the east and west boundaries of the ore body and the presence of the fault in the south.

Static water levels beneath the Project site have been measured as ranging from 26 to 43 mbgl in the north of the dolerite dyke to 6 to 18 mbgl south of the dyke.

The groundwater is currently recharged from rainfall events and discharge from other mine sites in the area. This discharge of mine water from other sites has led to raised water levels in the alluvial deposits south of the site of up to 20m.

A water disposal assessment was conducted for the volumes of mine dewatering required for the proposal. The result, presented in Appendix C, is via three discharge points from on tenure locations into WWC. These discharge points not only return the water back to the creek system promptly, but also provide some beneficial localised groundwater mounding. Discharge of water to the north of the ore body (at discharge point DL5 shown on Figure 5) has a mounding effect on groundwater levels (Figures 6, 7, 8 and 9). The benefit of water disposal at this location is that it is predicted to mitigate the advance of an area of elevated salinity (or saline wedge) known to exist 7 km north east of the tenement boundary, likely to be associated with the Fortescue Marsh. Mounding is also likely to occur on the eastern side of the tenement as a result of water seepage from the encapsulated TSFs into zones of lower permeable geology. .

Lowering of the groundwater beneath the tenement will occur in sequence as required by the mine plan, with discharge via three discharge points reflecting the dewatering sequence. It is expected that dewatering of between 22,000 to 62,000 kilolitres per day (kL/d) will be required, depending on the mining stage. As the site water demand is 15,700 kL/d, there will be a water surplus which will require disposal. The drawdown and disposal volume will vary throughout the mine life. As pits are mined out and completed, pumps will be shut off allowing a stepped groundwater recovery. A water balance summary by year is given in Table 10.

Table 10 Water Balance Summary (Annual Average Rates in kL/d)

Year	Total Dewatering	Maximum Water Demand	Surplus	Disposal to DL1	Disposal to DL4	Disposal to DL5
2016	62,707	15,700	47,007	15,010	15,999	15,999
2017	63,175		47,475	15,010	16,233	16,233
2018	60,166		44,466	15,010	14,728	14,728
2019	58,129		42,429	22,094	10,167	10,167
2020	22,263		6,563	0	3,282	3,282
2021	31,695		15,995	0	7,998	7,998
2022	30,305		14,605	0	7,303	7,303
2023	30,369		14,669	0	7,335	7,335
2024	42,756		27,056	0	13,528	13,528
2025	38,340		22,640	0	11,320	11,320

The predicted change of groundwater levels as a result of the Project (base case) have been modelled in terms of a change against predicted future groundwater levels (no development) and a change against the predicted future groundwater levels with the development and discharge water from other mine sites. Groundwater levels are heavily influenced by disposal of water to WWC, with recharge of the aquifer occurring relatively quickly. Generally, during the mine life dewatering will lower groundwater levels around the mine site and in parts of WWC. However, there are areas where the disposal of water to the creek will result in raising groundwater levels in the creek to above ground level. This will be influenced by additional cumulative flow from the Yandicoogina Mine expansion (of the associated Pocket and Billiards pits). Effectively, this discharge from upstream will recharge any groundwater drawdown which occurs from the dewatering within WWC. The amount of drawdown is shown on Figures 6 to 9. These figures show drawdown in relation to change against predicted future levels (no development). Negative values show where groundwater mounding will occur.

Long term, water levels are predicted to return to equilibrium levels within a ten year timespan (by 2028). However, due to the removal of the dolerite dyke, groundwater levels south of the dolerite dyke will return to levels deeper than the no development scenario (5 to 25m below pre-mining levels approximately) and levels north of the dyke shallower than the no development scenario (approximately 5 m above pre-mining level). Levels in WWC will return to pre-mining levels within two years. These changes to groundwater levels are incorporated into the assessments on, subterranean fauna and flora and vegetation, particularly groundwater dependent vegetation and riparian vegetation adjacent to WWC.

Surface Water

The nearest significant surface water feature is the WWC, at its closest point is situated 200 m east of the north east corner of the site (Figure 1). The WWC flows directly north from this point, away from the eastern tenement boundary. WWC is a major Pilbara drainage line which flows into the Fortescue Marsh, which in turn is a nationally designated wetland system and the final receptor of all surface water flows generated in the Upper Fortescue Basin.

Natural perennial flows in the WWC only occur at Weeli Wolli Spring (located approximately 25 km upstream). Artificial perennial flows occur at various locations within the Marillana and Weeli Wolli Catchments as a result of excess groundwater disposal from mine dewatering operations. Stream flow in the Eastern Pilbara is typically ephemeral, being directly related to intense rainfall events usually associated with cyclonic activity or localised thunderstorms. Surface water flow rates decay rapidly once rainfall has ceased. The drainage system upstream of the Fortescue Marsh has negligible base flow; stream flow infiltrates the watercourses and recharges the alluvial aquifers during these flow events.

The Marillana and WWC System receive water from a number of mining operations upstream from Iron Valley. Iron Valley is proposed to contribute to this discharge via three on tenure discharge locations. These locations will enter WWC at the positions identified on Figure 6 as DL1, DL4 and DL5, located north, east and south-east of the Project area respectively. A disposal options assessment is included in Appendix C. The options assessment concludes that re-injection of groundwater to the aquifer was not considered adequately reliable in that reinjection infrastructure was vulnerable to sustain damage during storm or cyclone events making this option impractical. Due to the preferential flow pathway from WWC into the underlying aquifer, discharge directly back to WWC system, was considered an effective recharge mechanism to the groundwater via the fault line (known as fault line East) noted in the groundwater section (see geological cross section on Figure 10).

Discharge water is expected to generate a surface flow in WWC (wetting front), but also contribute to groundwater recharge. The wetting front from discharging water from the proposal is expected to present as surface flow for approximately 5 to 6 km downstream (Figure 11). This point is approximately 40 km from the Fortescue Marsh and as such during non-rainfall periods (incorporating existing mining operations in the vicinity) is not expected to have a tangible effect on the Fortescue Marsh. The majority of the flow is expected to infiltrate into the creek bed prior to reaching the Fortescue Marsh (Appendix C).

In addition to the existing mining operations, the RTIO Yandicoogina project is seeking approval for an expansion to the operations which would see a discharge of approximately 83 GL/annum by 2017 (an increase of 30 GL/annum) (RTIO PER 2015) into WWC. In the absence of this Iron Valley BWT proposal, this is predicted to extend the wetting front 17 km downstream from the confluence of Marillana Creek with WWC. This will reach to within 7.5 km north of the Project site and mean that surface water will be present in WWC adjacent to the Iron Valley project.

Looking at the combined increase in the wetting front from both the Yandicoogina Pockets and Billiards expansion and Iron Valley BWT proposal, will be approximately 22 km downstream from Iron Valley and to within 20 km of Fortescue Marsh without a contribution from rainfall. It is expected that water levels within WWC will stabilise within two years after Iron Valley ceases discharge.

The cumulative change to the wetting front over the 10 year life of mine for Iron Valley will vary as the pumping rates change, but there are three significant positions, presented in Figure 11. In 2016 the movement of the wetting front produced by Iron Valley will be reached. This will remain until 2018 when the cumulative wetting front formed by the combined discharge of Yandicoogina and Iron Valley is achieved. This is likely to be sustained for approximately two years, when discharge will cease from the southern discharge point DL1. Post 2020, through to 2025, the wetting front will fluctuate with changes to pumping rates as identified in Table 10 and will experience further fluctuation with the onset of rainfall events, until all pumps at Iron valley cease. The wetting front will then only be influenced by current existing discharge plus RTIO's expansion operation until 2036 when RTIOs expansion operations are predicted to cease pumping.

This wetting front provides changes to the downstream ecosystems of the creek, potentially affecting fauna habitats within the creek (dealt with in the fauna section of this document), the flora and vegetation assemblages, particularly with respect to the riparian vegetation and the groundwater dependent vegetation species.

Minor Water Courses

The project is located within a local catchment area of approximately 64 km^2 (Iron Valley Catchment) which is a small part (1.6%) of the larger Weeli Wolli catchment of 4,000 km^2. Only one unnamed minor watercourse, which traverses the tenement just north of the southernmost pit, is likely to be affected by the proposal as the water course will be flanked north and south by WRLs. When this water course flows (only during limited periods throughout the year) it only carries a small percentage of the entire catchment. However, obstructing the flow with project infrastructure and impeding its flow is predicted to cause upstream flooding within the tenement. As such, the proposal design has provided an exclusion zone of 25 m either side of this water course to ensure disturbance is avoided. Surface water course and the exclusion area are shown in Figure 12

The mine site itself may act to intersect water flow to WWC. However, any intercepted water during operation will be recovered into the WWC via the dewatering then discharge. Following closure, the Project site will not represent a significant portion of the Weeli Wolli catchments (<1%) and will not significantly intercept surface or groundwater flows into WWC.

Given that the BWT proposal is wholly within the existing tenement boundary as AWT, the flood modelling prepared in 2012 for AWT is still considered valid. The tenement lies outside the 1:100yr floodplain of WWC channel, and is not considered to be at risk of major, regional scale flooding. However, there are six smaller water courses identified as flowing through the project area some of which that may generate significant volumes of flood water during extreme storm events (Figure 12). Flood depths of 0.5 m during a 1:100ARI is expected in catchment C13, C15 and C16 water courses, while a 1.0 – 1.5m depth is expected in the mining tenement in the path of the C14 catchment see Figure 12. BCP makes the commitment to appropriately rock armour the WRLs to ensure the integrity and stability of these landforms is maintained during such flood events. Surface water management for the other water courses likely to be intercepted by mining infrastructure are discussed in more detail in Section 2.3 of Appendix C, and these are made up of a combination of bunding, diversions around pits as well as allowing water to report to backfilled pits. These details will be developed into a surface water management plan, prior to commencement of operations.

Pit Lake

Following cessation of mining, and water extraction, the water levels in the pits are expected to recover within approximately 10 years. While some pit-infilling is planned, not all pits will be infilled to above groundwater level. This will result in pit lakes developing in pits C and N. These two pit lakes will be through-flow lakes, in which water flow is maintained and water is ‘refreshed’. Pit E is expected to be a sink, and will therefore be backfilled to above groundwater level, avoiding the generation and evapo-concentration of contaminants building up in the water column.

TSF Seepage

The TSF is likely to operate from 2016 to the end of mine life in 2025, with a constant seepage rate of approximately 1 to 5 L/s over the mine life. The water levels in the immediate TSF are constrained to not exceed groundwater level via the use of drain cells.

