MWH

BUILDING A BETTER WORLD

Yandicoogina Junction South West and Oxbow Iron Ore Project

Environmental Scoping Document (Revised May 2010)

Prepared for Rio Tinto

This document has been prepared specifically for Rio Tinto in relation to the Yandicoogina Junction South West and Oxbow Iron Ore Mine project proposal. It should not be relied upon by other parties nor used for any other purpose without the specific permission of MWH.

REVISION SCHEDULE

REV. NO.	DATE	DESCRIPTION	PREPARED BY	REVIEWED BY	APPROVED BY
8.0	14/12/2009	Final Draft (submitted to EPA Dec 17th 2009)	DH	DH	JC
9.0	05/02/2010	Amended Final Draft	DH	DH	MB/JC
10.0	04/03/2010	Amended Final Draft_V2	DH	DH	MB
11.0	12/04/2010	Amended Final Draft_V3	DH	MB	MB
12.0	19/04/2010	Amended Final Draft_V4	DH	MB	MB
13.0	05/05/2010	Amended Final Draft_V5	DH/MB	MB	MB

This document contains information about MWH, particularly about the culture of our organisation and our approach to business, which would be of value to our competitors. We respectfully request, therefore, that it be considered commercially sensitive.

In line with our Quality System, this document has been prepared by Daniel Huxtable and reviewed by Daniel Huxtable and signed off by Jim Campbell.

EXECUTIVE SUMMARY

Hamersley Iron Pty Ltd is proposing to develop new iron ore mines at the Junction South West (JSW) and Oxbow deposits at Yandicoogina. The company already operates mines at the nearby Junction Central (JC) and Junction South East (JSE) deposits, which are expected to be mined to their maximum extent by approximately 2014 and 2020 respectively. New mines at JSW and Oxbow will enable continuity of production from the overall Yandicoogina operation.

The EPA has set the level of assessment for the proposed mine operations at JSW and Oxbow at Public Environmental Review (PER). This Environmental Scoping Document (ESD) has been prepared to satisfy Section 6.1 of the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002* and in accordance with the *Guide to Preparing an Environmental Scoping Document* (EPA 2007). The proposal will also be referred to the Commonwealth Department of the Environment, Water, Heritage and the Arts under the *Environment Protection and Biodiversity Conservation Act 1999.*

The total resource within the JSW and Oxbow deposits subject to this proposal is approximately 320 Mt; the majority of which is below the water table. The project includes the following components*:

- new open cut iron ore mines within the Channel Iron Deposit (CID) at the JSW and Oxbow locations (excluding the Marillana Creek crossing at JSW);
- a dewatering system to lower the water table to allow mining of the ore reserves;
- new temporary waste dumps (for eventual return to mined areas), topsoil stockpiles and haul roads;
- flood protection bunding and diversion of minor streams away from the pit and into Marillana Creek; and
- infrastructure associated with drilling/blasting, loading and haulage/conveying of ore from the mine to the existing processing plant at JC.

Subject to final assessment and design, the project may also include the following components:

- a new processing plant located at JSW; and
- a pit void residue storage facility, depending on the processing requirements for the ore if wet processing is required.

Preliminary evaluation works, including evaluation drilling and metallurgical testwork, soil characterisation, and hydrolgeological pump testing will be undertaken prior to finalisation of the assessment (**Preliminary Evaluation Works**). Therefore the Preliminary Evaluation Works do not form part of this proposal. However *ongoing* evaluation works related to implementing this proposal (**Implementation Evaluation Works**) does form part of the proposal.

The environmental values of the project area are relatively well understood. The Yandicoogina locality has been extensively surveyed for vegetation, fauna and heritage values as a component of historical mining activities. The vegetation is typical of the central Pilbara and includes a low proportion of species and communities with conservation significance. A number of fauna with conservation significance occur in the locality, which are typically mobile and have natural ranges well beyond the project area. There are numerous Aboriginal heritage sites; comprised mostly of artefact scatters, scarred trees and rock shelters ranging from low to high archaeological significance.

The key potential environmental impacts of the project have been identified to include:

- impacts to the vegetation health and composition of the Marillana and Weeli Wolli creek systems, resulting from additional discharge of pit dewatering water into these systems;
- loss of groundwater dependant riparian vegetation along the section of Marillana Creek within and adjacent to JSW sub-area B, due to dewatering cones of depression;
- localised impacts to subterranean fauna within and adjacent to mine pits;
- changes to aquifer properties and groundwater chemistry resulting from the post mining landform; and
- greenhouse gas emissions, due to the scale of the mining operations proposed. Based on the emissions intensity of the existing operations at Yandicoogina, annual GHG emissions resulting from the entire Yandicoogina operations (JC, JSE, JSW & Oxbow) are likely to exceed 100,000 tonnes CO_2 equiv.yr^{-1} over the life of the project.

Other potential environmental impacts related to emissions of dust, noise, light, handling of waste and weeds can be readily managed using standard RTIO operating practices and procedures. A description of the practices and procedures to be used to address each of these factors will be included in the PER document. As a component of this, the efficacy of existing practices and procedures at the current Yandicoogina operations will be reviewed and evaluated.

To ensure that project related environmental impacts can be contained within acceptable limits, a series of management strategies and additional studies have been proposed for inclusion in the PER document. These include:

- pre-mining surveys to identify vegetation, flora, fauna and heritage values within the project disturbance footprint and adjacent areas as relevant to the assessment of environmental impacts. The outputs of the surveys will inform the design of management controls to protect these values;
- assessment of the conservation values of the Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh and threats to these values posed by the project;
- a review and evaluation of the impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have occurred as a result of historical mining at Yandicoogina, and the effectiveness of management strategies that have been employed to minimise impacts;
- prediction of impacts to riparian vegetation, major creeklines and groundwater systems, using the outputs of hydrological and hydrogeological modelling (including consideration of interactions between the creek bed alluvium and the underlying aquifer). The modelling outputs will also inform the development of management controls to minimise impacts during and post mining. The modelling work will be subject to an external peer review;
- an evaluation of water management options (relating to groundwater extraction and use) for the purposes of minimising discharge to creek systems. This will include evaluation of the quantity of water required for each stage in the mining process, consideration of critical points in the forecast water balance and contingency options for managing excess water;
- assessment of measures to minimise the greenhouse gas emissions intensity of iron ore mining and processing at the Yandicoogina operations; and
- development of a Groundwater and Surface Water Monitoring and Management Plan, which addresses:
    - collection of baseline groundwater data for the mine and any associated borefield areas;
    - collection of baseline data on the state and condition of ecosystems potentially affected by surface water discharge;
    - monitoring parameters for hydrological and ecosystem health change to ensure that changes and impacts are within acceptable limits; and

- primary and contingent management and reporting actions in the event that impacts are detected outside acceptable limits.

The Groundwater and Surface Water Monitoring and Management Plan (GSWMMP) will be included in the PER document, and developed in parallel with a revised Groundwater Operating Strategy for the Yandicoogina operations. The GSWMMP will be developed by RTIO in consultation with DEC and DoW.

Note that a number of environmental management initiatives currently in place for existing mining operations at JC and JSE can be extended and adapted to include proposed mining at JSW and Oxbow. These include:

- Yandicoogina JSE Riparian Vegetation Management Plan - this plan outlines procedures for the protection of riparian vegetation;
- Yandicoogina JSE Weed Management Plan - this plan outlines procedures to prevent the introduction of new weeds and reduce the spread of existing weeds;
- Yandicoogina Subterranean Fauna Management Plan – this plan aims to maintain the abundance, diversity, geographic distribution and productivity of stygofauna;
- Yandicoogina Decommissioning and Rehabilitation Plan – this plan outlines procedures for the closure of the current RTIO Yandicoogina operations at JC and JSE; and
- Yandicoogina Operations Groundwater Operating Strategy 2008 - this document states proponent commitments and responsibilities in managing the impacts of taking and using groundwater.

Revised versions of these existing Yandicoogina operations environmental management plans will be included in the PER document.

A summary of the relationships between environmental factors, EPA principles of environmental protection and the scope of proposed investigations to be included in the PER document is provided in Table A. Potential management responses are also included, which address each environmental factor and principle.

Table A: Relationships between environmental factors, potential environmental impacts, and the scope of investigations including management responses

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Additional Investigations	Potential Management Responses
Biophysical					
Flora and Vegetation	Within the project site and zone of hydrological influence (dewatering cones of depression and surface water discharge zones)	To maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Clearing of up to 1800 ha of vegetation compromising: • Spinifex hummock grasslands • Eucalypt woodlands • *Acacia* scrublands Disturbance to riparian vegetation in major creek systems and species with conservation significance. Altered health and composition of riparian vegetation, resulting from dewatering and surface water discharge to creek systems.	• review of previous flora surveys • review of DEC rare flora and TEC database • detailed flora and vegetation surveys of the project area (with sufficient coverage to properly define the values and significance of creek systems affected by dewatering discharge) • mapping of weed infestations • riparian vegetation health monitoring	• avoidance of species and ecological communities with conservation significance wherever practicable • adaptation of the current Yandicoogina JSE Weed Management Plan to provide the basis for preventing the introduction and spread of weed species - addressing weed identification, mapping and management for all activities associated with the project • adaptation of the current JSE Riparian Vegetation Management Plan to provide the basis for protecting riparian vegetation • development of rehabilitation completion criteria to provide the basis for preserving vegetation values (biodiversity, structural and functional attributes, land use attributes) post mining • consideration of cumulative impacts and the development of strategies and controls to minimise these

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Additional Investigations	Potential Management Responses
Fauna	Within the project site and zone of hydrological influence (dewatering cones of depression and surface water discharge zones)	To maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement in knowledge.	Clearing of the following fauna habitats: • low stony hills • valleys Disturbance to species with conservation significance and their habitat.	• review of previous fauna surveys • review of DEC threatened fauna database • detailed fauna surveys of the project area (with sufficient coverage to properly define the habitat values of the project area)	• avoidance of species and ecological communities with conservation significance wherever practicable • protection of uncleared habitat from threats and disturbance • development of rehabilitation completion criteria to provide the basis for reinstating fauna habitat values post mining
			Subterranean fauna may be affected by excavation disturbance and groundwater drawdown due to dewatering.	• review of results from previous surveys • additional surveys in and adjacent to anticipated impact zones for the new deposits, to enable potential impacts on species with restricted distributions to be evaluated	• hydrogeological modelling and monitoring will be used in conjunction with survey results to assess any potential impacts to animals and habitat from dewatering • excavation activities will be designed to avoid areas of subterranean fauna habitat wherever practicable
Land (terrestrial)	Within the project site	To maintain the integrity, ecological functions and environmental values of soils and landforms in the project area. To ensure that rehabilitation achieves an acceptable standard compatible with the intended land use, and consistent with appropriate mine closure objectives and criteria	Landform disturbance from earthworks and excavation.	Landform surveys	A conceptual Decommissioning and Rehabilitation Plan will be developed, which establishes mines closure objectives and criteria. The plan will address final landforms, surface water quality, aquifer water quality, revegetation techniques, post-closure land use options and surface water routing. It will also include specific monitoring programs addressing landform stability monitoring, revegetation monitoring and water quality monitoring.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Additional Investigations	Potential Management Responses
Wetlands (wetlands, rivers)	Within the project area and zone of hydrological influence	To maintain the integrity, ecological functions and environmental values of wetlands	Impacts to the vegetation health and composition of the Marillana and Weeli Wolli creek systems, resulting from additional discharge of pit dewatering water into these systems	• hydrological modelling to predict impacts to surface water systems, under a variety of possible dewatering and surface water discharge scenarios addressing water quantity and quality • assessment of the conservation values of the Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh and threats to these values posed by the project; • review and evaluation of the impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have occurred as a result of historical mining at Yandicoogina, and the effectiveness of management strategies that have been employed to minimise impacts • an evaluation of water management options (relating to groundwater extraction and use) for the purposes of minimising discharge to creek systems. This will include an evaluation of the quantity of water required for each stage in the mining process, consideration of critical points in the forecast water balance and contingency options for managing excess water	• evaluation of water use and alternative management options for the purposes of minimising discharge to creek systems • studies to address the potential extent and impact of increased surface water volumes in the Marillana Creek and Weeli Wolli Creek systems; this will include consideration of the RTIO Yandicoogina, BHPBIO Yandicoogina and Hope Downs mining areas • development of a Groundwater and Surface Water Monitoring and Management Plan • adaptation of the Yandicoogina JSE Riparian Vegetation Management Plan for application to the proposed mining areas at JSW and Oxbow • prevention of sedimentation and contamination of creek systems

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Additional Investigations	Potential Management Responses
Groundwater	Within the project site and zone of hydrological influence	To maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.	Groundwater drawdown from abstraction may cause long-term effects on the paleochannel aquifer by reducing aquifer storage. Changes to groundwater chemistry resulting from the post mining landform	• hydrogeological modelling of the paleochannel and alluvial aquifer systems, reflecting the addition of mining at JSW and Oxbow to the current Yandicoogina operations. • an evaluation of water management options (relating to groundwater extraction and use) for the purposes of minimising discharge to creek systems. This will include an evaluation of the quantity of water required for each stage in the mining process, consideration of critical points in the forecast water balance and contingency options for managing excess water. • impact studies addressing the potential extent and impact of increased surface water volumes in the Marillana Creek and Weeli Wolli Creek systems, including an evaluation of potential downstream impacts on the Fortescue Marsh. These will be informed by modelling outputs, and will include consideration of anticipated water disposal from new and existing RTIO Yandicoogina operations, BHPBIO Yandicoogina operations and Hope Downs 1 operations.	• use of improved models to predict impacts to groundwater systems, under a variety of possible dewatering and surface water discharge scenarios • ongoing monitoring of aquifers to enable impacts to be detected • development of a Groundwater and Surface Water Monitoring and Management Plan

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Additional Investigations	Potential Management Responses
Pollution Management					
Water Quality	Groundwater and surface water within the zone of hydrological influence	To ensure that emissions do not adversely affect environment values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.	Contamination of surface water and groundwater with chemicals or hydrocarbons.	• water quality sampling to establish baseline conditions • undertake sampling of aquatic fauna (fish, invertebrates, hyporheic fauna) • mineral waste characterisation	RTIO has well developed operating practices and procedures for the prevention of environmental contamination, which are used .at existing operations at Yandicoogina. This includes the appropriate handling and management of mineral waste. These practices and procedures will be updated and applied to the project.
Noise	Emissions from the project site	To protect the amenity of nearby residents from noise impacts resulting from activities associated with the project by ensuring the noise levels meet statutory requirements and acceptable standards.	Noise emissions arising from excavation and operation of the mines.	• monitoring of noise levels • assessment of potentially sensitive receptors • noise modelling assessment as part of the Yandicoogina Operations EMP	RTIO has well developed operating practices and procedures for noise management, which are used .at existing operations at Yandicoogina. This will be updated and applied to the project.
Light	Within the project site and surrounds	To avoid or manage potential impacts from light overspill and comply with acceptable standards.	Disruption to fauna nesting and roosting habits.	Ongoing monitoring of light spill impacts to fauna.	RTIO has well developed operating practices and procedures for light management, which are used .at existing operations at Yandicoogina. This will be updated and applied to the project.
Greenhouse Gases	Emissions from the project site	To minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.	Decrease in global air quality resulting from greenhouse gases.	RTIO will evaluate options for minimising the greenhouse gas emissions intensity of iron ore mining at the Yandicoogina operations.	Monitor and report greenhouse gas emissions deriving from the Project. Minimise greenhouse gas emissions where practicable, based on implementation of selected emissions reduction options.

Environmental Factor	Relevant Area	Environmental Objective	Potential Impacts	Additional Investigations	Potential Management Responses
Social Surrounds					
Aboriginal Heritage	Project site and zone of hydrological influence	To ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.	Groundwater drawdown may affect the presence and significance of known Aboriginal heritage sites. Excavation/earthworks may disturb Aboriginal heritage sites.	• review of all previous surveys conducted in the locality • Aboriginal heritage surveys of the project area and immediate surrounds as relevant for cultural heritage assessment	• RTIO has well developed practices and procedures for protecting Aboriginal heritage sites including a Cultural Heritage Management Plan (CHMP) for the Yandicoogina project area, which includes JSW and Oxbow. • ongoing consultation with heritage stakeholders • any proposal to disturb Aboriginal heritage sites will be assessed under Section 18 of the *Aboriginal Heritage Act 1972*.
Risk	Project site and surrounds	To ensure that risk from the project is as low as reasonably achievable and complies with acceptable standards and EPA criteria.	Risks to workers or general public as a result of the project	• health and safety audits • reporting and investigation of any incidents	RTIO has well developed practices and procedures for protecting human safety and welfare where associated with company operations.

Principle	Relevant (Yes/No)	Environmental protection considerations to be addressed in the PER document
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options.	Yes	To address this Principle, surveys and investigations are required for characterising possible threats to environmental values resulting from the project. Environmental assessments associated with the existing Yandicoogina operations provide a useful guide to key environmental sensitivities in the area. To enable an assessment of the risk – weighted consequences of various project design and implementation options, the following aspects have particular importance: • impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have already occurred as a result of historical mining; • the efficacy of environmental management practices and procedures used at the current Yandicoogina operations; • biological surveys for vegetation, flora and fauna (including stygofauna) within and adjacent o the project disturbance footprint; • heritage and cultural significance surveys within and adjacent o the project disturbance footprint; • the application of hydrogeological and hydrological modelling to predict impacts on the local groundwater system and Marillana and Weeli Wolli creek systems, including consideration of existing and proposed mining. These aspects should be discussed in detail in the PER document.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	Mining should not detract from future land use options at Yandicoogina. In particular, the local groundwater system needs to be protected during and post mining. Hydrogeological modelling will be an important tool for informing post mining landform design, to ensure the maintenance of aquifer water quality and throughflow. To address this Principle, the PER needs to describe the proposed approach for managing mine decommissioning and rehabilitation. Plans and approaches developed for the existing mining operations at Yandicoogina provide a basis for this. Options for minimising emissions of greenhouse gases implicated in global climate change also need to be considered in the PER.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	To address this Principle, Biological surveys are required to identify conservation values (within a local and regional context) within the project footprint and surrounding areas. This is necessary to ensure that important biodiversity values are detected and adequately protected. The survey results will inform the development of rehabilitation completion criteria, and should therefore include appropriate biodiversity and ecological integrity targets. The PER will need to include the results of biological surveys, and discuss the implications of these results for designing appropriate environmental protection strategies and measures.

Principle	Relevant (Yes/No)	Environmental protection considerations to be addressed in the PER document
4. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	RTIO has well developed operating practices and procedures to minimise and manage waste, which are used at existing operations at Yandicoogina. This includes characterisation of mineral waste and the design of appropriate waste disposal mechanisms. To address this Principle , the suitability of applying RTIO waste treatment and minimisation practices and procedures to the project needs to be evaluated and discussed in the PER.
5. Eco-Efficiency Producers of goods and services should produce competitively priced goods and services that satisfy human needs and improve quality of life, while progressively reducing ecological degradation and resource intensity throughout the full life-cycle to a level consistent with the sustainability of biodiversity and ecological systems.	Yes	To address this Principle, the PER should include an evaluation of the following options for minimising the greenhouse gas emissions intensity of iron ore produced by the project: • designing for process and equipment energy use efficiency • low emissions energy and materials procurement • best management practices to reduce energy consumption
6. Integrated Environmental Management If approaches to managing impacts on one segment of the environment have potential impacts on another segment, the best overall environmental outcome should be sought at a local, landscape, catchment and/or regional level.	Yes	The impacts of current and proposed mining activities affecting the Yandicoogina locality need to be assessed in the PER. This is particularly important with respect to the impacts of discharging water into the Marillana and Weeli Wolli creek systems.

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Rio Tinto

Yandicoogina Junction Southwest and Oxbow Iron Ore Project

Figures

Tables

Appendices

1 Introduction

1.1 Purpose of the document

Hamersley Iron Pty Ltd is proposing to develop new iron ore mines at the Junction South West (JSW) and Oxbow deposits at Yandicoogina. The company already operates mines at the nearby Junction Central (JC) and Junction South East (JSE) deposits, which are expected to be mined to their maximum extent by approximately 2014 and 2020 respectively. New mines at JSW and Oxbow will enable continuity of production from the overall Yandicoogina operation.

The proposal was originally referred to the Environmental Protection Authority (EPA) on January 1st 2008. The EPA determined that a Public Environmental Review (PER) level of assessment was required. This Environmental Scoping Document (ESD) has been prepared to satisfy Section 6.1 of the *Environmental Impact Assessment (Part IV Division 1) Administrative Procedures 2002* and in accordance with the *Guide to Preparing an Environmental Scoping Document* (EPA 2007a).

This ESD:

- provides a summary description of the project proposal, including justification for the project and consideration of alternative options;
- summarises the important biological, biophysical and social values and functions of the existing environment;
- identifies potential environmental impacts, their significance and management responses with consideration of the impact of the existing mining operations at Yandicoogina;
- proposes additional studies to inform the assessment and management of particular environmental impacts;
- describes previous and planned stakeholder consultation; and
- provides a project and assessment schedule.

This ESD addresses comments received on earlier drafts submitted to the EPA on 17 November 2008, 17 December 2009, 12 January 2010 & 17 March 2010. Comments on the draft were provided by the EPA, Department of Environment and Conservation (DEC), Department of Water (DoW), Department of Indigenous Affairs (DIA) and the Department of Mines and Petroleum (DMP)[1].

Note that the original ESD proposed an additional new mining area at the Billiard South deposit at Yandicoogina. The Billiard South deposit has subsequently been removed from the project proposal and is therefore not addressed in this ESD.

It is anticipated that the draft PER will be submitted to the EPA in late Q2 2010, following the completion of studies and investigations described in the ESD.

1.2 Proponent details

The proponent for this the proposal is Hamersley Iron Pty Ltd. The proposal is managed by Pilbara Iron Pty Ltd (Pilbara Iron) on behalf of Hamersley Iron, a wholly owned subsidiary of Rio Tinto Iron Ore. The key contact for this proposal is:

Ms Melinda Brand
Environmental Approvals Specialist
Rio Tinto Iron Ore
152-158 St Georges Terrace, Perth
GPO Box A42, Perth, WA 6837

[1] The Department of Mines and Petroleum and the Department of State Development were recently established, resulting from a restructure of the former Department of Industry and Resources (DOIR) in 2009. Comments on the original ESD were received from the DIOR.

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1.3 Proposal justification

The proposed project will facilitate the continuation of mining in the Yandicoogina locality as the existing mines at JC and JSE become depleted. Current projections show that the JC deposit will be mined to its maximum extent by approximately 2014. Production from JSE is expected to reach its maximum extent by approximately 2020.

Feasibility studies have indicated that global demand for iron ore is sufficient to warrant mining the JSW and Oxbow deposits. Implementation of the project will generate significant royalties and taxation payments for the State and the Commonwealth. Traditional landowners will also benefit under the terms of the Yandicoogina Land Use Agreement.

The project will allow an operational workforce to be maintained beyond the lifespan of the existing mines. New employment will be created in the mine construction phase. It will also prolong the utilisation of established mine and rail transportation infrastructure. The JSW and Oxbow deposits are in close proximity to existing mine infrastructure including ore processing plants and rail load facilities at JC. These deposits provide the most suitable option for ensuring continuity of production at Yandicoogina over the next 10 to 15 years.

2 Summary description of the proposal

2.1 Introduction

Hamersley Iron is proposing to develop new iron ore mines at JSW and Oxbow, in the Yandicoogina locality of the Pilbara region. Hamersley Iron has been mining iron ore at the nearby JC and JSE deposits since 1998 and 2006 respectively.

The proposed and existing mines are situated along an extensive Channel Iron Deposit (CID), characterised by a continuous iron mineralisation along a paleochannel. The total length of the CID is over 80 km. The main zone of the CID at Yandicoogina is approximately 500 m wide with a thickness of 45 to 50 m under approximately 10 m of overburden. It is estimated that the JSW and Oxbow deposits will collectively yield approximately 320 M tonnes of ore.

The proposal includes the following components:

- new open cut iron ore mines within the Channel Iron Deposit (CID) at the JSW and Oxbow locations (excluding the Marillana Creek crossing at JSW);
- a dewatering system to lower the water table to allow mining of the ore reserves;
- new waste dumps (out of pit waste dumping until in pit waste dumping of mined areas can occur), topsoil stockpiles and haul roads;
- flood protection bunding and minor stream diversion away from the pit and into Marillana Creek; and
- infrastructure associated with drilling/blasting, loading and haulage/conveying of ore from the JSW and Oxbow mines to current processing facilities at JC and JSE.

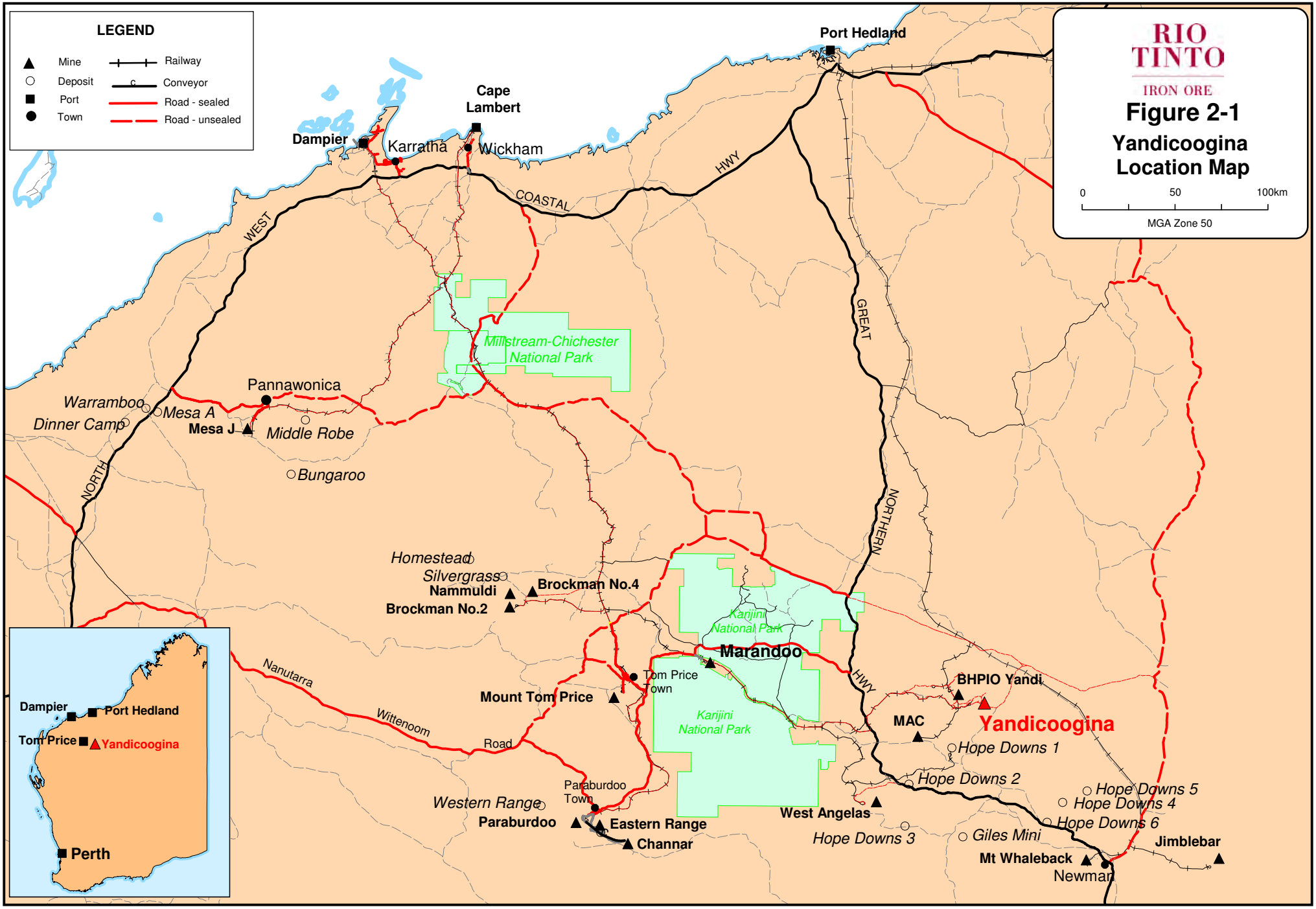
Subject to final assessment and design, the proposal may also include the following components:

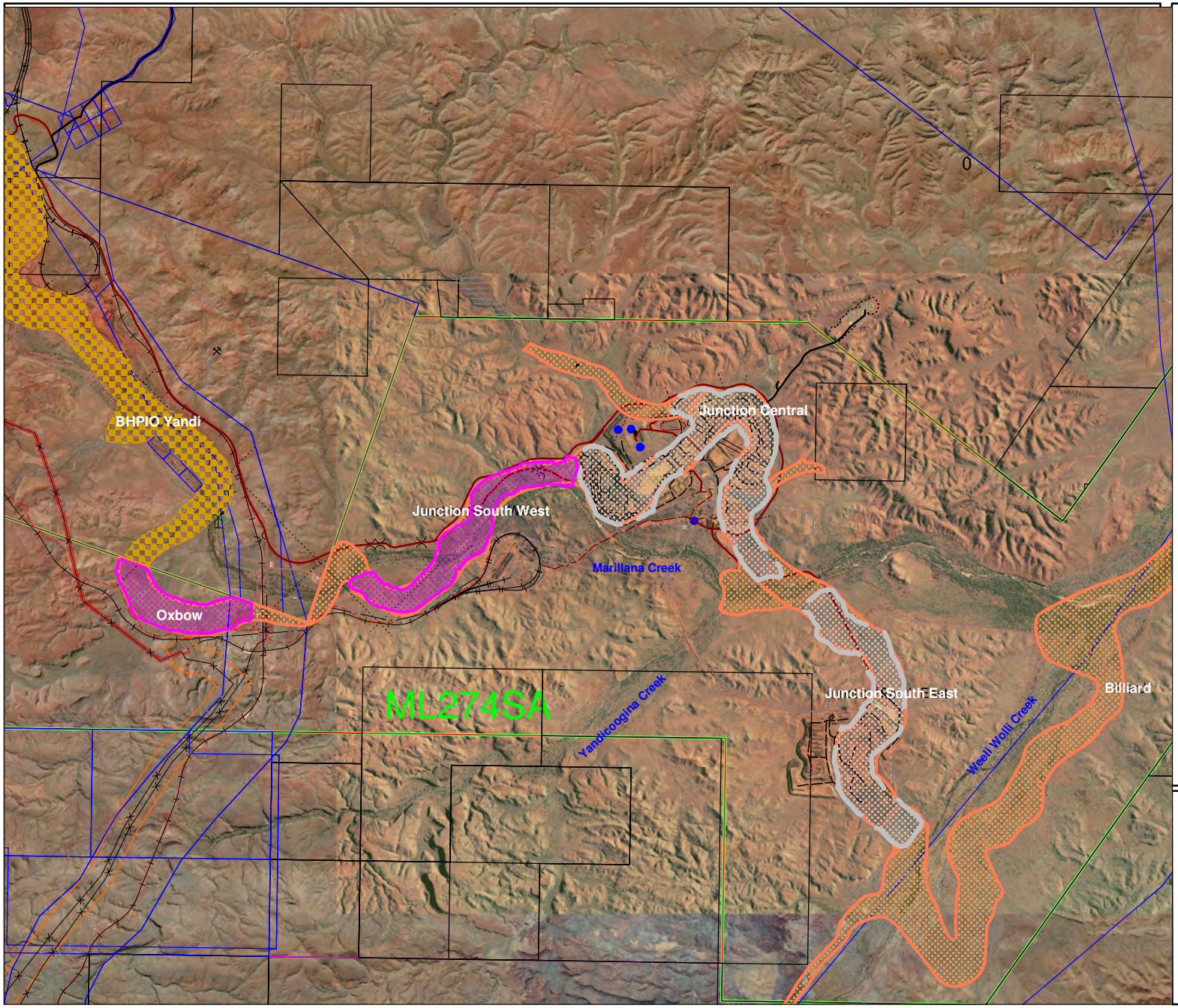
- a new dry processing plant located at JSW;
- new or expanded residue storage facilities at the existing Yandicoogina operations, depending on the processing requirements for the ore; and
- realignment of Phil's Creek near JC, as dictated by the eastern extent of the JSW pits.

Preliminary evaluation works, including evaluation drilling and metallurgical testwork, soil characterisation, and hydrolgeological pump testing will be undertaken prior to finalisation of the assessment (**Preliminary Evaluation Works**). Therefore the Preliminary Evaluation Works do not form part of this proposal. However *ongoing* evaluation works related to implementing this proposal (**Implementation Evaluation Works**) does form part of the proposal.

2.2 Location

The project area is located in the central Pilbara region of Western Australia, approximately 90 km north-west of Newman and 300 km south east of Dampier (Figure 2-1). The JSW and Oxbow deposits are located immediately west of the existing JC mine (Figure 2-2). The entire Yandicoogina mining operation is covered by ML274SA established under the *Iron Ore (Yandicoogina) Agreement Act 1996*.


LEGEND
Mine
Deposit
Port
Town
Railway
Conveyor
Road - sealed
Road - unsealed
RIO TINTO
IRON ORE
Figure 2-1
Yandicoogina Location Map
0
50
100km
MGA Zone 50
Port Hedland
Cape Lambert
Dampier
Karratha
Wickham
COASTAL HWY
WEST
GREAT NORTHERN HWY
NORTH
Millstream-Chichester National Park
Pannawonica
Warramboo
Dinner Camp
Mesa A
Mesa J
Middle Robe
Bungaroo
Homestead
Silvergrass
Nammuldi
Brockman No.4
Brockman No.2
Karijini National Park
Marandoo
Tom Price Town
Mount Tom Price
Nanutarra
Wittenoom
Road
Karijini National Park
BHPIO Yandi
MAC
Yandicoogina
Hope Downs 1
Hope Downs 2
Hope Downs 3
Hope Downs 4
Hope Downs 5
Hope Downs 6
West Angelas
Giles Mini
Jimblebar
Mt Whaleback
Newman
Paraburdoo Town
Western Range
Paraburdoo
Eastern Range
Channar
Dampier
Port Hedland
Tom Price
Yandicoogina
Perth



LEGEND

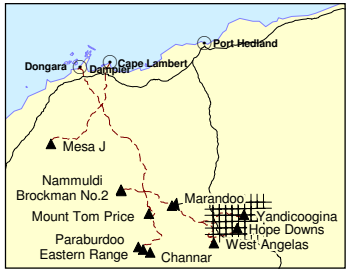
- Yandi CID outline (HI)
- Yandi Current Mining Area
- BHPIO Yandi CID outline
- Proposed Mining Areas
- Tenure
- Tracks
- Rail
- Transmission Line

0 2.5 5km

1:100K

N

LOCATION MAP



RIO TINTO IRON ORE

Figure 2-2

Yandi JSW & Oxbow Deposit Location and Conceptual Mine Layout

Drawn: MJB
Date: Dec 2009

Plan No.
Proj:

2.3 The proposal

2.3.1 Key characteristics

The proposal involves the construction of new iron ore mines at JSW and Oxbow: including 3 new mine pits, temporary surface waste rock dumps and associated supporting infrastructure. The JSW site includes 3 sub-areas termed A, B and C respectively (Figure 2-3). Mining will not include the Marillana Creek crossing within sub-area B. The eastern boundary of the proposed JSW Area C may extend to join the western edge of the JC pit. This would necessitate a creek realignment of Phil's Creek near the JC pit. The south west extension of the proposed JSW Area C is in close proximity to Marillana Creek, necessitating appropriate controls to protect this section of the creek. The northern boundary of the Oxbow disturbance area is defined by the mining tenement boundary. Care will be required to prevent any encroachment onto the neighbouring tenement held by BHP Billiton (BHPBIO).

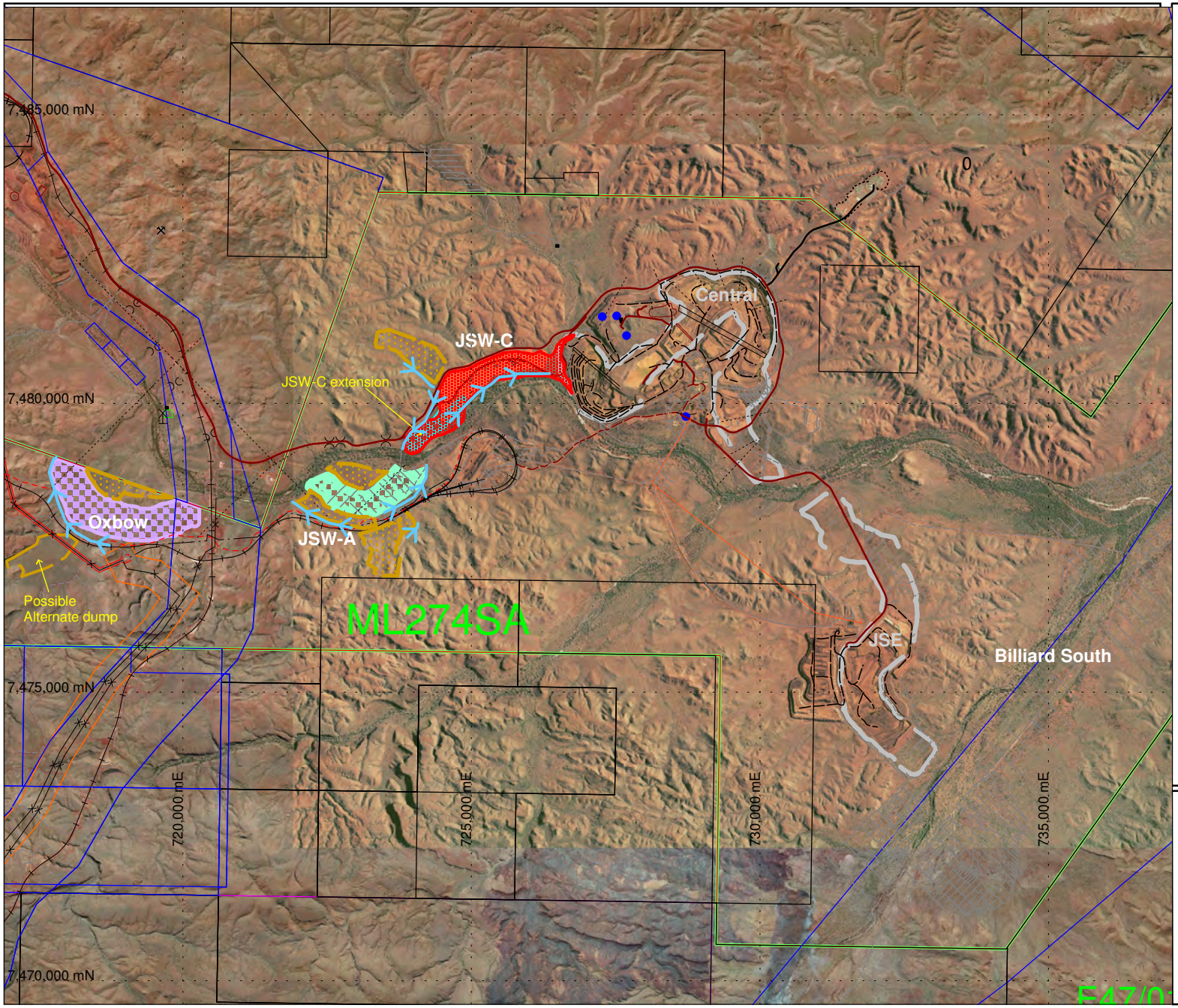
The project will extend the operating life of the overall Yandicoogina operations. It is also expected to increase the mining rate from the overall Yandicoogina operations up to a maximum of 70 Mtpa. Existing ore processing, rail load out and workforce accommodation facilities associated with the JC and JSE mines will be utilised by the project. Existing power, water supply and waste handling facilities will be extended as required to service the new mining areas.

The key characteristics of the proposal are summarised in Table 2-1. Note that this information is subject to ongoing design and feasibility studies, and is therefore indicative only. A final version will be included in the PER document.

Table 2-1 Key characteristics of the JSW and Oxbow iron ore mining proposal

Component	Proposal Characteristics	Detail
General	Project life	Up to 12 years.
	Production rate	52 Mtpa with the capacity to expand to approximately 70 Mtpa (combined total for JC, JSE, JSW and Oxbow operations).
	Ore deposit – channel iron deposit	JSW (excluding Marillana Creek crossing) and Oxbow. Total resource approximately 320 Mt.
	Timing	Construction in 2012, first throughput at JSW in 2013. First throughput at Oxbow in approximately 2017.
Mine and mining	Pits and ore types	Three separate pit areas: JSW-A, JSW-C, and Oxbow. Option of part of JSW-B (which does not cross the creekline).
	Striping ratio (average)	~0.4:1 waste to ore.
	Waste rock disposal	Total waste: 135 Mt. Temporary surface dumps and backfilling pits.
Processing and residue	Residue storage	Existing waste fines cells in the Junction Central pit void. Waste fines cells similar to those existing at JC will be developed at either JC or JSE to support additional wet processing if required.
	Product transport	As per existing Yandi operations i.e. by rail to Dampier Port and Cape Lambert, 300km north-west of Yandicoogina.

Component	Proposal Characteristics	Detail
Dewatering	General dewatering	Dewatering to a RL of 460 mRL at JSW and 470 mRL at Oxbow. Peak dewatering at rates of approximately 14 GL/a, and 8 GL/a are estimated for JSW and Oxbow respectively.
	Water disposal	Options, or combinations thereof, include: • integration (sharing) with other users; • discharge into ephemeral creeks; • dust suppression; and • pllacement into disused mine voids for accelerated post mining groundwater level recovery.
	Plant design	• Ore from JSW and Oxbow hauled back to processing facilities at JC and JSE. • Existing plant at JSE may be expanded to ~24Mtpa and may be modified to a wet process similar to the JC wet process. • Development of new dry crushing and screening plant(s) – either 1 or 2 – to support development of JSW (west) and Oxbow.
Power	Supply and distribution	Power will be sourced from the Hamersley Iron power stations located at Dampier and Paraburdoo (as per existing mines). New mines will be serviced by extensions to the existing on site power distribution network.
Workforce	Workforce	Operational workforce approximately 600 personnel. Construction workforce approximately 700 personnel.



LEGEND

- Conceptual Pit Outline
- Yandi Current Mining Area
- Conceptual Waste Dump
- Conceptual Diversion Drainage
- Roads
- Tracks
- Rail
- Transmission Line

0 2.5 5km

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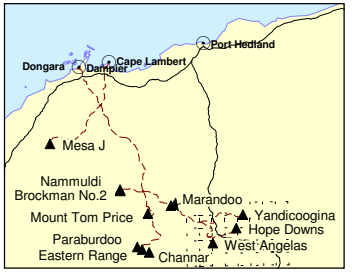
LOCATION MAP



RIO TINTO IRON ORE

Figure 5-3

Yandi JSW & Oxbow Conceptual pit/waste dump disturbance footprint

Drawn: MJB
Date: Dec 2009

Plan No.
Proj:

2.3.2 Ground disturbance

Up to 1,800 ha of new ground disturbance is anticipated based on preliminary mine plans. This will include mine pits, temporary waste dumps and stockpiles, borefields and pipelines, diversion drains, access roads and other ancillary infrastructure.

More accurate determination of the disturbance footprint is dependent on the finalisation of mine plans. Opportunities to minimise disturbance, particularly by using existing infrastructure, will be continuously sought during the planning process. The PER will include a comprehensive description of the proposed disturbance footprint, spatially defined using Geographical Information System (GIS) outputs. GIS data of proposed sample points, monitoring points, discharge points, existing and proposed disturbance footprint areas and conservation values will also be provided to the EPA where available.

2.3.3 Mining

Mining will involve conventional drill, blast, load and haul methods, as currently used at the JC and JSE mines. For ore blending purposes, several mine faces within the same pit will be worked simultaneously.

It is estimated that mining will produce approximately 135 million tonnes of waste rock. This will be used to backfill pits progressively where possible, or temporarily stored in surface waste dumps prior to pit backfilling.

2.3.4 Dewatering and water disposal

Dewatering is required to enable mining, as approximately 95% of the ore occurs below the water table. This will commence approximately 12 months prior to mining activities. Dewatering will be facilitated by vertical bore holes completed in a curtain or cluster arrangement spaced along the length of the CID. Permanent borefields will be placed at the downstream end of mining zones. Sacrificial bores will be located on the upstream margins of the developing pit limits. These will be consumed as the pit advances over time.

Water extracted during the dewatering process will be used for dust control and ore processing. A range of options for managing surplus water will be investigated as a component of the PER including:

- discharge into the Marillana Creek system;
- placement into disused pit voids for storage and seasonal discharge piping water discharge past existing operations;
- piping water to other users;
- reinjection (where technically viable); and
- barrier technology as a mechanism for reducing dewatering requirements.

2.3.5 Ore handling, processing and transport

The majority of the ore from Oxbow and JSW is anticipated to require dry processing. This material will be dry crushed and screened at receival points close to the Oxbow and JSW ore bodies, prior to transport via conveyor, truck or light rail (or a combination of these options) to utilise processing facilities at JC and JSE. The preferred ore transportation solutions will be identified in the PER document.

Ore processing will be integrated with the current Yandicoogina operations. The existing plant capacity, where practicable, will be utilised for the outputs from the JSW and Oxbow mines. Subject to more detailed engineering assessment, there may be a requirement to expand the capacity of the current Yandicoogina operations facilities. In the case of expanded wet processing facilities, this would necessitate additional waste fines disposal into disused pit voids.

Processed ore will be loaded onto trains at the existing train load out system immediately south of the proposed JSW mine. Existing facilities for tertiary crushing, screening and stockpiling adjacent to the train load-out loop may require expansion to support the additional volume.

2.3.6 Water supply

Water will be sourced from groundwater abstracted through mine dewatering process. If additional supply is required, further groundwater resources will be explored and approvals sought.

2.3.7 Power supply

Power supply will be derived from the existing distribution system at Yandicoogina, which is sourced from the Hamersley Iron power stations located in Dampier and Paraburdoo. High voltage take-off facilities were upgraded for the Yandi JSE project and additional infrastructure was installed to connect that power supply to the JSE site and plant. An onsite diesel fired generator at Yandi JC will provide back-up supply.

2.3.8 Workforce and accommodation

Approximately 700 personnel will be required for the construction phase. A temporary camp for up to 700 people for up 3 years will be required during this phase.

The existing operational workforce at the JC and JSE mines will be augmented by up to 140 additional personnel support the new mining operation. The existing accommodation village will be expanded to meet increased fly-in/fly-out workforce requirements.

2.3.9 Timing

Construction activities are proposed to commence in 2012.

Mining in JSW sub-areas A and C will commence in 2013. These deposits are expected to be depleted in approximately 2019 and 2016 respectively.

Mining will commence at Oxbow in approximately 2017. Production at Oxbow will decrease after 2024.

2.3.10 Nearby mining operations

The CID extends to the north and west of the Oxbow deposit, beyond the northern boundary of ML274SA. This area includes active iron ore mines operated by BHPBIO. Hamersley and BHPBIO share the existing access road and aerodrome under agreed arrangements.

The Hope Downs Mine 1, operated under joint venture arrangements between RTIO and Hancock Prospecting, is located approximately 20 km to the south of the RTIO Yandicoogina operations.

Iron Ore Holdings Limited (IOH) has recently been granted mining leases along Phil's Creek, approximately 10 km to the north west of the RTIO Yandicoogina operations. This project involves above water table mining of up to 1.5 Mtpa of iron ore over a project life of 5 years. The ore is proposed to be supplied to RTIO at Yandicoogina under a mine gate sale arrangement.

Brockman Resources Limited (Brockman) has also been granted a mining lease for its Marillana iron ore mining project, located approximately 15 km NNE of the RTIO Yandicoogina operations. This project is expected to include a below water table mining component.