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Table 11 Assessment of Impacts to Key Environmental Factors – Hydrological Process

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Hydrological process - *to maintain the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance are protected.*				
Impact 1 - Lowering and mounding of water table in the vicinity of the Iron Valley tenement. Depletion of aquifer to a maximum of 260 m AHD at peak of operations causing long term aquifer drawdown.	Aspect 1 - Dewatering of aquifer to enable dry pit excavation of ore below water table. - Existence of encapsulated TSF within integrated WRL. TSF seepage resulting in groundwater mounding. - Water discharge points into WWC resulting in localised mounding - Cumulative upstream increase in water flow within WWC, contributing to water mounding within WWC.	Management Aspect 1 - Monitoring of groundwater drawdown levels with respect to predicted values. - Restricting pumping rates in accordance with Department of Water licence based on the needs and sensitivities of the downstream environments. - A groundwater management plan will be put in place to manage dewatering with respect to GDEs identified in the flora and vegetation and subterranean fauna sections of this supporting document. - Discharge of water to WWC in the vicinity of the fault line, which returns water to the groundwater system. - Groundwater monitoring of groundwater levels and groundwater quality in the vicinity of predicted mounding, consistent with monitoring currently undertaken for AWT. The groundwater mounding is likely to mitigate some of the effects of dewatering.	Regulation of Aspect 1 - Subject to approval, a new ministerial statement for the Project with specified discharge volumes and pumping rates. - Department of Water dewatering licence. - Groundwater management plan. - As part of the AWT Project, under MS 933, the Proponent is committed to monitoring groundwater in the vicinity of the eastern WRL and would be maintained for the BWT proposal.	Outcome: Development of the proposal requires high volumes of water to be extracted and disposed of given the high connectivity along a fault line to the regional aquifer. The connectivity between the WWC system and the groundwater will be retained not only by the proposals own discharge of water into the system, but also the recharge from the progressively increased surface water flowing in WWC due to the mining activities upstream The outcome from this scenario will result in changes in groundwater levels over time, which will affect groundwater dependent vegetation and subterranean fauna. The changes will cause the temporary reshaping of habitat areas for the affected receptors. However, the extent of the habitats and the connectivity between them, allow for the ecosystems to be maintained through operations and return with equilibrium of groundwater levels (expected within 10yrs after pumping ceases).
Impact 2 - Potential for changes to hydrological regime through changes in the position of the wetting front and the subsequent effects on downstream receptors, aquatic fauna and flora and vegetation (riparian vegetation and groundwater dependent species).	Aspect 2 - Discharge of 17 GL/annum of groundwater into WWC.	Management Aspect 2 - Monitored discharge volumes in accordance with discharge detailed in Table 10 (quantity) to be complied with. - Dewatering and discharge management plan to be put in place to incorporate specific receptor indicators located downstream.	Regulation of Aspect 2 - Water discharge licence and application of appropriate discharge standard. - Subject to approval, a management based conditional environmental management plan will be developed.	Outcome: From the commencement of pumping, to its cessation, each phase may modify the receiving environment, through changing the location of the wetting front. However each phase will sustain the broader riparian ecosystems allowing them to return to equilibrium with water levels at the end of LOM thereby maintaining the hydrological regimes of groundwater and surface water so that existing and potential uses, including ecosystem maintenance are protected.
Impact 3 - Interception of surface water flows to WWC. Potential for changes in hydrological regime to downstream environment.	Aspect 3 - Expansion of mine pits and infrastructure.	Management Aspect 3 - Maintain: Current surface water drainage to manage clean water surface flows back to WWC – this is likely to occur through dewatering of pits during operation. - Avoid: Exclusion area of 25m to be maintained either side of the minor surface water course in the southern part of the Project area so that flows are not inhibited. - Rock armouring at the bases of the WRLs adjacent to creekline will be applied at heights adequate to maintain integrity and stability of the WRLs post closure of Iron Valley, being developed as part of Mining Proposal and mine closure plan. - Site surface water management plan to incorporate proposed mechanisms for sustainable water management.	Regulation of Aspect 3 - As part of the AWT Project, under MS 933, the Proponent is committed to managing drainage related issues. The Proponent's current commitments for the Project under MS 933 are detailed in Appendix B and would be maintained for the BWT proposal.	Outcome: Flow maintained in minor southern creek line preventing upstream flooding and disconnection to WWC. The Project site only represents a small portion (<1%) of the WWC catchment and is therefore the presence of the project is unlikely to significantly reduce water flow into WWC. BCP considers this outcome to meet the EPA objective for Hydrological processes. Water management will sustain adequate surface water flow to WWC, whilst maintaining site infrastructure and managing erodibility of WRLs.

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5.4 Inland Waters Environment Quality

5.4.1 EPA objective

Inland Waters Environmental Quality: To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.

Application of EPA policy to inland waters environmental quality is presented in Table 12.

Table 12 Application of EPA policy to Inland waters environmental quality

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Hydrological processes	EPA policy guidelines for hydrological processes Position Statement 4 (environmental protection of wetlands) (EPA 2004b)	Section 5.3 and technical appendix C	The studies identify the environmental values and functions of WWC and the hydrological balance between surface and groundwater in terms of quantity. The EPA principles are applied in the derivation of the residual impacts likely from the proposal.

5.4.2 Context/Key Survey Findings

The following information is sourced from the groundwater and surface water studies prepared by AQ2 and found in Appendix C. The orebody is a major aquifer and is linked to the WWC via a fault line, and with it, offering good water conductivity. As a result, the surface water quality is relatively similar in water chemistry to that of the groundwater. The comparisons in water chemistry are shown in Table 13.

Table 13 Comparison in water chemistry between groundwater and surface water

Groundwater						
	units	Central (PB1, PB2)	Eastern (MBA,MBK)	Southern (MBJ)		
pH	-	8.3	8.4	8.2		
Conductivity	µS/cm	840	865	340		
TDS	Mg/L	485	505	290		
Surface water						
Location / date	units	At Tarina (1997-2008)	At Waterloo bore	At IV (2014)	Within WWC (dry 2013)	Within WWC (wet 2014
pH		7.8	7.6	7.3	7.53	8.08
Conductivity	µS/cm	949	638	440	999	916
TDS	Mg/L	-	182	280	-	-

- A surface water quality sampling programme has been taken at the project and carried out in accordance with MS933. Collection of water samples has proved difficult, due to the intermittent flow in the WWC. The data was therefore supplemented with monitoring at different locations during one survey period in March 2015. The water quality readings have shown a number of elevated parameters within WWC above ANZECC guideline criteria. This may represent natural levels in WWC or may be due to discharge water entering into WWC from upstream activities.

- ANZECC guideline values are unlikely to be appropriate as trigger values in this scenario, as the criteria are likely to be exceeded before discharge occurs. Therefore site specific trigger values (SSTV) will be developed based on the baseline water quality of WWC.

Groundwater water chemistry is considered fresh to marginal in terms of salinity and slightly alkaline. Water quality has been found to reduce in 'quality' towards the Fortescue Marsh, with salinity levels an order of magnitude higher 25 km north of the Project in shallow aquifers and at high levels within 5 km in the bedrock aquifer.

It was recognised that a saline wedge existed north of the tenement, which had the potential to move toward the tenement boundary with a large dewatering campaign in operation. The positioning of the discharge locations was important in this regard and resulted in sites being selected that offered a suitable mitigating effect on the movement of the saline wedge south towards the project.

Water chemistry values for the water dewatering from the Project, are similar to that in the alluvium and Brookman Iron Deposits (approximately 500-700 TDS, and metals below the relevant freshwater quality guidelines for 95% species protection [ANZECC & ARMCANZ 2004]) with no significant impact from water chemistry on the WWC expected.

The presence of salt in the water is likely to produce a zone of evapo-concentrated salt at the point where the surface water returns underground at the wetting front. The variability of this point over the 10 years, means that build up at any particular point will be temporary (greatest 5 years between 2020 and 2025). These zones of elevated salt will be flushed out through natural rainfall events and cyclones.

Some site activities may result in suspended sediment-laden runoff during high precipitation events. However, these events will coincide with high flow events in the WWC and any run-off is likely to be in proportion to natural sediment loads.

The geochemical assessment of the open pits (Appendix H) identified rock of circum-neutral pH, non-saline, with negligible sulphur content and moderate to negligible buffering capacity, reaching a non-acid forming conclusion, indicating that the waste rock is not recognised as a potential source for acid mine drainage or metalliferous drainage.

The hydrological processes assessment in Section 5.1 identified the potential for groundwater mounding beneath the locations of the integrated TSFs. This initial categorisation of the mine material as being predominantly NAF, AMD nor MD are likely to be significant contaminant sources for the groundwater or nearby WWC. The creek is further protected by its subsurface flanks which have very low permeability.

The mine plan design has been developed to accommodate and ameliorate early predictions of potential environmental impacts. The mine plan, also severely restricted by available tenure moved from having several open pit lakes at the end of mine life to only retaining one, located towards the north of the main pit. One benefit of this change was the backfilling of pit E. This pit was likely to form a hypersaline pit lake sink. Pit E will be backfilled to above groundwater level to prevent this occurring.

Table 14 Assessment of Impacts to Key Environmental Factors – Inland Waters Environmental Quality

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Inland Waters Environmental Quality – *To maintain the quality of groundwater and surface water, sediment and biota so that the environmental values, both ecological and social, are protected.*				
Impact 1 - Depletion of aquifer potentially assisting the intrusion of a saline wedge and subsequent degradation of groundwater quality from north of the tenement boundary.	Aspect 1 - Dewatering aquifer for pit expansion.	Management Aspect 1 - The dewatering will be limited to a peak of 23 GL/annum. - Disposal of water north of the tenement boundary (discharge point DL5), expected to result in groundwater mounding to mitigate advancement of saline wedge potentially exacerbated by high dewatering rates.	Regulation of Aspect 1 - Subject to approval, a new ministerial statement for the Project with a specified abstraction volume. - RIWI licence amendment for groundwater abstraction permit will be obtained from DoW. - Works approval for prescribed premise category 6, under EP Regulations 1987	Outcome: The groundwater abstraction combined with the selected discharge locations is not expected to induce saline intrusions into the aquifer leading to changes to the groundwater quality. BCP considers with the measures proposed for this impact that the EPA object for Inland Waters Environmental Quality will be met.
Impact 2 - Discharge of up to 17GL/annum of groundwater to WWC. The groundwater is likely to be of a different quality than water within WWC.	Aspect 2 - Dewatering discharge into WWC.	Management Aspect 2 - Dewatering and discharge management plan to be put in place. This will detail water quality thresholds and limits at which management will be undertaken. Water quality thresholds will be applied relative to the upstream monitoring location. - Water will be discharged into WWC at three locations to dissipate discharge water and minimise the exacerbation of erosion of the creek bed at the point of discharge.	Regulation of Aspect 2 - Water discharge licence and application of appropriate discharge standard. - Subject to approval, management based condition environmental management plan will be developed.	Outcome: WWC is already an altered ecosystem, which is progressively changing from a perennial flow to a constant flow with minor seasonal fluctuations in quantity. The flow from Iron Valley may consolidate this change in the aquatic ecosystem. The water discharge criteria will be applied relative to upstream water quality values, as such are not anticipated to degrade water quality which threaten biota or third party users downstream, thereby meeting the EPA objective for Inland Waters Environmental Quality
Impact 3 - AMD seepage entering groundwater or surface water from TSF and pit voids.	Aspect 3 - Storage of rock waste and tailings.	Management Aspect 3 The geochemical assessment identifies potential for AMD as very low. The TSF would be appropriately engineered to prevent significant seepage.	Regulation of Aspect 3 - A works approval under the Environmental Protection Act 1986 (category 5c) will be submitted to the DER for approval for the construction and operation of the TSF's.	Outcome: Discharge from the TSFs of sufficient quantities to contaminate groundwater and surface water at Iron Valley are considered unlikely due to the design controls and appropriate drainage construction applied to this proposal. Together with the low AMD potential, the monitoring and management plan currently in place for the WRLs provides advance warning of any potential seepage before interacting with sensitive receptors. Therefore BCP considers with the measures proposed for this impact that the EPA object for Inland Waters Environmental Quality will be met

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5.5 Flora and Vegetation

5.5.1 EPA objective

Flora and Vegetation: To maintain representation, diversity, viability and ecological function at the species, population and community level.