3 Alternative options considered

3.1.1 Alternative mining methods and sequencing

Subject to final assessment and design, the Oxbow deposit may be brought forward to commence prior to the JSW deposit.

The final mining sequence will determine the timing and nature of infrastructure requirements including:

1) Overland conveyor systems to existing plants; and

2) Waste handling conveyor systems.

3.1.2 Alternative deposits

An evaluation of alternative mining deposits was undertaken by Hamersley Iron during an Order of Magnitude Study in 2007. Other deposits considered included Snooker, Meander and Billiard South.

Snooker and Meander are located approximately 20 km to the west of the project area. These deposits require further resource characterisation to enable mining feasibility assessment. The development of these deposits would require the construction of significant new infrastructure to facilitate ore extraction, processing and transport. The deposits are separated from the existing JC and JSE mine sites by the BHP Billiton operation.

The Billiard South deposit is located on the eastern margin of the Weeli Wolli creek, west of the JSE mine (Figure 2-2). The area includes an aquifer reinjection bore field servicing dewatering requirements from existing mines, which has been operated since 2007. Mining of the Billiard South deposit was originally planned to be included in this proposal, but was subsequently excluded for the following reasons:

1) Interaction between mining activities and the Weeli Wolli Creek is not yet fully understood;

2) Impact of dewatering from Hope Downs 1 mine and BHPBIO Yandicoogina has not been determined fully. The section of the Weeli Wolli creek below the Marillana Creek confluence receives disposal water emanating from dewatering at the Yandicoogina operations to the west. Above the confluence, the Weeli Wolli creek receives disposal water from the Hope Downs 1 mine site located approximately 20 km upstream. RTIO considers it appropriate to delay mining at this location until dewatering volumes from existing operations reduce, thereby minimising cumulative discharge impacts to the downstream Weeli Wolli creek system;

3) The reinjection borefield is located within the Billiard South deposit and an assessment and/or implementation of a relocation/replacement/removal bore field will need to be conducted; and

4) Capabilities of processing ore from this deposit are not yet fully understood and a review of processing capabilities at Yandicoogina may lead to an alternative outcome. This will require additional assessment.

3.1.3 No development option

Substantial economic benefits to the State of Western Australia would be foregone if the project was not to proceed because mine output would fall and eventually cease. The synergies with existing mining operations are not easily replicated at other localities in the Pilbara Region.

The existing workforce at Yandicoogina would be reduced prematurely without the development of new iron ore deposits. Opportunities for supporting local communities and infrastructure would also be foregone.

Mining has been occurring in the Yandicoogina locality since BHP commenced operations in 1992. The environmental values of the area have been well characterised. New mining at the JSW and Oxbow deposits will not introduce any new environmental factors or impact on high value environmental assets. The impacts of developing these new mines can be managed with appropriate environmental controls.

4 Applicable legislation

Key State and Commonwealth legislative and regulatory requirements relevant to the proposal are described in Table 4-1. The proposal will be referred to the Commonwealth Department of the Environment, Water, Heritage and the Arts under the *Environment Protection and Biodiversity Conservation Act 1999*; however it is anticipated that the proposal will not constitute a controlled action under this Act.

Table 4-1 Applicable Legislation and Regulations

Legislation	Description of key aspects[2]
State Government	
Aboriginal Heritage Act 1972	s.18 approval to disturb Aboriginal heritage sites that cannot be avoided.
Agricultural and Related Resources Protection Act 1976	Provisions for the control of declared plants and declared animals by land managers
Bush Fires Act 1954	Under s.27A of the Act, regulation of blasting and matters likely to cause bush fire danger.
Contaminated Sites Act 2003	Reporting and remediation of contaminated sites.
Dangerous Goods Safety Act 2004	Storage and use of explosives and other hazardous materials.
Environmental Protection Act 1986	Part IV approval of proposal. Part V Works Approval and Licensing for various proposal elements. Clearing of Native Vegetation Regulations 2004, Unauthorised Discharge Regulations 2004 and Controlled Waste Regulations 2007.
Health Act 1911	Construction and operation of wastewater treatment systems.
Iron Ore (Yandicoogina) Agreement Act 1996	Conditions relating to the establishment and operation of iron ore mining at Yandicoogina.
Land Administration Act 1997	Provides the legal framework for land access and land use activities on Crown land.
Main Roads Act 1930	Control of access areas – s.28A.
Mining Act 1978	Division 3 – Mining lease. Mining Regulations 1981.
Mines Safety and Inspection Act 1994	Obligations relating to the safety and welfare of the mine workforce. Mines Safety and Inspection Amendment Regulations 2009.
Occupational Safety and Health Act 1984	Part III of the Act sets out the duty of care requirements for employers and employees. Occupational Safety and Health Regulations 1996.
Rail Safety Act 1998	Owners and operators of railway must be accredited and comply with rail safety standards.
Rights in Water and Irrigation Act 1914	Licences required for taking or diverting of water in proclaimed areas. Permits required for infrastructure crossing watercourses and diversion of watercourses. Rights in Water and Irrigation Regulations 2000.
Wildlife Conservation Act 1950	Approval is required to take or disturb declared rare plants or animals which cannot be avoided.
Commonwealth Government	
Environment Protection and Biodiversity Conservation Act 1999	If the proposal is considered to be a "controlled action" under the EPBC Act, the approval of the Federal Minister for the Environmental will be required in accordance with the Commonwealth EPBC Act assessment process.
Native Title Act 1993	Consultative processes required with Native Title claimants.

[2] Including associated regulations

5 Regional setting

5.1 Land use

5.1.1 Regional land use context

Yandicoogina lies within the Shire of East Pilbara. The main Pilbara regional centres are Newman, Tom Price, Paraburdoo, Roebourne, Karratha and Port Hedland. Newman (population ~4500) is the nearest population centre to the project area, located approximately 90 km to the south east.

The principal land use in the region is pastoral grazing. Hamersley's Yandicoogina Mine is situated on the Marillana Station pastoral lease, held by a BHPBIO subsidiary. Other regional land uses include the traditional use of land by Aboriginal groups, tourism, conservation and other mining operations.

5.1.2 Local land use context

The JSW deposit is located immediately north of the existing rail load-out facility and train line. The Marillana creek crosses JSW sub-area B (Figure 5-1) and separates sub-area C from the rail load-out facility. The Hamersley railway line and power transmission corridor bounds the southern perimeter of sub-area A.

The Oxbow deposit is bounded by the Hamersley railway line to the south and the boundary of ML274SA to the north. It is separated from the rail load-out facility by the BHPBIO railway line and power transmission corridor, which is aligned north-south in this section.

Both areas receives run-off from hills on the southern side of the railway (Figure 5-1).

5.1.3 Conservation areas

The nearest major conservation reserves to the Yandicoogina locality include:

- Karijini National Park which lies approximately 70 km west of the project area; and
- Millstream-Chichester National park which lies approximately 190 km northwest of the project area.

The Weeli Wolli creek ultimately drains into the Fortescue Marsh, which is located approximately 40 km north of the project area. This area has been nominated for listing as a wetland of international importance under the RAMSAR convention.

DEC has identified the Fortescue Marsh on the Fortescue River, east of Mulga Downs on Marillana and Roy Hill Stations as a Priority Ecological Community (PEC Priority 1). The Weeli Wolli Spring riparian woodland and forest associations have also been identified as a PEC (Priority 1). PEC's are poorly understood ecological communities, which potentially have high conservation values and may be subject to threatening processes. They are classified as either priority 1, 2 or 3; ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities.

JSW sub-area A from southern boundary (rail line access road in foreground)

The Marillana Creek in JSW sub-area B

Oxbow area from near the western end looking South East, showing hills to the south (beyond railway line)

Figure 5-1 Images of the landscape near the JSW and Oxbow deposits (October 29, 2009)

5.2 Climate

The central Pilbara region experiences a semi-arid to arid climate. It is characterised by hot humid summers and relatively cooler, drier winters. Site records indicate that mean monthly temperatures typically exceed a maximum of 30^0C in December/January and reduce to a minimum of 16^0C in June/July.

Long term mean annual rainfall at the Yandicoogina locality is approximately 400 mm. However rainfall can vary substantially between years and over longer timescales. Recent rainfall has averaged more than 470 mm in the period 1999 to 2008. Annual potential evaporation is estimated to be 3,200 to 3,600 mm, well in excess of annual rainfall.

The high variability in annual rainfall is largely a consequence of cyclonic and thunderstorm activity. Cyclonic rainfall can cause transient high volume runoff events. Site rainfall records for the period 2005 to 2007 provide an example of this (Figure 5-2). During this period, monthly rainfall ranged from 0 mm to over 180 mm in January and February 2006.

Easterly winds are prevalent throughout the year, with generally higher wind speeds in the summer months.

5.3 Geology

The CID has formed in a channel eroded into bedrock of shale, dolerite and banded iron formation of the Weeli Wooli Formation which overlies the Brockman Iron Formation. The regional bedrock forms part of the broad easterly-trending Yandicoogina syncline. The syncline is bounded by the Lower Proterozoic Brockman Formation, which forms the scarp of the Hamersley range to the north.

The CID infills the paleochannels of the ancestral equivalents of the Marillana and Yandicoogina Creek systems and was deposited during the Tertiary period some sixty five million years ago. The project deposits are approximately 300 to 500 m wide and 45 to 50 m thick. The CID is mostly below the watertable and is overlain with unconsolidated alluvium/|colluvium comprising banded iron formation (BIF), chert, shale, minor dolerite and occasional CID clasts in a red-brown sandy to clay rich matrix. Alluvial cover varies in thickness from a thin veneer a few centimetres thick to 20 m or more across recent drainage lines, which in places have removed a significant thickness of the upper CID sequence.

The CID material is comprised of concentric rings of limonite and vitreous goethite around nuclei of hematite, goethite, turgite and iron oxide replaced wood which accumulated or formed in pre-existing river channels. Clay minerals typically occur in voids, fractures and other structures in the CID. Kaolinite is the dominant clay species.

5.4 Landscape

5.4.1 Biogeographical regions

The project area is within the Fortescue Botanical District of the Eremaean Botanical Province as defined by Beard (1975) and is located near the boundary of the Hamersley and Fortescue sub-regions of the Pilbara biogeographic region as defined by the Interim Biogeographic Regionalisation for Australia (IBRA) (Environment Australia, 2000). The majority of the project area is typical of the Hamersley sub-region and the major creek system forming part of the Fortescue sub-region. Table 5-1 describes the IBRA sub-regions. The bioregions and sub-regions are the reporting unit for assessing the status of native ecosystems, their protection in the national reserve system and for use in the monitoring and evaluation framework in the Australian Government's current Natural Resource Management initiatives.

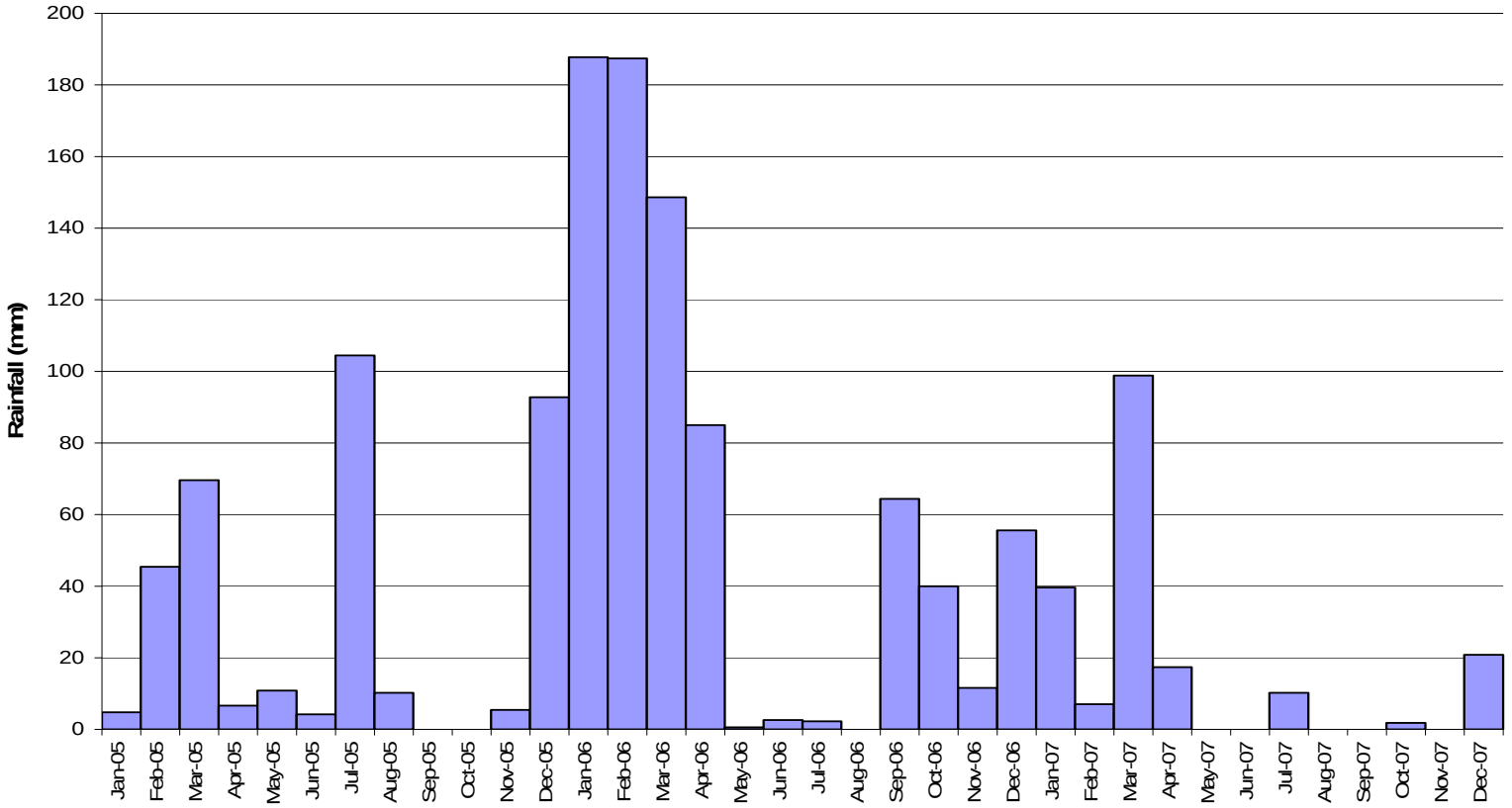


Figure 5-2 Monthly rainfall recorded at the Hamersley Iron Yandicoogina weather station in the period 2005 to 2007

Table 5-1 Description of the Hamersley and Fortescue sub-regions of the Pilbara Biogeographic Region

Pilbara Sub-region	Description
Hamersley	Mountainous area of Proterozoic ranges and plateaus of mulga woodland of bunch grasses on fine textured soils and snappy gum over *Triodia brizoides* on skeletal soils.
Fortescue Plains	Alluvial plains and river frontages, salt marsh, mulga bunch grass and short grass communities on alluvial plains. River Gum woodlands fringe drainage lines. Northern limit of mulga.

(Source: Environment Australia, 2000)

5.4.2 Major landforms

The CID lies in the central part of a broad, east-trending drainage basin with the Hamersley range to the North and an un-named range to the South. Surface gradients are around 1.5 m per km down the axis of the basin, and these are similar to the average gradient of the base of the CID.

The surface topography has been shaped by alluvial processes with the existing streams winding between low lying mesas and hills. Three major landforms can be distinguished:

- Low stony hills: These areas generally consist of hills, ridges and breakaways supporting a scattered overstorey of small trees (*Eucalyptus* and *Acacia* species) over moderately dense Spinifex (*Triodia* species) hummock grassland;
- Valleys: These areas consist of low stony plains in valleys supporting scattered overstorey of small trees (*Eucalyptus* and *Acacia* species) over sparse mixed shrubs and Spinifex (*Triodia* species). Alluvial flats are dominated by *Acacia* shrub lands with a moderately rich understorey of shrubs, herbs and tussock grasses; and
- Drainage lines: These areas vary from small gullies in upper hills to more major creeklines. Minor drainage lines differ very little from the vegetation type surrounding them and are usually species poor. Major creeklines comprise support *Eucalyptus* dominated woodlands and open forest over a mixed understorey of shrubs and grasses.

5.4.3 Land systems

The Pilbara region has been surveyed by the Western Australian Department of Agriculture and Food (DAFWA), for the purposes of land classification, mapping and resource evaluation. The region consists of 102 land systems; discernable on the basis of topography, geology, soils and vegetation (Van Vreeswyk *et al.* 2004).

The project area coincides with the Boolgeeda, McKay, Newman, Robe and River land systems (Table 5-2). The River land system includes the major drainage lines (Marillana, Yandicoogina and Weeli Wolli creeks).

Table 5-2 Land systems occurring within the Project area

Land System	Description
Boolgeeda	Stony lower slopes and plains derived from quaternary colluvium and situated below the surrounding hill systems. Major soil types include red loamy earths and red shallow loams. The vegetation is characterised by hard and soft spinifex grasslands and scattered mulga (*Acacia aneura*) shrublands. This land system is broadly distributed in the central and southern project area, on plains fringing the major drainage lines. It includes large areas of the CID deposits.
McKay	Hills, ridges, plateaux remnants and breakaways of meta-sedimentary and sedimentary rocks. Major soil types include stony soils and red shallow loams. The vegetation is characterised by hard spinifex grasslands with isolated trees and shrubs. This land system dominates the low hills of the project area.
Newman	Rugged jaspilite plateaux, ridges and mountains of varied geological origin. Major soil types include stony soils and red shallow loams. The vegetation is characterised by hard spinifex grasslands with isolated trees and shrubs. This land system is removed from the major creeklines and CID deposits and is unlikely to be included in the project disturbance footprint.
River	Major river channels and active flood plains formed from quaternary alluvium. Major soil types include red sands, loams and clays of varying depth. The vegetation is characterised by a mixture of hummock grasslands, shrublands and woodlands; including riverine fringing vegetation. This land system comprises much of the Marillana, Yandicoogina and Weeli Wolli creek systems.
Robe	Low mesas and buttes derived from tertiary pisolitic limonite and laterite. Major soil types include stony soils, shallow gravels and loams. The vegetation is characterised by hard and soft spinifex grasslands with isolated trees and shrubs. Within the project area, this land system has a limited distribution south west and south east of the intersection of the Marillana and Yandicoogina creek systems.

5.5 Vegetation and flora

The vegetation of the project area is typical of the central Pilbara. It includes the following broad vegetation types related to topography:

1. Low stony hills. a scattered overstorey of *Eucalyptus* and *Acacia* species over moderately dense Spinifex;
2. Undulating low stony plains in the valleys (Mosaic communities): Eucalypts over sparse mixed shrubs and Spinifex. Alluvial flats are dominated by *Acacia* communities over a moderately rich understorey of shrubs, herbs and tussock grasses; and
3. Minor drainage lines in the upper landscape: similar to (1).
4. Major creeklines: woodlands and open forests of *Eucalyptus camaldulensis, E. victrix* and other tree species over mixed understorey of shrubs and grasslands.

Discharges into Marillana Creek system from dewatering at BHPBIO and Hamersley operations have maintained artificially high water levels in the alluvials, which has resulted in some changes in the composition of creek vegetation along sections of the creeks due to the increased water availability. Phreatophytic vegetation, especially young saplings of the river-dwelling trees, have increased greatly in density around these areas.

5.5.1 Completed surveys

Numerous flora surveys have been completed in the Yandicoogina locality, in association with previous mining approvals and in advance of drilling programmes or construction projects. These surveys have included a broad survey of the Yandicoogina area (Mattiske Consulting, 1995) and subsequent targeted surveys for declared rare and priority flora (i.e. Biota 2002, 2003 and 2004a). The vegetation in the Yandicoogina locality is dominated by the following plant families:

- *Poaceae* (grasses);
- *Malvaceae* (hibiscus);
- *Mimosaceae* (wattles);
- *Papillonaceae* (peas);
- *Asteraceae* (daisy's); and
- *Amaranthaceae* (Mulla-mulla).

Mattiske Consulting (1995), in a vegetation survey associated with the development of the JC deposit, identified that many of the vegetation communities in the Yandicoogina locality had been influenced by past activities and events such as grazing and fire. These factors have acted to restrict certain components of those communities: for example grazing by introduced animals has led to the selective removal or reduction of some palatable understorey species along the main drainage lines and on the flats. Grazing impacts from cattle have been continuous for several decades on Marillana Station.

A more recent survey by Biota (2004a), associated with the expansion of mining to JSE deposit, reported that the upland vegetation in the Yandicoogina locality was generally in very good to excellent condition. The vegetation condition of the Yandicoogina Creek was surveyed to be in excellent condition west of the junction with Marillana Creek, and in moderately good condition for the remainder, with several weed species present but at very low densities. The vegetation of the section of the Weeli Wolli Creek within the Junction South East deposit area was considered to be seriously degraded, with almost total cover of the weed species *Cenchrus ciliaris* (Buffel grass) in the understorey.

The only Declared Rare Flora species currently recorded in the Yandicoogina locality is *Lepidium catapycnon*. This species is listed as DRF under WA legislation and Vulnerable under the Commonwealth EPBC Act. One specimen has been detected within a recently burnt out area on the foothills of the Oxbow area and is approximately 30 cm tall. The location is outside of the Oxbow pit footprint but within the unamended proposed footprint of disturbance.

A number of priority flora listed under the *Wildlife Act 1950* have also been recorded in the Yandicoogina locality (Table 5-3). Most of these species are associated with major creekline vegetation communities and are expected to have a low probability of occurring elsewhere in the project area.

5.5.2 Surveys in progress

Additional vegetation and flora surveys of the JSW and Oxbow locations have been completed by Biota Environmental Sciences during 2008 and 2009. The results of these surveys are currently being documented and will inform the PER.

Table 5-3 Priority Flora Identified in the Previous Surveys

Species	Status	Description
Olearia fluvialis	Priority 2	Perennial, low-shrub that appears to be quite uncommon, rather than rare, and is restricted to sporadic populations in creek habitats.
Sida sp. Barlee Range (S van Leeuwen 1642*)*	Priority 3	Low shrub recorded from a single site on the bank of Yandicoogina Creek
Themeda sp. *Hamersley Station (M.E. Trudgen 11431)*	Priority 3	Perennial tussock grass and, although only recorded from one site in the Yandi JSE area, has been recorded from other sites within the region.

(Source: Hamersley 2003, Strategen 2005)

5.5.3 Weeds

A number of weed species have been identified within the project area and wider Yandicoogina locality, based on recently completed surveys. These include:

- *Acetosa vesicaria* (Ruby Dock);
- *Argemone ochroleuca* subsp*. ochroleuca* (Mexican Poppy);
- *Bidens bipinnata* (Bipinnate Beggartick);
- *Cenchrus ciliaris* (Buffel Grass);
- *Citrullus colocynthis* (Colocynth);
- *Conzya bonariensis* (Flaxleaf Fleabane);
- *Malvastrum americanum* (Spiked Malvastrum);
- *Portulaca oleracea* (Purslane);
- *Setaria verticillato* (Whorled Pigeon Grass);
- *Sigesbeckia orientalis* (Indian Weed);
- *Sisymbrium orientale* (Indian Hedge Mustard);
- *Solanum nigrum* (Black Berry Nightshade); and
- *Vachellia farnesiana* (Mimosa Bush).

The recorded weed species generally occurred infrequently, with the exception of a number of Ruby Dock and Buffel Grass infestations associated with creeklines and areas disturbed by historical mining. Most of these species are widespread in the Pilbara region. None are Declared Plants under the *Agriculture and Related Resource Protection Act 1976* in the Yandicoogina locality. However Ruby Dock and Buffel Grass are regarded as invasive weed species. Ruby Dock was identified as a species with significance in a recent Yandicoogina operations inspection by Department of Mines and Petroleum (DMP) officers (DMP 2009 Yandicoogina AER Inspection – E0064/200502, October 2009).

5.6 Fauna

The major fauna habitats identified within the project area correspond with the three main vegetation groups outlined in Section 5.5.

5.6.1 Terrestrial fauna

An extensive amount of biological survey work has been undertaken in the Yandicoogina locality, largely in connection with historical CID mining (i.e. Ninox Consulting 1995, Biota 2004b). A review of this work is provided in Biota (2004b), which includes the statement that "*the region is one of the best collected in the State in terms of herpetofauna and mammals*".

A number of species with conservation significance have been detected in these surveys (Table 5-4). Previous studies have concluded that:

- no species limited to the surveyed areas or the wider Yandicoogina locality were recorded or expected to occur; and
- species with conservation significance which utilise, or have potential to utilise, the project area are unlikely to be significantly impacted by the project due to their widespread distribution, mobility and known occurrence well beyond the Yandicoogina locality.

Table 5-4 Species with conservation significance recorded near the project area

Species	State Level	Federal Level	Distribution
***Liasis olvaceus barroni* (Pilbara Olive Python)**	Schedule 1	Vulnerable	Regarded as a Pilbara endemic. Its known distribution coincides roughly with the Pilbara bioregion
***Dasyurus hallucatus* (Northern Quoll)**	Schedule 1	Endangered	Northern Australia including the Kimberley and Pilbara regions, Northern Territory and Queensland
***Falco peregrinus* (Peregrin Falcon)**	Schedule 4	-	Has an almost cosmopolitan distribution and is widespread throughout mainland Australia and Tasmania
***Ardeotis australis* (Australian Bustard)**	Priority 4	-	Occurs over much of WA with the exception of the more heavily wooded southern portions of the state. Its wider distribution includes eastern Australia and New Guinea
***Burhinus grallarius* (Bush Stonecurlew)**	Priority 4	-	Widespread in Australia and New Guinea. Remains common in tropical Australia but has declined in temperate Australia and has disappeared from many regions. Populations are apparently secure in the Pilbara
***Neochmia ruficauda subclarescens* (Star Finch)**	Priority 4	-	Endemic to Australia where it occurs from the Pilbara to south-eastern Australia. It is most common in the tropics
***Pseudomys chapmani* (Western Pebble-mound Mouse)**	Priority 4	-	Common to very common in suitable habitat with the Hamersley and Chichester sub-regions

5.6.2 Subterranean Fauna

Stygofauna includes obligate, groundwater dwelling aquatic fauna. Species of stygofauna have the potential to have very restricted distributions based on evolutionary history and specialised habitat requirements.

Stygofauna surveys have been undertaken as part of the assessment of potential biodiversity impacts for the JC and JSE projects (see for example Biota 2005). Field stygofauna collections had already been completed in the Yandi area as part of Hamersley Iron's ongoing stygofauna research programme since November 2003 and further work was completed in 2005 as part of the JSE project Environmental Protection Statement (EPS). The results of the 2005 survey indicated that almost all taxa recorded from the areas to be affected by groundwater drawdown occur elsewhere in the locality. The following stygal species have been identified within the existing Yandicoogina operational area and are likely to be found in the project area:

- Ostracoda
  - *Pilbaracandona sp.*
  - *Meridiescandona sp.*
  - *Gomphodella sp*.
- Copepoda
  - *Mesocyclops darwini.*
- Amphipoda
  - *Chydaekata sp.*
  - *Paramelitidae sp. 2.*
- Isopoda
  - *Pygolabis sp. 3.*
  - *Pygolabis sp. 1.*

Troglofauna includes obligate, subterranean dwelling fauna occurring above the water table. Species of troglofauna have the potential to have very restricted distributions based on evolutionary history and specialised habitat requirements

Historical surveys associated with earlier mining approvals did not target troglofauna, however more recent surveys have included a troglofauna sampling component. The proposed ore body to be mined is below the water table in an area that is regularly inundated with high stream-flow events following heavy rain or cyclonic activity (Figure 5-3). The water table is approximately 10 m below surface. As such troglofauna habitat is considered to be restricted.

5.6.3 Surveys in progress

Terrestrial fauna and subterranean fauna surveys of the JSW and Oxbow locations have been completed by Biota Environmental Sciences during 2008 and 2009. A targeted Northern Quoll survey was also conducted within the proposal area in late 2009. This survey did not identify the presence of Northern Quolls.

The results of these surveys are currently being documented. These will be included in the PER and inform the development impact management controls.

5.7 Surface Water

The JSW deposit is crossed by the Marillana Creek, immediately upstream of the existing JC mine site. Phil's creek is a tributary of Marillana Creek, which it joins from the north near the western end of the JC pit. The Oxbow deposit is located to the southwest of the Marillana Creek where it enters the RTIO Yandicoogina mining lease area.

The Marillana Creek feeds into Weeli Wolli Creek, which ultimately discharges into the Fortescue Marsh some 40 km to the north of Yandicoogina. The Fortescue Marsh comprises the more or less contiguous floodplain (lakes, marshes, pools) in the middle reaches of the Fortescue River (Department of Water, Environment, Heritage and the Arts, 2009).

Marillana and Weeli Wolli Creeks are both ephemeral and have a catchment areas of 2 250 km^2 and 1 750 km^2 respectively, above their confluence. Streamflow is completely dependent on rainfall and in normal circumstances the creeks are dry for most of the year, except for major pools. Large stream flows are generally associated with rain bearing depressions or high intensity cyclonic rainfall that brings heavy rain over a large area of the catchments. Flow to peak occurs within 24 hours; however flow recession is such that minor stream flow can continue for days after the peak has passed.

Within the project area there is also a dense network of minor drainage lines, formed by erosion from high intensity rainfall over the sparse vegetation cover and shallow soils. As such there is little sheet flow drainage.

Prolonged discharge of dewatering output into the Marillana Creek has caused sections of the creek downstream from existing operations (Hamersley Iron and BHPBIO) to retain water for much more of the year than normal. Sections of Weeli Wolli creek are similarly impacted, principally from Hope Downs 1 dewatering disposal. This water eventually infiltrates into the creek bed alluvium downstream of the Marillana Creek and Weeli Wolli Creek confluence. The extent of the wetting front will be assessed in detail in the PER document. Water quality of the dewatering discharges is monitored by Pilbara Iron on a quarterly basis. Concentration of total dissolved solids ranges from 400 to 550 mgL^{-1} and the pH ranges from 6.8 to 7.1.

5.8 Groundwater

The Yandicoogina Iron Ore deposits infill the dissected paleo-river valley of Marillana-Yandicoogina creek system, also called channel iron deposit (CID). The main CID extends some 80 km in northwest south-easterly direction and is located adjacent to the current alignment of Marillana Creek (Figure 5-3). The CID is approximately 300 to 500 m wide and bounded at depth by relatively less permeable basement rocks of the Weeli Wolli Formation. It is characterised by a relatively high water yield that is associated with secondary porosity. The CID is flanked by alluvium and unconsolidated materials which are also relatively transmissive. Extending further, the overall aquifer system is bounded by less transmissive parent rock materials.

The CID generally comprises coarse sand to granule sized placer deposits that have subsequently been cemented in goethite matrix. The porosity of the original sediments has largely been infilled by the goethite cementation and the primary porosity is now in solution features such as vugs and cavities, with the secondary porosity coming from extensive fracturing. An outline of the typical hydrological units in the project area is provided in Table 5-5.

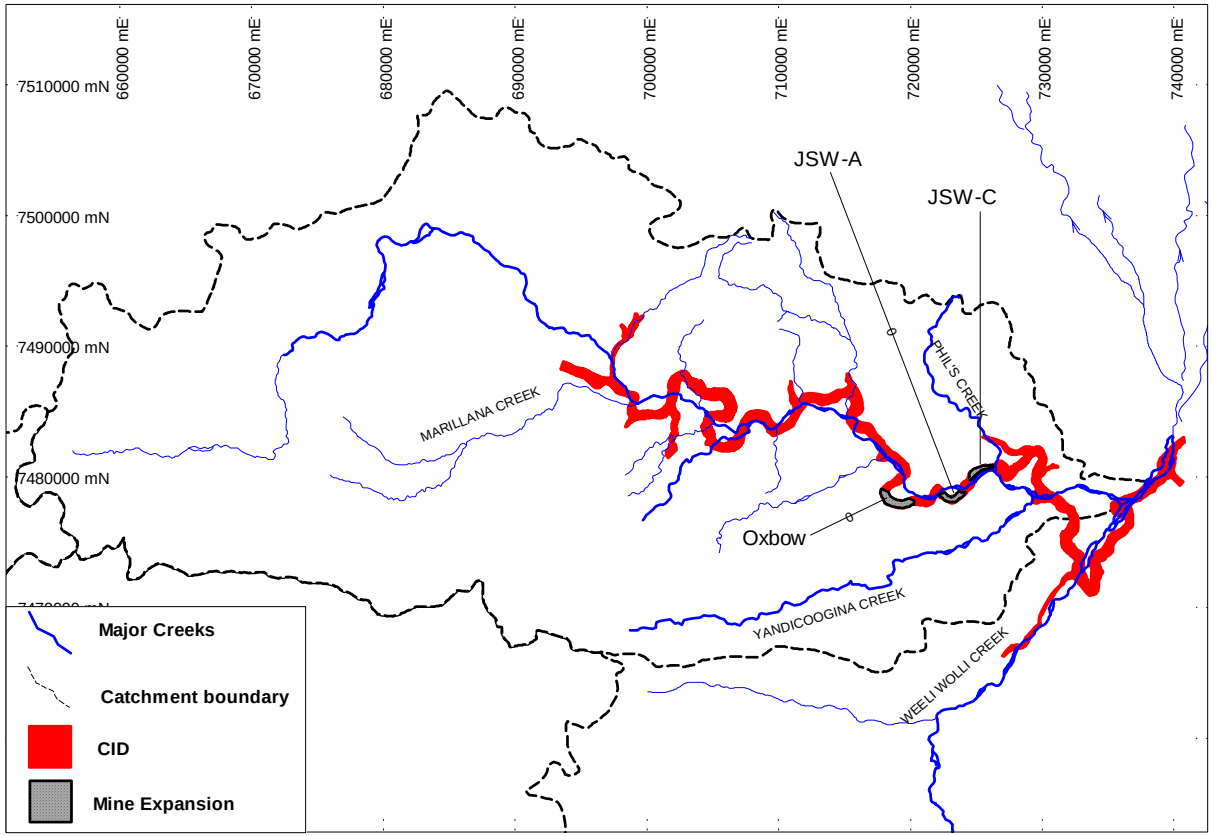


Figure 5-3 Location of the CID ore Body and Proposed Expansion Mining

Table 5-5 Description of the hydrological units in the project area

Hydrological unit	Geology	Description
1.	Recent alluvial deposits and the Eastern Clay conglomerate	Largely unsaturated with localised perched water tables. This unit occupies the upper 15 m of the channel profile. The alluvial aquifers associated with creeks are included in this unit
2.	Upper Weathered CID	This unit contains the main ore zone and is largely unsaturated. The unit has an average porosity of around 25%, however the effective porosity is significantly less as not all the void spaces are interconnected
3.	Limonite-goethite clay	This unit has large clay filled or open cavities that yield high volumes of water. The unit is not continuous throughout the CID. The underlying unit is a basal clay conglomerate unit that may have local limited secondary permeability
4.	Banded Iron Formation (Weeli Wolli Formation)	Permeability is generally low, with some minor permeability resulting from fracturing. This unit is considered the hydrological basement.

(Source of information: Strategen 2005)

The CID is recharged by direct rainfall, and seepage from surrounding alluvium and basement materials. The Marillana Creek that drains the catchment overlies the CID aquifer at RTIO Yandicoogina mine site in several areas (Figure 5-3), and is also considered a major source of recharge to the CID aquifer. The discharge from CID occurs through evapotranspiration by phreatophytic vegetation in the Creek alluvium and by through flow to the southeast (Strategen, 2005).

Stream flow in the Marillana Creek normally occurs only after heavy rainfall events. However, the discharge of surplus water from BHPBIO Yandi mine operations since 1992 and RTIO Yandicoogina mine operations since 1998 directly into the Marillana Creek have resulted in continuous stream flow and saturated bank storage. The increased discharge rates and continuous creek flow have resulted in significant leakage into the CID aquifer.

Based on the information obtained from recent drilling and test pumping, the conceptual model for the groundwater flow system underlying the flood plains of Marillana Creek has recently been updated. The new conceptual model comprises a CID that is surrounded by relatively transmissive alluvium/in situ weathered material that is in direct connection with the CID. The river gravel underlying Marillana Creek and overlying the alluvium contributes a significant volume of water to the CID aquifer. The new conceptual outline of the flood plain of Marillana creek is shown in Figure 5-4. The combined width of the CID and alluvium aquifers range from ~1000 to ~2000 m. The maximum depth is 110 m in the middle of the CID channel diminishing towards the flanks of the flood plain (Kirkpatrick & Dogramaci, 2009).

The updated model has important implications for the dewatering of proposed and existing pits at JSW, Oxbow and JSE. The direct contribution of Marillana Creek surface water to the CID and the relatively large storage capacity of the alluvium surrounding CID mean that drawdown in the CID aquifer during dewatering results in considerable leakage from the saturated alluvium and creek bed. The prediction of the dewatering volume to achieve dry mining conditions at JSW and Oxbow will be accomplished by using the updated conceptual model of the flood plain to carry out groundwater numerical modelling for the whole RTIO Yandicoogina mining area.

Groundwater in the CID is fresh with salinities ranging from 150 to 600 mgL^{-1}. The water meets drinking water standards for inorganic chemicals. The BHPBIO Yandi mine, ~12 km upstream from the JC mine, operates a similar open cut mining operation with dewatering discharge to Marillana Creek. This discharge saturates the creek alluvium and CID between BHPBIO and Yandicoogina (Strategen, 2005).

5.9 Aboriginal heritage

The Bunjima, Nyiyaparli and Innawonga language groups lodged a native title claim over the Yandicoogina area in June 1996. The claim is managed by the Pilbara Native Title Service.

In March 1997, Hamersley Iron entered into the Yandicoogina Land Use Agreement (YLUA) with the Aboriginal parties which facilitated the granting of tenure for the Yandicoogina Project. The agreement provides benefits to the Aboriginal parties over 20 years for education, training, employment, business and community development. The YLUA is jointly managed by Gumala Aboriginal Corporation (GAC) and Hamersley Iron.

5.9.1 Archaeological and ethnographic sites

Extensive archaeological and ethnographic surveys have been undertaken within the Yandicoogina locality (e.g., Quatermaine 1993, 1995, 1996; Hammond 1997; Archae-Aus 2001, 2003; O'Conner and Brunton 1995; MacDonald 2003; Day 2004). These surveys identified numerous Aboriginal heritage sites. These sites comprise mostly of artefact scatters, scarred trees and rock shelters ranging from low to high archaeological significance. There is one possible grave site which was identified within the Yandicoogina JSE project area. Subsequent investigation by ground penetrating radar (GPR) survey confirmed an anomalous area of earth but could not unequivocally confirm the existence of the burial.

There have been a number of ethnographic sites identified within the Yandicoogina area, most significantly Weeli-Wolli Creek and Marillana Creek. Significant creeks within the area have also been identified as having important associations with camping, ceremonies and cultural activities. A heritage exclusion zone has been identified around Weeli-Wolli Creek, Marillana Creek and Phil's Creek. The Native Title claimants have requested that no ground disturbance work be undertaken in the creeks without prior discussion and agreement.

5.10 European heritage

No sites of European heritage significance are known to occur within the Yandicoogina locality or immediate surrounds.

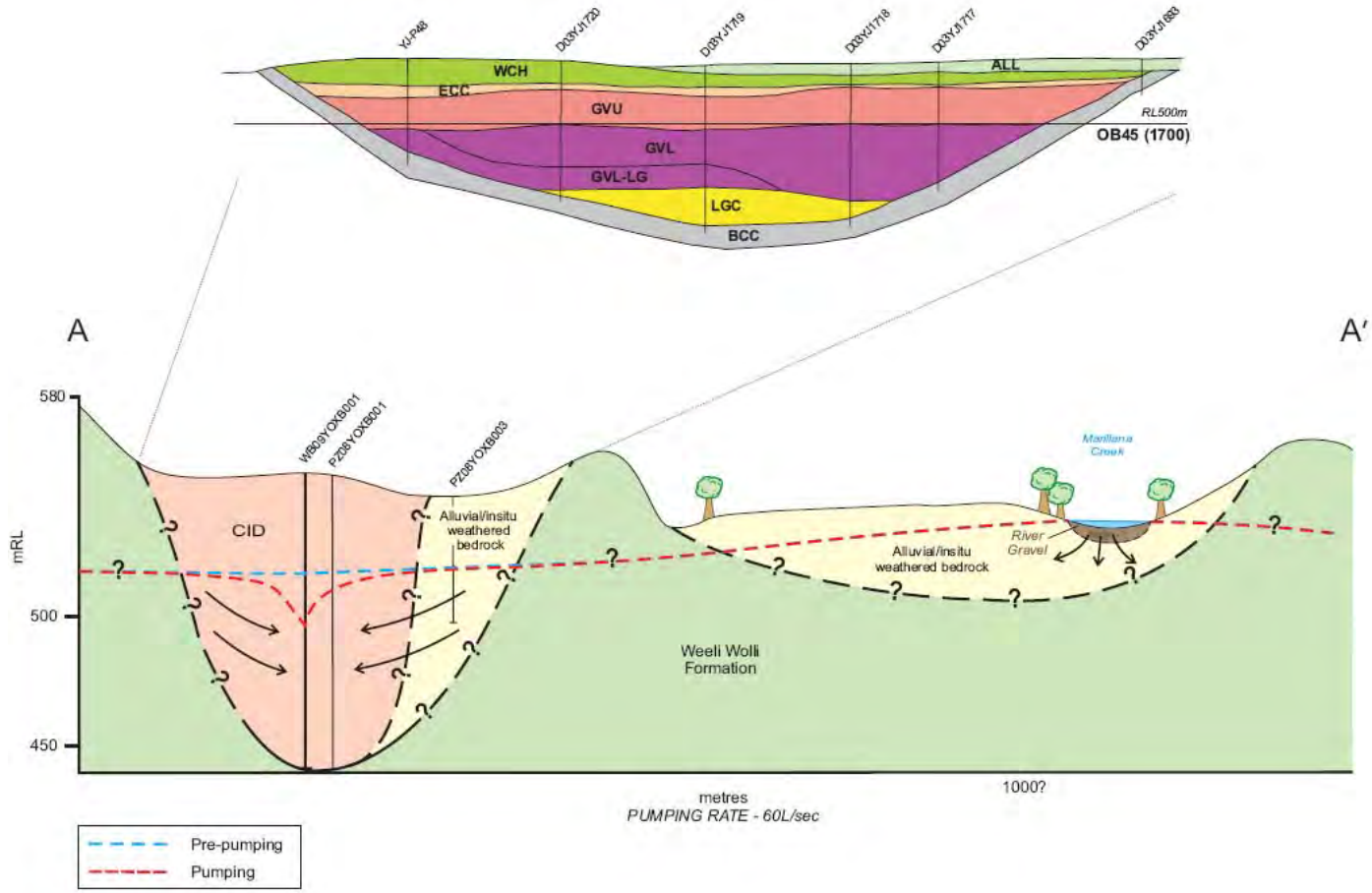


Figure 5-4 **The updated conceptual model for the CID aquifer, showing the relative extent of the surrounding transmissive alluvium/in situ weathered bed rock material in the flood plain**

6 Assessment of environmental factors

6.1 Flora and vegetation

The EPA environmental objective for flora is to maintain the abundance, diversity, geographic distribution and productivity of flora at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.

Vegetation clearing has the potential to cause loss of conservation significant species and important vegetation communities in the major creeklines. Mining activities could result in the introduction and spread of weeds. There is also the potential for altered fire regimes to affect vegetation structure and composition. Uncontrolled dust emissions could result in localised vegetation smothering.

Dewatering and surplus water discharge will affect phreatophytic vegetation along sections of the Marillana Creek. Cones of depression created by dewatering are known to cause drought stress in affected trees. Vegetation in the Marillana creek section adjacent to the JSW deposit will be highly exposed to water drawdown impacts. Surplus water discharge can result in altered species composition in the creeklines, and induce an artificial reliance of affected vegetation on disposal water. These issues require consideration in the context of impacts from historical and current mining activities.

6.2 Fauna

The EPA environmental objective for fauna is to maintain the abundance, diversity, geographic distribution and productivity of fauna at species and ecosystem levels through the avoidance or management of adverse impacts and improvement of knowledge.

The project has the potential to impact upon fauna (including subterranean fauna) via the death or displacement of individual animals from dewatering activities, vegetation clearing and spills/leaks. Other impacts include the possible obstruction of fauna movements due to increased presence of human activity and disruption to nesting and roosting habits from dust, noise and light emissions.

6.3 Surface water

The EPA environmental objective for surface water is to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

Surface water drainage systems will be locally modified to divert flows around mine pits and infrastructure. This may include a realignment of Phils Creek if the JSW Area C pit is extended to join the existing JC pit. Inappropriately designed structures could create an erosion hazard or permanently truncate flow to Marillana Creek.

There are six surface water discharge structures currently used for the disposal of surplus water from the JC and JSE operations into the Marillana Creek. It is anticipated that these structures will be used for the disposal of additional mine pit dewatering water generated by the project, unless a more optimal configuration is identified (as informed by hydrological modelling). This subject will be addressed in project water management planning (to be included in the PER document).

The vegetation of the creek systems at Yandicoogina is adapted to infrequent, ephemeral flow following large storm events. These flow events are orders of magnitude larger than mine water disposal volumes. Modifying this regime due to continual water discharge can alter the health and composition of the creek system vegetation. The Marillana Creek and Weeli Wolli Creek sections downstream of the JSW deposit have been receiving discharge water from BHPBIO dewatering operations since the early 1990's, and additional discharges from the Hope Downs 1, JC and JSE mines more recently. New surface water discharge resulting from the project could extend and/or prolong the extent of this impact.

The PER document will identify and assess potential impacts to the aquifer reinjection facility resulting from the project, within the context of developing an overall water management plan for the current and proposed Yandicoogina operations.

Unmanaged waste disposal, spills/leaks and run off from mine infrastructure areas could result in surface water contamination.

6.4 Groundwater

The EPA environmental objective for groundwater is to maintain the quantity of water so that existing and potential environmental values, including ecosystem maintenance, are protected.

Groundwater levels at JSW and Oxbow will be substantially reduced during the working life of the mine pits as a result of dewatering. Combined with excavation activities, this could affect the throughflow characteristics of the CID aquifer.

Mining disturbance could also potentially affect water quality in the ground water system. For example, inappropriately designed below water table pit voids could result in groundwater salinisation due to the evaporative concentration of salts.

Other potential sources of groundwater contamination include unmanaged waste disposal, spills/leaks and run off from mine infrastructure areas.

6.5 Aboriginal heritage

The EPA environmental objective for heritage is to ensure that changes to the biophysical environment do not adversely affect historical and cultural associations and comply with relevant heritage legislation.

Aboriginal heritage sites could potentially be disturbed by proposed activities such as clearing, dewatering, excavation and surface water discharge although it is Rio Tinto policy to avoid heritage sites wherever practicable. Section 18 approval under the *Aboriginal Heritage Act 1972* will be required where disturbance to heritage sites cannot be avoided.

6.6 Greenhouse gases

The EPA environmental objective for greenhouse gases is to minimise emissions to levels as low as practicable on an on-going basis and consider offsets to further reduce cumulative emissions.

Based on the emissions intensity of the existing operations at Yandicoogina, annual GHG emissions resulting from the entire Yandicoogina operations (JC, JSE, JSW & Oxbow) are likely to exceed 100,000 tonnes CO_2 equiv. yr^{-1} over the life of the project. This will consist of $C0_2$ released through fossil fuel combustion associated with mining, ore processing, ore transportation, plant and equipment.

6.7 Landform and soils

The EPA environmental objective for landform and soils is to maintain the integrity, ecological functions and environmental values of the soil and landform.