Application of EPA policy to flora and vegetation is presented in Table 15.

Table 15 Application of EPA policy to flora and vegetation

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Flora and vegetation	Guidance statement 51 – Terrestrial flora and vegetation surveys for EIA in WA (EPA 2004) Position Statement 2 – Environmental protection of native vegetation in WA (EPA 2000) Position statement 3 – Terrestrial biological surveys as an element of biodiversity protection (EPA 2002)	Section 5.5 and technical appendix D The principles of PS2 are applied to the derivation of the outcomes and conclusions for the IV proposal. The principles of PS3 are applied to the derivation of the outcomes and conclusions for the IV proposal.	Adequacy of the basis of flora and vegetation site survey and data analysis follows GS51.

5.5.2 Context/Key survey findings

A flora and vegetation assessment was undertaken by Astron in 2012 for the proposal area as part of the AWT Project. This supporting document includes revised clearing area calculations based on the additional site activities and infrastructure requirements for BWT. Astron was also requested to prepare an additional report that focussed on the effects of groundwater changes to groundwater dependent vegetation (GDV) and riparian vegetation that may be affected by the BWT proposal. The GDV report accompanies the 2012 report in (Appendix D).

Flora representation

The AWT flora survey was conducted across the entire Iron Valley tenement. It concluded that there were no conservation significant species, threatened ecological communities or protected ecological communities present.

Vegetation Representation

The vegetation is representative of two regions classified under Interim Biogeographic Regionalisation for Australia (IBRA). These are Fortescue PIL 2 – 224.1 ha and Hamersley PIL 3 – 89.6 ha. The IBRA regions are shown on Figure 13. The vegetation sub-formations (National Vegetation Information System Level 4) found within the 2012 flora and vegetation survey area fall into the following broad categories (Figure 14):

- Eucalyptus scattered low trees over Acacia scattered shrubs over Triodia hummock grasslands on rocky hillcrests and slopes.
- Acacia shrublands over Triodia hummocks and scattered tussock grasses in creeklines/drainage.
- Mixed open shrublands (Acacia, Corchorus, Grevillea and Senna) over Triodia hummock grasslands and scattered tussock grasses on plains.

Associated with these three classifications are six vegetation associations, these are listed below, identifying the total number of hectares of the association within the tenement:

- Rocky hillslopes / hill crest vegetation association: *Eucalyptus leucophloia* subsp. Leucophloia scattered low trees over scattered *Grevillea wickhamii* and *Acacia bivenosa* tall shrubs over open *Triodia basedowii* or *T. lanigera* (*T. epactia*) hummock grassland. Clearing for BWT 166.7 ha, within an original 468.25 ha representation within tenement (Astron survey area).
- Creeklines / drainage vegetation association: *Acacia tumida* and *Grevillea wickhamii* open shrubland over very open *Triodia epactia* hummock grassland. Clearing for BWT 23.8 ha, within an original 114.02 ha representation within tenement (Astron survey area).
- Plains vegetation associations:
    - Plains 1: *Grevillea wickhamii* scattered tall shrubs over *Indigofera monophylla* and *Senna spp*. open shrubland over *Triodia epactia* open to very open hummock grassland with *Aristida holathera var. holathera* scattered tussock grasses. Clearing for BWT 23.4 ha, within an original 57.44 ha representation within tenement (Astron survey area).
    - Plains 2: Mixed *Malvaceae* (*Corchorus*, *Hibiscus*, *Sida spp*.) and *Senna spp*. Shrubland over *Triodia epactia* open to very open hummock grassland with *Aristida holathera var. holathera* and **Cenchrus ciliaris* scattered tussock grasses. Clearing for BWT 95.9 ha within an original 187.74 ha representation within tenement (Astron survey area).
    - Plains 3: *Acacia ancistrocarpa*, *A. inaequilatera* open to scattered shrubs over *Triodia lanigera* open hummock grassland with *Eragrostis eriopoda* scattered tussock grasses. Clearing for BWT 3.0 ha within an original 213.57 ha representation within tenement (Astron survey area).

Vegetation Associations – Direct Impacts from Clearing

The clearing of vegetation as part of the development of the BWT proposal, will not result in the loss of any conservation significant species, threatened ecological communities (TEC) or protected ecological communities (PEC). Therefore direct clearing for the BWT proposal is not considered a key environmental impact excepting for the fact that it is considered good to excellent vegetation and therefore triggers an offset for its clearing.

However the design of the project footprint has been minimised. The design has incorporated the need for an exclusion zone either side of the southern creekline, to allow for unimpeded flow and movement of fauna between the ranglands and WWC. The design has also incorporated the need to backfilling and progressive rehabilitation, which has resulted in the need for non-permanent topsoil storage areas. The manipulation of the mine plan in conjunction with these measures has restricted the clearing to 314 ha of native vegetation for the BWT mine development. The quality of this vegetation considered good to excellent. This 314 ha is in addition to the already approved 674 ha of good to excellent condition vegetation for the AWT project.

Groundwater Dependent Vegetation

The most influential aspect of the BWT project is the extent of dewatering and the discharge of this water to WWC. Astron has undertaken an assessment of GDV in an area of 10 km radius from the centre of the tenement (Appendix D). For this study, Astron used *Eucalyptus victrix, Eucalyptus camaldulensis* (facultative phreatophytes) and *Melaleuca argentea* (obligate phreatophyte) *as* key indicator species for their potential groundwater dependence and known presence in the area. Using a combination of three different methods: visual inspection of aerial imagery, analysis of multispectral satellite (Landsat) imagery and on-ground reconnaissance this study inspected GDV along 25 km of the Marillana/WWC System. This approach tends to focus on vegetation of ‘good health’, as this is what returns the best ‘green-ness’ indexing using the multispectral satellite imagery. As such the GDV in the assessment is regarded to be in good health, this was ground truthed during the field walk-over, thereby offering a conservative assessment.

The findings of the study showed that within the 10 km radius 31,416 ha, the total area containing GDV was 2,284 ha. GDV was found along the entire inspected length of the creek system, with little variability in vegetation health, ranging mostly along the creek, but at times up to 1.5 km from the creek bed, within the flood plain.

The range in abundance varied between the dryer northern parts of Weeli Wolli, compared to greater extent of numbers in the southern reaches of Weeli Wolli and Marillana Creeks. The following observations were made:

- The southern section of the system is clearly affected by current level of discharge from nearby mining operations. Southern areas were wetter and more highly productive, supporting dense stands of the trigger species.
- Areas north of the tenement are not influenced by mine discharge currently and were observed to be drier with less abundance of the indicator species. This suggests that the southern areas are likely to support vegetation that is both discharge and groundwater dependent.

Vegetation Associations – Indirect Impacts from Water Discharge

From the desktop and field study, a risk assessment was applied to the areas where GDV was found, and these areas mapped, based on the relative changes to groundwater levels and the presence of surface water. The risk assessment methodology was applied to both the base case (BWT in isolation plus the current level of upstream discharge) as well as the cumulative scenario of additional upstream water discharge from the RTIO pockets and billiards expansion project, currently under EPA assessment. The details of the risk assessment are provided in Appendix D, the findings of the risk assessment were mapped as presented in Figure 15. The risk assessment arrived at the following conclusions.

- The base case scenario identified approximately 591 ha (23%) to be at a high risk (50 to 100%) probability of decline. Figure 15 shows the majority of the high risk area located within approximately 6 km of the Weeli Wolli / Marillana confluence.
- Surface water discharge from BWT was likely to pose a moderate risk (10 – 50% probability of decline) immediately downstream of the discharge points, with no risk beyond the projected Iron Valley wetting front.
- The cumulative scenario, incorporating BWT with the additional discharge from RTIO Pockets and Billiards expansion, concludes with a similar proportion of high risk of decline (583 ha, 23%) though the distribution is pushed further north, up to approximately 14 km north of the confluence of the two creeks and approximately 2 km north of the discharge location DL5 (Figure 5).
- The results suggest that the cumulative impacts could mitigate potential negative impacts of drawdown from the BWT project along the southern portion of the WWC system, but push them further north, which could be either positive in some areas and negative in others, depending on species, spatial distribution of vegetation and tolerance to inundation and water logging.
- Groundwater modelling for BWT showed relatively rapid recovery of the groundwater levels to equilibrium within 10 years of the pumps stopping. It is likely that there will then follow a period of readaptation for the GDV which again may cause some water stress on the vegetation. The modifications to the mine plan design have enabled a staged reduction in discharge to the WWC. This in turn will limit the abruptness of the change in water availability downstream.
- Given the extent of significant GDV in the vicinity of the project, and the apparent good health of upstream populations (already receiving additional water from mine discharge) and downstream populations, recovery of the ecosystem is expected, particularly if management measures such as staged discharge reduction are implemented.