The creation of stable and safe landforms post mining is a requirement for mine closure. Unmanaged waste disposal, spills/leaks and run off from mine infrastructure areas could result in soil contamination. Appropriate landforms are required to enable desired post mining land use, and protect groundwater resources and surface water quality. Of particular importance at Yandicoogina is the maintenance of CID aquifer throughflow, surface water quality and groundwater water quality.

6.8 Visual amenity

The EPA environmental objective for visual amenity is to ensure that aesthetic values are considered and measures are adopted to reduce visual impacts on the landscape as low as reasonably practicable.

The project area is distant from major population centres or other communities. However maintenance of aesthetic values is an important consideration for mine closure. This will include creation of suitable final landforms and maintenance of ecological water requirements for vegetation.

6.9 Air quality

The EPA environmental objective for air quality is to ensure that emissions do not adversely affect environmental values or the health, welfare and amenity of people and land uses by meeting statutory requirements and acceptable standards.

The project has the potential to lead to a localised reduction in air quality from unmanaged dust emissions.

6.10 Noise

The EPA environmental objective for noise is to protect the amenity of nearby residents from noise impacts resulting from the activities associated with the project by ensuring the noise levels meet statutory requirements and acceptable standards.

Unmanaged noise and vibration emissions from mining activities have the potential to cause a nuisance to camp residents and mine workers.

7 Assessment of potential environmental impacts

7.1 Significant potential environmental impacts

The significance of potential environmental impacts relating to each of the environmental factors identified in Section 6 was assessed by the project study team, using a standard internal RTIO risk assessment approach. A full description of the process used is contained in Appendix B. This process resulted in the identification of a series of potential project related impacts with a relatively high level of significance. These included:

Biological

- impacts to the vegetation health and composition of the Marillana and Weeli Wolli creek systems, resulting from additional discharge of pit dewatering water into these systems.
- loss of groundwater dependant riparian vegetation along the section of Marillana Creek within and adjacent to JSW sub-area B, due to dewatering cones of depression; and
- localised impacts to subterranean fauna within and adjacent to mine pits.

Physical

- changes to aquifer properties and groundwater chemistry resulting from the post mining landform.

Social

- greenhouse gas emissions implicated in global climate change, due to the scale of the mining operations proposed. Based on the emissions intensity of the existing operations at Yandicoogina, annual GHG emissions resulting from the entire Yandicoogina operations (JC, JSE, JSW & Oxbow) are likely to exceed 100,000 tonnes CO_2 equiv. yr^{-1} over the life of the project.

The development of management responses to minimise the extent of these impacts will require detailed discussion in the PER document.

7.2 Other potential environmental impacts

The following potential environmental impacts relating to the project were identified as having a lower level of significance, due to the low sensitivity of environmental receptors in the project area and/or the availability of demonstrated mitigation and management controls (including avoidance).

Biological

- localised impacts to terrestrial fauna;
- localised impacts to non-riparian vegetation, including clearing and disturbance; and
- fire disturbance

Physical

- pollution resulting from generation, handling and disposal of materials and wastes;
- dust emissions from mining activities; and
- noise emissions from mining activities

Social

- disturbance to Aboriginal heritage sites; and

- degradation of visual amenity

7.3 Environmental protection principles

The potential environmental impacts of the project have been assessed against the Principles in S4A of the *Environmental Protection Act 1986* (Table 7-1). This has contributed to the identification of key environmental protection considerations that need to be addressed in the PER document.

Table 7-1 Relationships between the Principles in S4A of the *Environmental Protection Act 1986* and environmental impact assessment considerations to be addressed in the PER document

Principle	Relevant (Yes/No)	Environmental protection considerations to be addressed in the PER document
1. The precautionary principle Where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation. In application of this precautionary principle, decisions should be guided by – (a) careful evaluation to avoid, where practicable, serious or irreversible damage to the environment; and (b) an assessment of the risk – weighted consequences of various options.	Yes	To address this Principle, surveys and investigations are required for characterising possible threats to environmental values resulting from the project. Environmental assessments associated with the existing Yandicoogina operations provide a useful guide to key environmental sensitivities in the area. To enable an assessment of the risk – weighted consequences of various project design and implementation options, the following aspects have particular importance: • impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have already occurred as a result of historical mining; • the efficacy of environmental management practices and procedures used at the current Yandicoogina operations; • biological surveys for vegetation, flora and fauna (including stygofauna) within and adjacent o the project disturbance footprint; • heritage and cultural significance surveys within and adjacent o the project disturbance footprint; • the application of hydrogeological and hydrological modelling to predict impacts on the local groundwater system and Marillana and Weeli Wolli creek systems, including consideration of existing and proposed mining. These aspects should be discussed in the PER document.
2. The principle of intergenerational equity The present generation should ensure that the health, diversity and productivity of the environment is maintained and enhanced for the benefit of future generations.	Yes	Mining should not detract from future land use options at Yandicoogina. In particular, the local groundwater system needs to be protected during and post mining. Hydrogeological modelling will be an important tool for informing post mining landform design, to ensure the maintenance of aquifer water quality and throughflow. To address this Principle, the PER needs to describe the proposed approach for managing mine decommissioning and rehabilitation. Plans and approaches developed for the existing mining operations at Yandicoogina provide a basis for this. Options for minimising emissions of greenhouse gases implicated in global climate change also need to be considered in the PER.
3. The principle of the conservation of biological diversity and ecological integrity Conservation of biological diversity and ecological integrity should be a fundamental consideration.	Yes	To address this Principle, biological surveys are required to identify conservation values (within a local and regional context) within the project disturbance footprint and surrounding areas. This is necessary to ensure that important biodiversity values are detected and adequately protected. The survey results will inform the development of rehabilitation completion criteria, and should therefore include appropriate biodiversity and ecological integrity targets. The PER will need to include the results of biological surveys, and discuss the implications of these results for designing appropriate

Principle	Relevant (Yes/No)	Environmental protection considerations to be addressed in the PER document
		environmental protection strategies and measures.
4. The principle of waste minimisation All reasonable and practicable measures should be taken to minimise the generation of waste and its discharge into the environment.	Yes	RTIO has well developed operating practices and procedures to minimise and manage waste, which are used at existing operations at Yandicoogina. This includes characterisation of mineral waste and the design of appropriate waste disposal mechanisms. To address this Principle, the suitability of applying RTIO waste treatment and minimisation practices and procedures to the project needs to be evaluated and discussed in the PER.
5. Eco-Efficiency Producers of goods and services should produce competitively priced goods and services that satisfy human needs and improve quality of life, while progressively reducing ecological degradation and resource intensity throughout the full life-cycle to a level consistent with the sustainability of biodiversity and ecological systems.	Yes	Note that all existing RTIO operations have targets for increasing efficiency and for reducing energy consumption and the emission of greenhouse gases To address this Principle, the PER should include an evaluation of the following options for minimising the greenhouse gas emissions intensity of iron ore produced by the project: • designing for process and equipment energy use efficiency • low emissions energy and materials procurement • best management practices to reduce energy consumption
6. Integrated Environmental Management If approaches to managing impacts on one segment of the environment have potential impacts on another segment, the best overall environmental outcome should be sought at a local, landscape, catchment and/or regional level.	Yes	The impacts of current and proposed mining activities affecting the Yandicoogina locality (i.e. cumulative impacts) need to be assessed in the PER. This is particularly important with respect to the impacts of discharging water into the Marillana and Weeli Wolli creek systems.

8 Management strategies and proposed studies/ investigations

Proposed management strategies for each of the environmental factors identified in Section 7 are described in Table 8-1 and discussed in further detail in Sections 8.1 to 8.7. A number of additional studies to support the development of appropriate controls to minimise environmental impacts have also been proposed.

RTIO has identified that mine pit dewatering and water management by discharge into the Marillana and Weeli Wolli creek systems constitute the most significant environmental risks associated with the project. These creek systems have already been impacted by historical mining activities at Yandicoogina by RTIO and BHPBIO. The Weeli Wolli creek system upstream of Yandicoogina also receives discharge water from the Hope Downs mining operation. Management of impacts to the creek systems requires consideration of the impacts of existing and proposed mining activities. As such, the following aspects of pit dewatering and water disposal will be evaluated and included in the PER:

- assessment of the conservation values of the Marillana Creek, Weeli Wolli Creek and Fortescue Marsh and impacts to these values caused by historical mining activities at Yandicoogina;
- improved calibration and validation of Yandicoogina operations water balance models, including the interface between the aquifer systems and the Marillana and Weeli Wolli creek systems. This will inform the prediction of potential environmental impacts resulting from different water disposal and management scenarios, taking into consideration impacts from other operations in the vicinity;
- options for minimising additional discharge into the Marillana and Weeli Wolli creek systems (for example water sharing with other users, sequencing of current and proposed dewatering activities and non-discharge water management options);
- ongoing evaluation of current and future impacts to the creek systems using appropriate impact assessment and monitoring methods, including consideration of contingency plans for dewater discharge to Weeli Wolli and Marillana creeks if impacts are detected; and
- discussion of the projected mine closure process, relating to the protection of aquifer through flow characteristics, groundwater quality, surface water quality and native fauna post mining.

Based on the outcomes of these investigations, a Groundwater and Surface Water Monitoring and Management Plan will be developed by RTIO in consultation with DEC and DoW for inclusion in the PER. This plan will address:

- collection of reliable baseline groundwater data for the mine and any associated borefield areas;
- collection of suitable baseline data on the state and condition of ecosystems potentially affected by surface water discharge;
- monitoring parameters for hydrological and ecosystem health change to ensure that changes and impacts are within acceptable limits; and
- primary and contingent management and reporting actions in the event that impacts are detected outside acceptable limits.

The Groundwater and Surface Water Monitoring and Management Plan will be developed in parallel with a revised Groundwater Operating Strategy for the Yandicoogina operations. This latter document is a component of groundwater abstraction licensing requirements under the *Rights in Water and Irrigation Act 1914*.

Completed biological surveys in the Yandicoogina locality indicate a relatively low abundance of species or communities with high conservation significance. However additional surveys will be conducted to ensure that biodiversity and ecological values within the project area are identified and protected to acceptable levels. Heritage surveys will also be conducted for similar purposes.

The project will increase the amount of greenhouse gases that are emitted over the life of the Yandicoogina operations. Some level of greenhouse gas emissions is an unavoidable consequence of mining activities. The PER will address opportunities to minimise the emissions intensity of the iron ore mining and processing across the Yandicoogina operations. The need for any offset activities will also be evaluated, taking into account new legislative requirements.

Other environmental risks including emissions of dust, noise, light, handling of waste and weeds can be readily managed using standard RTIO operating practices and procedures. A description of the practices and procedures to be used to address each of these factors will be included in the PER document.

Note that a number of environmental management initiatives currently in place for existing mining operations at JC and JSE can be extended and adapted to include proposed mining at JSW and Oxbow. These include:

- Yandicoogina JSE Riparian Vegetation Management Plan - this plan outlines procedures for the protection of riparian vegetation;
- Yandicoogina JSE Weed Management Plan - this plan outlines procedures to prevent the introduction of new weeds and reduce the spread of existing weeds;
- Yandicoogina Subterranean Fauna Management Plan – this plan aims to maintain the abundance, diversity, geographic distribution and productivity of subterranean fauna.;
- Yandicoogina Decommissioning and Rehabilitation Plan – this plan outlines procedures for the closure of the current RTIO Yandicoogina operations at JC and JSE;
- Yandicoogina Operations Groundwater Operating Strategy 2008 - this document states proponent commitments and responsibilities in managing the impacts of taking and using groundwater; and
- Yandicoogina Cultural Heritage Management Plan – this document outlines procedures to protect heritage sites and values.

Revised versions of these existing Yandicoogina operations environmental management plans will be included in the PER document.

Additional biological and heritage surveys are proposed as a component of the PER, to be completed prior to the PER submission. All survey work undertaken will be consistent with relevant EPA Guidance Statements including:

- No 20. Sampling of Short Range Endemic Invertebrate Fauna for Environmental Impact Assessment in Western Australia (EPA, 2009);
- No. 41 Assessment of Aboriginal Heritage (EPA, 2004b);
- No. 51 Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004a);
- No. 54 Sampling of subterranean fauna in groundwater and caves (EPA, 2003) and associated Draft Guidance 54a Sampling methods and survey considerations for subterranean fauna in Western Australia (EPA, 2007b); and
- No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia (EPA, 2004c).

RTIO intends to commission peer reviews of selected studies and investigations conducted for the PER (Appendix C).

Table 8-1 Proposed environmental management strategies and additional studies

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Vegetation clearing	Priority and DRF flora and TECs	Removal of individual plants or populations of conservation significant species.	Pre-disturbance surveys to enable species with conservation significance to be detected and avoided wherever practicable. Mine site rehabilitation using endemic species.	A detailed flora/vegetation survey of all areas likely to be affected by the project. This would include an evaluation of the regional and local significance of detected plant species and vegetation types within the project area, and mapping of species with conservation significance.	The results of vegetation surveys will inform rehabilitation completion criteria, including species diversity targets. Surveys will be conducted in accordance with relevant EPA Guidance Statements.
	Priority and DRF flora and TECs	Introduction and spread of weeds reduces the ability of conservation significant species to persist at the Yandicoogina locality.	Mapping and monitoring of weed infestations, use of hygiene procedures to minimise spread of weeds by vehicles and equipment, ongoing weed control as required to eradicate or contain weed species.	Weed species to be identified and mapped as a component of a detailed flora/vegetation survey of all areas likely to be affected by the project.	Existing weed control procedures at Yandicoogina JC and JSE mines will be reviewed and updated for application to this proposal.
	Significant fauna species	Death or displacement of individual animals or populations of conservation significant species.	Identification and avoidance of significant fauna wherever practicable.	A full review of previous fauna studies, reports and monitoring programs for the project area, This would include an assessment of habitat types and values within the project area. Targeted surveys for species identified as having conservation significance at the Yandicoogina locality may also be undertaken where the need is identified.	The results of the fauna surveys and study review will inform rehabilitation completion criteria. Surveys will be conducted in accordance with relevant EPA Guidance Statements.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Vegetation clearing	Significant fauna species	Habitat modification for subterranean fauna due to disruption to surface water infiltration and nutrient transport	Identification and avoidance of subterranean fauna and their habitat wherever practicable.	Targeted surveys for subterranean fauna in and adjacent to the project area	Surveys will be conducted in accordance with relevant EPA Guidance Statements.
	Soils and landform	Erosion (by wind and/or water)	Implement soil management practices in accordance with RTIO policies and procedures		RTIO soil management practices in the Pilbara have been rigorously developed and demonstrated to be effective where properly implemented
Dewatering	Weeli Wolli and Marillana Creeks	Discharge of dewatering water into creek lines potentially further changing the vegetation health and composition of the Marillana and Weeli Wolli creek systems	Evaluate the potential for impacts to occur and develop strategies so mitigate or minimise these impacts. This includes a minimising surface water discharge to creek systems, and ongoing monitoring of the creek systems, to enable impacts from the project to be detected and responded to if they occur.	Identification of the specific conservation values of the Marillana Creek and Weeli Wolli creek systems within the predicted footprint of disturbance, taking into consideration similar creek systems in a local and regional context. Impact studies addressing the potential extent and impact of increased surface water volumes in the Marillana Creek and Weeli Wolli Creek systems, including an evaluation of potential downstream impacts on the Fortescue Marsh. These will be informed by modelling outputs, and will include consideration of anticipated water disposal from new and existing RTIO Yandicoogina operations, BHPBIO Yandicoogina operations and Hope Downs 1 operations (i.e. consideration of cumulative impacts).	The sections of Marillana Creek and Weeli Wolli Creek anticipated to be affected by the project have already been impacted by historical mining activities. Some discharges into Marillana Creek will continue and are necessary to maintain the environmental water requirements for riparian vegetation

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Dewatering	Weeli Wolli and Marillana Creeks	Discharge of dewatering water into creek lines potentially further changing the vegetation health and composition of the Marillana and Weeli Wolli creek systems	Evaluate the potential for impacts to occur and develop strategies so mitigate or minimise these impacts. This includes a minimising surface water discharge to creek systems, and ongoing monitoring of the creek systems, to enable impacts from the project to be detected and responded to if they occur.	Improved calibration and validation of Yandicoogina operations water balance models, including the interface between the aquifer systems and the Marillana and Weeli Wolli creek systems. This will inform the prediction of potential environmental impacts resulting from different water disposal and management scenarios, taking into consideration cumulative impacts Evaluation and selection of options to mimimise discharge impacts.	
	Fortescue Marsh	Altered hydrology	Evaluate the potential for impacts to occur and develop strategies so mitigate or minimise these impacts. This includes minimising surface water discharge to creek systems.	Assessment of the known conservation values of the Fortescue Marsh and the threats to these values posed by the project. This will include consideration of other mining activities currently occurring within the Upper Fortescue River catchment. Improved calibration and validation of Yandicoogina operations water balance models, including the interface between the aquifer systems and the Marillana and Weeli Wolli creek systems. This will inform the prediction of potential environmental impacts resulting from different water disposal and management scenarios, taking into consideration cumulative impacts Evaluation and selection of options to mimimise discharge impacts as required.	The Fortescue Marsh has the potential to be impacted by multiple mining projects in the Central Pilbara. The Weeli Wolli creek is a tributary of the Marsh.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Dewatering	Aboriginal Heritage	Loss of / change to cultural values of Weeli Wolli Creek and Marillana Creek.	Identification and avoidance of Aboriginal heritage sites wherever practicable. Ongoing consultation with Native Title Claimants and other heritage stakeholders	Aboriginal heritage surveys within and immediately adjacent to the project area	The sections of Marillana Creek and Weeli Wolli Creek anticipated to be affected by the project have already been impacted by historical mining activities. The existing Yandicoogina Cultural Heritage Management Plan will be reviewed and updated as required for this proposal Surveys will be conducted in accordance with relevant EPA Guidance Statements.
	Groundwater/ aquifer	Loss/ disturbance of groundwater dependant creek line/riparian vegetation along a section of Marillana Creek.	Options for maintaining ecological water requirements in Marillana Creek during mining will be explored.	Monitoring (in progress) of impacts to the creek systems will be continued, enabling impacts from the project to be detected and responded to if they occur	The existing Riparian Vegetation Management Plan for current operations at Yandicoogina will be reviewed and updated as required for this proposal
	Groundwater/ aquifer	Groundwater drawdown from abstraction may cause long-term effects on the CID paleochannel aquifer by reducing aquifer storage capacity.	Hydrogeological modelling and will be used to identify potential impacts and develop management strategies for these. This assessment will address the impacts of existing and proposed mining operations	Refinement, calibration and validation of hydrogeological models of the CID paleochannel aquifer; spanning the existing and proposed operations at Yandicoogina. Ongoing liaison with other key stakeholders operating in the catchment (Hope Downs 1 & BHPBIO Yandi) will feed into impact assessments	Modelling will enable the design of appropriate management controls, to ensure that important functional aspects of the aquifer are preserved.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Earthworks/ Excavation	Groundwater	Changes to aquifer properties and groundwater chemistry resulting from the post mining landform.	Hydrogeological modelling will be used to develop an optimal final landform design (pit voids) to protect ground water quality.	Refinement, calibration and validation of hydrogeological models of the CID paleochannel aquifer; spanning the existing and proposed operations at Yandicoogina. Assessment of water management options for mine closure.	It is assumed that BHPBIO will not exceed their approved groundwater salinity targets of 2,000 mgL^{-1} TDS proposed at closure for the upstream component of the CID paleochannel aquifer system. The existing Decommissioning and Rehabilitation Plan for current operations will be reviewed and updated as required for this proposal.
	Surface water	Creekline modifications due to possible realignment of part of Phil's creek between JC and proposed JSW-C pit and haul road creek crossings of Marillana creek.	Surface water diversion structures will be designed to minimise disruption to natural flow paths and safely discharge flows to the receiving environment post closure.	Surface water modelling to understand regional flow balance pre and post-mining.	Existing RTIO procedures and practices provide the basis for effective design, construction and operation of surface water diversion structures.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Earthworks/ Excavation	Surface Water	Contamination of surface water by sediments and pollutants.	Potential contaminants will be contained and disposed off appropriately.	Review the design of the containment structures and/or identify engineering options to reduce runoff contribution.	Existing RTIO procedures and practices provide the basis for the storage, handling and disposal of potential contaminants.
	Soils and landform	Landform modification and disturbance. Pit voids will only be partially backfilled due to a lack of available backfill materials. This could potentially affect throughflow and water chemistry in surface and groundwater systems.	Optimising cut and fill to minimise the necessity for borrow pits or waste dumps, area of disturbance minimised as far as reasonably practicable. Final landforms will be designed to emulate the pre-disturbance condition as much as is practicable, in accordance with RTIO practices and procedures.	Water balance modelling will be used to inform final landform design (pit voids) to minimise salinisation. Mapping the extent and key characteristics of the landforms and soils of the proposal area and relevant surrounds.	The existing Decommissioning and Rehabilitation Plan for current operations will be reviewed and updated as required for this proposal.
Earthworks/ excavation	Subterranean fauna	Direct loss of subterranean fauna and habitat within the project disturbance footprint	The distribution of subterranean fauna and their habitat will be mapped within and adjacent to the project area Subterranean fauna habitat will be preserved wherever practicable	Subterranean fauna surveys within and adjacent to the project area	Surveys will be conducted in accordance with relevant EPA Guidance Statements.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Earthworks/ excavation	Aboriginal Heritage	Destruction of heritage sites.	Heritage values within the project area will be identified and avoided wherever practicable, through surveys and consultation with Aboriginal heritage stakeholders.	Additional surveys over proposed new disturbance areas will be undertaken in conjunction with the relevant registered native title claim group and other Aboriginal heritage stakeholders.	The existing Yandicoogina Cultural Heritage Management Plan will be reviewed and updated as required for this proposal Surveys will be conducted in accordance with relevant EPA Guidance Statements.
Runoff	Surface water	Alteration of drainage channels or flow characteristics due to mine pit footprints, infrastructure including haul roads and ex-pit waste dumps.	Avoid interference with surface water drainage as far as practicable (i.e. designing all crossings to ensure adequate passage of surface water flows), slow and disperse surface water flows to minimise erosion, and mimic existing flows as far as practicable, redistribution of flows to mimic pre-existing conditions as far as practicable.	Surface water modelling and identification of all locally significant drainage lines and their catchments will be included in the environmental assessment documentation.	Drainage will be designed to represent natural surface flow as far as reasonably practicable.
Runoff	Surface water	Sedimentation of natural drainage systems.	Bare surfaces will be stabilised as quickly as possible. Drainage will be designed to slow and disperse surface water flows to minimise erosion.	Modelling and design of runoff management controls to prevent erosion and sediment transport into creek systems.	Existing mining operations at Yandicoogina have successfully prevented any significant sedimentation of the Marillana and Weeli Wolli creek systems.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Spills or leaks	Soils and landform	Soil contamination	Containment of potentially contaminating materials and activities within bunded areas, direction of potentially contaminated flow to specifically designed ponds, and no liquid or solid waste directed to sensitive areas. Capture and detention areas will be sited to avoid environmentally sensitive areas.		Potential contamination sources will be designed to accommodate flood events and positioned to maximise containment and avoid sensitive receptors. Existing RTIO procedures and practices provide the basis for the storage, handling and disposal of potential contaminants.
	Fauna	Death or displacement of individual animals	Containment of potentially contaminating materials and activities within bunded areas, direction of potentially contaminated flow to specifically designed ponds, and no liquid or solid waste directed to sensitive areas.	Targeted fauna studies to ensure sensitive species are identified and avoided.	Existing RTIO procedures and practices provide the basis for the storage, handling and disposal of potential contaminants.
	Surface water and groundwater	Surface water and groundwater contamination	Containment of potentially contaminating materials and activities within bunded areas, direction of potentially contaminated flow to specifically designed ponds, and no liquid or solid waste directed to sensitive areas.	Identification of chemicals and other hazardous goods associated with the project. Investigate options for minimising quantities required and using alternative less hazardous goods that can be substituted.	Existing RTIO procedures and practices provide the basis for the storage, handling and disposal of potential contaminants.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Spills or leaks	Flora and vegetation	Localised loss of vegetation.	Containment of potentially contaminating materials and activities within bunded areas. Appropriate treatment and disposal of materials.	A detailed flora/vegetation survey of all areas likely to be affected by the project, evaluation of the regional and local significance of vegetation within the project area.	Existing RTIO procedures and practices provide the basis for the storage, handling and disposal of potential contaminants.
Liquid, mineral and solid waste disposal	Surface water and groundwater.	Surface water and groundwater contamination.	Containment of potentially contaminating materials and activities within designated waste disposal areas. Appropriate treatment and disposal of materials. Waste facilities will be designed to accommodate flood events avoid sensitive areas.	Identification of chemicals and other hazardous goods associated with the project. Investigate options for minimising quantities required and alternative less hazardous goods that can be substituted.	Existing RTIO procedures and practices provide the basis for the storage, handling and disposal of potential contaminants.
	Priority and DRF flora and TECs	Loss of significant DRF and/or TECs	Containment of potentially contaminating materials and activities within bunded areas, direction of potentially contaminated flow to specifically designed ponds, and no liquid or solid waste directed to sensitive areas. Appropriate treatment and disposal of materials.	A detailed flora/vegetation survey of all areas likely to be affected by the project, evaluation of the regional and local significance of vegetation within the project area. This will ensure that sensitive species are identified and avoided.	Existing RTIO procedures and practices provide the basis for the storage, handling and disposal of potential contaminants.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Liquid, mineral and solid waste disposal	Soils and landform	Soil contamination.	Containment of potentially contaminating materials and activities within bunded areas, direction of potentially contaminated flow to specifically designed ponds, and no liquid or solid waste directed to sensitive areas. Appropriate treatment and disposal of materials.	The environmental assessment documentation will include a review of acid sulphate risk exposure.	Waste facilities will be designed to accommodate flood events avoid sensitive areas.
Increased human presence in locality	Aboriginal Heritage	Disruption to archaeological / ethnographic sites.	Comprehensive surveys to identify sites, fencing to avoid sites / sensitive areas, cultural awareness training.	Review of RTIO heritage incident procedures.	The existing Yandicoogina Cultural Heritage Management Plan will be reviewed and updated as required for this proposal. Surveys will be conducted in accordance with relevant EPA Guidance Statements.
	Fauna	Possible disruption to fauna.	Appropriate employee/contractor site inductions, reduce vehicle speeds, identification of location of significant species.	A full review of previous fauna studies, reports and monitoring programs for the project area, This would include an assessment of habitat types and values within the project area. Targeted surveys for species identified as having conservation significance at the Yandicoogina locality may also be undertaken where the need is identified.	Existing mining operations at Yandicoogina have been successful in preventing significant disruption to fauna species due to increased human presence in the locality.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Increased human presence in locality	Fauna	Introduction of feral animals.	On and off-site feral animal control.	Review of RTIO feral animal control procedures.	
Fire	Flora and vegetation	Alteration to vegetation community composition.	Fire Management Plan.	Investigate natural fire regime of the area.	Fire management practices used at existing Yandicoogina operations will be replicated for new mining areas.
	Fauna	Temporary loss of habitat.	Fire Management Plan.	Investigate natural fire regime of the area.	Fire management practices used at existing Yandicoogina operations will be replicated for new mining areas.
Dust emissions	Flora and vegetation	Reduction to growth rates and distribution.	Regular monitoring of dust levels, dust suppression.		Existing RTIO procedures and practices provide the basis for effective dust control.
	Air quality	Localised reduction in air quality.	Dust suppression.		Existing RTIO procedures and practices provide the basis for effective dust control.
Greenhouse gas emissions	Air quality	Contribution to the cumulative impact of atmospheric CO_2 emissions implicated in global climate change.	Minimise the emissions intensity of iron ore mining and processing. Identify any requirement for offsets.	Assessment of options to minimise the emissions intensity of iron ore mining and processing at JSW and Oxbow. Evaluation of the need for offsets and options for offsets.	The approach taken to managing greenhouse gas emissions will be consistent with current State and National policies.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Mitigation/ Management Strategies	Additional Studies	Comments
Light emissions	Fauna	Disruption to nesting and roosting habits during the night.	Appropriate lighting controls, downward facing lighting, identification of locations of significant fauna habitat.	A full review of previous fauna studies, reports and monitoring programs for the project area, This would include an assessment of habitat types and values within the project area. This will ensure that sensitive species are identified and avoided.	
Noise and vibration emissions	Fauna	Death or displacement of individual animals.	Use of standard RTIO practices and procedures to protect fauna from noise (e.g. purchase of plant and equipment which meets appropriate noise standards and regular noise maintenance, management of blasting to minimise noise impacts, routine noise monitoring).	A full review of previous fauna studies, reports and monitoring programs for the project area, This would include an assessment of habitat types and values within the project area.	Existing RTIO procedures and practices provide the basis for effective noise and vibration control.
Noise and vibration emissions	Mine residents/workers	Nuisance	Use of standard RTIO practices and procedures to protect the workforce and wider community from noise (e.g. purchase of plant and equipment which meets appropriate noise standards and regular noise maintenance, management of blasting to minimise noise impacts, routine noise monitoring).		Mining, ore processing and transport will not occur near any towns or sensitive premises. Existing RTIO procedures and practices provide the basis for effective noise and vibration control.

8.1 Vegetation and flora

The major risks to flora and vegetation are related to the loss and/or disturbance of significant species and ecological communities, impacts to riparian vegetation from mine pit footprints and water discharge into creek systems, and the introduction and spread of weeds. Management strategies to address these impacts include:

- pre-mining surveys to collect baseline data for rehabilitation and identify any species and ecological communities with conservation significance;
- avoidance of species and ecological communities with conservation significance wherever practicable;
- adaptation of the current Yandicoogina JSE Weed Management Plan to provide the basis for preventing the introduction and spread of weed species - addressing weed identification, mapping and management for all activities associated with the project;
- adaptation of the current JSE Riparian Vegetation Management Plan to provide the basis for protecting riparian vegetation;
- riparian vegetation health monitoring;
- the development of rehabilitation completion criteria to provide the basis for preserving vegetation values (biodiversity, structural and functional attributes, land use attributes) post mining; and
- development of measures to minimise cumulative impacts.

During 2009 a detailed flora and vegetation survey of the project area was undertaken by Biota Environmental Sciences, consistent with EPA 2004a. The results of this survey are in the process of being compiled. The scope of work included:

- a review previous biological reporting and other literature relevant to the Yandicoogina locality;
- establishment of a series of detailed flora recording quadrats to provide quantitative species data for the project area and surrounds;
- identification and mapping of vegetation types;
- species identification and vouchering of specimens with the WA Herbarium as required; and
- identification of any species or features of particular conservation significance, and discussion of potential impacts and management measures.

It is anticipated that additional surveys will be conducted in 2010 which target downstream creekline areas (subject to hydrogeological modelling outputs) and individual species requiring more detailed assessment on the basis of their conservation significance. These additional surveys will have sufficient coverage to:

- establish the values and significance of creek systems affected by dewatering discharge.
- In the event that species with restricted distributions are identified, surveys extending beyond the area of predicted impacts will be conducted to enable an evaluation of the significance of potential impacts on these species.

Pending the outcomes of the survey work, the need for more detailed environmental management controls (for example significant species management plans) will be evaluated.

The PER document will include the findings of project biological surveys, and a full description of management strategies and measures for minimising impacts on vegetation and flora.

8.2 Terrestrial fauna

The major risks to fauna include death or displacement of individual animals or populations and habitat removal or degradation. Management strategies to address this include:

- pre-mining surveys to identify habitat types and any species with conservation significance;
- avoidance of species and ecological communities with conservation significance wherever practicable;
- protection of uncleared habitat from threats and disturbance; and
- development of rehabilitation completion criteria to provide the basis for preserving fauna habitat values post mining.

During 2009 a detailed a terrestrial fauna survey of the project area was undertaken by Biota Environmental Sciences, consistent with EPA 2004c and EPA 2009. The results of this survey are in the process of being compiled. The scope of work included:

- review previous biological reporting and other literature relevant to the Yandicoogina locality;
- identification and description of fauna habitat within the project area;
- systematic sampling of vertebrate fauna within survey area, including:
    - establishment of trapping grids within the project area to survey ground fauna;
    - avifauna censuses consistent with that used elsewhere in the bioregion; and
    - deployment of harp nets to trap bat species.
- targeted searches for invertebrate fauna groups of potential conservation significance (e.g. for example Short Range Endemics);
- vouchering of specimens as required; and
- identification of any species or features of particular conservation significance and discussion of potential impacts and management measures.

Following the compilation of the survey results, the need for additional targeted surveys to be included in the PER will be assessed. In the event that species with restricted distributions are identified, surveys extending beyond the area of predicted impacts will be conducted to enable an evaluation of the significance of potential impacts on these species.

The PER document will include the findings of project biological surveys, and a full description of management strategies and measures for minimising impacts on terrestrial fauna.

8.3 Subterranean fauna

The major risks to subterranean fauna are the removal of animals and their habitat within the project area resulting from dewatering and excavation activities.

Management strategies to address these impacts are related to ensuring that an adequate area of subterranean fauna habitat is preserved and protected from mining activities. This will require an assessment of subterranean fauna distribution and habitat in and adjacent to proposed disturbance areas. Hydrogeological modelling and monitoring will be used to assess any potential impacts to animals and habitat from dewatering. Excavation activities will be designed to avoid areas of subterranean fauna habitat wherever practicable.

During 2009 a detailed a subterranean fauna survey of the project area was undertaken by Biota Environmental Sciences, consistent with EPA 2003. The results of this survey are in the process of being compiled. The scope of work included:

- review of previous subterranean fauna survey data form the Yandicoogina locality;
- an additional sampling survey for subterranean fauna in and adjacent to anticipated groundwater impact areas for the new deposits;
- morphological identification of collected specimens (with DNA comparisons where required);
- vouchering of specimens as required; and
- identification of any species or features of particular conservation significance and discussion of potential impacts and management measures.

In the event that species with restricted distributions are identified, surveys extending beyond the area of predicted impacts will be conducted to enable an evaluation of the significance of potential impacts on these species.

The PER document will include the findings of project subterranean fauna surveys and investigations, and a full description of management strategies and measures for minimising impacts on subterranean fauna.

8.4 Surface water

The major risks to surface water are related to the discharge of dewatering water into creek systems, disturbance of natural drainage systems (for example creek realignments and sedimentation) and contamination from waste disposal. These risks will be managed via the minimisation of additional discharge into Marillana Creek and Weeli Wolli Creek, appropriate design of discharge outlets, appropriate design of creek diversion and modification structures, and the containment and treatment of potential contaminants.

Creek diversion and modification structures will include:

- Modification to Marillana Creek to provide flood protection for JSW Area C;
- Haul and access road creek crossings of Marillana Creek to service JSW Area A and potentially Oxbow;
- Possible modification of part of Phil's creek between JC and the proposed JSW-C pit. This area contains ore that may be exploited later in the mining of JSW Area C. Preliminary evaluations suggest that backfill into the Phil's creek areas of the Junction Central pit will allow for creek flows to be either:
    - directed into the JC Pit (isolated from JSW pit by backfilled material); or
    - diverted around the JC pit and directed back into Marillana Creek further downstream.
- Diversion of local drainage and small creeks up gradient of the mine areas.

A range of additional studies and evaluations related to the management of surface water discharge will be included in the PER, outlined as follows:

- identification of the specific conservation values of the Marillana Creek and Weeli Wolli creek systems within the predicted footprint of disturbance, taking into consideration similar creek systems in a local and regional context;
- assessment of the known conservation values of the Fortescue Marsh and the threats to these values posed by the project. This will include consideration of other mining activities currently occurring within the Upper Fortescue River catchment;

- a review and evaluation of the impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have occurred as a result of historical mining at Yandicoogina, and the effectiveness of management strategies that have been employed to minimise impacts;
- hydrological modelling of Marillana Creek. Weeli Wolli Creek and Fortescue Marsh to characterise surface water behaviour for various flooding and surface water discharge scenarios addressing water quantity, water quality and timing of disposal (for example to better mimic the natural flow regime).
- evaluation of water use and alternative management options for the purposes of minimising discharge to creek systems. This will include evaluation of the quantity of water required for each stage in the mining process, consideration of critical points in the forecast water balance and contingency options for managing excess water;
- impact studies addressing the potential extent and impact of increased surface water volumes in the Marillana Creek and Weeli Wolli Creek systems, including a consideration of water quality and an evaluation of potential downstream impacts on the Fortescue Marsh. These will be informed by modelling outputs, and will include consideration of anticipated water disposal from new and existing RTIO Yandicoogina operations, BHPBIO Yandicoogina operations and Hope Downs 1 operations (i.e. consideration of cumulative impacts); and
- development of a Groundwater and Surface Water Monitoring and Management Plan.

If required, the most suitable option for managing disturbance to Phil's creek will be evaluated in the PER and included in the proposed Groundwater and Surface Water Monitoring and Management Plan. The PER will include a description of stormwater management controls to be used to prevent contaminants (e.g. hydrocarbons and sediment) entering the environment. It will also describe how uncontaminated stormwater will be prevented from interfering with mine pits and other project structures.

The Yandicoogina JSE Riparian Vegetation Management Plan will be adapted for application to the new mining areas at JSW and Oxbow. The existing plan stipulates that a 200 m mining exclusion zone is maintained either side of the Marillana Creek. To access the ore deposit at JSW, there will be a requirement to encroach upon the 200 m buffer where the Marillana Creek crosses the deposit. The implications of encroaching the buffer, and potential management controls for this, will be evaluated as part of the PER.

As a component of validating hydrological model, RTIO will engage a suitability qualified consultant to undertake a peer review of the model. The outputs of the peer review will be included in the PER document. It is anticipated that the findings of the peer review will inform the development of the Groundwater and Surface Water Monitoring and Management Plan.

The PER document will include the findings of studies and investigations relating to surface water, and a full description of management strategies and measures for minimising impacts on riparian systems. In the event that a new dry processing plant is required at the JSW location, a description of associated drainage layout will also be included in the PER document.

8.5 Groundwater

The major risks to groundwater are related to modification of aquifer systems due to groundwater abstraction activities, contamination from spills/leaks and the prevention of aquifer salinisation in the long term. These risks will be managed by using hydrogeological modelling to inform mine planning and design, ongoing monitoring of aquifers and the containment and treatment of potentially contaminating materials.

Proposed studies and information to be incorporated into the PER includes:

- hydrogeological modelling of the paleochannel and alluvial aquifer systems, reflecting the addition of mining at JSW and Oxbow to the current Yandicoogina operations;

- use of model outputs to inform the prediction of impacts to groundwater systems (based on surface and groundwater interactions), under a variety of possible dewatering and surface water discharge scenarios;
- evaluation of water use and alternative management options for abstracted groundwater, for the purposes of minimising and managing discharge to creek systems. This will include an evaluation of the quantity of water required for each stage in the mining process;
- ongoing monitoring of aquifers to enable impacts from the project to water levels and chemistry to be detected;
- studies addressing impacts to the local hydrogeological regime. This will include consideration of the RTIO Yandicoogina, BHPBIO Yandicoogina and Hope Downs mining areas and address long term protection of aquifer water quality; and
- development of a Groundwater and Surface Water Monitoring and Management Plan.

With respect to the evaluation for water use and alternative management options for abstracted groundwater, consideration will be given to the following hierarchy of management options for abstracted groundwater:

1. Re-use onsite (e.g. processing and dust suppression)
2. Transfer to meet other demand (including external water users)
3. Aquifer recharge via pit voids
4. Reinjection into aquifers
5. Storage and evaporation
6. Controlled release of water (for example to better mimic natural flow patterns); and
7. Uncontrolled release of water

Waste fines generated from wet processing of ore are anticipated to be managed in existing tailings facilities at JC, in accordance with the operating conditions of the existing facility. The PER will identify if any new tailings facilities are required, and if so assess potential environmental impacts and their management. This will include a discussion of potential impacts on the transmissivity and water quality of groundwater aquifers.

As a component of validating hydro-geological model, RTIO will engage a suitability qualified consultant to undertake a peer review of the model. The outputs of the peer review will be included in the PER document. It is anticipated that the findings of the peer review will inform the development of the Groundwater and Surface Water Monitoring and Management Plan.

The PER document will include the findings of studies and investigations relating to groundwater, and a full description of management strategies and measures for minimising impacts on groundwater systems.

8.6 Aboriginal heritage

The major risks to Aboriginal Heritage are related to the disturbance of archaeological or ethnographic sites and impacts on the heritage values of sites and places. Management strategies are in place to ensure comprehensive surveys are undertaken by archaeologists, anthropologists and traditional owners across all areas of proposed ground disturbance, and the appropriate protection and management of sites.

Previous heritage reports will be collated to create a map of areas that have been surveyed. Additional surveys of proposed new disturbance areas will be undertaken in conjunction with the relevant native title claim group. RTIO has well developed practices and procedures for protecting Aboriginal Heritage sites including a Cultural Heritage Management Plan (CHMP) for the Yandicoogina project area, which includes JSW and Oxbow. Any proposal to disturb heritage sites will be assessed under Section 18 of the *Aboriginal Heritage Act 1972*.

The PER document will include the findings of studies and investigations relating to cultural heritage, and a full description of management strategies and measures for minimising impacts on cultural heritage values.

8.7 Air quality

Existing RTIO procedures and practices used at Yandicoogina are effective in preventing significant dust emissions. Similar methods will be used to control dust for disturbance activities associated with the project.

The project will increase the amount of greenhouse gases that are emitted over the life of the Yandicoogina operations. Management strategies include minimisation of the emissions intensity of iron ore mining and processing across the Yandicoogina operations. Possible measures for achieving this will be evaluated in the PER including:

- designing for process and equipment energy use efficiency;
- low emissions energy and materials procurement; and
- best management practices to reduce energy consumption.

The need for emissions offsets, such as revegetation carbon abatement offsets, will also be evaluated.

The PER document will include a full description of management strategies and measures for minimising impacts related to greenhouse gas and dust emissions. In the event that a new dry processing plant is required at the JSW location, a description of associated dust control features will also be included in the PER.

8.8 Closure and rehabilitation

A conceptual Decommissioning and Rehabilitation Plan will be developed for the project and included in the PER. This will be adapted from the existing plan developed for the JC and JSE operations.

A conceptual Decommissioning and Rehabilitation Plan will be developed, which establishes mine closure objectives and criteria. The plan will address final landforms, surface water quality, aquifer water quality, revegetation techniques, post-closure land use options and surface water routing in accordance with relevant mine closure and rehabilitation guidelines. It will also include specific monitoring programs addressing landform stability monitoring, revegetation monitoring and water quality monitoring.

Backfilling of pits is dependent on the available backfill material and will be the subject of ongoing mine closure planning for the overall RTIO Yandicoogina operations. This will occur in consultation with relevant regulatory authorities. Water balance modelling will inform mine closure planning, to assist with the determination of the most appropriate final landform to maintain groundwater quality, aquifer throughflow and ecological water requirements. The PER will include a discussion of the mine closure planning process, including the potential impacts of pit lakes on groundwater quality, surface water quality and native fauna. Management approaches to address these impacts will also be discussed.

Mineral waste material produced by mining activities is anticipated to be similar in composition to that already generated at the existing JC and JSE operations. The JSW and Oxbow deposits have been assessed by RTIO as having a low risk for acid rock drainage (ARD) and asbestiform minerals.

The handling and management of mineral wastes generated by the project will be in accordance with the *Rio Tinto Environmental Standard: Mineral Waste Management*. Under this standard, waste and ore is required to be geochemically characterised during exploration drilling and waste is further geochemically characterised during operations. The results of studies related to waste characterisation as applicable to the project will be included in the PER documentation, along with an assessment of the potential for long term contamination of the remaining pit lakes and the potential impacts on fauna.

8.9 Considerations for environmental monitoring programs

Environmental management strategies and plans for the project will be developed and implemented within an adaptive management framework. A suite of environmental monitoring activities will be required that:

- enable the performance of management controls to be assessed; and
- enable project related impacts to environmental values to be detected, evaluated and responded to.

Monitoring will hence provide the basis for assessing and modifying operating management controls, or for instigating new controls where the need is identified.

The anticipated span of monitoring activities required for the project is described in Table 8-2, including a possible selection of monitoring parameters for key environmental factors. Each environmental management plan (EMP) included in the PER will specify monitoring programs for those environmental factors within the ambit of the plan. Appropriate monitoring parameters will be identified for inclusion in the EMP's, with associated sampling methodology and frequency described. For selected parameters, quantitative and measurable targets and trigger values for contingency actions will be established. Surveys and investigations undertaken to support the preparation of the PER will provide baseline (pre-disturbance) information to assist with the derivation of these targets and trigger values.

8.10 Consideration of cumulative impacts

In assessing the potential environmental impacts of the project, it is necessary to consider other mining operations in and adjacent to the Yandicoogina locality. This is particularly the case with respect to dewatering and water disposal, given that the CID is a large continuous system that is influenced by mining activities at multiple locations.

Environmental management strategies developed and described in the PER document will take into account:

- the hydrological cycle, riparian systems and associated ecosystems, where project related impacts interface with impacts from other mining operations;
- interactions between aquifers and surface water hydrology, and how these interactions are influenced by dewatering and water disposal from current and proposed mining activities; and
- opportunities for holistic environmental management across the RTIO mining operations at Yandicoogina, for example with respect to integrated water management.

Table 8-2 Environmental factors to be addressed by monitoring activities, with examples of associated monitoring parameters.[3]

Environmental factor	Examples of monitoring items or parameters	Relevant project Environmental Management Plans (EMP's) or operating procedures
Flora and vegetation	species presence/absence species distribution (including weeds) species diversity species richness foliage cover vegetation health indicators	Riparian Vegetation Management Plan Groundwater and Surface Water Monitoring and Management Plan Weed Management Plan Decommissioning and Rehabilitation Plan
Subterranean fauna	species presence/absence species distribution species diversity species richness	Subterranean Fauna Management Plan
Surface water	water levels flow rates extent of wetting front water quality parameters (e.g. pH, electrical conductivity, total dissolved solids, total suspended solids, major ions, heavy metals, total recoverable hydrocarbons, total nitrogen and total phosphorous)	Groundwater and Surface Water Monitoring and Management Plan
Groundwater	water levels water quality parameters (e.g. pH, electrical conductivity, total dissolved solids, total suspended solids, major ions, heavy metals, total recoverable hydrocarbons, total nitrogen and total phosphorous)	Groundwater and Surface Water Monitoring and Management Plan Groundwater Operating Strategy
Aboriginal heritage	parameters relating to site condition community consultation	Cultural Heritage Management Plan
Greenhouse gases	energy (fuels and electricity) consumption project emissions (overall and by category) emissions intensity	Yandicoogina Operations EMP

[3] Note that a final set of monitoring parameters will be included in the PER documentation, as identified during the preparation of this documentation.

Environmental factor	Examples of monitoring items or parameters	Relevant project Environmental Management Plans (EMP's) or operating procedures
Landform and soils	erosion	Groundwater and Surface Water Monitoring and Management Plan Decommissioning and Rehabilitation Plan
Visual amenity	skyline vistas vegetation	Decommissioning and Rehabilitation Plan
Air quality	ambient atmospheric parameters (eg wind speed, direction, air temperature, humidity) particulates (dust) greenhouse gas emissions contaminants	Yandicoogina Operations EMP
Noise	noise intensity time period duration frequency	Yandicoogina Operations EMP

9 Stakeholder consultation

9.1 Introduction

Since mining commenced at Yandicoogina, Pilbara Iron has sought to keep relevant stakeholders up to date with studies relating to any future mining in the area.

The following stakeholders will be consulted regarding the development of the project:

9.1.1 Government agencies

- The Office of the Environmental Protection Authority (EPA);
- Department of Environment and Conservation (DEC) Pilbara Regional Office;
- Department of Environment and Conservation (DEC) Kensington Office - Environmental Management Branch and Science Division;
- Department of Water (DoW);
- Department of Mines and Petroleum (DMP); and
- Department of Planning and Infrastructure (DPI).
- The Department of State Development

9.1.2 Local government

- Shire of East Pilbara.