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Table 16 Assessment of Impacts to Key Environmental Factors – Flora and Vegetation

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Flora and Vegetation – *To maintain representation, diversity, viability and ecological function at the species, population and community level*				
Impact 1 - Clearing of an additional 314 ha of native vegetation of good to excellent condition.	Aspect 1 - Clearing of native vegetation	- Application of an offset to account for the residual good to excellent vegetation that will be cleared as part of the BWT project. - The Project footprint has been adjusted to minimise clearance of good to excellent vegetation. This has been adjusted based on maintaining an exclusion zone along the southern creekline and the modification of the mine plan to backfill pits, integrate the TSF to the WRLs and progressively rehabilitate, thereby reducing the space required for clearing. - Existing construction and operational management plans to manage impacts. Key actions include: • Management procedures in place to prevent accidental clearing. • Progressive clearing and rehabilitation will be undertaken. • Vehicles and machinery will only use designated tracks/roads.	Regulation of Aspect 1 - Subject to approval, a ministerial statement for the Project with a specified clearing limit, a defined Proposal Area and a condition relating to Offsets and Rehabilitation.	Outcome: No TECs, PECs, or Threatened flora species will be affected by the Proposal as none have been recorded within the defined Proposal area. Progressive rehabilitation will be undertaken where possible and landforms rehabilitated in the long term. The residual, unavoidable impacts on clearance of good to excellent vegetation from this Proposal will be addressed via the provision of an offset in accordance with EPA requirements. The unavoidable clearing of 313.2 ha is such that it is expected to maintain representation, diversity, viability and ecological function at the species, population and community level, because the vegetation communities within the site are widely represented outside the proposed clearing area, and meet the EPA objective for flora and vegetation.
Impact 2 - Groundwater table draw down and mounding affecting groundwater dependent vegetation with the influence of the extension of the permanent water wetting front in WWC. Likely to result in decline (high risk of decline; 50 – 100% probability of decline) of approximately 23% (590 ha) of identified GDV and riparian vegetation within 10 km radius of the tenement boundary.	Aspect 2 - Dewatering for development of the mine pit. - Discharge of 17 GL/year into WWC.	Management Aspect 2 Groundwater - Monitoring of groundwater drawdown levels and the condition assessment of groundwater dependent vegetation. As per current management and reporting. - The current use of groundwater by many of the species is unknown, therefore future monitoring will ascertain if degradation is occurring. - Dewatering discharge will be diverted to WWC at three key locations, to enable rapid return of water to the system. This discharge is considered to ameliorate the effects of lowering of groundwater. - The fluctuation of the position of the wetting front through modification and changes to pumping rates over the life of mine, means there will not be a sustained position of the wetting front >5yrs during the 10 year mine life. Discharge - Dewatering and discharge management plan to be put in place to incorporate specific receptor indicators located downstream. - Monitoring of water quantity and quality discharged from site included in plan. - Monitoring of water parameters upstream to be used as reference for meeting criteria. - Riparian vegetation health to also be included in management plan. - Monitored discharge volumes in accordance with Table 10 (quantity) to be complied with.	Regulation of Aspect 2 - A GDV management plan is currently in place for the AWT project. This will expanded to include the BWT impact area. This will detail future monitoring and management objectives (management based conditional EMP). - Water discharge licence and application of appropriate discharge standard. - Subject to approval, a dewater and discharge management conditional environmental management plan will be developed.	Outcome: The potential impacts on GDV have been phrased in terms of potential risk. 590 ha (23% of GDV within a 10km radius) have been identified as at a high risk of decline. The location of the impact is dependent on whether the project exists cumulatively with RTIO's expansion project, but the extent of risk is similar. Areas upstream already affected by additional water in WWC has shown signs of flourishing. GDV exists extensively in the WWC and Marillana Creek system. Impacts are likely to affect some areas of the system more than others, and it is likely that there will be some loss of individual trees as a result of the proposal. The loss is likely to be temporary, due to the fluctuations of the groundwater level and the movement of the wetting front over time (proportional to pumping rates). With the rapid recovery of the groundwater levels (within 10 years of stopping the pumps) the indicator species and ecosystem is expected to recover as groundwater levels and permanency of water in the creek system returns to natural pre-mining levels. It is under these conditions that BCP considers that the indicator species will be able to maintain representation, diversity, viability and ecological function at the species, population and community level and will meet the EPA objective.

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Impact 3 - Spread of existing weed and/or introduction of new weeds.	Aspect 3 - Vehicle and earth movements - Visitors to site (animals and people)	Management Aspect 3 - Current weed mapping and routine weed inspections to continue - Clearing will be undertaken in weed free areas prior to infested areas where practicable to limit the opportunity to spread. - Weed, disease and pest hygiene requirements as per current practice including vehicle wash down and inspections. - Environmental inductions will be conducted with the workforce to include the identification of weed species, hygiene practices to prevent introduction and spread of weeds and the reporting of infestation sites.	Regulation of Aspect 3 - Weed management will be in accordance with the requirements of the *Agriculture and Related Resources Protection Act 1976.* - *Environmental Protection Act 1986* - *Environmental Protection and Biodiversity Conservation Act 1999* - *Environmental Weed Strategy for Western Australia (CALM, 1999)* - *Conservation and Land Management Act 1984.*	Outcome: Continuing to implement the current weed management plan at Iron Valley it is considered that weeds will not significantly impact native flora and vegetation and will therefore meet the EPA objective for flora and vegetation.
Impact 4 Ceasing Discharge of Groundwater The potential impact is that vegetation supported by the groundwater discharge will be degraded over time, removing fauna habitat and vegetation once the groundwater discharge has ceased: - Degradation of fauna habitat along WWC. - Degradation of vegetation and flora along WWC. - Degradation of ecosystem in WWC	Aspect 4 - Groundwater discharge during operations	Management Aspect 4 - Water discharge will be gradually reduced during the end of operations to minimise the effects of abruptly ceasing WWC surface flow. - The groundwater discharge will be undertaken over a number of discharge points, dispersing flow and potential impacts. - There will be continued flow in WWC from other mining operations upstream after Iron Valley ceases production.	Regulation of Aspect 4 - Conditional EMP to maintain pumping rates within the volumes predicted.	Outcome: Ceasing the discharge at BWT proposal is likely to have some effect on the ecosystem within WWC. At that stage the groundwater will start to return to pre-proposal state, and the surface water expression will do as well. However, the presence of the wetting front will be dependent on the mining operations upstream. The extensive nature of the GDV up and downstream, means that the return the ecosystem to pre-mining scenario is expected. The ceasing of water discharge in this manner is therefore likely to ecologically sustain the return of GDV into closure to the areas affected by the proposal during operation, thereby in the long term, meeting the EPA objective.

5.6 Terrestrial Fauna

5.6.1 EPA objective

Terrestrial Fauna: To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

Application of EPA policy to hydrological processes is presented in Table 17.

Table 17 Application of EPA policy to terrestrial fauna

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Terrestrial fauna	Guidance statement 20 – sampling of short range endemic invertebrate fauna for EIA in WA (EPA 2009) Guidance statement 56 – terrestrial fauna surveys for EIA in WA (EPA 2004c) Position statement 3 – Terrestrial biological surveys as an element of biodiversity protection Technical guide on terrestrial vertebrate surveys for EIA (EPA 2002)	Section 5.6 and Technical appendix E	SRE surveys for the original survey on which this BWT project continued, followed GS20 The vertebrate fauna surveys for AWT on which this assessment relies, were carried out in accordance with GS56 The principles of PS3 are applied to the derivation of the outcomes and conclusions for the IV proposal

5.6.2 Context/Key Survey Findings

The terrestrial fauna technical studies are included in Appendix E of this document. It includes the original Bamford consulting Ecologists' vertebrate fauna report from the original submission from 2012 with a covering letter explaining the additional impact from the BWT proposal. Appendix E also includes the aquatic fauna report produced by Wetland Resource Management (WRM) and the original and revised subterranean fauna report, prepared by Bennelongia. The Short range endemic study report by Dalcon Environmental is included accompanied by a report from Phoenix and a covering letter from the EPA which removes the current SRE condition and the need for further SRE studies within the tenement boundary. This section briefly outlines the findings of each of the studies.

Conservation Significant Species – Listed under the WC Act and EPBC Act
The pre-site desktop study identified the potential for 21 conservation significant species to occur in the proposal area, a field survey was undertaken for the Project in 2011, and reviewed and updated to take account of the BWT in 2015. Four current conservation significant species were recorded from field surveys:

- Rainbow Bee-eater (migratory under EPBC act).
- Australian Bustard (Priority 4 under the WC Act).
- Western-pebble-mound mouse (Priority 4 under the WC Act).
- Rufous-crowned Emu-wren (not listed but considered locally significant).

One species previously considered to occur in the area, Crest-tailed Mulgara *Dasycercus cristicauda*, was included as a precaution in the AWT assessment. The incidence of this species has since been discounted from the region, with the sightings to be that of the non-listed Brush-tailed mulgara *Dasycercus blythi*.

Fauna Habitat – Direct Impacts from Site Clearing

The location of these species found within the study area is presented in Figure 16. The migratory Rainbow Bee-eater was recorded throughout the study area, but no nests were found. This species breeds in a wide variety of sandy habitats across much of the state, in the north Kimberly, on the swan coastal plain and in the south west. It is a widespread species that is opportunistic in its use of habitat. The Rainbow Bee-eater was observed within the Boolgeeda land system of the project area which is recognised to exist extensively within 15 km from the project boundary. Clearing of suitable habitat within the Boolgeeda land system will be less than that cleared for AWT, additional percentage clearing of habitat <2.38%.

The Australian Bustard was recorded with tracks over much of the project area The Australian bustard was recorded within the Boolgeeda land system of the project area which is recognised to exist extensively within 15 km from the project boundary. Clearing of suitable habitat within the Boolgeeda land system will be less than that cleared for AWT, additional percentage clearing of habitat <3.82%.

Western Pebble mound mice are active within the area, and old activity from the Pebble mound mouse was recorded to the southwest corner of the site (outside the proposed clearing footprint) while active mounds were located nearby outside of the tenement boundary. The Western Pebble mound mouse was found within the Newman land system which is recognised to exist extensively within 15 km from the project boundary. Clearing of suitable habitat within the Newman land system will be less than that cleared for AWT, additional percentage clearing of habitat <0.7%.

The Rufous Crowned Emu Wren was found nearby but outside the tenement boundary within the Boolgeeda land system which is recognised to exist extensively within 15 km from the project boundary. Clearing of suitable habitat within the Boolgeeda land system will be less than that cleared for AWT, additional percentage clearing of habitat <3.82 %.

These species recorded during the survey are not considered to be significantly affected by the BWT proposal with the additional clearing of approximately 314 ha, as their habitat is found extensively outside the tenement boundary (Appendix E).

In the AWT assessment, a further two species listed under the EPBC Act 1999 (Northern Quoll, Pilbara Olive Python) were included and discussed, but not recorded during the survey. Although of suitable habitat, the northern quoll was not recorded in repeated surveys in the general region and has only been found very infrequently in the general area.

The Pilbara Olive Python is likely to be resident in the area. Both the Olive Python and the Northern Quoll will have favourable habitat type further removed as part of the BWT proposal. Their habitat types are linked to land systems, particularly the Newman Land system.

The clearing will result in clearing 215 ha that represents vegetation within the Newman land system. This equates to 1.2% of proportional impact upon the Newman Land System within a 15 km radius of the site.