9.1.3 Non-government agencies

- Wildflower Society of Western Australia;
- Conservation Council; and
- Gumula Aboriginal Corporation.

9.1.4 Community

- Marillana Pastoral Station.

9.2 Consultation program

The stakeholder consultation programme is on-going and includes:

- initial distribution of information about the proposal;
- ongoing consultation with the agencies throughout the assessment process on an as needs basis; and
- ongoing activities throughout the assessment process including meetings with stakeholders, public meetings and informal information sessions when environmental documentation is released for public comment.

Table 9-1 provides an overview of the proposed consultation program.

Table 9-1 Proposed consultation program

Tool	Possible activities	Timing
Awareness/ information campaign	Proposal briefing note or presentation distributed to stakeholders.	At commencement of consultation program and ongoing as required
	Maintenance of proposal webpage on the RTIO website. The webpage will: • enable proposal documents to be read or downloaded • allow for the public to provide online feedback • be regularly updated to reflect the status of the proposal.	Following the release of the PER document for public comment (scheduled or Q3 2010)
	Stakeholder meetings/briefings.	Ongoing and as required (Q1 to Q3, 2010)
Stakeholder sessions	Proposal follow-up meetings/briefings, webpage updates including feedback to stakeholders on how their input has affected proposal decisions. This will include consultation with DEC and DoW regarding hydrological and hydrogeological modelling activities and the development of the Groundwater and Surface Water Monitoring and Management Plan.	Ongoing (Q1 to Q3, 2010)
Ongoing feedback to stakeholders	Proposal follow-up meetings/briefings.	Ongoing (Q1 to Q3, 2010)

10 Proposal and assessment schedule

Studies and investigations to be included in the PER (Appendix C) are scheduled to be completed by Q3 2010.

In accordance with the EPA guidelines for the impact assessment process, the EPA will provide comment on the draft PER prior to approving it for release to the public. It is scheduled that this review period will occur in Q2/Q3 2010. All comments received from EPA delegates will be considered by the proposal Study Team and incorporated into the PER document as appropriate.

The finalised PER document, addressing EPA comments and including the findings from completed studies and investigations, is scheduled to be released for public comment in Q3/Q4 2010.

11 Study team

The study team consists of RTIO personnel assisted by various specialist consultants (Table 11-1). This team will manage the assessment of project related environmental impacts, coordinate additional studies on relevant environmental factors and review and update existing Yandicoogina environmental management controls (such as EMP's). The outputs from these processes will be incorporated into the PER documentation.

Table 11-1 Key Public Environmental Review (PER) study team personnel

Role/Title	Name (Organisation)
Rio Tinto Iron Ore	
Study Manager	Peter Sage
Project Engineering Manager	Stuart Kennedy
Environmental Approvals Specialist (Part IV)	Melinda Brand
Specialist Environmental Advisor	Katrina Burke
Hydrology Technical Study Leader	Kirsty Beckett
Hydrogeology Technical Study Leader	Shawan Dogramaci
Heritage Advisor	Luke Lowery
Government Approvals Advisor	Clare Tyler
Metallurgy & Process Design	Stuart Pritchard
Senior Mine Planner	Sean Dowley
Closure Planning Specialist	Garry Davies
Specialist Consultants	
Part IV Environmental Approvals (Scoping Document, PER)	Dan Huxtable (MWH)
Subterranean Fauna Study Leader	Garth Humphries (Biota)
Vegetation and Flora Study Leader	Rachel Warner (Biota)
Fauna Study Leader	Phil Runham (Biota)

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Appendix A Summary of key revisions made to the draft ESD (in response to comments received from the Office of the EPA on 18 February, 2010)

Summary of key revisions made to the draft ESD (in response to comments received from the Office of the EPA on 18 February, 2010)[4]

Document Section	Section Title	Type of amendment	Description of amendment(s)
Executive Summary		Statements inserted (shown in bold)	Other environmental risks including emissions of dust, noise, light, handling of waste and weeds can be readily managed using standard RTIO operating practices and procedures. **A description of the practices and procedures to be used to address each of these factors will be included in the PER document. As a component of this, the efficacy of existing practices and procedures at the current Yandicoogina operations will be reviewed and evaluated.**
			To ensure that project related environmental impacts can be contained within acceptable limits, a series of management strategies and additional studies have been proposed for inclusion in the PER document. These include:
			• pre-mining surveys to identify vegetation, flora, fauna and heritage values within the **project disturbance footprint and adjacent areas as relevant to the assessment of environmental impacts**. The outputs of the surveys will inform the design of management controls to protect these values; • **assessment of the conservation values of the Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh and threats to these values posed by the project**; • **a review and evaluation of the impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have occurred as a result of historical mining at Yandicoogina, and the effectiveness of management strategies that have been employed to minimise impacts**; • **prediction of impacts to riparian vegetation, major creeklines and groundwater systems, using the outputs if hydrological and hydrogeological modelling (including consideration of interactions between the creek bed alluvium and the underlying aquifer). The modelling outputs will also inform the development of management controls that minimise during and post mining. This modelling work will be subject to an external peer review**;

[4] Note that this does not include minor amendments (for example grammatical corrections) that do not significantly change the information content, context or intent of the document.

Document Section	Section Title	Type of amendment	Description of amendment(s)
Executive Summary		Statements inserted (shown in bold)	• an evaluation of water management options (relating to groundwater extraction and use) for the purposes of minimising discharge to creek systems. **This will include evaluation of the quantity of water required for each stage in the mining process, consideration of critical points in the forecast water balance and contingency options for managing excess water.**
			Development of a Groundwater and Surface Water Monitoring and Management Plan, **which addresses:** o **collection of baseline groundwater data for the mine and any associated borefield areas;** o **collection of baseline data on the state and condition of ecosystems potentially affected by surface water discharge;** o **monitoring parameters for hydrological and ecosystem health change to ensure that changes and impacts are within acceptable limits; and** o **primary and contingent management and reporting actions in the event that impacts are detected outside acceptable limits.**
			The Groundwater and Surface Water Monitoring and Management Plan (GSWMMP) will be included in the PER document, and developed in parallel with a revised Groundwater Operating Strategy for the Yandicoogina operations. The GSWMMP will be developed by RTIO in consultation with DEC and DoW.
			Revised versions of existing Yandicoogina operations environmental management plans will be included in the PER document (*refers to EMP's for Riparian Vegetation, Weeds, Subterranean Fauna, Decommissioning and Rehabilitation Plan, Cultural Heritage and the Groundwater Operating Strategy*).

Document Section	Section Title	Type of amendment	Description of amendment(s)
2.3.1	Key characteristics	Table 2.1 clarified and updated to reflect latest conceptual mine plan	Project life – up to 12 years 52 Mtpa with the capacity to expand to approximately 70 Mtpa (combined total for JC, JSE, JSW and Oxbow operations). First throughput at Oxbow in approximately 2017. Total waste 135 Mt
2.3.2	Ground disturbance	Statement inserted (shown in bold)	More accurate determination of the disturbance footprint is dependent on the finalisation of mine plans. Opportunities to minimise disturbance, particularly by using existing infrastructure, will be continuously sought during the planning process. **The PER will include a comprehensive description of the proposed disturbance footprint, spatially defined using Geographical Information System (GIS) outputs. GIS data of sample points, monitoring pints, discharge points, existing and proposed disturbance footprint areas and conservation values will also be provided to the EPA where available.**
2.3.5	Ore handling, processing and transport	Section rewritten for greater clarity	**The majority of the ore from Oxbow and JSW is anticipated to require dry processing. This material will be dry crushed and screened at receival points close to the Oxbow and JSW ore bodies, prior to transport via conveyor, truck or light rail (or a combination of these options) to utilise processing facilities at JC and JSE. The preferred ore transportation solutions will be identified in the PER document.** **Ore processing will be integrated with the current Yandicoogina operations. The existing plant capacity, where practicable, will be utilised for the outputs from the JSW and Oxbow mines. Subject to more detailed engineering assessment, there may be a requirement to expand the capacity of the current Yandicoogina operations facilities. In the case of expanded wet processing facilities, this would necessitate additional waste fines disposal into disused pit voids.** **Processed ore will be loaded onto trains at the existing train load out system immediately south of the proposed JSW mine. Existing facilities for tertiary crushing, screening and stockpiling adjacent to the train load-out loop may require expansion to support the additional volume.**

Document Section	Section Title	Type of amendment	Description of amendment(s)
5.1.3	Conservation areas	Statement inserted	**The DEC has identified the Fortescue Marsh on the Fortescue River, east of Mulga Downs on Marillana and Roy Hill Stations as a Priority Ecological Community (PEC Priority 1). The Weeli Wolli Spring riparian woodland and forest associations have also been identified as a PEC (Priority 1). PEC's are poorly understood ecological communities, which potentially have high conservation values and may be subject to threatening processes. They are classified as either priority 1, 2 or 3; ranked in order of priority for survey and/or definition of the community, and evaluation of conservation status, so that consideration can be given to their declaration as threatened ecological communities.**
5.3	Geology	Section rewritten for greater clarity (modifications shown in bold)	The CID infills the paleochannels of the ancestral equivalents of the Marillana and Yandicoogina Creek systems and was deposited during the Tertiary period some sixty five million years ago. The project deposits are approximately 300 to 500 m wide and 45 to 50 m thick. The CID is mostly below the watertable and is overlain with **unconsolidated alluvium/|colluvium comprising banded iron formation (BIF), chert, shale, minor dolerite and occasional CID clasts in a red-brown sandy to clay rich matrix. Alluvial cover varies in thickness from a thin veneer a few centimetres thick to 20 m or more across recent drainage lines, which in places have removed a significant thickness of the upper CID sequence.**
			The CID material is comprised of concentric rings of limonite and vitreous goethite around nuclei of hematite, goethite, turgite and iron oxide replaced wood which accumulated or formed in pre-existing river channels. Clay minerals typically occur in voids, fractures and other structures in the CID. Kaolinite is the dominant clay species.
5.5.3	Weeds	Section rewritten to reflect the most recent weed mapping outputs from the Yandicoogina opertaions	**A number of weed species have been identified within the project area and wider Yandicoogina locality, based on recently completed surveys. These include:** • ***Acetosa vesicaria*** **(Ruby Dock);** • ***Argemone ochroleuca*** **subsp*. ochroleuca*** **(Mexican Poppy);** • ***Bidens bipinnata*** **(Bipinnate Beggartick);** • ***Cenchrus ciliaris*** **(Buffel Grass);**

Document Section	Section Title	Type of amendment	Description of amendment(s)
			• ***Citrullus colocynthis*** **(Colocynth);** • ***Conzya bonariensis*** **(Flaxleaf Fleabane);** • ***Malvastrum americanum*** **(Spiked Malvastrum);** • ***Portulaca oleracea*** **(Purslane);** • ***Setaria verticillato*** **(Whorled Pigeon Grass);** • ***Sigesbeckia orientalis*** **(Indian Weed);** • ***Sisymbrium orientale*** **(Indian Hedge Mustard);** • ***Solanum nigrum*** **(Black Berry Nightshade); and** • ***Vachellia farnesiana*** **(Mimosa Bush).** **The recorded weed species generally occurred infrequently, with the exception of a number of Ruby Dock and Buffel Grass infestations associated with creeklines and areas disturbed by historical mining. Most of these species are widespread in the Pilbara region. None are Declared Plants under the *Agriculture and Related Resource Protection Act 1976* in the Yandicoogina locality. However Ruby Dock and Buffel Grass are regarded as invasive weed species. Ruby Dock was identified as a species with significance in a recent Yandicoogina operations inspection by Department of Mines and Petroleum (DMP) officers (DMP 2009 Yandicoogina AER Inspection – E0064/200502, October 2009).**
6.3	Surface Water	Statement inserted	**There are six surface water discharge structures currently used for the disposal of surplus water from the JC and JSE operations into the Marillana Creek. It is anticipated that these structures will be used for the disposal of additional mine pit dewatering water (as informed by hydrological modelling). This subject will be addressed in project water management planning (to be included in the PER document).**

Document Section	Section Title	Type of amendment	Description of amendment(s)
6.3	Surface Water	Statement inserted	**There is an existing aquifer reinjection facility at the Billiard South deposit, upstream of the confluence of the Marillana Creek and Weeli Wolli Creek. The utility of the reinjection facility is influenced by water disposal from existing operations at Yandicoogina and Hope Downs. At the present time it is unclear how additional water discharge volumes generated by the project will affect the overall functioning of this facility. This subject will be addressed in project water management planning (to be included in the PER document).**
6.7	Landform and soils	Statement inserted	**Of particular importance at Yandicoogina is the maintenance of CID aquifer throughflow, surface water quality and groundwater quality.**
7	Assessment of potential environmental impacts	Section restructured and rewritten to remove explicit reference to risk based methodology in main document.	This section describes potential environmental impacts that could result from the project and their significance. It includes an assessment of potential impacts against the Principles in S4A of the *Environmental Protection Act 1986*, and considerations to be addressed in the preparation of the PER document. The RTIO internal environmental impact assessment process used to identify and evaluate potential project related environmental impacts is fully described in Appendix B.
8	Management strategies and proposed studies/investigations	Statements inserted (shown in bold)	As such, the following aspects of pit dewatering and water disposal will be evaluated and included in the PER: • **assessment of the conservation values of the Marillana Creek, Weeli Wolli Creek and Fortescue Marsh and impacts to these values caused by historical mining activities at Yandicoogina;** • **improved calibration and validation of Yandicoogina operations water balance models, including the interface between the aquifer systems and the Marillana and Weeli Wolli creek systems. This will inform the prediction of potential environmental impacts resulting from different water disposal and management scenarios, taking into consideration impacts from other operations in the vicinity;**

Document Section	Section Title	Type of amendment	Description of amendment(s)
8	Management strategies and proposed studies/investigations	Statements inserted (shown in bold). Table 8-1 has also been updated to reflect the amendments made in this document Section 8.	• options for minimising additional discharge into the Marillana and Weeli Wolli creek systems (for example water sharing with other users, sequencing of current and proposed dewatering activities and non-discharge water management options); • ongoing evaluation of current and future impacts to the creek systems using appropriate impact assessment and monitoring methods; and • **discussion of the projected mine closure process, relating to the protection of aquifer through flow characteristics, groundwater quality, surface water quality and native fauna post mining.**
			The Groundwater and Surface Water Monitoring and Management Plan will be developed in parallel with a revised Groundwater Operating Strategy for the Yandicoogina operations. This latter document is a component of groundwater abstraction licensing requirements under the *Rights in Water and Irrigation Act 1914*.
			Other environmental risks including emissions of dust, noise, light, handling of waste and weeds can be readily managed using standard RTIO operating practices and procedures. **A description of the practices and procedures to be used to address each of these factors will be included in the PER document.**
			Revised versions of existing Yandicoogina operations environmental management plans will be included in the PER document (*refers to EMP's for Riparian Vegetation, Weeds, Subterranean Fauna, Decommissioning and Rehabilitation Plan, Cultural Heritage and the Groundwater Operating Strategy*).
			RTIO intends to commission peer reviews of selected studies and investigations conducted for the PER (Appendix C).

Document Section	Section Title	Type of amendment	Description of amendment(s)
8.1	Flora and vegetation	Statements inserted (shown in bold)	It is anticipated that additional surveys will be conducted in 2010 which target downstream creekline areas (subject to hydrogeological modelling outputs) and individual species requiring more detailed assessment on the basis of their conservation significance. These additional surveys will have sufficient coverage to:
			• establish the values and significance of creek systems affected by dewatering discharge. • **In the event that species with restricted distributions are identified, extend beyond the area of predicted impacts to enable an evaluation of the significance of potential impacts on these species.**
			The PER document will include the findings of project biological surveys, and a full description of management strategies and measures for minimising impacts on vegetation and flora.
8.2	Terrestrial fauna	Statements inserted	**In the event that species with restricted distributions are identified, surveys extending beyond the area of predicted impacts will be conducted to enable an evaluation of the significance of potential impacts on these species.**
			The PER document will include the findings of project biological surveys, and a full description of management strategies and measures for minimising impacts on terrestrial fauna.
8.3	Subterranean fauna	Statements inserted	**In the event that species with restricted distributions are identified, surveys extending beyond the area of predicted impacts will be conducted to enable an evaluation of the significance of potential impacts on these species.**
			The PER document will include the findings of project subterranean fauna surveys and investigations, and a full description of management strategies and measures for minimising impacts on subterranean fauna.

Document Section	Section Title	Type of amendment	Description of amendment(s)
8.4	Surface Water	Statements inserted (shown in bold)	**A range of additional studies and evaluations related to the protection of surface water will be included in the PER, outlined as follows:** • **assessment of the known conservation values of the Fortescue Marsh and the threats to these values posed by the project. This will include consideration of other mining activities currently occurring within the Upper Fortescue River catchment;** • **a review and evaluation of the impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have occurred as a result of historical mining at Yandicoogina, and the effectiveness of management strategies that have been employed to minimise impacts;** • **hydrological modelling of Marillana Creek. Weeli Wolli Creek and Fortescue Marsh to characterise surface water behaviour for various flooding and surface water discharge scenarios addressing water quantity, water quality and timing of disposal (for example to better mimic the natural flow regime).** • evaluation of water use and alternative management options for the purposes of minimising discharge to creek systems. **This will include evaluation of the quantity of water required for each stage in the mining process, consideration of critical points in the forecast water balance and contingency options for managing excess water;** • **impact studies addressing the potential extent and impact of increased surface water volumes in the Marillana Creek and Weeli Wolli Creek systems, including an evaluation of potential downstream impacts on the Fortescue Marsh. This will include consideration of anticipated water disposal from the project area in addition to that from existing RTIO Yandicoogina, BHPBIO Yandicoogina and Hope Downs mining areas (i.e. consideration of cumulative impacts).**

Document Section	Section Title	Type of amendment	Description of amendment(s)
8.4	Surface Water	Statements inserted (shown in bold)	**The PER will include a description of stormwater management controls to be used to prevent contaminants (e.g. hydrocarbons and sediment) entering the environment. It will also describe how uncontaminated stormwater will be directed around mine pits and other project structures.**
			As a component of validating hydrological model, RTIO will engage a suitability qualified consultant to undertake a peer review of the model. The outputs of the peer review will be included in the PER document. It is anticipated that the findings of the peer review will inform the development of the Groundwater and Surface Water Monitoring and Management Plan.
			The PER document will include the findings of studies and investigations relating to surface water, and a full description of management strategies and measures for minimising impacts on riparian systems. In the event that a new dry processing plant is required at the JSW location, a description of associated drainage layout will also be included in the PER
			Proposed studies and information to be incorporated into the PER includes: • **hydrogeological modelling of the paleochannel and alluvial aquifer systems, reflecting the addition of mining at JSW and Oxbow to the current Yandicoogina operations;** • **use of model outputs to inform the prediction of impacts to groundwater systems (based on surface and groundwater interactions), under a variety of possible dewatering and surface water discharge scenarios;**
8.5	Groundwater	Statement inserted	**With respect to the evaluation for water use and alternative management options for abstracted groundwater, consideration will be given to the following hierarchy of management options for abstracted groundwater:**

Document Section	Section Title	Type of amendment	Description of amendment(s)
8.5	Groundwater	Statements inserted	**1. Re-use onsite (e.g. processing and dust suppression)** **2. Transfer to meet other demand (including external water users)** **3. Aquifer recharge via pit voids** **4. Reinjection into aquifers** **5. Storage and evaporation** **6. Controlled release of water (for example to better mimic natural flow patterns); and** **7. Uncontrolled release of water**
			As a component of validating hydro-geological model, RTIO will engage a suitability qualified consultant to undertake a peer review of the model. The outputs of the peer review will be included in the PER document. It is anticipated that the findings of the peer review will inform the development of the Groundwater and Surface Water Monitoring and Management Plan.
			Waste fines generated from wet processing of ore will be managed in existing tailings facilities at JC, in accordance with the operating conditions of the existing facility. The PER will identify if any new tailings facilities are required, and if so assess potential environmental impacts and their management. This will include a discussion of potential impacts on the transmissivity and water quality of groundwater aquifers.
			The PER document will include the findings of studies and investigations relating to groundwater, and a full description of management strategies and measures for minimising impacts on groundwater systems.

Document Section	Section Title	Type of amendment	Description of amendment(s)
8.6	Aboriginal heritage	Statement inserted	**The PER document will include the findings of studies and investigations relating to cultural heritage, and a full description of management strategies and measures for minimising impacts on cultural heritage values.**
8.7	Air quality	Statements inserted	**The project will increase the amount of greenhouse gases that are emitted over the life of the Yandicoogina operations.** **The PER document will include a full description of management strategies and measures for minimising impacts related to greenhouse gas and dust emissions. In the event that a new dry processing plant is required at the JSW location, a description of associated dust control features will also be included in the PER.**
8.8	Closure and rehabilitation	Statements inserted (shown in bold)	**Backfilling of pits is dependent on the available backfill material and will be the subject of ongoing mine closure planning for the overall RTIO Yandicoogina operations. This will occur in consultation with relevant regulatory authorities. Water balance modelling will inform mine closure planning, to assist with the determination of the most appropriate final landform to maintain groundwater quality, aquifer throughflow and ecological water requirements. The PER will include a discussion of the mine closure planning process, including the potential impacts of pit lakes on groundwater quality, surface water quality and native fauna. Management approaches to address these impacts will also be discussed.** **Mineral waste material produced by mining activities is anticipated to be similar in composition to that already generated at the existing JC and JSE operations. The JSW and Oxbow deposits have been assessed by RTIO as having a low risk for acid rock drainage (ARD) and asbestiform minerals.**

Document Section	Section Title	Type of amendment	Description of amendment(s)
8.8	Closure and rehabilitation	Statements inserted (shown in bold)	**The handling and management of mineral wastes generated by the project will be in accordance with the Rio Tinto Environmental Standard: Mineral Waste Management. Under this standard, waste and ore is required to be geochemically characterised during exploration drilling and waste is further geochemically characterised during operations. The results of studies related to waste characterisation as applicable to the project will be included in the PER documentation along with an assessment of the potential for long term contamination of the remaining pit lakes and the potential impacts on fauna.**
8.9	Considerations for environmental monitoring programs	New Section	**see page 55**
8.10	Consideration of cumulative impacts	New Section	**see page 55 to 57**
9	Stakeholder consultation	Table 9-1 updated	*Greater clarity provided in the timing column* *Statement inserted:* **This will include consultation with DEC and DoW regarding hydrological and hydrogeological modelling activities and the development of the Groundwater and Surface Water Monitoring and Management Plan.**
Appendix C	Summary of proposed studies &investigations to be included in the PER document	New Appendix	***The table in this Appendix provides a consolidated summary of all proposed studies and investigations to be included in the PER document.***

Appendix B Risk assessment methodology

Risk Assessment Methodology

Rio Tinto Iron Ore (RTIO) uses a risk assessment framework for the identification and evaluation of environmental impacts resulting from mining projects. The assessment is typically undertaken by multiple project team members, with collective experience and expertise across a range of disciplines relevant to specific project characteristics.

Environmental risk assessment is a process that evaluates the likelihood and consequence of project activities impacting on environmental values. The risk assessment process enables potential environmental hazards or threats to be identified, evaluated and prioritised. This can inform decision making by proponents (including sub contractors) and regulatory authorities with respect to designing additional studies and environmental management controls. The risk assessment framework used by RTIO provides a systematic, transparent process that is amenable to external review.

Potential social impacts can also be factored into the risk assessment process, enabling any additional consultation requirements to be identified. In addition, the prioritisation of risk allows a better understanding of where resources should be concentrated by regulatory authorities and proponents.

1.1.1 Background

The risk assessment for the Yandicoogina Junction South West and Oxbow Iron Ore Project was undertaken and reviewed by members of the project study team. The assessment procedure adopted was consistent with the principles and guidelines contained in the following documents:

- AS/NZS 4360:2004 *Risk Management*; and
- Australia Standards Hand Book (HB) 203:2006 *Environmental risk management - principles and process*.