It is likely that the Pilbara Olive Python relies not only on the vegetation found within the Newman land system but also on the River Land Systems. With no River Land systems existing within the tenement boundary, but is extensively found within 15 km from the site, the extent of clearing results in a very low proportional impact for Pilbara Olive Python habitat of 1.07%. Where the proposal site is located, it is likely that the Pilbara Olive Python uses minor water courses to access WWC from the elevated areas to the west. As such the creek line located to the south of the project is likely to already provide this access. The application of a 25 m exclusion area either side of the creek centreline is a design measure that will not only maintain water flow from the elevated topography, but also provide a corridor for east west fauna access.

The assemblage of vertebrate fauna expected to occur within the project area reflects the community structure of the Pilbara Region. The fauna assemblage is not considered unique, with the environment widespread in the region, and the assemblage considered typical of the region. In terms of completeness, the overall assemblage is lacking a few of the usual mammals but is otherwise substantially complete (Bamford, Appendix E). The disturbance of conservation significant habitat that is likely to result from the proposal is very low, when assessed with suitability of habitat within the wider 15 km radius (Bamford, Appendix E).

Fauna Habitat (fringing vegetation) – Indirect Impacts from dewatering and water discharge

Dewatering and discharge affects from both the BWT project and the cumulative scenario when combined with RTIO expansion, was assessed as a high risk for decline over approximately 590 ha (23%) of GDV species within 10 km from the tenement. Of the species already associated with the project, the GDV is likely to support the Pilbara Olive Python and large riverine eucalypts may also provide habitat for Northern Quoll, should it be found in the area. Such changes will have both adverse and positive effects on the fauna assemblage. Olive Pythons may be robust enough to survive the predicted changes as they shelter in living or dead trees and feed on a range of animals. There may be a change in the proportional representation of some other species in the assemblage as a result of changes in their local pattern of distribution.

Aquatic Fauna

There are currently four separate surface water zones that appear in WWC adjacent to the project area. These are:

- Upper adjacent reach, which comprises perennial flow of pools and riffles. This is characterised by diverse macroinvertebrate assemblage, rich hyporheic fauna and abundance of fish.
- The second is the off-channel pools, which are most likely perched permanent / semi-permanent pools supporting zooplankton assemblages, but low diversity of macroinvertebrates and fish.
- The third is the lower adjacent reach of WWC which consists of surface expression in the form of isolated permanent and semi-permanent pools upstream and adjacent of the project that are unconnected by surface flows, except following rainfall events. This is characterised by little instream habitat, lentic macroinvertebrate assemblage, rich hyporheic fauna and low diversity and abundance of fish.
- The last of these areas is downstream reach, which exhibits episodic surface flows following rainfall, has no permanent semi-permanent pools and is relatively homogenous faunal assemblage structure composed of species adapted to intermittent flows and species with adaptations to survive desiccation.

The WRM Aquatic Fauna Survey (Appendix E) found a number of conservation significant species stygobitic, SRE hyporheic and Pilbara endemic micro-invertebrate and macro-invertebrate taxa present in the WWC. These taxa have local and/or regional distributions outside of the Project impact area. Many of the samples were taken from standing water pools.

During the survey a potentially new cladoceran species *cf. Anthalona* sp (water flea) was recorded. Further work could be undertaken to understand the presence of this species to determine if it is a new species, or an outlier of an existing species.

Three fish species were found at locations around of the Project site, with more in-stream habitats and species present upstream, most likely as a result of upstream discharge into WWC. Fish were generally found to be of low diversity, in common with other rivers in similar environments such as the Fortescue River.

It is predicted that given the similarities of groundwater and surface water in the vicinity of the tenement, that most change to the aquatic ecosystem is likely to be the availability of water and the movement of the wetting front over the life of the project.

The initial drawdown associated with the BWT project will result in increased depth to groundwater within the upper adjacent reach of the creek and potential loss of permanent surface flows, loss or reduction in sub-surface flows and loss of permanent semi-permanent off channel pools, this will reduce available habitat for a number of conservation significant fauna. Excluding the cladoceran cf. Anthalona sp., populations of all conservation significant taxa have known local and or regional distributions outside the project area, therefore distribution and conservation status of these species are unlikely to be impacted by the project development.

The change in water availability is unlikely to lose or fragment habitat, and it can be argued that discharge of adequate water quality may provide alternative suitable habitat with the movement of the wetting front downstream. Continuous surface flows will likely result in an increase in instream habitat heterogeneity and diversity of hyporheic, macroinvertebrate and fish fauna, moving away from the existing assemblage and community structure. It is anticipated that upon cessation of discharge, aquatic fauna assemblages of lower WWC will shift back towards current altered baseline condition.

Provided surface water quality resultant from groundwater discharge is adequate, it can be considered changes to hydrological regime following the commencement of cumulative dewatering discharge will temporarily enhance biodiversity and conservation values baseline for the duration of dewatering discharge. There may be temporary generation of evapo-concentration of salts or calcite deposition, but there are likely to occur even in the absence of the BWT project.

Short Range Endemic

The potential short range endemic, *Aganippe MYG086* identified during the AWT assessment, was ruled out as a non-SRE after specimens underwent further DNA identification analysis (Appendix E). No further assessment on SREs is undertaken within this ER.

Table 18 Assessment of Impacts to Key Environmental Factors – Terrestrial Fauna

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Impact 1 – Direct Clearance of Fauna Habitat - Clearance of 314 ha of fauna habitat from expansion of pits and infrastructure. An assessment has been undertaken on the amount of vegetation to be cleared as a percentage habitat reduction in the wider area based on land system and vegetation type. This found that the amount of habitat to be lost for any one species would be very low. - Impacts to conservation significant fauna were generally considered to be minor as the fauna habitats are contiguous and well-represented outside of the proposal area. - Key significant species which may be impacted are considered to be Pilbara Olive Python and Northern Quoll.	Aspect 1 - Expansion of pits and infrastructure	Management Aspect 1 - Avoiding clearing of native vegetation through minimising the disturbance footprint - Cleared areas will be rehabilitated as soon as practicable. - Areas will be progressively cleared to allow for the movement of species. - Weed management practices will be implemented to prevent further loss of habitat. - Fauna observations, disturbances and near misses within the proposal area would be recorded and reported by all site personnel. - Mine plan has been altered to reduce habitat loss for conservation sensitive species (exclusion area) and retain linkages between the rangeland and WWC.	Regulation of Aspect 1 - Subject to approval, a new ministerial statement for the Project with a specified clearing limit, a defined Proposal Area and a condition relating to management of terrestrial fauna. - Impacts to EPBC species managed through discussions with DotE.	Outcome: While some individuals at a local level may be affected by the proposal, the disturbance area entailing habitat is very low for the Pilbara Olive Python and the Northern Quoll, and the proposal is unlikely to affect overall species populations. Diversity, viability and ecological function will be maintained at a species, population and assemblage level, thereby meeting the EPA objective for fauna.
Impact 2 – Aquatic Fauna in WWC - Impacts to aquatic fauna - stygobitic, SRE hyporheic and Pilbara endemic micro-invertebrate and macro-invertebrate taxa in WWC from groundwater discharge. - The change in the water regime (change of characteristics and volume) may potential lead to the change in macroinvertebrate assemblages due to changes in flow conditions and presence of water.	Aspect 2 - Groundwater discharge	Management Aspect 2 - Monitoring discharge parameters to WWC. - Application of discharge parameters to WWC, in relation to upstream water quality levels. SSTVs to be established as part of management based conditional environmental management plan.	Regulation of Aspect 2 - Subject to approval, management based condition environmental management plan will be developed. - Likely management based condition relating to preparation of dewatering and discharge management plan.	Outcome: - The management based condition EMP will detail further water quality monitoring to be undertaken within WWC. Management actions will be developed to detect any biological change so that additional actions can be taken to further investigate and determine management procedures. - Any potential impacts to local populations are unlikely to impact overall species populations, given that the majority of species are known in the wider area. - The exception is a potentially new cladoceran species cf. *Anthalona* sp (water flea). However, the additional discharge of water to WWC is likely to increase available, therefore not adversely affect this species. Given the above, diversity, viability and ecological function will be maintained at a species, population and assemblage level.
Impact 3 – Indirect Impacts to Fringing Fauna Habitat along WWC Changes to extent and health of riparian vegetation which supports habitat for Pilbara Olive Python and Northern Quoll. Changes will result in some vegetation deaths as well as the flourishing of vegetation with increases in water availability	Aspect 3 Groundwater discharge	Management Aspect 3 Discharge - Dewatering and discharge management plan to be put in place to incorporate specific receptor indicators located downstream. - Monitoring of water quantity and quality discharged from site included in plan. - Monitoring of water parameters upstream to be used as reference for meeting criteria. - Riparian vegetation health to also be included in management plan. - Monitored discharge volumes in accordance with Table 10 (quantity) to be complied with.	Regulation Aspect 3 - A GDV management plan is currently in place for the AWT project. This will expanded to include the BWT impact area. This will detail future monitoring and management objectives (management based conditional EMP). - Water discharge licence and application of appropriate discharge standard. - Subject to approval, a management based conditional dewatering and discharge environmental management plan will be developed.	Outcome: Safeguards for access between the rangelands and the creek have been included in the project design. The changes to the riparian vegetation will be progressive over time. The Pilbara Olive python and Northern Quoll are considered robust to survive the predicted changes as they can shelter in living or dead trees and feed on a range of animals. Based on this assessment it is understood that the riparian vegetation will be sustained in the Weeli Wolli and Marillana Creek system, thereby continuing to support the riverine habitat of the olive python and other species over time, thereby maintaining the diversity, viability and ecological function at a species, population and assemblage level

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5.7 Subterranean Fauna

5.7.1 EPA objective

Subterranean Fauna: To maintain representation, diversity, viability and ecological function at the species, population and assemblage level.

Application of EPA policy to stygofauna is presented in Table 19.

Table 19 Application of EPA policy to stygofauna

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Subterranean fauna	EAG 12 – consideration of subterranean fauna in environmental impact assessment in WA (EPA 2013c) Guidance statement 54a – sampling methods and survey considerations for subterranean fauna in WA (EPA 2007)	Section 5.7 and Technical appendix E	EAG12 and GS54a have been used in the technical appendix and in this supporting document, through the identification of adequate sampling effort and data interpretation.

5.7.2 Context/Key Survey Findings

An assessment on the subterranean fauna which may be affected by the BWT proposal has been undertaken and is included as Appendix E. This included level 2 troglofauna and stygofauna site survey conducted in 2009 and 2011. Subsequent targeted sampling in 2015 was undertaken for two potentially restricted stygofauna species.

Troglofauna
Troglofauna are air breathing subterranean fauna that use geology with fissures and voids for habitat. Vertical connectivity with the surface is important for the supply of carbon and nutrients, while lateral connectivity is important for the dispersal of species. The geology of the site is not unique, and is similar both inside and outside of the proposed pit outlines (Appendix E)

- Sampling yielded Sixteen species of troglofauna from 112 troglofaunal animals from within the Project area
- 11 of these species were found within the mine pit
- Nine of these 11 are found elsewhere in areas outside of mine pits or elsewhere in the Pilbara.
- The remaining two species of troglofauna (Chilopoda sp. and *Lagynochthonius* 'PSE43') were recorded as singletons, with single animals collected.

The detection of singletons provides no information about the spatial extent of their ranges. The Chilopoda sp. was recorded as a singleton but this may have been due to the poor condition of the specimen which only allowed for a poor level of identification.

Many of the troglofauna collected at Iron Valley are known more widely in the Pilbara. While some of these species may have a surface dispersal phase, the abundant schizomid *Draculoides* 'SCH020' is highly likely to be a troglobiont without any surface dispersal. Therefore, the distribution of this abundant species can be used as an indicator of the degree of habitat connectivity between impact and reference areas at Iron Valley. Given that *Draculoides* 'SCH020' occurs both within and to the south of the impact area, there is evidence of some habitat connectivity between the mine pits and the area to the south of them. Nocticola sp. B09, which is also considered to be a troglobite, has the same pattern of distribution.

Troglofauna distributions suggest that the dolerite dyke that partially transects the project trending in an east / west direction is not a barrier to troglofauna. Four species recorded at the project site are known from both sides of the dyke.

The pseudoscorpion *Lagynochthonius* 'PSE43' is known from a single juvenile, which provides no information about the spatial extent of species range. The ranges of the troglofaunal *Lagynochthonius* 'PSE039' is known from several deposits at Mining Area C, Yandicoogina and at least three orebodies at Jinidi in the Pilbara. Other species have more tightly restricted distributions, such as *Lagynochthnius asema* which is restricted to Mesa A in the Rob Valley. Considering the habitat connectivity demonstrated by the distribution of other troglofauna species in the Iron valley project, and the fact that species of *Lagynochthonius* may be widespread, it is considered likely that the range of *Lagynochthonius* 'PSE043' extends outside the proposed mine pits. Consequently, it is concluded that the threat to troglofauna conservation values from mining at the BWT proposal is low for both singletons.

Stygofauna

Stygofauna are water borne subterranean animals that rely on the presence of groundwater as well as suitable pore spaces typically within 32 m of the surface for a suitable habitat, with abundance typically decreasing with depth below ground. Habitat within alluvium and calcrete are usually considered to be the most productive, but species have been found to occur in moderate abundance in banded iron formations. At Iron Valley the alluvial drainage channels are considered to be the links between the project and the wider area. There is the potential for the dolerite dyke that transects the Project area to act as a barrier for stygofauna between the northern and southern portions. However, studies so far show that the dyke is not acting as a barrier to stygofauna movement. The study, conducted by Bennelongia (Appendix E) found the following:

- 2,152 specimens of stygofauna found in the Project area comprising 22 species.
- Twenty of the 22 species are known to occur beyond the Project area.
- The two remaining species encountered which are only known from within the pit area, are the Ostracod *Meridiescandona* sp. BOS 171 and Syncarid *Bathynella* sp. B24.

The Bathynella species was represented by two individuals from one bore and this highly restricted range representation is likely to be an artefact of sampling. Other Bathynella sp have been sampled at longer ranges, as shown on Figure 17. This figure shows Bathynella Sp. B23 located to the north at the 2 m drawdown contour, and a Bathynella sp. located adjacent to the Marillana Creek some 7 km to the south west of the pits. This connectivity is consistent with the other 20 species of stygofauna represented outside of the project area.

The Ostracod *Meridiescandona sp*. BOS171, was collected from five drill holes within the area of predicted groundwater drawdown, the sample locations are shown in Figure 18. This apparent restriction in range is in contrast to the range of other species within the Meridiescandona Genus. This clustering of samples south of the dyke is in contrast to the extent of those collected north of the dyke. This contrast is likely due to the difference in water levels existing on either side of this low permeability dolerite dyke.

Table 20 Instances of positive stygofauna collections either side of the dolerite dyke

Species of Stygofauna found north and south of the dyke	(sampling locations found)	
	South	North
Diacyclops humphreysi humphreysi	14	3
Paramelitidae Genus 2 sp. B01	8	2
Paramelitidae sp. B16	6	1
Paramelitidae sp. B26	3	6
Meridiescandona lucerna	3	2

The Hydrogeological cross sections for the pit locations identify a layer of alluvium approximately 30 m thick (Figure 4). This layer is thinnest at the top of the dyke, where it is within 10 m of the surface. The groundwater that is found within the tenement, south of the dyke, is hydro-geologically inhibited by the low permeability barrier of the dyke. It is proposed that following a heavy rainfall event, especially in the case of a cyclone, the southern groundwater levels increase and overtop the dyke allowing water levels to also rise on the northern side. The results from the study suggests that the depth of the suitable alluvial habitat allows the passage of stygofauna such as those recorded on both sides of the dyke including the closely related *Meridiescandona lucerna*, as well as the species in question, the *Meridiescandona* sp. BOS171. The depth which is reached with the progressive reduction of groundwater levels after such heavy rainfall events means that abundance of individuals is reduced to the point where collection is unlikely.

The additional mechanism that allows connectivity to the north is that the dolerite dyke is truncated within the eastern boundary of the tenement. Figure 19 shows a cross section of how the groundwater changes around this eastern boundary without the presence of the dyke. As such, maintaining the connectivity within the alluvium, the stygofauna is also able to connect to similar habitat around the eastern edge of the dyke to the alluvials further north.

The connectivity of habitat inside and outside the project area is demonstrated by the detection of 20 of the 22 species included in this study. This includes the largest stygofauna species known from the Pilbara, the *Pygolabis* sp. B01, which are known to occur in surrounding parts of the Weeli Wolli / Marillana Creek drainage channel. Given the extent of the alluvials, the range of *Meridiescandona* sp. BOS171 may continue farther north to areas where groundwater is shallower, so that a significant proportion of the population would be outside the predicted area of groundwater drawdown. This would mean that *Meridiescandona* sp. BOS171 would have a range of the same order of magnitude as other species of *Meridiescandona.*

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Table 21 Assessment of Impacts to Key Environmental Factors – Subterranean Fauna

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Subterranean Fauna – To maintain representation, diversity, viability and ecological function at the species, population and assemblage level				
Impact 1 - Troglofauna - Loss of stygofauna habitat and individuals.	Aspect 1 - Removal of subterranean fauna habitat from pit excavation. - Loss of subterranean fauna habitat from groundwater mounding from discharge of groundwater from the site.	Management Aspect 1 - Pits have been minimised to reduce footprint and excavation depth. - Pumping rates have been modified to minimise project wide and cumulative environmental impacts - Good connectivity with WWC means that rapid return of water levels will be experienced within 10yrs of stopping the pumps.	Regulation of Aspect 2 - Condition within the Ministerial Statement for monitoring groundwater depth levels to those predicted. - Licence and works approval for discharge to limit the amount of water being discharged to WWC, as predicted.	Outcome: There will be a prolonged loss of subterranean fauna habitat due to the direct excavation of habitat from mining operations at the pits. The dewatering levels will largely be restricted to within the project area, given the positioning of the water discharge points to Weeli Wolli. The majority of the species identified within the study are known to occur outside the pit habitats. Those that were not identified outside the pit habitats are considered likely to exploit the contiguous habitat connectivity available as a result of the alluvial/colluvial material extending both north and south from the pit areas. The clear connectivity is demonstrated by other related and non-related subterranean fauna species collected in this study. As the subterranean fauna species found in the Project area also exist outside the pit boundaries or are likely to be have connectivity to suitable habitats elsewhere, the pit excavation will have a likely impact on local individuals. As such, the project is predicted to maintain representation, diversity, viability and ecological function for troglofauna and stygofauna at the species, population and assemblage level.
Impact 2 - Stygofauna - Loss of stygofauna habitat and individuals.	Aspect 2 - Pit excavation as well as through the broader lowering of the water table by dewatering to enable safe and dry pit excavation.	Management Aspect 2 - Pit dewatering has been limited in the project design, through modifying the pumping rates. Which in turn limits the extent of dewatering effects outside the project area - Dewatering will be limited to 23 GL/annum. - Good connectivity with WWC means that rapid return of water levels will be experienced within 10yrs of stopping the pumps.	Regulation of Aspect 2 - Condition within the Ministerial Statement for monitoring groundwater depth levels.to those predicted. - Licence and works approval for discharge to limit the amount of water being discharged to WWC, as predicted.	

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5.8 Rehabilitation and decommissioning

5.8.1 EPA Objective

Rehabilitation and decommissioning: To ensure that premises can be closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the state.

Application of EPA policy to rehabilitation and decommissioning is presented in Table 22.

Table 22 Application of EPA policy to rehabilitation and decommissioning

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Rehabilitation and decommissioning	- Guidelines for preparing mine closure plans (EPA/DMP 2015) - Guidance for the assessment of environmental factors - Rehabilitation of terrestrial ecosystems (EPA 2006)	Flora and vegetation section 5.5 and Appendix D.	The policy is applied as per the objectives that are applicable to EIA and rehabilitation planning stages 3.1.1.

5.8.2 Context/Key Survey Findings

The Iron Valley project already has a mine closure plan that was submitted and approved by the DMP as part of the AWT Mining Act assessment in 2012. The three year review and update cycle for the existing mine closure plan is now due, and the plan will be updated to include the additional features of the BWT proposal. Primarily, this will include the risks to closure in the introduction of tailings facility cells within the WRLs, as well as the surface water aspects required due to the changes in site layout and the ongoing commitment to rehabilitation. The current mine closure plan will meet the requirements of *the OEPA/DMP Guidelines for Preparing Mine Closure Plans (2015)*.

A risk assessment workshop has been undertaken for the proposal to identify the inherent risks, controls and residual risks posed by the Project to a successful site closure. The residual high level risks have been summarised in this section. The complete risk assessment has been included as Appendix F. The complete Mine closure plan will be submitted with the Mining Proposal as part of the subsequent approvals.