The procedure is designed to provide a uniform approach to assigning levels of risk to different aspects of the proposal. A more detailed description of the risk assessment methodology is outlined as follows.

1. Risk assessment context

Establish the context

The initial step of the risk management process was to establish the context for the risk assessment both internally and externally. For example, identification of key stakeholders, business drivers, company strategies and objectives provided information on the ability to resource the management of risk.

Risk management context

An important step in developing the risk assessment was to adequately define the objectives and scope of the proposed JSW and Oxbow iron ore mining project (see previous sections), the activities which will be carried out to construct the project and once operation has commenced the expected benefits of the project and the main issues of concern. Once defined, these factors can provide context for the risk assessment process.

Risk evaluation criteria

The criteria in which the risk was evaluated against came from different sources including:

- legislation
- regulatory and corporate policy

- ethical guidelines
- project objectives
- standards, guidelines and codes of practices
- experience and professional judgement

2. Identification of risk

Identifying hazards

Identifying the activities or 'hazards' that may impact environmental factors (such as flora, fauna, groundwater etc) is important for accurately identifying sources of risk. Identification of hazards associated with the project has been made by considering expert judgement, input from stakeholders and examining project component activities and processes.

Identifying stressors

Potential 'stressors' or actions (e.g. vegetation clearing) associated with project can be numerous and involve many different potential impacts. Stressors, unlike hazards, will be similar from project to project as the environment will be impacted in the same way but perhaps to different extents.

Identification of receptors

This process requires background knowledge of the existing environment in which the project is to be situated in order to determine a particular receptor or receiving environment. The more information available, the easier it is to identify receptors and any key receptors that may be particularly sensitive to stressors. Receptors have been identified in Chapter 5.

3. Analysis of risk

Risks are analysed based on the likelihood that a stressor will impact a receptor and the consequence that this impact will have on the environment.

Consequence

To describe the type and duration of potential impact associated with a project, five categories of consequence (or severity) have been created:

- low
- minor
- moderate
- major
- critical

Likelihood

A description of likelihood categories are shown in Table 1.

Table 1 Qualitative measures of 'likelihood'

Level	Descriptor	Description
5	Almost certain	Is expected to occur in most circumstances
4	Likely	Will probably occur in most circumstances
3	Possible	Could occur
2	Unlikely	Could occur but not expected
1	Rare	Occurs only in exceptional circumstances

(Australia Standards Hand Book 203:2006 *Environmental risk management - principles and process*)

4. Evaluation of risks

Once the risks are analysed, then can be assigned a level based from estimation for each stressor and receptor through an assessment of consequence and likelihood. A qualitative scoring system is used which involves using an environmental risk matrix (Table 2).

Table 2 Environmental risk matrix

			Consequence				
			Low	**Minor**	**Moderate**	**Major**	**Critical**
		Risk factor	**1**	**2**	**3**	**4**	**5**
Likelihood	**Almost certain**	**5**	5	10	15	20	25
	Likely	**4**	4	8	12	16	20
	Possible	**3**	3	6	9	12	15
	Unlikely	**2**	2	4	6	8	10
	Rare	**1**	1	2	3	4	5

Table 3 Risk definitions

Extreme	Potentially unacceptable. Modification of proposal and major mitigation required.
High	Significant mitigation (including offsets) required. Assessment required.
Moderate	Substantial mitigation may be required. Assessment required.
Low	Some mitigation may be required. No assessment required but address in EMP as routine controls.

Once risk levels have been determined, they may be categorised as tolerable, acceptable or intolerable (Table 4) and these categorisations can determine the level of ongoing management, monitoring and/or mitigation required to reduce the risk.

Table 4 Risk evaluation

			Consequence				
			Low	Minor	Moderate	Major	Critical
		Risk factor	1	2	3	4	5
Likelihood	Almost certain	5					
	Likely	4				INTOLERABLE	
	Possible	3			ACCEPTABLE		
	Unlikely	2	TOLERABLE				
	Rare	1					

For example, risks that are tolerable, there may still be a requirement for ongoing management and monitoring and management procedures should be developed to ensure that tolerable risks remain within this category. For risks that are intolerable (or in the extreme zone), management action may be required immediately, which could involve cessation of the particular activity until the risk is reduced into the acceptable or tolerable categorisations.

Once risks have bee prioritised according to the above categorisation, the highest ranked risks (not necessarily those with the most severe consequences) should be addressed first, and the most cost-effective solutions to reduce them should be found. For example, effective measures can often be taken to remove or mitigate risk very early in the concept design and therefore, the objective of the risk assessment within this scoping document will aim to:

- determine risks;
- categorise risks; and
- provide effective measures to mitigate or reduce the risks.

1.2 Risk assessment results

The outputs of the risk assessment for the environmental factors discussed in the ESD are provided in Table 5.

1.3 Treatment of risks

Once the risks have been assigned a level and category, there is a requirement to identify treatment opportunities to those risks that are not tolerable in order to reduce the risk ranking. A treatment hierarchy should generally follow those adopted for the treatment of safety issues. For example, a possible treatment hierarchy could include:

1. avoid the risk
2. mitigate the risk
3. reduce the likelihood
4. reduce the consequence
5. share the risk
6. retain the risk
7. physically separate
8. duplicate resources
9. transform the risk
10. consider the context

Once the treatment option has been established it must be assessed to ensure that the risk is now tolerable. The same measures used to analyse the risks can be used once again to ensure the risk treatment options are adequate.

Table 5 Environmental Risk Assessment for the Yandicoogina JSW and Oxbow Iron Ore Project

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Likelihood	Consequence	Inherent risk	Risk evaluation (as per Environmental Risk Matrix)	Assumptions (if applicable)
Vegetation clearing	Priority and DRF flora and TECs	Removal of individual plants or populations of conservation significant species.	3	3	9	Moderate	Individuals and populations of conservation significant species may occur within clearing footprints.
	Priority and DRF flora and TECs	Introduction and spread of weeds reduces the ability of conservation significant species to persist in the Yandicoogina locality.	2	2	4	Low	Weed species and their extent have been identified in flora surveys at JSW and Oxbow. The Weed Management Plan being implemented for the JC and JSE operations is readily adaptable to the project area.
	Significant fauna species	Death or displacement of individual animals or populations of conservation significant terrestrial species.	2	3	6	Moderate	The conservation significant species known to occur in the Yandicoogina locality are all relatively mobile and have extended ranges. No SRE species are known to occur in the Yandicoogina locality.
	Significant fauna species	Habitat modification for subterranean fauna due to disruption to surface water infiltration and nutrient transport.	2	2	4	Moderate	Recent surveys have detected the presence of stygofauna and troglofauna in the Yandicoogina locality.
	Soils and landform	Erosion (by wind and/or water).	3	2	6	Low	Soil management practices used at existing Yandicoogina operations have been effective at preventing erosion. The same (or similar as appropriate) methods will be used for proposed activities.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Likelihood	Consequence	Inherent risk	Risk evaluation (as per Environmental Risk Matrix)	Assumptions (if applicable)
Dewatering	Weeli Wolli and Marillana Creeks and Fortescue Marsh	Discharge of dewatering water into creek lines, potentially further changing the vegetation health and composition of the Marillana and Weeli Wolli creek systems and the Fortescue Marsh.	5	3	15	Extreme	The current environment is not pristine: dewatering discharge from BHPBIO and Yandi JC operations has been occurring for ~20 years and dewatering discharge directly into Weeli Wolli Creek currently occurs from Yandi JSE and Hope Downs Operations. The Yandicoogina operations are distant from the Fortescue Marsh, but could potentially contribute to the cumulative impacts of multiple mining projects around the Marsh.
	Aboriginal heritage	Loss of / change to cultural values of Weeli Wolli Creek and Marillana Creek.	3	3	9	High	No significant heritage sites have been found to occur within the JSW and Oxbow mining areas or immediate surrounds.
	Groundwater / aquifer	Loss/ disturbance of groundwater dependant creek line/riparian vegetation along a section of Marillana Creek.	5	3	15	Extreme	Impact will be localised within cones of depression around dewatering borefields. The section of Marillana Creek expected to be affected is already disturbed due to historical water discharge activities.
	Groundwater/ aquifer	Groundwater drawdown from abstraction may cause long-term effects on the paleochannel aquifer by reducing aquifer storage.	3	3	9	High	A calibrated and validated hydrogeological model is required to make an assessment of the impacts of dewatering.
	Groundwater/ aquifers	Death or displacement of individual animals or populations of subterranean fauna.	5	3	15	Extreme	Recent surveys have detected the presence of stygofauna and troglofauna in the Yandicoogina locality.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Likelihood	Consequence	Inherent risk	Risk evaluation (as per Environmental Risk Matrix)	Assumptions (if applicable)
Earthworks/excavation	Groundwater	Changes to aquifer properties and groundwater chemistry resulting from the post mining landform.	3	4	12	High	The CID is an extended and connected aquifer system at and downstream of the project area.
	Surface water	Creekline modifications due to possible realignment of part of Phil's creek between JC and proposed JSW-C pit and haul road creek crossings of Marillana creek.	4	3	12	High	Modifications to creek systems will need to ensure that the functionality of the creek systems is not comprised, including during peak flow events.
	Surface water	Contamination of surface water by sediments and pollutants.	3	3	9	High	The mining activities are adjacent to the Marillana Creek and overlie a regionally significant aquifer.
	Soils and landform	Landform modification and disturbance. Pit voids will only be partially backfilled due to a lack of available backfill materials. This could potentially affect throughfllow and water chemistry in surface and groundwater systems.	5	3	15	Extreme	Mining operations at JSW may require some minor drainage lines close to their intersection with Marillana Creek.
	Subterranean fauna	Direct loss of subterranean fauna and habitat within the project disturbance footprint.	5	2	10	High	Habitat will be removed within mining pits
	Aboriginal heritage	Interference with Aboriginal heritage sites.	2	5	10	High	Heritage surveys have shown that no significant Aboriginal heritage sites occur within the mine pit footprints

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Likelihood	Consequence	Inherent risk	Risk evaluation (as per Environmental Risk Matrix)	Assumptions (if applicable)
Runoff	Surface water	Alteration of drainage channels or flow characteristics due to mine pit footprints, haul road creek crossings of Marillana creek and the possible realignment of part of Phil's creek between JC and proposed JSW-C pit and	5	2	10	High	Surface flow will be altered within the footprint of the mine (diversion drains will be created in conjunction with mine planning to control surface water flows). Surface water flows are dependant on high rainfall/cyclonic activity.
Runoff	Surface water	Sedimentation of natural drainage systems.	3	2	6	Moderate	Changes to surface hydrology from mining activities and construction of infrastructure could increase sediment in the drainage systems without adequate controls.
Spills or leaks	Soils and landform	Soil contamination.	2	2	4	Low	Mining will not require or create large quantities of contaminants. The CID does not contain acid forming materials.
Spills or leaks	Fauna	Death or displacement of individual animals (including subterranean fauna).	2	2	4	Low	Mining will not require or create large quantities of contaminants. Potential contamination events would be highly localised.
Spills or leaks	Surface water and groundwater	Surface water and groundwater contamination.	3	2	6	Moderate	Mining will not require or create large quantities of contaminants. Potential spills or leaks will be highly localised.
Spills or leaks	Flora and vegetation	Localised loss of vegetation.	2	2	4	Low	Storage facilities will not be in close proximity to sensitive flora and vegetation.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental factor/receptor	Potential Impacts	Likelihood	Consequence	Inherent risk	Risk evaluation (as per Environmental Risk Matrix)	Assumptions (if applicable)
Liquid, mineral and solid waste disposal	Surface water and groundwater	Surface water and groundwater contamination.	1	3	3	Low	The project will largely be serviced by existing landfill and sewerage treatment facilities. Any new facilities will be small scale and localised. No new types of waste (relative to existing mining operations) will be produced. Waste rock dumps are not expected to contain any acid forming materials. All waste storage areas will be sited to avoid major creek systems and other sensitive areas.
Liquid, mineral and solid waste disposal	Priority and DRF flora and TECs	Loss of significant DRF and/or TECs.	1	4	4	Moderate	Disposal of any waste will be well separated from sensitive flora/vegetation
Liquid, mineral and solid waste disposal	Soils and landform	Soil contamination.	2	3	6	Moderate	The project will largely be serviced by existing landfill and sewerage treatment facilities. Any new facilities will be small scale and localised. No new types of waste (relative to existing mining operations) will be produced. Waste rock dumps are not expected to contain any acid forming materials. All waste storage areas will be sited to avoid major creek systems and other sensitive areas.
Increased human presence in locality	Aboriginal Heritage	Disruption to archaeological / ethnographic sites.	3	3	9	High	Access to Aboriginal heritage sites will be excluded and the workforce educated to avoid these sites, as per current operational procedures at JC and JSE.
Increased human presence in locality	Fauna	Possible disruption to fauna.	3	1	3	Low	The workforce will be educated to avoid disruption to fauna, as per current operational procedures at JC & JSE.
Increased human presence in locality	Fauna	Introduction of feral animals.	2	2	4	Low	Existing feral animal control activities at Yandicoogina will be maintained.

Aspect (stressor) Most have potential to occur across all activity phases	Environmental context (receptor)	Potential Impacts	Likelihood	Consequence	Inherent risk	Risk evaluation (as per Environmental Risk Matrix)	Assumptions (if applicable)
Fire	Flora and vegetation	Alteration to vegetation community composition.	1	3	3	Low	Fire prevention and suppression controls are already in place for existing mining operations. These will also be applied to new mining areas.
Fire	Fauna	Temporary loss of habitat.	1	3	3	Low	Fire prevention and suppression controls are already in place for existing mining operations. These will also be applied to new mining areas.
Dust emissions	Flora and vegetation	Reduction to growth rates and distribution.	3	1	3	Low	Dust management controls are already in place for existing mining operations. These will also be applied to new mining areas. There is a readily available water supply for dust control.
Dust emissions	Air quality	Localised reduction in air quality.	3	1	3	Low	Dust management controls are already in place for existing mining operations. These will also be applied to new mining areas. There is a readily available water supply for dust control.
Greenhouse gas emissions	Air quality	Contribution to the cumulative impact of atmospheric CO_2 emissions implicated in global climate change.	4	2	8	High	The project is expected to produce in excess of 100,000 tonnes CO_2 equiv. per annum due to the scale of mining involved.
Light emissions	Fauna	Disruption to nesting and roosting habits during the night.	2	2	4	Low	Nesting and roosting sites are not restricted in extent. Light disruption to sensitive areas will be avoided wherever possible.
Noise and vibration emissions	Fauna	Disruption to fauna.	2	2	4	Low	Noise management controls are already in place for existing mining operations. These will also be applied to new mining areas.
Noise and vibration emissions	Mine residents/workers	Nuisance	2	2	4	Low	Noise management controls are already in place for existing mining operations. These will also be applied to new mining areas.

Appendix C Summary of proposed studies and investigations to be included in the PER document

Summary of proposed studies and investigations to be included in the PER document[5]

Environmental aspect or factor	Description of proposed study/investigation	Consultation and review process[6]
Vegetation and flora	Vegetation and flora survey of project clearing footprint and surrounding areas (including areas predicted to be affected by groundwater drawdown).	Survey to be undertaken by a suitably qualified botanical consultant and internally reviewed by RTIO.
	Vegetation and flora survey of surface water discharge impact zone.	Survey to be undertaken by a suitably qualified botanical consultant and internally reviewed by RTIO.
	Targeted surveys for species with conservation significance (where the need is identified from more general surveys).	Survey to be undertaken by a suitably qualified fauna consultant and internally reviewed by RTIO.
	Review, update and extension of Yandicoogina JSE Riparian Vegetation Management Plan.	Assessment by RTIO project study team; plan to be developed in consultation with DEC.
	Review, update and extension of Yandicoogina JSE Weed Management Plan.	Assessment by RTIO project study team; plan to be developed in consultation with DEC..
Subterranean fauna	Subterranean fauna survey of project disturbance footprint (mining and groundwater drawdown) and surrounding areas.	Survey to be undertaken by a suitably qualified fauna consultant and internally reviewed by RTIO.
	Review, update and extension of Yandicoogina Subterranean Fauna Management Plan.	Assessment by RTIO project study team; plan to be developed in consultation with DEC.

[5] All surveys will be undertaken in accordance with relevant EPA Guidance Statements
[6] Prior to inclusion in the PER document

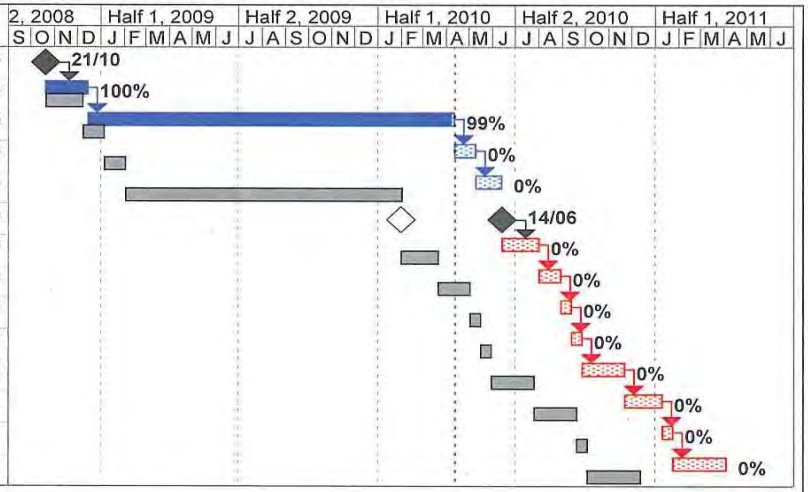
Environmental aspect or factor	Description of proposed study/investigation	Consultation and review process[6]
Surface Water	Groundwater and Surface Water Monitoring and Management Plan	To be developed by RTIO in consultation with DoW and DEC.
	Identification of the specific conservation values of the Marillana Creek and Weeli Wolli creek systems within the predicted footprint of disturbance, taking into consideration similar creek systems in a local and regional context.	Assessment by RTIO project study team.
	Assessment of the known conservation values of the Fortescue Marsh and the threats to these values posed by the project. This will include consideration of other mining activities currently occurring within the Upper Fortescue River catchment.	Assessment by RTIO project study team.
	A review and evaluation of the impacts to Marillana Creek, Weeli Wolli Creek and the Fortescue Marsh that have occurred as a result of historical mining at Yandicoogina, and the effectiveness of management strategies that have been employed to minimise impacts.	Assessment by RTIO project study team.
	Hydrological modelling of Marillana Creek. Weeli Wolli Creek and Fortescue Marsh to characterise surface water behaviour for various flooding and surface water discharge scenarios addressing water quantity, water quality and timing of disposal (for example to better mimic the natural flow regime).	Modelling to be undertaken by RTIO and subject to external peer review.
	Evaluation of water use and alternative management options for the purposes of minimising discharge to creek systems. This will include evaluation of the quantity of water required for each stage in the mining process, consideration of critical points in the forecast water balance and contingency options for managing excess water.	Assessment by RTIO project study team, in consultation with DoW and DEC.
	Impact studies addressing the potential extent and impact of increased surface water volumes in the Marillana Creek and Weeli Wolli Creek systems, including an evaluation of potential downstream impacts on the Fortescue Marsh. These will be informed by modelling outputs, and will include consideration of anticipated water disposal from new and existing RTIO Yandicoogina operations, BHPBIO Yandicoogina operations and Hope Downs 1 operations (i.e. consideration of cumulative impacts).	Assessment by RTIO project study team.

Environmental aspect or factor	Description of proposed study/investigation	Consultation and review process[6]
Groundwater	Groundwater and Surface Water Monitoring and Management Plan	To be developed by RTIO in consultation with DoW and DEC. This will occur in parallel with a revised Groundwater Operating Strategy for the Yandicoogina operations
	Hydrogeological modelling of the paleochannel and alluvial aquifer systems, reflecting the addition of mining at JSW and Oxbow to the current Yandicoogina operations;	Modelling to be undertaken by RTIO and subject to external peer review.
	Use of model outputs to inform the prediction of impacts to groundwater systems (based on surface and groundwater interactions), under a variety of possible dewatering and surface water discharge scenarios.	Assessment by RTIO project study team.
	Evaluation of water use and alternative management options for abstracted groundwater, for the purposes of minimising and managing discharge to creek systems. This will include an evaluation of the quantity of water required for each stage in the mining process.	Assessment by RTIO project study team, in consultation with DoW and DEC.
	Ongoing monitoring of aquifers to enable impacts from the project to water levels and chemistry to be detected.	Assessment by RTIO project study team.
	Studies addressing impacts to the local hydrogeological regime. This will include consideration of the RTIO Yandicoogina, BHPBIO Yandicoogina and Hope Downs mining areas and address long term protection of aquifer water quality.	Assessment by RTIO project study team.
	Assessment of potential environmental impacts related to new tailings facilities (if required)	Assessment by RTIO project study team.

Environmental aspect or factor	Description of proposed study/investigation	Consultation and review process[6]
Aboriginal heritage	Aboriginal heritage survey in project disturbance footprint and immediate surrounds.	Undertaken by RTIO in conjunction with Aboriginal heritage stakeholders
	Review, update and extension of Yandicoogina Cultural Heritage Management Plan	Assessment by RTIO
Greenhouse gases	Assessment of options for: • designing for process and equipment energy use efficiency; • low emissions energy and materials procurement; and • best management practices to reduce energy consumption	Assessment by RTIO
Closure	Review, update and extension of Yandicoogina JC and JSE Decommissioning and Rehabilitation Plan	Assessment by RTIO project study team plan to be developed in consultation with DoW and DEC..
Mineral waste	Mineral waste characterisation, as a component of the *Rio Tinto Environmental Standard: Mineral Waste Management.*	Assessment by RTIO project study team.
Non-mineral waste	Review, update and extension of Yandicoogina JC and JSE Operations Environmental Management Plan (EMP)	Assessment by RTIO project study team.
Dust	Review, update and extension of Yandicoogina JC and JSE Operations Environmental Management Plan (EMP)	Assessment by RTIO project study team.
Noise	Review, update and extension of Yandicoogina JC and JSE Operations Environmental Management Plan (EMP)	Assessment by RTIO project study team.
	Noise modelling for optimisation of project operations (where the need is identified)	Assessment by RTIO project study team.

Appendix D OEPA - RTIO Proposed Timeline

ID	Task Name	Duration	Start	Finish
1	Scoping Document (ESD) received - 1st draft	0 days	Tue 21/10/08	Tue 21/10/08
2	ESD- EPASU comments on 1st draft	56 days	Tue 21/10/08	Mon 15/12/08
3	Proponent prepares revised ESD	483 days	Tue 16/12/08	Mon 12/04/10
4	ESD Approval	28 days	Tue 13/04/10	Mon 10/05/10
5	Proponent prepares draft PER	34 days	Tue 11/05/10	Sun 13/06/10
6	PER received - 1st draft	0 days	Mon 14/06/10	Mon 14/06/10
7	EPASU provides comments on PER document	49 days	Mon 14/06/10	Sun 1/08/10
8	Proponent revises PER document	29 days	Mon 2/08/10	Mon 30/08/10
9	Approval of final PER document	14 days	Tue 31/08/10	Mon 13/09/10
10	Proponent arranges release of PER document	14 days	Tue 14/09/10	Mon 27/09/10
11	Public review period for PER document	56 days	Tue 28/09/10	Mon 22/11/10
12	Prop. prepares submission summmary & response	49 days	Tue 23/11/10	Mon 10/01/11
13	EPASU reviews response to submissions	14 days	Tue 11/01/11	Mon 24/01/11
14	EPA report and recommendations published	70 days	Tue 25/01/11	Mon 4/04/11



Project: Yandicoogina JSW PER
Date: Mon 12/04/10

Critical
Critical Split
Critical Progress
Task
Split
Task Progress
Baseline
Baseline Split
Baseline Milestone
Milestone
Summary Progress
Summary
Project Summary
External Tasks
External Milestone
Deadline