- The following closure objectives, consistent with AWT have been proposed for the Project:
  - Rehabilitated land forms are safe, stable and non-polluting
  - Vegetation on rehabilitated land is native and self-sustaining
  - Measures to mitigate public health and safety hazards have been agreed with stakeholders and implemented.
- The following project risks at closure were identified as high and are presented in Table 23, below.
  - WRL of up to 100m in height exposing top batters to wind/water erosion (high)
  - Spills from TSF resulting in injury or loss of life (high)
  - Presence of weeds (medium)
  - Presence of people and or feral animals during closure leading to injury or loss of life (medium)
  - Fauna access to rehabilitation leading to its failure (medium)
  - Failure of vegetation resulting in dust generation and impacts on local receptors (medium)
  - Soil erosion in rehabilitated areas leading to failure of rehabilitation (medium)
  - Hydrocarbon spills caused by closure activities, leading to remedial work (medium)

- Failure of western WRL batter due to high volumes and subsequent erosion/rehabilitation failure (medium)
- Development of hypersaline pit lake leading to fauna and flora death (medium)
- Presence of pit lake leading to attracting fauna and people post closure (medium)
- Failure of abandonment bund leading to uncontrolled access and potential injury or death (medium)
- Cessation of discharge resulting in change to GDE/riparian veg (medium)
- Return of groundwater levels resulting in redistribution of subterranean fauna (medium)

Table 23 Assessment of Impacts to Key Environmental Factors – Rehabilitation and decommissioning

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Rehabilitation and decommissioning – *To ensure that premises can be closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with agreed outcomes and land uses, and without unacceptable liability to the state.*				
Impact 1 – Tailing Storage Facility The potential impacts with regards to the TSF a breach of the TSF as follows: - Fauna fatalities and degradation of fauna habitat. - Degradation of flora and vegetation. - Safety aspects (potential for loss of life).	Aspect 1 - Design and quality of construction of the Project	Management Aspect 1 - The TSF will be appropriately designed by a geotechnical engineer to prevent failure and encapsulated within the WRL. - The TSF will be located away from the drainage line in the south of the Project area. - An appropriate period of post closure monitoring will be undertaken.	Regulation of Aspect 1 - An amended mine closure plan will be prepared and submitted to the DMP for approval. - *Mining Act 1978.*	Outcome: Closure of the Project will be managed subject to approval of the mining proposal and mine closure plan. It is considered these provisions will enable the Project to be closed with a safe, stable, sustainable and non-polluting landform meeting the EPA's Objective for this factor.
Impact 2 – Site safety and stability of pit and landforms Failure of the landforms and pit could lead to release of sediments into the environment and potential safety implications.	Aspect 2 - Construction of the pits and WRL	Management Aspect 2 - The pits and landforms will be appropriately designed by a qualified geotechnical engineer to reduce the risk of failure. Appropriate setbacks to the edge of the tenement area and surface water feature exclusion area will be put in place - Access to the site will be reduced by the removal of access roads, signage and construction of safety bunds. - Construction of project features both pre and post closure will be outside the zones of instability	Regulation of Aspect 2 - The design will be subject to Regulator (DMP) approval prior to construction - An amended mine closure plan will be prepared and submitted to the DMP for approval. - *Mining Act 1978.*	Outcome: The limited AMD potential of the TSF waste and waste rock coupled with the design requirements of aTSF and WRL and pit stability will ensure that the premises can be closed, decommissioned and rehabilitated in an ecologically sustainable manner, consistent with the agreed outcomes and land uses, and without unacceptable liability to the state. Thereby meeting the EPA objective.
Impact 3 – Pit Lakes Source of potential contamination.	Aspect 3 Presence of the pit lakes post closure	Management Aspect 3 All pits except C and N will be backfilled to above the water table. Pits C and N are located on a hydrogeological gradient allowing groundwater to flow through the system. This reduces the risk of the pits developing into groundwater sinks.	Regulation of Aspect 3 - The design will be subject to Regulator (DMP) approval prior to construction - An amended mine closure plan will be prepared and submitted to the DMP for approval. - *Mining Act 1978*	Outcome: the resulting pit lakes will not become contaminant sinks, thereby being ecologically sustainable post closure and meeting the EPA objective for this factor.
Impact 4 – Inadequate topsoils and seed volumes and seed viability for rehabilitation. A lack of topsoil and seed bank for the Project may lead to the following: - Inadequate rehabilitation. - Surface instability on rehabilitated landforms. - Erosion of rehabilitated landforms.	Aspect 4 - Rehabilitation of the Project site	Management Aspect 4 - Progressive rehabilitation will be undertaken to test adequacy of topsoil and seed. - Rehabilitation and seed propagation trials will be undertaken. - The seed list will be modified as required following the rehabilitation trials. - Additional topsoil will be generated by rock mulching should it be required.	Regulation of Aspect 4 - A mining proposal and mine closure will be prepared and submitted to the DMP for approval. - *Mining Act 1978.*	Outcome: Management measures provide safeguard for sustaining vegetation rehabilitation in accordance with the EPA objective.

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Impact 6 – Rehabilitation failure from excessive exposure to wind and water erosion Leads to a reduction in the potential for successful rehabilitation.	Aspect 6 Presence of landforms in areas subject to fast water volume flows during flooding events.	Management Aspect 6 - Progressive rehabilitation - Landform design to account for height and exposure to weathering - Provision of adequate protection in surface water prone areas susceptible to erosion	Regulation of Aspect 6 - A mining proposal and mine closure will be prepared and submitted to the DMP for approval. - *Mining Act 1978*.	Outcome: The current mine closure plan is being updated as part of its cycle. This includes commitment for design, vegetation rehabilitation trials to be completed as well as ensuring an adequate seed stock is available as required during the life of mine to achieve rehabilitation at closure. The sign-off by the geotechnical engineer and the DMP as part of the Mining Proposal and Mine Closure plan update, will govern the adequacy of the measures included in the mine closure strategy. These measures enable this impact to have an outcome that meets the EPA objective for rehabilitation and decommissioning.

5.9 Offsets

5.9.1 EPA objective

Offsets*:* To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.

Application of EPA policy to rehabilitation and decommissioning is presented in Table 24.

Table 24 Application of EPA policy to environmental offsets

Topic (environmental factor)	Applicable policy	Reference within this document	Rationale in meeting policy
Environmental offsets	WA environmental offsets policy (EPA 2011) WA Environmental offsets guidelines (EPA 2014b)	Flora and vegetation management of clearing 314 ha of good to excellent vegetation (Section 5.5)	Principle 1 of the offsets policy states that offsets will only be considered after avoidance and mitigation options have been pursued. The WA offsets guidelines indicate that a fund may be a suitable way of reconciling offsets strategically to overcome land use tenure issues.

5.9.2 Context/Key Survey Findings

Environmental aspects of the proposal were assessed for potential significant residual impacts. These residual impacts are limited to the vegetation communities identified within the clearing footprint that were found to be in good to excellent condition

The EPA considers that the cumulative environmental impact from the growth in mining in the Pilbara needs to be addressed so that conservation management actions can be implemented proactively and the costs associated with these are divided between all users of the region (not just the last comers). The EPA considers that the increased amount of clearing of native vegetation in the Pilbara Bioregion, combined with the predicted future activities requiring clearing and other impacts from pastoralism and fires, is likely to result in a significant impact on environmental values. Subsequently the EPA has determined that a proactive approach to limiting these impacts is required and that a possible solution is the establishment of a strategic regional conservation initiative for the pooling of offset funds in the Pilbara.

The EPA sees considerable merit in proponents contributing to a strategic regional conservation initiative for the Pilbara region, and has recommended such an approach for preceding proposals in the area. This approach to environmental offsets has established an appropriate body, with rigorous and transparent governance arrangements, to implement initiatives to improve the environmental values within the Pilbara IBRA region. The offsets for Iron Valley, as with its preceding AWT proposal, will be a contribution to the Pilbara Offsets Fund relative to the 314 ha of good to excellent vegetation that will be cleared as part of this proposal. This is consistent with the 2014 WA environmental offsets guidelines (EPA 2014b).

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Table 25 Assessment of Impacts to Key Environmental Factors - Offsets

Inherent Impact	Environmental Aspect	Mitigation Actions to Address Residual Impacts	Proposed Regulatory Mechanism for Ensuring Mitigation	Outcome to Demonstrate that Proposal Meets EPA Objectives
Offsets – *To counterbalance any significant residual environmental impacts or uncertainty through the application of offsets.*				
Impact Loss of 314 ha of vegetation considered to be in good to excellent condition	Aspect - Vegetation clearing to occur as part of project construction phase.	Management Aspect - The clearance footprint has been minimised, by incorporating integrated TSFs within the WRLs, substantial backfilling of pits and exclusion zones being maintained for fauna passage and surface water through flow. - Areas will be progressively rehabilitated - The existing closure plan (prepared for AWT) will be updated to account for the changes associated with this BWT proposal, whilst maintaining a proposal that can be closed in an ecologically sustainable manner, consistent with agreed outcomes and land uses.	Regulation of Aspect A condition regarding offsets will be detailed in the ministerial statement. Approval of BCP's mine closure plan update to account for the rehabilitation effort, trials and progress towards closure of the BWT project.	Type of offset: provision of funds to a Pilbara strategic conservation initiative, in accordance with the EPAs established offset rates for the clearing of good to excellent condition native vegetation in the Pilbara Outcome: The proposed offset will counterbalance the residual impact of clearance of native vegetation for the BWT proposal.

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6.0 Other Environmental Factors

This Section provides a summary of other environmental factors considered not to be key environmental factors for the BWT proposal. This is either due to them being not applicable, or adequately controlled through existing project controls or regulatory instruments. These were discussed with the EPA during a scoping meeting on 28 August 2015. It is not considered that further assessment is required of other environmental factors.

Table 26 Other Environmental Factors

Potential Impact	Aspect	Mitigation Actions to Address Impact	Mechanism for Ensuring Mitigation
Air Quality and Atmospheric Gases – *To maintain air quality for the protection of the environment and human health*			
- Suffocation of flora due to dust impacts. - Health impacts on people.	- Blasting. - Drilling. - Earthmoving. - Trenching. - Vehicle movements. - Greenhouse gas emissions.	- Large distance to human receptors. The closest residential dwelling is approximately 12km north east (Marillana homestead). - Dispersed and temporary nature of dust generation. - Application of water to unsealed roads. - Controlling vehicle speeds along unsealed roads. - Air quality impacts have been assessed as part of AWT project. No changes expected.	- Implementation of a dust management plan.
Amenity – *To ensure that impacts to amenity are reduced as low as reasonably practicable*			
- Long term changes to landscape being viewed unfavourable.	- Pit - Mine infrastructure	- Large distance to human receptors. The closest residential dwelling is approximately 12km north east (Marillana homestead). - Minimising the clearing area for the Project. - Clearing work areas as they are required. - Backfilling pits - Progressive rehabilitation to be undertaken. - All supporting infrastructure removed on completion of the project.	- The rehabilitation intended for the site will be described in the mining proposal and mine closure plan. - The Mining Proposal and mine closure plan are required under the *Mining Act 1978.*

Potential Impact	Aspect	Mitigation Actions to Address Impact	Mechanism for Ensuring Mitigation
Heritage – *To ensure historical and cultural associations are not adversely affected*			
- There are three registered aboriginal heritage sites within the Project tenement. The project is located within the Nyiyaparli Native Title Claim.	- Mining Pit - Infrastructure - Site Operations	- Permission to disturb heritage sites has been obtained through an application under Section 18 of the *Aboriginal Heritage Act* 1972. - All site personnel to receive an appropriate induction with regards to Aboriginal heritage matters. - Consultation ongoing with aboriginal heritage groups (Appendix G)	- Section 18 of the *Aboriginal Heritage Act 1972.*
Human Health – *To ensure that human health is not adversely affected*			
- There is the potential for impacts to personnel from site operations and construction.	- Mining Pit - Infrastructure - Site Operations	- Large distance to human receptors. The closest residential dwelling is approximately 12km north east (Marillana homestead). - The current construction and operational environmental management plan will be expanded to include the BWT proposal.	- Construction and operational management plan.
Landforms – *To maintain the variety, integrity, ecological functions and environmental values of landforms*			
- Excavation of pit will change valley landform. - WRLto be constructed which will affect ecological function in the short term.	- Mining pit - WRL	The pit will be backfilled with waste rock material. The WRL will be rehabilitated in line with the mining proposal and amended mine closure plan.	- Mining proposal and mine closure plan required under the Mining Act 1978.
Terrestrial Environmental Quality			
- Introduction of TSF may pose a risk of contamination of soils within the immediate vicinity of the integrated WRL containing the TSF cell	- TSF	- Standard engineering controls can be used to management potential impacts from leaching of contaminants from the TSF.	- Sign off of structure by an appropriately qualified geotechnical engineer. - Works approval and licence from the DER for the TSF.

7.0 Principles of the Environmental Protection Act

This Section describes how the BWT proposal has met the principles of Environmental protection. The principles of Ecologically Sustainable development are incorporated into the EP Act and the EAG8 2015. These principles have been considered for the BWT proposal and are summarised in Table 27.

Table 27 Principles of the EP Act 1986

Principle	Project application and document references
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 the application of the precautionary principle, decisions should be guided by: - Careful evaluation to avoid, where practicable, serious or irreversible damage to the environment - An assessment of the risk-weighted consequences of various options	This is one of the key principles for environmental impact assessment and applicable for each of the assessment factors addressed in this document. In Section 5, the precautionary principle is applied to the scope of the baseline studies, and the conservative extent of the management measures. This is to ensure that where gaps in scientific knowledge may exist, the management measures adequately cover the broader extent of the potential impact.
Principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations.	The project design and the environmental mitigation and management measures detailed in this supporting document will ensure that the health, diversity and productivity of the environment is maintained or enhanced for the benefit of future generations (Section 5.3 to 5.7). The potential impacts post closure and the mitigation and management applied to avoid these impacts, is particularly in line with this principle (Section 5.8).
Principle of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration	Minimising impact in order to maintain conservation of biological diversity and ecological integrity has been applied in the first instance to the project design (Section 1), whereby avoidance and minimisation of significant fauna habitats has been a priority. This is done through minimising clearing, and provision of exclusion zones for fauna and water passage, modification of pumping rates and water disposal discharge points. Dewatering volumes have been kept to a minimum through the use of only in pit production bores. Where the disturbance has been unavoidable, rehabilitation has been proposed, which is currently adopted in the existing mine closure plan. The conservation values of the environments within WWC will not be reduced significantly by the project and biological diversity and ecological integrity is considered to have been met in the outcomes of each of the applicable environmental factors (Section 5).

Principle	Project application and document references
Principles relating to improved valuation, pricing and incentive mechanisms - Environmental factors should be included in the valuation of assets and services - The polluter pays principle – those who generate pollution and waste should bear the cost of containment, avoidance or abatement. - The users of goods and services should pay prices based on the full life cycle costs of providing goods and services, including the use of natural resources and assets and the ultimate disposal of any wastes. - Environmental goals, having been established should be pursued in the most cost-effective way, by establishing incentives 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.	BCP is committed to implement proven, practical and economically viable technologies. All engineering designs have been reviewed to identify opportunities for improved energy efficiency and greenhouse gas reduction, and all proven, practical and economically viable opportunities have been implemented. Suppliers and materials with low carbon footprints will be utilised where practicable BCP recognises that project costs include mitigation, management and closure actions.
The principle of waste minimisation All reasonable and practice able measures should be taken to minimise the generation of waste and its discharge into the environment	The BWT proposal will reduce landfill by minimising the amount of materials brought to site and by reusing and recycling materials where possible Optimal WRL design has been incorporated into the AWT project and will continue to be used under the BWT proposal modifications. This includes incorporating optimising waste rock movements to facilitate the opportunity for progressive rehabilitation. It also includes continuation of waste management systems to reduce and manage waste streams generated by the project.

8.0 Conclusions

8.1 Proponents conclusion

BCP is proposing to develop the Iron Valley BWT proposal as an amendment to the existing AWT operations. The access to BWT resource will extend the life of the operations by approximately 10 years, but significantly increase the throughput. The additional components of the operation include possible beneficiation and the related TSF cells to encapsulate the process waste generated.

Environmentally, the proposal means additional potential pressure is being applied to the surface and groundwater systems in the vicinity of the tenement, in particular WWC and its connectivity to the groundwater aquifers. The proposal applies temporary incremental pressure to the system as it works within an already altered baseline ecosystem. This impact assessment has taken into account future reasonably foreseeable projects in the form of a two scenario assessment; one which deals with the proposal in isolation, the other which includes hydrological effects in the form of additional discharge from upstream into WWC.

The findings of the assessment are considered to meet the EPA objectives for each of the limited number of preliminary environmental factors considered that were derived in conjunction with key stakeholders and regulators associated with the proposal.

The preliminary key environmental factors assessed in the BWT proposal are:

- Hydrological process (groundwater)
- Hydrological process (surface water) and Inland waters
- Flora and vegetation
- Fauna
- Subterranean fauna
- Rehabilitation and closure

These were similar to the AWT except for three differences. This proposal included Aquatic fauna in the terrestrial fauna factor, stygofauna was expanded and comprehensively investigated, and the flora and vegetation extended the study by more thoroughly covering the likely impacts to groundwater dependent vegetation / riparian vegetation in the vicinity of WWC and the fluctuating wetting front across the 10 year life of mine.

Given the good connectivity between groundwater and surface water in the vicinity of WWC, as well as the physical constraints for space existing on the tenement several project design modifications were applied in an iterative process as potential environmental impacts became known. Some of these include:

- Specific locations for water discharge points to maximise the recovery of the groundwater system. This resulted in minimising the drawdown to the extent possible.
- Modification of the pumping rates across the life of mine, to minimise the abrupt changes to water availability in the creek system
- Minimising the dewatering volumes by designing the production bore locations to be within pit only
- Maintaining an exclusion corridor between the ranges and the Creek system, not only for unimpeded water passage during flooding, but also providing an access route for conservation significant species using this habitat.
- Integrating the TSF into the WRL to minimise the surface clearance footprint
- Back filling pits that would result in a groundwater sink

In addition to these design measures, the management and mitigation has been applied to be consistent with the operations currently occurring as part of the AWT operations, but also relying on other Regulatory agencies processes and mechanisms to reach an environmentally acceptable outcome.

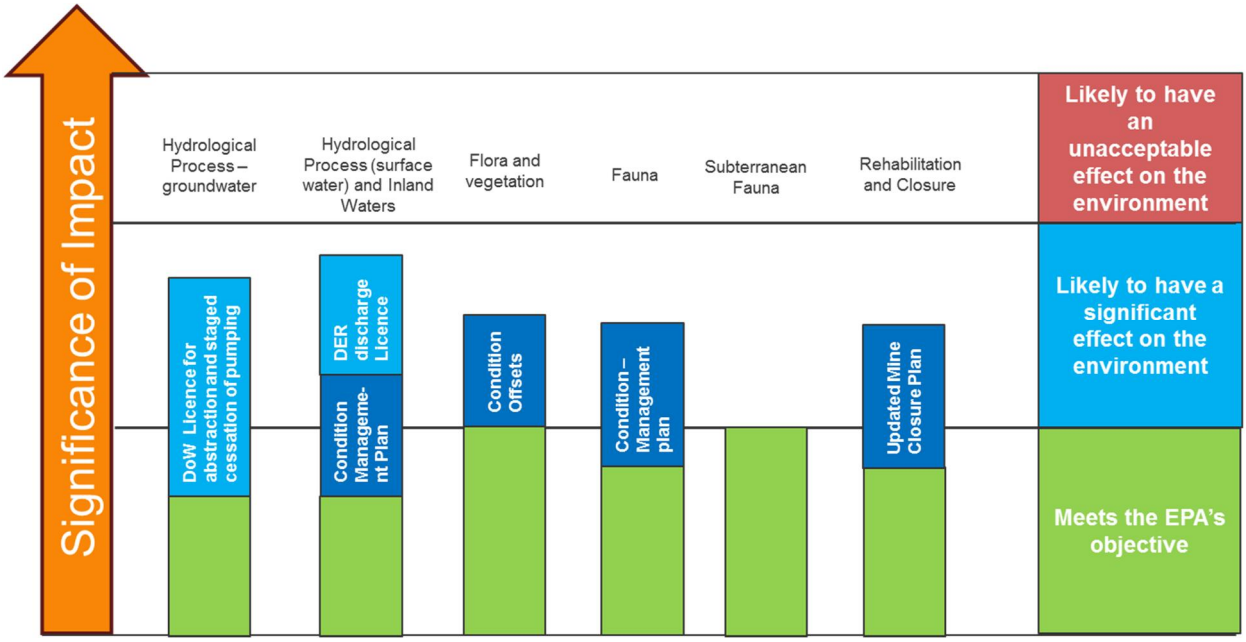
The key and other environmental factors included in this assessment have been assessed against the EPA's objectives and relevant guidelines. The proposal has been prepared with design, layout and management controls identified to avoid, minimise or manage potential environmental impacts. Given the configuration of the proposal to avoid significant impacts to environmental assets and values, and the existing and proposed management actions and controls to protect the environment currently being undertaken, the proponent considers that the proposal will meet the EPA's objectives and is environmentally acceptable.

In conjunction with the conclusions reached in this assessment, as explained above, BCP considers that this supporting document includes all content requirements in accordance with EAG 14, so that an API-A level of assessment may be applied to the Iron Valley BWT proposal. In accordance with EAG 14, the proposal raises only a limited number of key environmental factors that can be readily managed and for which there is an established condition-setting framework. The proposal is also consistent with established environmental policies, guidelines and standards, which have been identified throughout the document. The proponent, in preparation of the supporting document has consulted at length with key stakeholders to the project including decision making authorities and has addressed in the assessment, comments raised during the consultation process. It is understood that due to the size of the Iron Valley BWT proposal, that any concern regarding its implementation would be limited locally.

8.2 Application of the Significance Framework

The figure below shows a conceptual application of the EPA significance framework. It provides an overview of the proponents view on residual impacts related to the environmental factors addressed in the assessment. The impact assessment concludes that the EPA objectives for all factors assessed will be met.

Plate 1 Conceptual Application of the EPA Significance Framework



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